

University of Tartu  
Department of Semiotics

Felix Siivonen

**ECOSEMIOTIC FITTING OF WHITE-TAILED DEER AND ROSA RUGOSA AS  
INVASIVE SPECIES IN SOUTHERN FINLAND**

Master's Thesis

Supervisor: Prof. Timo Maran

Tartu

2021

## Table of contents

<b>Acknowledgments</b> .....	<b>4</b>
<b>Introduction</b> .....	<b>5</b>
<b>Research aim and questions</b> .....	<b>7</b>
<b>1 Approaches to invasive species</b> .....	<b>8</b>
1.1 On terminology .....	8
1.1.1 Nativeness .....	8
1.1.2 Invasiveness .....	10
1.2 Evolutionary perspectives to invasions .....	12
1.2.1 Drivers of evolution .....	12
1.2.2 Causes for unnatural extinctions .....	15
1.3 Invasive species as a cultural phenomenon .....	17
1.3.1 By-products of culture .....	17
1.3.2 Nature threatening culture .....	20
1.4 Shifting agencies .....	21
<b>2 Semiotics of invasive species</b> .....	<b>25</b>
2.1 Fitting as a semiotic process .....	26
2.1.1 Agency in fitting .....	26
2.1.2 Fitting as community structuring .....	28
2.2 Ecosemiotic fitting .....	31
2.2.1 Invasions and the semiosphere .....	32
2.2.2 Invasions in different natures .....	34
2.2.3 Invasiveness in communities and agencies .....	36
<b>3 White-tailed deer and <i>rosa rugosa</i> as invasive species in Finland</b> .....	<b>40</b>
3.1 White-tailed deer in Finland .....	40
3.1.1 White-tailed deer in Finnish culture .....	42
3.2 <i>Rosa rugosa</i> in Finland .....	44
3.2.1 <i>Rosa rugosa</i> in Finnish culture .....	46
<b>4 Methodology</b> .....	<b>48</b>
4.1 Semiotic modeling and ecosemiotics .....	48
4.3 Actor-network theory .....	50
4.4 Local knowledge .....	55
<b>5 Methods and material</b> .....	<b>58</b>
5.1 Semi-structured interviews .....	58
5.2 Participatory observations .....	60

<b>6 Analysis</b> .....	<b>62</b>
6.1 Fitting of white-tailed deer on Skärlandet .....	62
6.1.1 Measures to control and prevent foraging .....	65
6.1.2 White-tailed deer foraging and commercial agriculture .....	69
6.1.3 Hunting as collective strategy of control .....	70
6.1.4 Foraging as ecosemiotic fitting .....	73
6.2 Fitting of rosa rugosa in Hanko .....	75
6.2.1 Rosa rugosa and property ownership .....	78
6.2.2 Rosa rugosa eradication in Hanko .....	81
6.2.3 Habitat selection as ecosemiotic fitting .....	83
<b>Conclusions</b> .....	<b>86</b>
<b>References</b> .....	<b>89</b>
<b>Kokkuvõte</b> .....	<b>114</b>
<b>Annex 1: Semi-structured interview questions</b> .....	<b>116</b>
<b>Annex 2: Maps of the research areas</b> .....	<b>118</b>
<b>Annex 3: Licence</b> .....	<b>119</b>

## **Acknowledgments**

First and foremost, I wish to express my deep gratitude to all my interviewees on Skärlandet island and in Hanko who readily and openly shared their thoughts, experiences and difficulties with me. These rich and deep insights are the heart of this study.

Special thanks to Ilmari Räsänen Foundation and Finnish Game Management Foundation for their financial support that effectively enabled my fieldwork. Also special thanks to Emilia and Heikki who both aided me in making my fieldwork happen in practice.

I am grateful to my supervisor Timo Maran for the patient academic guidance, support, and encouragement since our first discussions on the topic of this thesis in late 2019. My huge thanks also to Nelly Mäekivi for her valuable feedback during this project, and to Terhi Rytteri for sharing valuable texts that were hard to come by.

And last but not least, I want to thank the small group of participants of the Colombian-Mexican-Finnish Spicy Movie Club of Tiigi 6 whose contribution for this thesis has been the energy from togetherness and laughter.

## **Introduction**

The movement of species on different geographical scales between habitats and ecosystems is a key mechanism in shaping biodiversity (Jeltsch *et al.* 2013). It influences, for example, the fundamental evolutionary processes of speciation (Baker 1978) and the structuring and maintaining of population and community stability (Hanski 1999).

On the other hand, humans have intentionally and unintentionally transported other species beyond their geographical barriers for thousands of years (Boivin *et al.* 2017) and, indeed, the accompaniment of other species has made human dispersal historically possible (Crosby 1986). However, distances, speed, and volume of anthropogenic species movement has increased significantly in the era of global transportation and commerce in the past few hundred years (di Castri 1989). Some species that are introduced by humans beyond major barriers of their dispersal establish and begin to spread at the cost of different changes in the receiving ecosystem, such as decreasing populations of some other species, and human cultural processes, such as economy, culture and health (Mack *et al.* 2000; McNeely 2001). These species are known as invasive species or invasive alien species (sometimes abbreviated as IAS). Some of these introductions have little impact (Williamson, Fitter 1996; Davis 2003) while some can lead to rapid extinctions of other species. A famous case is the introduction of brown tree snake into the island of Guam (Savidge 1987). This background of diverse ecological-cultural impacts and their interpretations form the basis for this thesis in approaching invasive species.

From a semiotic perspective, invasive species are an interesting phenomenon. Being an anthropogenic phenomenon (Pfeiffer, Voeks 2008: 282), their introductions as well as perceptions, interpretations, and management include strong dimensions of sign-processes both in nature and in culture (Emmeche 2001; Robbins 2004; Rotherham, Lambert 2011; Magnus, Remm 2018). Recently Kull (2020) has proposed a concept of semiotic fitting as a model to analyze the role of different agents in biological communities based on their functional and communicational relationships in the community. While semiotic fitting is a perspective in conceptualizing nativeness of biological communities, the aim in this thesis is

to expand the concept into ecological-cultural communities and mobilize ecosemiotic fitting in analyzing the functional and communicational roles of invasive species in ecosystems where human cultures are an integral shaping force.

In this thesis, I will first discuss the usage and definitions of terms of nativeness and invasiveness. Then I will go through different approaches in conceptualizing human relationships with invasive species. The literature review is organized according to different interpretations of invasive species as natural, as cultural and as integrated naturecultural (Latour 1993; Haraway 2003) phenomenon.

In chapter 2, I will take a semiotic approach to invasive species and formulate an understanding of ecosemiotic fitting as a way to analyse the ecological-cultural role of invasive species in communities that are composed of ecological-cultural networks. Chapters 3, 4, and 5 are dedicated to exploring the ecological-cultural role of white-tailed deer (*Odocoileus virginianus*) and rosa rugosa (*Rosa rugosa*) in two geographical locations and communities in Southern Finland.

In order to bring two different invasive species and the multiple ecological and cultural factors into one analytical framework for the analysis of ecosemiotic fitting, I am deploying core elements of Actor-network theory (ANT). Rather than being an unified theory, ANT is a compilation of flexible conceptual and analytical methodologies that can be used in diverse ways. In this thesis the main contribution of ANT will be in identifying and following human and nonhuman agencies as mediator-actors that interact. Moreover, I will apply the concept of ecoculture (Pilgrim, Pretty 2010) to integrate local ecological-cultural conditions and knowledge into the analysis of ecosemiotic fitting of the mentioned species.

## **Research aim and questions**

The aim of this thesis is two-fold. On a theoretical level, I aim to contribute an ecosemiotic understanding of the phenomenon of invasive species as ecological-cultural networks that are based on sign-processes. The need for more integrated and interdisciplinary ecological-cultural approaches in the research on invasive species is highlighted in many recent discussions (review by Kapitza *et al.* 2019). On a more practical level, I aim to contribute new perspectives in understanding the ecological-cultural roles of white-tailed deer and *rosa rugosa* as invasive species in Finland and for the invasive species discourse in Finland in general. Increasing network-knowledge in encountering and managing these two invasive species could contribute to more efficient, just and sustainable conservation activities.

The research questions in this thesis are:

- How does white-tailed deer and *rosa rugosa* ecosemiotically fit in the ecological-cultural communities of Skärlandet island and Hanko in Southern Finland?
- How does this ecosemiotic fitting affect these ecological-cultural communities?

## **1 Approaches to invasive species**

Invasive species is a complex but interesting topic if approached as a both natural and cultural phenomenon: it can take a strong position in both domains. On the one hand, invasive species can be understood as by-products of human cultural processes, as “trash animals” (Nagy, Johnson 2013), mistakes by the 19th century acclimatization societies (Dunlap 1997; Coates 2006), or as effects of globalization (Pimentel *et al.* 2000; Emmeche 2001; Baskin 2002). On the other hand, invasive species can also be perceived as nature, as opportunities to test and develop ecological theories (Gause 1934; Shrader-Frechette 2001; Davis 2006), as drivers of evolutionary change (e.g. Darwin 1859; Shantz 1906; Shine *et al.* 2011), or even as “nature’s salvation” (Pearce 2015). To bridge these often contradictory views, some authors have turned into integrated approaches to deconstruct the strict native/alien and nature/culture dichotomies (Robbins 2004; Larson 2007, 2010; Subramaniam 2014) and to reconceptualize research and management of invasive species as transdisciplinary networks and interactions. I will explore different approaches into defining nativeness and invasiveness in this chapter, and then focus on examining invasive species research in ecological and cultural domains. This provides a basis towards an ecosemiotic understanding of invasive species.

### **1.1 On terminology**

#### **1.1.1 Nativeness**

Definitions and terminology used to refer to nativeness and invasiveness of species has been debated frequently (Shackelford *et al.* 2013). One strong view among the scientific community is that native/non-native dichotomy is, or should be, distinguished from the understanding of invasiveness of species (Falk-Petersen *et al.* 2006; Young, Larson 2011),



but as the recent review by Gbedomon *et al.* (2020) shows, terminology has remained one of the key areas of disagreements in the field of invasive species research.

Many authors understand nativeness as a dispersal history of a species that is independent from humans (Falk-Petersen *et al.* 2006: 1412), although conclusive evidence of such is often hard to find (Chew, Hamilton 2011). In determining temporal thresholds for nativeness as a dispersal history, Webb (1985) proposed the beginning of the Neolithic period, while Binggeli (1994) draws the line on the end of the last glaciation period. However, such historical milestones are problematic since humans have been moving around globally far longer and probably dispersed flora and fauna while doing so (Coates 2007; Boivin *et al.* 2017).

At the same time, nativeness has multiple modalities that complicate efforts to construct a clear terminology. The term can refer to an ancient understanding of a connection between all species (humans included) and places where they occur (Chew, Hamilton 2011) and is thus connected with a notion of cultural belonging (e.g. Tošić 2012). Nativeness can also be understood as a political notion that translates into classical discourses about the right of soil/birthplace (*jus soli*) and the right of blood/inheritance (*jus sanguinis*) (Alonso 1995), or citizenship rights in more modern vocabulary. In addition, Chew (2006) and Chew and Hamilton (2011) have reconstructed the historical development of native/non-native dichotomy as an arbitrary synthesis of pre-Darwinian taxonomy and pre-Victorian legal discourse. In an evolutionary sense, nativeness can be understood as the climax of natural selection linked with geography as either local superiority (competition) or well-suitedness (adaptation) (Gould 1998).

Nevertheless, some scholars see the practice of defining species in native/non-native axis as a fundamental principle that organizes and justifies research on species movements and management projects in many of its dimensions (e.g. Peretti 1998; Hall 2003; Warren 2007; Chew, Hamilton 2011). Some take a more pragmatic approach and emphasize not only the usefulness of defining species between the two categories but also the necessity of the division in conducting research (e.g. Richardson *et al.* 2000; Pyšek *et al.* 2004). For example, Pyšek *et al.* (2004: 131) argue that recognizing species as natives or non-natives is important since the effects of non-native species as invasive species is a global issue, and comparable mapping of species movements is a key aspect in understanding patterns and determinants for invasiveness. Moreover, in preventing ecosystem damage by management,

Richardson *et al.* (2000: 94) argue, unclear, undefined, and unaccepted terminology can obstruct value-neutral negotiation of management priorities.

On the other hand, Goodenough (2010: 13) claims that nativeness and native range of species is becoming increasingly archaic. This notion is supported by the view that native/nonnative dichotomy is insufficient in making sense of the new dynamics of biogeography in the era of the anthropocene (Hill, Hadly 2018). Hence, the majority of researchers agree that nativeness should be understood as a dynamic concept in both ecological and cultural sense, rather than referring to a fixed identity of places and species. Majority of researchers agree that the entrance of species into ecosystems where they are new will result in some impacts on native species, but disagreements emerge on how they should be measured, whether the impacts are negative, positive or neutral against a reference plane of nativeness, and whether they need to be translated into management and control as predictive or strong eradication measures (Young, Larson 2011; Davis *et al.* 2011; Simberloff 2011a).

As seen here, nativeness of a species in contemporary research is a concept used to encapsulate biological and ecological properties (typical habitat of a species) and dynamics (e.g. Lotka-Volterra equations in Molles 2016: 289) rather than histories of belonging. This background is shared in this thesis but its controversiality is acknowledged: nativeness, in the absence of more established terms, is understood as referring to functional relationships between species and resulting ecosystem stability rather than identity derived from dispersal history. More particularly this stability, referred to by nativeness, is approached from a semiotic perspective by using the concept of semiotic fitting (Kull 2020) discussed in more detail in chapter 2. Understanding the approaches to nativeness discussed here constitute an important basis for understanding nativeness as it is referred to in the concept of semiotic fitting.

### **1.1.2 Invasiveness**

Rather than referring to the identity or history of a species, invasiveness can be understood as an interaction dynamics in native/non-native dichotomy. Invasions, invasiveness and invasive species are generally defined on the basis of novelty by two qualifiers: (1) the expansion of species happens by human agency, and (2) expansion causes serious negative

ecological, such as direct (e.g. predation) or indirect (habitat alteration) population decreases of other species, and economic impacts (crop damages, infrastructure damages) (Lockwood *et al.* 2007).

The latter point especially creates divisions. While some authors focus mainly on negative impacts (e.g. Drake *et al.* 1989, Mack *et al.* 2000, Simberloff 2005), some define invasiveness based on the rate and distance of species dispersal across major geographical barriers (Richardson *et al.* 2000; Daehler 2001) and propose terms such as pests and weeds to denote species that are considered harmful. Advocates of range-based definitions in assessing invasiveness of species often emphasize three points; firstly, formulating impact criteria is inevitably subjective and can undermine objective scientific endeavors; secondly, focusing on impacts can neglect the “stages of invasion” (Richardson *et al.* 2000) such as initial introduction and establishment of a new population; and thirdly, eradication of invasive species whose impacts prove to be damaging can become costly compared to costs of predictive measures (Pimentel 2000; Lodge *et al.* 2006).

Impact-based approaches often emphasize the “rule of tens” (Williamson, Fitter 1996) which states that 10 percent of all introduced species establish and further 10 percent proceed to become harmful. Defining all spreading species as potential threats for all types of ecosystems can lead to meaningless rejection of species only based on their origins assessed by range-based approaches (Davis *et al.* 2011). This debate between prevention and observation has also instigated allegations of xenophobia and racism from one side, and invasion denialism from the other side (extensive reviews of this debate in Simberloff 2003; Frank 2019). In the more positive impact-based definitions, some emphasize the evolutionary importance of species interactions (Shantz 1906; Shine 2011; Ricciardi, Cohen 2007) or neutral or positive impacts of these encounters (Davis *et al.* 2011; Davis, Thompson 2000). The key point in invasions is that newly formed interactions between species can have multiple effects either immediately or gradually or not effects at all (at least theoretically) (Goodenough 2010). Most controversial and heated debates have emerged in the juxtaposition of social topics (e.g. immigration) and ecological invasion discourse (Subramaniam 2001; Simberloff 2003). In an extreme example, Gröning and Wolschke-Bulmahn (1992, 2004) connected ecological invasion discourse with racial ideologies of German national socialism in the first half of 20th century – an initiative that

saw equally heated responses (e.g. Sorvig 1994). Recently invasion terminology surfaced in political rhetoric in Finland.<sup>1</sup>

In this thesis I will use invasive species in reference to human-introduced nonnative species which have begun spreading and causing ecological and cultural impacts in the ecocultural (discussed in chapters 2 and 4) systems where they become abundant. My choice to differ slightly from the often used approach of defining invasive species more strictly by serious negative impacts is justified by the notion that invasions always result in multiple impacts depending on point of view, and can be socially considered negative, neutral, or positive even simultaneously (Simberloff *et al.* 2013). Also, some have noted that species that are considered native can cause invasive-like impacts (review by Carey *et al.* 2012).

This is especially important when taking a semiotic approach to invasive species, since from an Peircean semiotic perspective (as a basis for biosemiotic and ecosemiotic approaches) interpretation plays a key role in meaning-making. The semiotic aspect of invasiveness is discussed more thoroughly in chapter 2, but as Eco (1976: 146) notes: “[T]he interpretant acts in the background as an unnoticed but highly effective mediation that permits one to understand signs and to apply them to a specific concrete experience”. Therefore I will attempt to maintain the difference between harmful, beneficial and neutral invasion impacts contextually throughout this thesis. Also, similar differentiation is in use in Finnish terminology<sup>2</sup>, which enables me to better map my interview material (in Finnish) with my analysis in English.

## **1.2 Evolutionary perspectives to invasions**

### **1.2.1 Drivers of evolution**

Interest in speciation and species distribution dates back to the late 18th and 19th century (Chew, Hamilton 2011; Pyšek *et al.* 2004; Cadotte 2006). However, Cadotte (2006: 16)

---

<sup>1</sup> In June 2019 a Finnish member of the parliament from the rightwing conservative party True Finns juxtaposed Finland’s refugee and asylum policy with invasive species prevention plans. The speech generated a wide public debate and was assessed by the attorney general as meeting the legal criteria for prosecution of incitement towards an ethnic group. However, the parliament later voted against removing the higher-than-normal immunity possessed by its members in this particular case and no further actions were taken.

<sup>2</sup> In Finnish the term “vieraslaji” is conventionally used in describing invasive species, and “haitallinen vieraslaji” is used to refer to harmful invasive species.

argues, it was Charles Darwin's classic *The Origin of Species* (1859) that initiated attempts to explain why species spread and what are the implications of species movements. Cadotte (2006: 16) argues that while these non-native species posed a challenge to Darwin, he "cleverly used non-indigenous species as a device to test or illustrate his theory of natural selection and descent with modification". Both Carboni *et al.* (2013) and Park *et al.* (2020) see that Darwin had two contradictory conclusions: On the one hand, similarity with native species could enhance the establishment of non-native species due to ability to adapt to the same conditions, and on the other hand, Darwin saw that greater differences between species can also translate into lack of competition and can increase chances of establishment by new arrivals.

American evolutionary biologist Stephen Jay Gould (1941–2002), one of the most influential critics of the gradualist view on evolution theory, has deconstructed the connection between evolution and nativeness (1998). According to Gould, one type of reading of evolutionary theory asserts that the theory explains the optimal state of nature in which natural selection "works for the best forms and most balanced interactions" (*ibid.*, 5), or in other words, connects nativeness with optimality, and superiority, through selection. And another type of reading, Gould argues, connects a particular geographic place as most well-suited for a particular species. As Gould (*ibid.*, 7) illustratively puts the argument: "Why, after all, would a plant live on in this-or-that region of 500 square kilometers unless this domain acted as its 'natural' home – the place where it, uniquely, and no other species, fits best".

Gould takes a critical point of view to these arguments. According to him, the first fallacy is that even Darwin observed how native plant species were poor competitors against introduced species even if introduced species had no history of adaptation in their new habitats. Thus, if the idea of optimality was correct, the well-adapted native plants would be able to stand their ground against newcomers (*ibid.*, 6). Another fallacy that Gould points out is that in constantly changing nature species "do not necessarily, or even generally, inhabit the geographic area best suited to their attributes" (*ibid.*, 7). Instead, Gould (*ibid.*, 8-9) argues, native species should be understood as species which simply arrived first or evolved in the place, and their success only indicates well-suitedness not optimality. However, Gould does not completely reject an idea of harmful invasions even if he rejected the idea that invasions are unnatural:

At least we know what natives will do in an unchanged habitat, for they have generally been present for a long time and have therefore stabilized and adapted. We never know for sure what an imported interloper will do and our consciously planted exotics have "escaped" to disastrous spread and extirpation of natives (the kudzu model) as often as they have supplied the intended horticultural or agricultural benefits. (Ibid., 9)

One evolution-based theoretical idea which has been often tested against invasion events is the idea of co-evolution in community structuring (Ehrlich, Raven 1964; Thompson 2005). It describes the evolution of one species in response to the evolution of another with which it has close ecological interactions (predator-prey, parasitism, mutualism etc.). For example, in the context of invasions, coevolutionary approach can offer a view on community interactions which invasions come to rearrange (being not co-evolved with species which they encounter). However, formation of close interaction relationships between species does not always require a common evolutionary history, Daniel Janzen (1980) argues. Janzen (ibid.) has shown that new mutualistic pairing can occur simply by matching the independently developed habits of both species together. He (1985) has thus proposed "ecological fitting" as a concept to describe how species' habits can simply fit together in interactions rather than needing to evolve gradually over a long period of time.

In the post-Darwinian ecology, academic interest in species movements and encounters has taken many directions. Two domains of questions are shared across the different fields: firstly, what makes species invasive and what makes ecosystems invadable? Studies have also followed two distinct directions, one emphasizes species movement and mixing as conservation concern due to the diverse impacts and the other focuses its dimensions in evolutionary and genetic processes (Davis 2006; Barrett 2015).

This tradition is resonating, for example, in Brown and Sax (2004), who argue that "biological invasions are nothing new" (ibid., 532). They promote that, firstly, human impact on Earth has not yet exceeded the impacts of previous rapid disruptions, and secondly, disruptions have always been temporary followed by rapid recovery periods. In another account, Sax and Gaines (2003) find that, although invasive species can decrease diversity on a global scale, they might increase diversity on regional and local scales (e.g. ecosystems). Similarly, Davis *et al.* (2011) find no evidence that invasive species pose "an apocalyptic threat" for species diversity. They (ibid., 153) assert that categorization of species based on nonscientific notions (nativeness and belonging) does not contribute in advancing ecological knowledge nor produce strong ecological or economic rationale upon which to build conservation efforts. However, when it comes to the questions of species

traits, the neutral line of thinking has turned into exploring aspects such as changes in genotypes and phenotypes and effects of invasions on genetics in general (e.g. Sakai *et al.* 2001; Davidson *et al.* 2011).

The concept of invasive species has its roots in traditional general ecology that questions the magnitude of the capacities by humans to alter the large-scale (spatially and temporally) natural processes, especially that of evolution, as discussed in this sub-chapter. Against the grand backdrop of contemporary understanding of evolution theory the conceptualization of invasive species is mostly grounded on the particular attribute of being human-induced. This leads to the question how unnaturalness of invasions is understood and argued. The relationship between invasive species and evolution theory is important in further understanding the key role of invasive species in the shift in ecological thinking in the era of the anthropocene.

### **1.2.2 Causes for unnatural extinctions**

Invasion ecologists have debated frequently on the origins of viewing species movement as an environmental protection issue (e.g. Chew, Hamilton 2011; Simberloff 2011b). At its core, the problem of invasions is based on the role of new species in changes in species richness, i.e. biodiversity. According to one view, perception of impacts by non-native species as harmful invasions is linked with a more broad shift in conservation ecology towards a “crisis discipline” (Soulé 1990; Pullin 2002; Wilson 2002) contextualized by growing evidence of human influence in the functioning of ecosystems globally. Linking the decreasing biodiversity with human introductions of species is a starting point for the problematization of invasive species.

Authors usually name British ecologist Charles Elton (1900–1991) as the pioneer in his *The Ecology of Invasions by Animals and Plants* (1958) not only for recognizing and popularizing human-induced dispersal of species as problematic (Ricciardi, MacIsaac 2008; Richardson 2011) but also for establishing the straight-forward militaristic language used (and highly debated) today (Eser 1998; Davis *et al.* 2001). The focus and tone is evident, for example, when Elton (1958: 15) declares that

It is not just nuclear bombs and wars that threaten us, though these rank very high on the list at the moment: there are other sorts of explosions, and this book is about ecological explosions. An ecological explosion means the enormous increase in numbers of some kind of living organism – it may be an infectious virus like influenza, or a bacterium like bubonic plague, or a fungus like that of the potato disease, a green plant like the prickly pear, or an animal like the grey squirrel.

Elton synthesized many concepts to understand and explain why some new species seemed to spread more rapidly than others and outcompete established competitors in a given ecosystem. For example, Elton (*ibid.*, 117) used the term ecological resistance to describe that it is not only the abilities of the invasive species that matter but also response by the established species in the ecosystem. This idea that diversity in an ecosystem translates into resistance against invasion events formed a strong foundation for invasion research (Kitching 2011: 7).

Simberloff (2011b) argues that the key moment for problem-sensitive invasion research was not Elton's account but the founding of a dedicated programme on invasions under the Scientific Committee on Problems of the Environment project (SCOPE) which operated between 1982–1988 and funded a large amount of studies on impacts of invasions during the end of the 1980's (Drake *et al.* 1989; Mooney *et al.* 2005). In *The Diversity of Life* (1992) Edward O. Wilson placed invasive species as the second biggest threat to biodiversity after habitat degradation and before pollution (*ibid.*, 24; but see also criticism by Gurevitch, Padilla 2004).

The problem-sensitive path set firmly by Elton and later by the SCOPE has two domains. On one hand, a great interest has been directed towards invasive species' traits, and on the other hand, towards ecosystem characteristics. As research questions, these can be translated into questions: what makes some species invasive and what makes ecosystems prone to invasions?

Several invasion hypotheses (Hufbauer, Torchin 2007) answer these questions. Darwinian-inspired empty niche hypothesis suggests that some ecosystems, especially island ecosystems, often under-utilize resources, which results in empty niches that can be either filled by established species via evolution or by invasive species (Hierro *et al.* 2005). An alternative to this is the sampling hypothesis, which states that lower diversity simply decreases the probability of presence of a superior competitor (Shea, Chesson 2002: 175). Enemy release hypothesis, on the other hand, suggests that relocated species are “released” from their former enemy-interactions and are thus able to allocate more resources into



dispersal and reproduction leading into dominant position in their new habitat (Torchin, Mitchell 2004).

Species-specific approaches propose that species that become invasive have unique traits and characteristics (such as novel weapons; Callaway, Ridenour 2004) making them superior competitors for other species (Sax, Brown 2000). More ecosystem-focused is the understanding that some ecosystems are more invadable than others due to different factors (biotic resistance hypothesis, see Hufbauer, Torchin 2007: 85). Island ecosystems, especially, have been considered vulnerable to invasions since they are sensitive to fluctuations in the equilibrium between immigration and extinction, as described in the island biogeography theory by MacArthur and Wilson (1967). Particularly in invasion ecology these ecosystem-focused approaches concentrate on the diversity-invasibility hypothesis (DIH) which asserts that diversity of an ecosystem makes them more resilient towards invasions (e.g. Hobbs, Huenneke 1992; Fridley 2011).

The increased understanding of multidimensionality of invasion events and ecology in the era of the anthropocene has shifted a great deal of interest into understanding human dimensions in invasions. However, early examinations on human dimensions were mainly interested in the impacts of invasions for human social and cultural processes (McNeeley *et al.* 2001), but recently an increasing amount of studies have focused on how human social and cultural processes participate in facilitating invasions (Kapitza *et al.* 2019). The shift into emphasising human dimensions has two important implications. Firstly, it locates human cultural processes together with ecological processes into the core of the phenomenon. Secondly, humans not only suffer from many of the ecological impacts but are also key agencies in facilitating and making the invasions possible. What is presented here is the ecological shift towards acknowledging the role of human cultures in invasions. In the following sub-chapters these cultural aspects are discussed more closely.

### **1.3 Invasive species as a cultural phenomenon**

#### **1.3.1 By-products of culture**

Hattingh (2001) frames the cultural approach to the phenomenon of invasive species partly as a linguistic interpretation. He argues that while the vocabulary of invasions follow

conceptual dualisms, such as native/non-native and harmful/harmless, the ideals attached to these are challenged by both the contemporary economic organization of material flows, namely globalization, and an interpretation framework of postmodernism.

Following Lyotard's (1984) notion of "the grand narratives" of the 19th century, Hattingh (*ibid.*, 186) argues that according to the grand narrative of economic globalization, invasive species can only be acknowledged if they pose a threat to it and reacted upon only if reaction appears as an economic rationale. But on the other hand, postmodernism marks a "loss of faith in all of these grand narratives" (*ibid.*, 187) due to postmodernist dissolution of such notions as context, time and space. Moreover, Hattingh writes

[...] our notions of origin and originality have become fluid. We know for instance that everything around us must have had a historical beginning, but as soon as we try to locate that within a particular place and time, these beginnings shift back indefinitely in time, leaving us at best in a state of spacio-temporal disorientation with no background against which things can be interpreted. (*Ibid.*, 188)

However, such reading of postmodernist condition can also empty out all justifications for conservation, Hattingh reminds. All that is left would be "a sense of resignation about the landscapes and ecological systems we live in, no matter how degraded or 'invaded' they are by alien species" (*ibid.*, 188). Instead a more positive interpretation would suggest "an ethical challenge to make certain decisions" and "to take full responsibility for the foreseen consequences" (*ibid.*, 188).

Nearly all flora and fauna introductions globally over the course of the last 500 years can be seen as human-induced (Mack, Lonsdale 2001). Not undermining ecological research on invasive species, Hattingh (*ibid.*, 191) notes, "it is still humans who introduce the value distinctions between healthy and unhealthy, between harmed and unharmed ecosystems, or between 'good' and 'bad' non-native species." Pfeiffer and Voeks (2008: 282) emphasize the same point: "[i]nvasive species are anthropogenic phenomena".

Invasiveness of species can be understood not only as conceptual linguistic construction by humans, but in the sense that human cultural activities are the main cause for invasions (*sensu* Elton) and that invasions have direct consequences for human activities (McNeely 2001). Global trade is often emphasized as a key area of invasion pathways (Baskin 1998; Hulme *et al.* 2008). Similarly, a study by Ernst (1998) concludes that different transport networks are key aid for invasions. Chaloupka and Domm (1986) have

shown that in some protected areas the amount of invasive species correlates with visitor count.

From this perspective invasions are a by-product of human cultural systems in both symbolic and material dimensions. Such a position has also instigated extreme interpretations of invasive species as “biological pollution” (Boudouresque, Verlaque 2002). Nagy and Johnson (2013: 4) explore the term “trash animals” that describes species which are perceived worthless in human cultural valuations:

“Trash” describes an animal as worthless, useless, and disposable, none of which are inherent qualities of an animal itself; rather, it defines an animal’s relationship to humans or attitudes about how humans understand the way an animal fits into our worldview.

Trash animals carry with them the shared symbolic and real history with humans (Nagy, Johnson 2013: 2). Furthermore, Nagy and Johnson argue that describing invasive species as “bio-pollution” reveals much more about background (cultural) ideals of nature rather than species’ characteristics and makes any scientific account lose its objectivity (ibid., 2).

Particularly interesting phenomena which reflects invasions as cultural products is the emergence of acclimatization societies in English-speaking colonies in the 19th century. These societies took on a mission to export and import species to supplement flora and fauna in the new colonies or their old homelands which they perceived as lacking certain species. Most imports by acclimatization societies were motivated by what Mack (2001) names as “call home syndrome” that mixed different cultural systems: food from home, ornaments from home etc. For example, Groves (1986) has mapped these introductions which have resulted in severe ecological problems later. Not all such imports have happened based on sentimental motivations (Ritvo 2014) but filling cultural functions is often a guiding principle in introductions and ecological reconsiderations fall behind. Examples of such introductions are the Nile perch (*Lates niloticus*) introduction in Lake Victoria (Pringle 2005) and introductions of kudzu (*Pueraria*) plants in the US (Blaustein 2001).

The main point here is that species are not just indifferently transported and introduced by humans but introductions are often driven by human motivations that have many cultural bases. One way to map the cultural processes through which invasive species are transported and the motivations that result in transportation is presented by Hulme *et al.* (2008) as “invasion pathways”. An important idea here is that freedom of movement of commodities and people in, for example, global trade and tourism, are processes that

constitute an important aspect of globalization which is mostly considered as an important mechanism in improving lives – one of the costs being the spread of invasive species and their harmful effects.

### **1.3.2 Nature threatening culture**

Another way to conceptualize invasive species is that they represent wild and uncontrolled nature that threaten human cultures. Invasive species can be understood as a more active category of nature that emerges to modify or threaten cultural processes. Most evidently the threat of species invasion has been contextualized in economic terms already since Elton (1958: 147) who noted that invasions mostly occur on agricultural lands. Studies on economic losses have become an influential path in invasion research (e.g. Pimentel *et al.* 2000; Brunson, Tanaka 2011).

In many cases invasive species as natural entities come to establish a strong cultural position even if rejected from the ecological category of nativeness suggesting a discontinuity between ecological and cultural understandings of natural processes. For example, Nuñez and Simberloff (2005) have mapped several invasive flower species which have acquired a role as official state flower in the United States. The spread of the kudzu plant (*Pueraria*) in the Southern US is an example of an invasion that has had a huge impact in the cultural sphere, according to Blaustein (2001). This phenomena can be understood following the idea that some species are posited as “cultural keystone species” (Garibaldi, Turner 2004), but should not be since this fixes them as cultural entities and can hinder conservation efforts (Nuñez, Simberloff 2005).

Pfeiffer and Voeks (2008) attempt to formulate a framework to assess cultural impacts of species invasion globally. They (*ibid.*, 282) define culturally invasive biota as “non-native organisms or genetic material that have ecologically displaced or extirpated native biota, resulting in a detectable cultural impact on resident societies”. According to the authors (*ibid.*) these impacts can be classified as culturally impoverishing (loss or replacement of culturally important native species and their traditions linked with them), culturally enriching (augmenting cultural traditions in such domains as food, narratives and symbolic uses) and culturally facilitating (perpetuating ethnobiological interactions of diaspora communities with nature, enabling post-migration cultural continuity).

Pretty (2002: 18) offers one perspective to what appears as a separation of ecological and cultural:

A remote community cannot know the detailed mechanisms by which legumes interact with rhizobia in the soil to fix atmospheric nitrogen; nor will they know the properties of a chemical that pollutes a well. What they know will have been built up from accumulated individual and collective experiences, fixed in time through story-telling.

Even though Pretty focuses mainly on agricultural disconnection between plants and food, his central notion is, it think, translatable into ecological perspective to invasive species: isolating invasive species as nature by certain linguistic and scientific representation can result in opposing them as otherness against human culture.

#### **1.4 Shifting agencies**

Some perspectives have emphasised the aspect of cooperation between human and nonhuman species in dispersal. Most notably Alfred Crosby (1986) has proposed a historical view that the transportation of flora and fauna from Europe into North-America had a fundamental role in affecting the course of global development both socially and ecologically. According to Crosby (*ibid.*, 293) “[t]he success of portmanteau biota and its dominant member, the European human, was a team effort by organisms that had evolved in conflict and cooperation over a long time”.

To conceptualize certain species as constitutive to human cultural identities, Garibaldi and Turner (2004) proposed a concept of cultural keystone species (CKS), an extension of the ecological concept of keystone species (see, Paine 1969; Power *et al.* 1996). According to Garibaldi and Turner (*ibid.*), cultural keystone species are species which have integrated into the cultural traditions and narratives of certain communities in such a way that their influence in the human cultural identities is exceptionally widespread. The role of cultural keystone species has multiple modalities in human culture, Garibaldi and Turner (*ibid.*) suggest, for example as a source of food or medicine, in technology, in narratives and ceremonial rituals, and in language.

The question arises whether any invasive species can acquire such a position? According to Nuñez and Simberloff (2005) the answer is yes, but they argue that the concept of cultural keystone species can also obstruct conservation activities if applied to invasive

species. While Garibaldi and Turner (*ibid.*) expect the position as cultural keystone species to increase community dedication for conservation effort of the species, Nuñez and Simberloff (2005) argue the opposite: “What if a restoration program depends upon eradicating or controlling an exotic CKS? What if the community decides to restore an exotic species that forms part of its tradition?” Referring to observations by Barnosky *et al.* (2004, cited in *ibid.*) that primitive cultures can have destructive impacts in their environment, Nuñez and Simberloff (*ibid.*) see that the relationship between cultural and ecological systems is not always informed by each other and can “easily be out of sync” – an interesting notion that unfortunately cannot be discussed further here.

Nevertheless, proposal by Garibaldi and Turner (2004) reflects a larger project in environmental conservation of linking ecological systems and cultural systems in order to understand the changing dynamics of human’s perception of their environment (e.g. Cavalli-Sforza, Feldman 1981; Berkes, Folke 1998; Berkes *et al.* 2003). When it comes to invasive species in particular, this shift has inspired an increasing amount of interdisciplinary studies (Kapitza *et al.* 2019). Still, a notable knowledge gap prevails, Abrahams *et al.* (2019) argue.

One early example of a network-focused approach to invasions is by Robbins (2004) where he follows the framework of actor-network theory (ANT) formulated during the 1980’s and 1990’s by its key authors Michel Callon (eg. 1984) and Bruno Latour (eg. 1987, 1993) and John Law (eg. 1991). I will discuss ANT and its applicability to study invasive species more extensively in later chapters, but to describe it simply here: Actor-network theory is an analytical framework to identify and make visible dynamic relationships between different actors that can be either human or nonhuman (Latour 2005). For example, cultural meanings attached to some invasive species as discussed earlier could be understood as agencies or part of the species agency. Tracing and acknowledging any interactions on one hand dissolves the border between dualisms such as nature and culture (or native and non-native), but can also offer a way to see the dynamics in such emerging complex systems. According to Robbins (2004: 153), in invasion events, “[t]he approach has strong explanatory purchase because it directs attention away from individual people, species, and habitats and toward their interrelationship”. Focusing then on the question whether human influence in invasion events is random or not, Robbins (2004: 142) writes:

The human elements of the problem are overlooked, in terms of both the patterned behaviors of people in setting the conditions for invasion and the impact of invasions on human history. Some species only invade rapidly when human conditions or disturbance regimes shift and where social conditions change, for example.

According to Robbins (*ibid.*, 145-146) invasions are often “prepared”. By this he means either physical preparation, such as enhancing invasion probabilities by landscape disruptions that follow patterns of human land use; social preparations, such as divergence of different stakeholders in defining desirability of a species; and economic preparations that change valuations of resources and can potentially transform species into invasive species threatening this new valuation. In this intersectional context, different participants face different consequences which can lead into “alliances” between actors (human or nonhuman) who benefit from the invasion. And further, through self-reinforcing “feedback loops”, these alliances can enhance the rate of invasion, Robbins (*ibid.*, 146) argues. As Robbins (*ibid.*, 140) partly provocatively describes: “It is not species, but sociobiological networks that are invasive”.

Jepson *et al.* (2011) apply ANT as a framework to examine different actors influencing a conservation project around the asian elephant. They show how values and actions in conservation are not shaped solely by humans but also by nonhuman species and technology. Following Emirbayer and Mische (1998) they (*ibid.*, 231) discuss the agency of the asian elephant in conservation taking three forms of agencies, iterative, projective and evaluative. In their example, the physical capacity of the asian elephant to interact with geolocation technology projectively enables the realization of goals, hopes and demands of human conservation actors. Jepson *et al.* (*ibid.*) focus on conservation of endangered species, but the approach is analogous to invasive species management – although in the case of preventing the spread or eradicating invasive species as conservation of nature does not always clearly state what actually is being conserved.

Connections between ecological and cultural domains in invasions can be interpreted on a strong-weak axis, as discussed by Simberloff (2018). While Simberloff readily acknowledges the prospects of converging ecological and cultural approaches to nativeness and invasiveness, he also notes the concerns towards extreme applications which deny nature or nativeness any ontology (*ibid.*, 209). Such views, “deemphasize the enormously long sweeps of time through which ecological communities are typically formed in nature” (*ibid.*, 213).

The idea of shifting agencies in invasions presented here could also be called distribution of agencies into networks of relations. This is not to refrain that species themselves can be ecologically disastrous by causing increased extinction in native species, nor to argue that invasive species are just cultural constructions. The point in discussing network-approach to invasions is, on one hand, to simply point out that it is the direction already taken in invasive species research, and on the other hand, to show the potential for a connection between invasive species research and semiotics.



## **2 Semiotics of invasive species**

In the previous chapter I have explored some ecological, cultural and integrated approaches to invasive species and described how the phenomenon of invasive species has taken multiple modalities in all of these domains. As the recent development in ecological invasion research shows, more emphasis has been given to human processes and shifting agencies that influence not only on how invasions occur and are made possible but also on how invasions are culturally understood and contextualized. As Pfeiffer and Voeks (2008: 282) underline: “[i]nvasive species are anthropogenic phenomena”.

One of the shifts in semiotics has been the extension of semiotic concepts from human culture into ecological processes and the inclusion of humans and human cultural structures into ecosystems (Maran 2020: 1). Maran and Kull (2014: 41) have defined ecosemiotics as “a branch of semiotics that studies sign processes as responsible for ecological phenomena”, and more recently Maran (2020: 4) has proposed ecosemiotics as a study on “the interactions between environmental conditions and semiotic processes and the diversity of life stories, meaning-making strategies, and narratives that spring from these intertwinings”. The phenomenon of invasive species is a prime example of the many meeting points between ecology and ecosemiotics: invasive species as an ecological phenomenon can have multiple ecosystemic impacts which affect sign-relations that organize, facilitate and regulate relationships between species and between species and environment. Semiotic response to the questions of what makes species invasive and what makes ecosystems invadable would be to focus on the relationships that emerge from traits and characteristics.

What follows in this chapter is an outline of a framework for analyzing how invasive species fit into ecosystem relationships and into semiotic processes that organize them. This framework is adapted from the concept of semiotic fitting (Kull 2020) which is extended into integrating humans and human cultural structures as agencies in forming ecological-cultural communities.

## **2.1 Fitting as a semiotic process**

The particular research interests in this thesis are the roles of white-tailed deer and *rosa rugosa* as invasive species in two communities in Southern Finland. As discussed in the first chapter, ecological usage of the term fitting originates from Janzen (1985) as an alternative to co-evolutionary views on formation of species relationships. Fitting as a semiotic concept was recently proposed by Kull (2020) as an alternative understanding of nativeness of a biotic community as based on functional semiotic relationships of species. In this sense semiotic fitting is also an initiative into the broader discussion outlined in the first chapter. Here I will focus on two particular aspects in Kull's proposition: the first is the aspect of agency in semiotic fitting and the second is the concept of community as a context where fitting occurs.

### **2.1.1 Agency in fitting**

The first important aspect of semiotic fitting is that it focuses on organisms as active participants in the formation and maintenance of relationships in a biological community. According to Kull (2020: 9), fitting is “the agent's capacity for making and preserving the local semiotic bonds, meaning the agent's functional or communicational match with its surrounding”. Fitting differs from ecological fitness, a Darwinist position that species capacity in affecting evolutionary processes is based on their superior traits as competitors in reproduction. This dynamic was coined already by Spencer (1864: 144) as “survival of the fittest” and it has been later discussed in different ways (e.g. Waddington 1968; Dennett 1995). In invasion research some concepts such as enemy-release hypothesis is seen to directly result in reallocation of energy from defence into growth and reproduction (e.g. Bazzaz *et al.* 1987) and thus providing direct evolutionary advantage (Blossey, Nötzold 1995).

But fitness as a portfolio of properties in evolutionary success can, however, be seen as being either purely genotypic (neo-Darwinism) or including phenotypic dimension (neo-Lamarckism) of acquired features in an organism's lifetime (see the extensive

discussion in Gould 2002). An influential idea to balance these opposites was developed by an American psychologist James Mark Baldwin (e.g. 1896, 1902), who proposed that cognitive plasticity (in children as well as animal offsprings) and genetic inheritance act together; the former facilitating the latter “until genetic adjustments appeared and were fixed through natural selection, offering more permanent support for the new adaptation” (Hoffmeyer 2008: 204). Baldwin (1896) named this phenomenon as organic selection, later becoming known as the Baldwin effect. This idea of semiotic management of evolutionary success was introduced into biosemiotics as semiotic fitness by Hoffmeyer (1997, 2003) who defined it as a measurement of semiotic ability to manage “translation process” between genetic and environmental information (1997: 370). In other words, Darwinian adaptation from this perspective becomes a conscious adaptation through semiotic abilities of translation between environmental information and genetic information. Maran (2012: 148), following Lotman (2009), suggest that this new emergent area between two different semiotic systems could be understood as “the lived expression of an organism in its environment, manifested in meaningful adaptations and correspondences, communicative interactions and behaviours”.

As Kull (2020: 15) writes, semiotic fitness is one of the earlier concepts upon which semiotic fitting is based. Fitting as well as semiotic fitness differs from biological fitness by being a qualitative feature rather than quantitative. Fitting is driven by choice-making, and it emphasizes the organism’s capacity of self-design. Therefore, natural selection is more of a result of fitting by choices (ibid., 14). However, as Maran (2012: 148) notes, the qualitiveness and open-endedness of semiotic processes result in inevitable immeasurability of semiotic fitness as compared to measurability of (reproductional) fitness in biological terms. In the case of semiotic fitness, its measurability would be more likely based on “semiotic unfitness” (ibid., 148). This point is interesting since the idea of success in semiotic fitness underlies the success of “agent’s functional or communicational match with its surrounding” in the concept of semiotic fitting (Kull 2020: 9). Invasiveness from this perspective could very well be understood as semiotic unfitting – unsuccessful effort to create and maintain functional relationships that result in destructive events in the ecosystem.

Against evolution theory, semiotic fitting follows Janzen’s (1985) observations that often species interactions with its surroundings or with other species do not require a long evolutionary development, but the formation of relations is more simply about finding

functional matching relations upon arrival into a new ecosystem. From a semiotic point of view, Janzen's emphasis on what Kull (2020: 12) calls "search-and-find behaviour" also foregrounds many semiotic processes that are fundamental in an organism's agency, especially perception, recognition and interpretation.

Especially recognition is a key process in fitting: for Kull (ibid.) recognition is what constitutes the process of speciation. For example, the recognition concept of species (Paterson 1993) means that speciation is an active construction of the individual itself through the process of recognizing other individuals compatible for mating. Recognition and the resulting group formation of individuals (recognition window) is also the starting point for the biosemiotic concept of species that highlights it as a communicational category initiated by recognition and interpretation of distinctions (Kull 2016). It is what makes species "real", or more importantly, capable of making choices in semiotic fitting (Kull 2020: 11).

On the other hand, Jakob von Uexküll's model of organism's functional cycle (e.g. Uexküll 1982[1934]) underlies not only fitting but more or less any biosemiotic discussion on agency. Making distinctions by recognition is a key semiotic meaning-making process that is in play in many interactions that are of interest in invasion research. It is a central process in situations where invasive species are concerned since invasiveness describes ecological encounters without a shared history of relationships stored in phylogenetic cognitive processes such as memory. For example, the concept of naïveté in predator-prey relationships describes effectively a case of failed recognition of a novel predator (Carthey, Banks 2014). Agency as it is understood in semiotic fitting is highly relevant for this thesis, since the key difference in semiotic fitting and ecosemiotic fitting – as they are understood in this thesis – is that semiotic fitting posits the agency more as a species' capacity while ecosemiotic fitting here follows actor-network theory which suggests that agencies are much more distributed in the network of agents and negotiated in the encounters.

### **2.1.2 Fitting as community structuring**

Kull (2020) offers semiotic fitting as a model to analyze the role of different agents in a biological community. He (ibid., 10) defines community as "a set of species that are functionally linked, i.e. linked by restorable mediated bonds, [...] relations based on

processes of recognition”, or more specifically as “local set of code-related species”. Hence, Kull (ibid., 16) argues that “nativeness of the community is a product of fitting, not vice versa”. In this definition, the physical environment as an ecosystem or habitat providing resources and physical boundaries, is excluded since “[c]ommon resources usually cannot serve as a mediator that creates specific links. Functional relations between plants almost always require non-plant organisms for mediation”. More importantly, biological communities are in the core of the concept since they are “the systems in which fitting occurs” (ibid., 10). From this perspective the questions of semiotic communities are also of interest in this thesis since they are the contexts in which a semiotic version of invasiveness can appear:

[...] defining community as the functionally related set of species — i.e. as a self-restorable (which also means inheritable) network of species, as consortia, as we will later see — implies that there could be species in a territory that do not belong to the community (ibid., 10).

Among some community ecologists there have been attempts to export community approaches more strongly into ecological research focused on invasions (Shea, Chesson 2002). For Uexküll, ecological communities as collections of different Umwelts are nature’s compositions, points and counterpoints that have an integral tendency to resonate in harmony. Invasions appeared to him as cases of disharmony. Uexküll (1982[1934]) discusses the late 19th century invasion of prickly pear cactus (*Opuntia ficus-indica*) in Queensland Australia as an example of, to borrow Uexküll’s special vocabulary, point without its counterpoint as applied into analysis of enemy relations in nature. Only the successful biocontrol of this invasion by introducing the larvae of its native enemy, cactus moth (*Cactoblastis cactorum*), from South America decades later proved to be the functional counterpoint bringing the dissonance back to harmony at end in the 1930's by limiting the reproductive capacities of the prickly pear cactus (Hoffmann *et al.* 2020). This passage by Uexküll would translate in invasion ecology as an enemy-release hypothesis offered as an interaction-based explanation to why some introduced species succeed in establishing and becoming invasive (Elton 1958; Maron, Vilà 2001; Keane, Crawley 2002). However, as later studies have shown, not all cases of biocontrol end well. For example Simberloff and Stiling (1996) and Mack *et al.* (2000) have shown how some biocontrol species not only fail to control the original invasion but can become invasive themselves. Functional relationships between point and counterpoint in one location are not directly

translatable into another suggesting that there are more than just these two “melodies” influencing.

Furthermore, recognition as a shared process across species is viewed as giving dynamic structures in ecological communities: Intraspecifically it directs reproduction and interspecifically it sets in motion prey and predator relations and mutualisms, among others. From a broader perspective, Goodale *et al.* (2010) discuss the important role of communication between species by sensory cues and signals in ecological cross-trophic communities. They (*ibid.*, 359) find that flow of information in such communities can determine the functional roles of different species in space and time. Sánchez-García *et al.* (2017) have discussed olfactory signals, or odortypes, as similar ecological layer of code shared among several species in an ecosystem. To describe the shared flow of information, or “informational layer” (Patten, Odum 1981) in ecological communities, some authors have emphasized the public or social character of such ecological information (Seppänen *et al.* 2007).

Moreover, semiotic regulative interactions in ecosystems can be indirect, such as cases of facilitation (Maran 2020: 16). Here, again, invasion ecology offers a contact point: Simberloff and Von Holle (1999) has shown that invasion of one species can in fact facilitate the invasion of another through either alteration of the ecosystem or by providing resources for the successful entry for the next arrival. They (*ibid.*) describe this type of process as “invasional meltdown”. Related to this, some studies have also found an interesting contradiction in the classical diversity-invasibility hypothesis: while there is evidence of negative correlation between species diversity and invasions, there is also evidence of increased presence of invasive species in ecosystems where diversity is high (Shea, Chesson 2002: 174). The authors (*ibid.*, 174) reason that varying environmental conditions explain this contradiction, but that, on the other hand, this observation also emphasizes the regulative and facilitative role of both species-species and species-environment relations in invasions.

There is an interesting tension in positioning semiotic fitting with the main traditions in community ecology. What is often called Clementsian (*sensu* Frederic Edward Clements (1874–1945)) tradition takes ecological communities as networks of interactions between different species and thus as a kind of deterministic self-organized systems themselves. Another tradition follows Gleasonian (*sensu* Henry Allan Gleason (1882–1975)) idea of communities as a dynamic continuum of individual species traits which randomly connects

assemblages of populations to a specific habitat in a particular area (Verhoef, Morin 2010: 1). These two traditions differ in that Clementsian tradition sees community relations as results of what could be understood as co-evolution (Ehrlich, Raven 1964) while Gleasonian tradition pursues community assembly as inherently chaotic or neutral process of random dispersal without strict niche borders (Hubbell 2001). This connects with Janzen's idea of ecological fitting. Semiotic fitting is in a way also an attempt to sew together these two traditions: the biological community is a functional emergent whole itself, but rather than being self-organized they have a capacity of self-design based on individual interpretative ontogenetic agency.

## **2.2 Ecosemiotic fitting**

As noted in the beginning of this second chapter, semiotic fitting, as it is proposed by Kull (2020), is limited in addressing the fitting of invasive species. While semiotic fitting focuses on the functional balance and integrity of biological communities, i.e. nativeness, human cultural interpretations of invasive species is a process that is an inseparable part of the conceptualization of the phenomenon. Invasiveness is an ecological-cultural phenomenon that is strongly contextualized and problematized as an anthropogenic phenomenon while being highly visible in the ecological processes that influence ecosystem relationships.

As mentioned above, ecosemiotics is a branch of semiotics that adopts a broad view on semiosis in ecology by including humans and human cultural structures as well as material boundaries into sign-processes. As such, it has potential in addressing the complexities surrounding invasive species. An ecosemiotic approach could be more suitable in understanding invasiveness as a process of semiotic fitting. The main focus here is to attempt to expand the concept of semiotic fitting on two domains: (1) including humans and human cultural structures as agencies that participate in making and maintaining functional and communicational relationships in ecological communities, and (2) by viewing communities as co-constructed by both ecological and cultural processes. This forms a basis for analyzing the phenomenon of invasive species from an ecosemiotic perspective. In this part, I will first discuss the concept of the semiosphere as providing a broad background or a top layer for semiotic processes in both nature and culture and a context in which invasive species are perceived, interpreted and produced or managed. To support this, I will adopt the

concept of different natures (Kull 1998) as an ecosemiotic understanding of the dynamics and translations between materiality and culturality of invasive species. Finally, I will explore ecosemiotics on a community-level using the concept of ecocultures (Pilgrim, Pretty 2010).

### **2.2.1 Invasions and the semiosphere**

The phenomenon of invasive species as an environmental problem highlights what is identified as a broader need in semiotics to build a framework for exploring semiotic diversity of ecosystems that would include humans and human cultures (Maran 2021). As discussed earlier, a similar project is ongoing in invasion ecology, which has only fairly recently begun shifting from researching the impacts of the phenomenon to human processes into understanding the role of human processes in creating and maintaining invasions (Kapitza *et al.* 2019). The concept of the semiosphere can help to understand the broader ecological and cultural space in which invasions occur, and how they are conceptualized against a broader semiotic background.

The concept of the semiosphere has two tendencies which both are inspired by Vladimir Vernadsky's use of the term biosphere (1998[1926]) as a life's topmost layer that is responsible for past and future creation of all life. On the one hand, the adaptation of this idea into cultural studies is usually connected with cultural semiotics of Juri Lotman (1922–1993), who used the term to describe the most general and all-encompassing top layer of sign-processes that organize cultural processes, i.e. conditions for the emergence of languages (Lotman 2005). The semiosphere could be described simply as “the semiotic space necessary for the existence and functioning of languages” (Lotman 1990: 123). On the other hand, Vernadsky's usage inspired the biological application of the semiosphere in the early biosemiotic community. For example, Jesper Hoffmeyer (1996: vii) used the term explicitly as a similar life's macro-level organizational structure as atmosphere, hydrosphere and biosphere. If the biosphere comprises the biological processes that integrate all life on Earth together through flows of matter and energy, the biological semiosphere does the same by flows of signs and meanings. Important aspect is that signs do not operate independently: for example, Kotov and Kull (2011) emphasize that the semiosphere is a compilation of semiotic relations. This follows Lotman's (1990: 125) argumentation that signs get their



meanings in relation to other signs – hence the understanding of the semiosphere as a space where signs are in relation with other signs.

Two interlinked ideas that are included in the concept of the semiosphere as discussed by Lotman are useful when thinking about invasive species as an ecological-cultural phenomenon. The first aspect is the question of boundaries in the semiosphere and the second is about the idea of translation. As we have seen, invasiveness is usually understood as crossing boundaries, both cultural and biogeographical.

Lotman saw the semiosphere being structured according to the dynamics between “core” and “periphery” which can be described as an increase (towards the core) or decrease (towards the periphery) in organization and familiarity of the signification system (i.e. language). Yet, the semiosphere is not about simple dualisms or hegemonies. Nor is it about metaphorical spaces, but about lively dynamics across multiple (ambivalent) boundaries on multiple levels and real-world spatial dynamics (such as cultural organization of cities; Nöth 2015: 13–14). Lotman argues:

In fact, the entire space of the the semiosphere is transected by boundaries of different levels, boundaries of different languages and even of texts, and the internal space of each of these sub-the semiospheres has its own semiotic ‘I’ which is realized as the relationship of any language, groups of texts, or separate texts, to a metastructural space which describes them [...]. (Lotman 1990: 138)

In other words, cultural entities, or texts (Uspenskij *et al.* 1973) are not only translated and moved around in the cultural space, but each of them are systems themselves with a certain identity that is constituted in relation to other entities. Nöth (2015: 20) notes that boundaries in the semiosphere acquire two quite different functions for Lotman. On the one hand they both separate by dividing a cultural norm from counter-cultural periphery, and therefore constitute a sense of cultural identity by giving it a well-organized form. On the other hand, and especially in Lotman’s later writings, boundaries acquire a function of filtration and translation making them relevant in biosemiotic understanding of communication, Nöth argues (*ibid.*). These aspects are also emphasized by Semenenko (2012: 55) who argues that boundaries within and between different systems or sub-semiospheres should be seen as ambiguous and permeable, since they act as active translators between external and internal. But more importantly, they should be understood as active creators of new information (Lotman 1990: 140) and thus also “catalysts for communication” (Semenenko 2012: 55).

Petrilli and Ponzio have highlighted the limitations of Lotman’s the semiosphere due to its focus on human cultural systems (2015: 48–49). Also the biological semiosphere, as it

is discussed by Hoffmeyer (1996), limits its focus to signs that are predominantly iconic or indexical. From the basis of the two ways by which the semiosphere has been mixing with biology, there have been several propositions for ecosemiotic approach to the semiosphere that would act as a similar wide communicational background for ecological-cultural systems (Maran 2021). This is especially relevant when it comes to invasive species since oftentimes a species becomes identified invasive for a location by its scientifically known ecological properties before becoming perceived iconically or indexically in nature. The complex mixture of human ideas and ecological relationships that underlie nativeness and invasiveness is a good example of a phenomenon that is simultaneously symbolic, indexical and iconic and which, as a semiotic system itself, transcends boundaries and is translated in the temporal and spatial dimensions of the ecological semiosphere. According to Maran (ibid.), the concept of ecosemiosphere would integrate levels of symbolic (human cultural communication), iconic and indexical sign-processes as well as material conditions for ecological communication. Especially important is the prospect of such an approach to address occurrences of miscommunication: invasiveness can be understood as a serious environmental problem that has its origins in the disruptions in relationship between humans and nature and can lead into extinction level events in nature.

### **2.2.2 Invasions in different natures**

The concept of different natures in the semiosphere proposed by Kalevi Kull (1998) is an influential model to understand the dynamics between material and symbolic levels of nature. In this thesis this model is useful in describing the ecological-cultural dynamics by which invasive species are perceived, recognized and interpreted – the core processes in fitting. Furthermore, this approach can also support the efforts in understanding the role of human culture in ecological studies on invasions.

The distinction between nature as an ontological reality and nature as it appears for humans is included already in the writings of Augustine, Hegel, Rousseau and others (Gubeljic *et al.* 2000). It has also been a central notion in the phenomenological understanding that, for any subject, there is always a certain ontological horizon that marks the limits of being (Heidegger used the term “Dasein” to describe this condition for humans) (Buchanan 2008: 5). Jakob von Uexküll expanded this idea with his notion of Umwelt, the

subjective being for all organisms and used the concept of functional cycle to describe the dynamics of perception and operation by which an organism not only passively observes but actively operates in its own Umwelt (Uexkull 1982 [1934]).

By recontextualizing the idea of functional cycle into the semiosphere, Kull (1998) describes a flow of purely cultural symbolic references of nature into the material ontological nature. In Kull's (1998: 355–357) formulation, the cycle between nature as perceived by humans (1-nature) and nature as produced (2-nature) is operating between and constantly informed by both the ontological, material nature (0-nature) and the virtual, imagined nature (3-nature), i.e. nature as deposited in human culture (e.g. art, science). As a result, the culturally informed flow both replaces and covers the more materially linked meanings in nature. More importantly, the representations of nature on the symbolic level of the third nature are arbitrary and need not to be synchronous with object-level changes. Symbolic signs thus acquire, Nöth (2014) argues, strong autonomy and activity.

A central point of this model of different natures is that not only have humans operated the material nature into images of their culturally informed interpretations of it (2-nature), but while doing so have also altered the material conditions from which iconic and indexical interpretations are made by all other living organisms on Earth. This can be seen in “semiotization of natural environments” in landscape design, species management and breeding (Maran, Kull 2014: 45), and, I would add, introduction of invasive species. This connection highlights well why any issue with invasive species is not graspable purely on the level of representational nor material relationships. What is relevant here is that human motivations and the meanings attached to certain species sprout up from both culturally and biologically driven perceptions (Mäekivi, Maran 2016). Probably apt examples of this dynamics are the 19th century acclimatization societies that were largely motivated by the perceptions that the current flora and fauna in either their new or previous homelands lacked some preferred aesthetic and functional “serviceable traits” (Ritvo 2014: 69). What followed from these perceptions were highly organized systems for global importing and exporting of species which are today classified as invasive (ibid.).

If the idea of the semiosphere, and especially of the ecosemiosphere, offers a broad view into the shared ecological-cultural background against which all perceived phenomena are interpreted, the idea of different natures presented here describes the human process of this interpretation – and, more importantly, the implications of the impacts of this process for other species and material nature. Most importantly the concept of different natures is a

semiotic description of the whole chapter 1 of this thesis: Invasive species can be understood as nature that humans attempt to re-interpret as culture, or they can be understood as cultural entities that need to be re-imagined as nature. This framework is an important idea in the ecosemiotic application of fitting as an ecological-cultural process.

### **2.2.3 Invasiveness in communities and agencies**

Both ecological and cultural relations can be organized spatially and temporally in various ways. This means that scales and boundaries matter in ecosemiotic studies. Maran and Kull (2014: 46) write about the environment as an “interface for semiotic and communicative relations”. Since the 1990’s the role of locality in ecological processes has seen a major shift from previously dominant island biogeography theory (MacArthur, Wilson 1967) towards metapopulation theory (e.g. Hanski 1999) which is a network-type understanding of population dynamics and extinctions (Mittelbach, McGill 2019). For social anthropologists the idea of cultural locality leads into a question whether there is an idea of human belonging to a particular locale – whether histories, narratives, myths and rituals have local rootedness (Lovell 1998). For example, Schama (1995) has underlined the deep phenomenological dimensions in these questions as well as the reflective connection between human experience and surrounding physical place. Locality from these perspectives is ontologically a deeply ecological and cultural idea.

There are several ways to conceptualize locality as an ecological-cultural idea. For example, Frost (2016: 4) approaches humans as “biocultural creatures”, as individuals living through a human life from birth to death as it is framed by local natural conditions, human habitats. Baker (1969) used the term bioculture to describe biological and cultural mechanisms used by Peruvian Quechua people in adapting to and maintaining high-altitude habitats in the Andean plateau. Similarly, Poe *et al.* (2014) present a model to approach local socioecological systems that comprise processes of meaning-making, governance, livelihood and interaction with biophysical surroundings. In their approach, communities are understood as spatial accumulations of cultural meanings and values. They also emphasize the role of local ecological knowledge not in the simple perception of the local environment but in maintaining and regenerating the sociocultural sense of place. This thesis follows the idea of ecocultures by Pilgrim and Pretty (2010) that describes the local ecological-cultural

assemblages. In the context of this thesis, ecoculture can more precisely describe the focus on local ecological-cultural relations that humans have formed with invasive species.

According to the authors,

[e]cocultures comprise human cultures that have retained, or strive to regain, their connection with the local environment, and in doing so, are improving their own resilience in light of the multitude of pressures they face, including global climate change. The term ecoculture represents the inextricable links and interplay that can be observed between ecological and cultural systems. [...] [E]cocultural systems not only comprise the social institutions and distinct frameworks of a community, but also the worldviews, identity, values, distinct cultural practices and behaviours that make a community or group culturally distinct. (Pilgrim, Pretty 2010: 11)

Ecocultures is a concept that can be used in addressing anthropogenic environmental change as it appears on a local level (eg. Rapport, Maffi 2010). Here an idea of integrated biological and cultural diversity becomes an important aspect in the functional integrity of ecocultural communities. For example, in invasion ecology, the term resilience refers to the capacity of ecosystems to restrain imbalances in different ecological relations, but Pilgrim and Pretty (2010: 11) extend this to a notion of ecocultural resilience as a similar functional capacity in the whole system. Ecocultural resilience is a close idea to semiotic fitting: if semiotic fitting focuses on agents' capacity to make and maintain functional relations, ecocultural resilience extends the scope to the whole ecological-cultural system and emphasizes the network-type resistance of systemic disturbances. Bodin (2017) has a similar focus when he discusses collaborative networks maintaining communities. For Bodin, collaboration is not a superficial compilation of different stakeholders but rather an operational relationships between participants, i.e. "who the actors are, with whom they collaborate, and how the structures [...] relate to the actors' abilities to address different environmental problems" (ibid., 356–357).

Interesting point by Bodin (ibid.) relates to the situations of failure in collaborative networks to address environmental problems in a community. He (ibid.) argues that collaborative networks can fail in both horizontal and vertical dimensions: the continuum of ecological diversity (metapopulation) can be disturbed due to mismatches in the horizontal management operations (such as maintaining crucial population dispersal connections, or ecological corridors) between land owners. In the vertical dimension, communication can fail to transcend different managerial layers imposed on the community, from governmental administration to local land ownership. The interesting observation here is that fragmentation in local cultural perception of nature and landscape fragmentation can

form a destructive connection. A tension underlies this idea: landscape or habitat fragmentation is one of the leading factors in biodiversity loss (Fahrig 2003), while cultural diversification is considered an important process in many social domains (OECD 2020). This further highlights the importance of semiotic processes in creating and maintaining different local ecocultural links.

Emmeche (2001) made an early ecosemiotic approach to address the problems that invasive species bring to local diversity and values. For him, invasive species represent “eco-semiotic disturbance” (ibid., 237) caused by the boundary-defiant phenomenon of globalization which, if understood as expansion of Western socioeconomic values and systems, is characterized as a process of global homogenization. From an ecosemiotic point of view, this homogenization can have two interconnected problematic effects in local communities, Emmeche (ibid.) argues: Firstly, the difference between heterogeneity and homogeneity is not simply about the amount of species in an ecosystem, but about semiotic activity and functionality of the system. Hence, “the role [of a species] is a relational property determined by the whole network” (ibid., 242). The question is not what a particular species brings into the system but rather what the system requires for its stability. The second point relates to the ethical discussion on preferring certain species over another. Neither ecological nor cultural systems are indifferent towards its parts to the extent that the parts can be simply replaced and no stable ecosystem identity exists (in post-modern sense), but ecological and cultural system possess contingency which means that they have become what they are not purely in random way but under certain unique conditions, Emmeche argues (ibid., 246–247). This suggests that some species have more ecological and cultural reasons and purpose to participate in the functioning of the whole system than others. Another way to put this is that ecosemiotic agency is tied to the local community, and that semiotic fitting is a process of maintaining this locality. This connection is also highlighted by the negative correlation between species’ semiotic fitness and adaptability: longer the period of semiotic interactions between a species and its environment, the less it is capable of adapting to changing semiotic conditions (Maran 2002: 73).

According to Kull (2020: 10, 16) fitting is tied to localities and local communities. More importantly, locality in ecosemiotic fitting is also in close dialogue with network-approaches to invasive species discussed towards the end of chapter 1. For example, both Robbins (2004) and Jepson *et al.* (2011) consider agencies and alliances emerging and being shaped in local conditions. Here the idea of ecoculture is a valuable

concept in supporting the important aspect of locality in the application of ecosemiotic fitting.

[...]

In this theoretical part of the thesis, I have offered a literary review of invasive species research. As discussed, invasive species occupied the minds of the early Darwinists who attempted to interpret the role of new species in ecological processes, such as evolution. Later there have been two opposing views, one holding invasive species as natural occurrences, the other as anthropogenic reasons for extinctions. However, invasive species have always been interpreted also against cultural issues, such as belonging, nationality, citizenship, globalization and xenophobia. For this reason, invasion research has begun incorporating the two dimensions together. In chapter 2, I have offered a compilation of semiotic concepts that would place sign-processes as responsible for construction of the phenomenon of invasive species. Central to this is the concept of semiotic fitting. It is a way to understand the role of different species in a community, but in order to fully grasp the dimensions of invasive species, ecosemiotic concepts of ecosemiosphere and different natures are needed to emphasize the functional and communicational dynamics between humans and human cultural structures, other species and environmental structures. These concepts support the idea of ecosemiotic fitting as a model to explore the functional and communicational role of invasive species in ecological-cultural communities. What follows in the empirical part of this thesis is a fieldwork in two different localities in the Southern Finland archipelago region where two introduced species, white-tailed deer and *rosa rugosa*, have become abundant and began causing ecological-cultural impacts. Methodological frameworks of semiotic modeling, actor-network theory and local knowledge that will be discussed in chapter 4 as connecting the theoretical and empirical parts.

### 3 White-tailed deer and *rosa rugosa* as invasive species in Finland

#### 3.1 White-tailed deer in Finland

White-tailed deer (*Odocoileus virginianus*) is considered native to North-America. It is a large ungulate species belonging to the family *Cervidae* and genus *Odocoileus* with another similar North American species, the mule deer (*Odocoileus hemionus*) (Heffelfinger 2011).

White-tailed deer was originally introduced in Finland as a new game species on three occasions, in 1934, 1937 and 1948. It resembles both roe deer (*Capreolus capreolus*) and fallow deer (*Dama dama*), common native deer species in Finland, but is also distinguished by relatively larger body size and the characteristically long tail which is white from the underside and used by the deer in inter- and intraspecific communication, especially in alerting others of danger. Moreover, as a unique feature, the Finnish population of white-tailed deer has a darker, longer nose than native population in the US. This is considered as an effect of an early genetic bottleneck in the Finnish population (ibid., 29).

In their foraging habits, deer are herbivorous browsers and since they prefer young buds, leaves and branches they rarely find enough nutrition in mature forests. Instead, human-altered landscapes, especially due to forestry practices, have become suitable habitats for deer (McShea 2012). If different dietary plants are present and abundant, white-tailed deer can be selective browsers, ignoring especially grasses and sedges (Anderson *et al.* 2001). Diet preferences can also vary depending on age and gender (Kie, Bower 1999). During the early growing season, white-tailed deer have been found preferring flowering plants (Rooney 2009) and especially popular among deer are orchids and lilies (Fletcher *et al.* 2001). Towards the autumn, deer has been found diversifying its diet to include berries, fruits and even mushroom (Crawford 1982). During the winter the dietary selection broadens significantly and some studies have shown grazing of woody plants and even dead leaves (ibid.). During the fairly long winters in Finland the white-tailed deer has also been found to forage juniper, aspen, rowan, stripe, blueberry twigs and even lichen (Andersson, Koivisto 1980 cited in Niemi, Nyman 2013: 18). Snow conditions have a



significant impact on foraging and survival of white-tailed deer individuals. Thus, winter feeding practices play a key role in decreasing the rate of mortality (Niemi, Nyman 2013: 18).

Population density (Kie, White 1985) and habitat quality (Rhodes *et al.* 1985) are the most important factors that affect white-tailed deer reproduction. Depending on the latitude and photoperiods, white-tailed deer rut in northern ranges during autumn and early winter, and breed during the late spring with a litter size in general as one or two (Demarais, Strickland 2011), although triplets are not uncommon and even quintuplets have been reported (Van Deelen *et al.* 2007). Climate, population density, habitat quality, age of the doe and prior reproduction affect the nutrition intake of carrying does, which in turn influences the fawn birth weights and subsequently their survival (Demarais, Strickland 2011: 47).

White-tailed deer population in Finland has been rapidly increasing in the past few decades. This follows a global trend in increase in many cervid species populations (Côté 2011: 379) The resulting increase in grazing has both direct and indirect ecological impacts. In Elisaari island in the inland archipelago in Southern Finland, studies have shown that cervid grazing – of which the majority is by white-tailed deer – has disturbed the renewal of local oak groves (Lammi 2010). Also due to strong foraging pressure by the white-tailed deer especially towards flowering plants, evidence from Finnish archipelago suggest some indirect impacts on butterfly populations, such as some local extinctions in the metapopulation (Niemi, Nyman 2013: 17). It is noteworthy that negative ecological impacts caused by the species are not purely attributable to its status as an invasive species: In its native regions in North-America, diverse negative impacts have been reported as a consequence of rapid increase in population and domestic expansion (e.g. Rooney 2001; Russel *et al.* 2001). Predation plays a key role as a limiting factor for white-tailed deer population. In North America white-tailed deer is an important prey species for the large- and medium-size predator species, especially wolves, bears, and coyotes. In Finland the eurasian lynx (*Lynx lynx*) and wolf (*Canis lupus*) are considered the main predators for white-tailed deer (Wikström 2018; Poutanen 2020). Due to the size-difference between the canadian lynx (*Lynx canadensis*) and the bobcat (*Lynx rufus*), the european lynx could be understood as a novel predator for white-tailed deer, although there is some uncertainties whether female lynx are able to kill larger white-tailed deer individuals (Ministry of Agriculture and Forestry 2007: 16).

Since the late 1930's, white-tailed deer population in Finland has grown rapidly in size. According to estimates collected by Kekkonen *et al.* (2012: 5), the population reached 1 000 individuals in the early 1960's. Recent estimates by the Finnish Natural Resources Institute indicate the population continued to grow steadily until around 2010 when the population began rapidly growing from some 50 000 individuals in 2010 to over 120 000 in 2020 (Aikio, Pusenius 2021: 10). Both the establishment of a sustainable population from only a handful of individuals as well as the rapid growth of the population has been uniquely successful compared to other introductions in Europe and in New Zealand where white-tailed deer have been struggling to do the same (Heffelfinger 2011).

Today white-tailed deer has expanded its range from the initial locale of introduction towards the South-Western part of Finland and to a lesser degree towards the inland. In the most dense areas it is estimated that the amount of species is more than 50 individuals per 1000 hectares, while in the areas further inland the sightings are few and occasional (Aikio, Pusenius 2021: 5). Due to being such a popular game species and being already managed by the game management authorities, its listing as harmful invasive species and complete eradication from Finland is not considered feasible (Niemi-Laitinen 2012: 19). Thus, at present, white-tailed deer has been listed in the category of monitored or locally harmful invasive species (*ibid.*, 49).

### **3.1.1 White-tailed deer in Finnish culture**

The idea to introduce white-tailed deer to Finland was born in the early 1930's among Finnish emigrants in Minnesota, US, as a proper gift to their old homeland and as a reconnection to their memories of Finnish nature (Kairikko, Ruola 2005: 42). In a letter to the Finnish Hunter's Association, the Finnish Consul to Duluth, Minnesota, A. Aaltio, wrote: "[I]t would enhance the economy of Finnish inhabitants, add a new, valuable component to Finnish nature and open a completely new hunting possibility for Finnish sportsmen" (Aaltio cited in *ibid.*). In late 1934, after an exhausting two-week trip, five fawns arrived in Finland and were placed in Laukko estate in Central Finland from where they were released in 1938. The Laukko estate is still remembered in the vernacular nickname, the Laukko Deer, given to the Finnish population of white-tailed deer. Since two individuals died already during the trip to Finland and one before the release, two additional

introductions from the US took place in 1937 and 1948 in an attempt to diversify the genetic pool (ibid., 60-65).

Upon arrival the newcomer was received with mixed public opinion but today it has become a popular game species with also a high economic value in that respect (ibid., 42). According to Kairikko and Ruola (ibid., 56) there are implications that the white-tailed deer achieved a strong cultural role relatively soon after its arrival, escape and establishment in the wild: during the war years in Finland (1939-1944) and especially during the dearth in post-war years, white-tailed deer poaching remained a rare practice and the population did not suffer a decline. It was not purely a legal issue but also a social issue: stories tell of cases of “lynching” of those who attempted it (ibid., 56). In 1948 the rare, even if established, species, was given a conservation status in the Finnish law thus acknowledging and formalizing its presence in the country (ibid., 80).

In Finland the white-tailed deer carries its initial site of introduction not only in its vernacular nickname, Laukko deer, but also as a cultural symbol in the municipal region where it first became established. White-tailed deer has been named as the official symbol animal of the municipality of Pirkanmaa in Central Finland and it is also the subject of the sculpture that represents the achievement award given out by the municipal government. According to the description of the award, white-tailed deer “is a symbol for our young municipality, who is searching its place, capable of adapting to changing conditions and able to find the elements of success with its active attitude”.<sup>3</sup>

In ecosystems where the white-tailed deer has been introduced, fairly little research has been done on ecological-social impacts (Niemi, Nyman 2013: 23). Niemi and Nyman conducted a questionnaire-based study on local (visitors and residents) perceptions and observations of white-tailed deer in Tammissaari national park and nearby archipelago areas. They found dispersed and large diversity in perception on the size and density of the species which, they write, which can support the immediacy of perceptual range: “changes in the island where the own summer cottage is, might be easily reflected on the larger picture” (ibid., 34, my translation). Niemi and Nyman (ibid., 34) conclude that the respondents largely consider white-tailed deer being an important part of the fauna in the study area, but that the degree and diversity of the perceived negative impacts (such as damages for

---

<sup>3</sup> Pirkanmaan palkinto, nd, [original in Finnish, my translation]. Available at <https://www.pirkanmaa.fi/tietoa-pirkanmaasta/pirkanmaan-palkinto/>. Accessed on 25.4.2021.

gardening and cultivations, forestry and the role in traffic accidents and tick vectors) should be managed by decimating the present population.

### **3.2 Rosa rugosa in Finland**

*Rosa rugosa* (*Rosa rugosa*; sometimes called Japanese rose or Beach rose) is considered native to North-Eastern Asia (Bruun 2005). It is a multi-stemmed deciduous perennial shrub of the family *Rosaceae*. Its leaves are wrinkly (*Rugosa* in latin translates to “wrinkled”) and its flowers have a single layer of petals with either pink or white coloring. Its hips are large and deep red, especially towards their ripeness in the late summer or early autumn. From its dense network of creeping rhizomes it can grow stems full of small thorns to a height of 1.5-2 meters forming dense shrubs (Weidema 2006).

The earliest taxonomical documentation of *rosa rugosa* in Europe is from the late 18th century and there is evidence of the species being cultivated in Britain already during that time (Bruun 2005: 462). First feral findings in Europe were however done in Germany in the mid-19th century (Weidema 2006). Today the species is considered being feral in 16 European countries (Bruun 2005: 442) while in many places in its native range *rosa rugosa* is considered endangered due to habitat loss by building activities (Zhang *et al.* 2018)

In Finland, *rosa rugosa* has been cultivated to some extent since the early 1900's (Ryttäri 1998: 18) and the first feral shrubs in the country were found in 1919 (Erkamo 1949 cited in Aspelund, Ryttäri 2010: 3). Most likely *rosa rugosa* was introduced and established in Finland, St. Petersburg and the Baltics somewhat simultaneously during the early 20th century (Bruun 2005: 462). The initial introduction of *rosa rugosa* to Finland is difficult to pinpoint since probably there had been several introductions over a period of time – a characteristic of invasions described by the propagule pressure hypothesis (discussed in chapter 1). While *rosa rugosa* has been a European-wide ecological concern (Essl 2006; Boer 2013), it has not been listed as harmful invasive species in the official lists of the European Union. However, in 2019 *rosa rugosa* was listed in Finland as a nationally harmful invasive species. A ban for its sales came into force immediately while a ban for its cultivation will come into force in June 2022 (Ministry of Agriculture and Forestry 2019).

According to Aspelund and Ryttäri (2010: 3–4) the strong dispersal capability of *rosa rugosa* was observed and noticed in Finland already around the 1930's, especially in the

archipelago ecosystems. Some studies have shown almost exponential dispersal of *rosa rugosa* in Helsinki region archipelago during the 20th century and later expansion of its range into Bothnian Bay, the northernmost part of the Baltic Sea (Kurtto, Helyranta 1998; Lampinen, Lahti 2009 cited in *ibid.*). Today *rosa rugosa* is most commonly found in the archipelago of the Gulf of Finland but can be found throughout the shores of Finland (Kunttu, P., Kunttu, S-M. 2017: 100).

Concerns of the ecological impacts caused by *rosa rugosa* dispersal and overgrowths in beaches and dunes in Finland were raised already in the mid-1970's (Skytén 1978 cited in Kunttu *et al.* 2016). According to Bruun (2005: 442), in Britain, *rosa rugosa* appears to be able to disperse almost without any limitations, although its preferred habitat is dry coastal locations, especially sandy dunes and beaches, which in addition to rocky shores and species-diverse meadows resemble strongly its native habitats in NE Asia. The successfulness of *rosa rugosa* in these habitats is often attributed to its enhanced salt tolerance (Dirr 1978) and adaptiveness to sand cover (Belcher 1977). As a result of various introductions for various purposes for decades the species is often found feral also in more urban areas, such as road verges, railway slopes, building sites and field edges (Fremstad 1997 cited in Bruun 2005).

However, sandy dune and beach habitats are characteristically vulnerable to increases in covering growths (Kunttu, P., Kunttu, S-M. 2017), for example due to the often harsh dry and sunny conditions that has resulted in species specialization. In these habitats the effect of the increase in shading by *rosa rugosa* shrubs alters the conditions to the extent that the resulting impacts for many other species is negative. Therefore, as a highly dominant species, *rosa rugosa* can outcompete and displace both common and rare species (Iserman 2008a). Moreover, Stefanowicz *et al.* (2019) found that *rosa rugosa* can strongly impact the nutrition levels on sandy dunes which can have broader community-wide consequences. In Finland, Niemivuo-Lahti (2012) has estimated that *rosa rugosa* poses a significant threat to 21 species that comprise both insects and vascular plants found in sandy dune and beach habitats.

Negative impacts of *rosa rugosa* are considered to be amplified by its efficient capacity of dispersal: By sea, its hips and seed are highly buoyant and can float in sea currents for more than half a year, while its hips are popular nutrition among birds and thus seeds are also effectively dispersed (Bruun 2005: 453-454). According to Kunttu *et al.* (2016: 165) bird dispersal is especially evident on the outer islands. Also, *rosa rugosa* is

very effective in its local dispersal: it can begin to regrow its stems even from very small pieces of its rhizome (ibid., 165) meaning that its complete eradication can be very difficult and costly. Also, in its native range in NE Asia, *rosa rugosa* is found as having a more particular role in different species compositions in the diverse shrub zone between the dunes grassland and dune forest (Nakanishi, Fukumoto 1994, cited in Weidema 2006) which can be understood as a major limiting factor for the local dispersal of the species. Also some specialized herbivorous arthropods and pathogenic microorganisms are considered as limiting factors for *rosa rugosa* reproduction in its native range but not in its new regions (Bruun 2006). Ecologically, *rosa rugosa* has been considered as a keystone species due to its potential in becoming a highly dominant species on sandy beaches and dunes (e.g. Kjellsson *et al.* 1997: 235). It has also been found to have higher pollen viability compared to other rose species (Bruun 2005: 452) which could further compete with the pollination of native flower plants. In addition, Rytteri and Aspelund (2010) observed that in the wind cover produced by *rosa rugosa* enhanced the growth of scots pine seedlings that can potentially further increase the covering vegetation. *Rosa rugosa* can also facilitate other invasions through its strong capacity to alter habitat conditions that can further provide suitable opportunities for other potential invasive species (Isermann 2008b).

### **3.2.1 Rosa rugosa in Finnish culture**

*Rosa rugosa* has been used in many different ways in its native region and its regions of introductions. For example, rose oil pressed from *rosa rugosa* is commonly used in traditional chinese medicine and as tea flavour, while rose oil in general has been an important component in the perfumery industry (Wu *et al.* 1985; Hashimoto, Furukawa 1990). Also, *rosa rugosa* flowers are edible and ingredients in jellies and preserves (Facciola 1990 cited in Lim 2014), and its petals are sometimes utilized in making tea, jam, wine and juice (Nowak *et al.* 2013). More familiar is the usage of its hips, which can be eaten raw when ripe, cooked or dried. Studies have found that *rosa rugosa* hips are a major source of vitamin C (Lust 1974 cited in Lim 2014).

In Finland *rosa rugosa* has been used as ornamental plant in private gardens and public spaces but due to the formation of dense shrubs the species *rosa rugosa* is often found also as providing different landscape design structures in urban environments, namely

hedgerows (e.g. Ryttyäri 1998; Kunttu *et al.* 2016 ). Before the ban on its sales, *rosa rugosa* was also a popular plant in private gardening due to its resilience and long period of flowering. Especially common has been the use of *rosa rugosa* in highway design in Finland. Its traits of growing dense shrubs, rough-textured leaves and high tolerance for road anti-ice salt have been the key properties for the preference of its usage in highway design. Such vegetation has been seen as sequestering dust caused by the traffic (Tielaitos 1996) while also providing, for example, anti-glare against oncoming traffic and user perception of narrowness which has been understood as a way to reduce driving speeds (Stenberg 1991).

Differently from white-tailed deer, *rosa rugosa* lacks any well-known cultural narrative of its foreign origin. Neither does its Finnish name (“Kurtturuusu”, literally meaning wrinkly rose) reveal its origins unlike the one of its regularly used English names, Japanese rose. When the species was announced as nationally harmful invasive species, several opinion pieces emerged to criticize the decision by referring to perceptions of its usefulness for pollinators as well as its healthiness as food and fears of the magnitude of the costs involved in its eradication<sup>45</sup>. Weidema (2006) noted that in many locations in Europe *rosa rugosa* has been often captured in tourist guide photos and postcards and to some extent has become an iconic element in the perception of beach scapes. Distinguishing *rosa rugosa* by appearance from other rose species, especially from the non-invasive selectively bred varieties of the species, is not easy. Therefore, it can be expected that the diverse cultural meanings attached to roses in general likely apply to *rosa rugosa* perception.

---

<sup>4</sup> Yli-Kovero, Tapio 2019. Kurtturuusua ei pidä hävittää [In English: *Rosa rugosa* should not be eradicated, my translation] *Helsingin Sanomat* 13.6.2019. Available at <https://www.hs.fi/paivanlehti/13062019/art-2000006140132.html>. Accessed on 15.04.2021.

<sup>5</sup> Pääkkönen, Esko J. 2020. Kurttulehtiruusun tuhoamispakko ihmetyttää – Isot kulutkin siitä tulevat [In English: Obligation to destroy *rosa rugosa* surprises – it will be costly too, my translation]. *Aamulehti* 24.5.2020. Available at <https://www.aamulehti.fi/lukijalta/art-2000007429373.html>. Accessed on 15.04.2021.

## 4 Methodology

### 4.1 Semiotic modeling and ecosemiotics

Semiotic modeling includes both ontological and epistemological suggestions in semiotics. Usually semiotic models and modeling is connected with Tartu-Moscow semiotic school's influential ideas on expanding the idea of language as signifying system from natural language into "secondary modeling systems" or languages of culture(s) (e.g. myths, religion, architecture, music, art criticism) that are built upon the natural language which they subsequently called primary modeling system (Uspenskij *et al.* 1973; Lotman 2011[1976]; Salupere, Torop 2013). According to Salupere and Torop (2013: 26) natural language as a primary modeling system is "human being's main means of thinking and communicating" while the secondary modeling system is to be understood as "culture's collective experience and the reflector of its creativity".

Sebeok and Danesi (2000) write that semiotic modeling can be understood as both ontological and epistemological notion: objects exist as themselves and as models of themselves. Most importantly, in the context of this thesis, what Sebeok and Danesi (*ibid.*) emphasize is that constructing these models is an instinct-like behaviour not only for humans but to a large extent for nonhuman species as well – the threshold being with representational (symbolic) models, which are constructible only by human cultural forms. Sebeok and Danesi (*ibid.*, 5) write:

The ability to make models is, actually, a derivative of semiosis, defined simply as the capacity of a species to produce and comprehend the specific types of models it requires for processing and codifying perceptual input in its own way. Semiosis is a capacity of all life forms; representation, on the other hand, is a unique capacity of the human species, which develops during the neonate and childhood periods.

As an example of extending the modeling behaviour into nonhuman organisms, Uexküll's Umwelt can be understood as a model of the world for the organism (Sebeok 1986: 21–23). Or the ability of a bird to navigate during its annual migration is an ability to construct a



model that consists of all of the knowledge and iconic and indexical sign-relations with the physical environment that it needs (Maran 2019: 290). Therefore, “[m]odels can be considered as tools of making sense of or handling more complex semiotic objects of the world” (ibid., 290).

Methodologically semiotic models follow and attempt to represent the structures and actions of signs (Coletta 2015). In this thesis, I’m following Peirce’s (CP 2: 228) definition of a sign as “something which stands to somebody for something in some respect or capacity”. Maran and Kull (2014) argue that when viewed in Peirce’s framework, the semiosis includes both processes of recognition and interpretation. These, as discussed throughout in this thesis, constitute much of ecological relationships and are of great importance in the phenomenon of invasiveness as the appearance of novel species into the Umwelts of other species. Moreover, as Maran (2007: 270) notes, the never-ending chain of interpretations, which for Peirce (CP 2.228; 1.339) meant semiosis, is closely related with ecological processes in which matter and energy flow in the ecosystem. Secondly, Peirce’s triadic sign-model connects the sign/representamen and object together in iconic (based on resemblance), indexical (based on causality) and symbolic (based on convention) sign-relations offers a suitable framework for understanding different signs and their relations in ecological-cultural systems since, as discussed throughout this thesis, invasive species are multimodal and multidimensional phenomenon which can take multiple meanings in both ecological and cultural domains. In other words, invasive species participate in and affect iconic and indexical relations in nature with other species as well as symbolic relations in human culture.

Second methodological point would be to examine “how objects, signs, and meanings or outcomes (interpretants) are replicated, transcribed, and translated (as geneticists would say) over time” (Coletta 2015: 965). This dynamic aspect is related to the movement, filtration, translation and creative modification of semiotic systems in and between the boundaries in the semiosphere (Lotman 2005). Moreover, it reflects the meta-level where modeling occurs. Maran (2019: 291) identifies three types of modeling devices on in the meta-level modeling: (1) languages of special properties and areas of usage, (2) systems that follow particular conceptualizations or terminologies, and (3) relations that derive from “dominant cultural topics”, i.e. morphisms. These linguistic devices are used to construct further representational models and thus become themselves part of the self-reflective and self-descriptive layer of semiotic research. Maran (ibid., 291)

writes that “it is in this relation between the original and the model where the language, the cultural tradition, the discipline, the code and so on of the interpreter, become involved and make the difference”. Maran (*ibid.*) also illustrates an ecosemiotic application of semiotic modeling with a forest as a semiotic model. The key points of focus in such models are, following Maran (*ibid.*, 294-299), (1) shared ecological codes that enable inter-specific communication in the community; (2) capacities to participate in the omnidirectional sign-processes; (3) points of condensation in sign-activity; (4) reality of the environment and bodies, meaning that conditions and structures are not just imagined; and (5) presence of inefficiency or incompleteness of sign-processes leaves space for changes. Taking that invasive species in this thesis are explored in ecosemiotic communities that comprise of ecological and cultural relations between agents, and that invasive species are agents that participate in the process of semiotic fitting in these communities, approaching these communities as semiotic models and fitting as semiotic modeling could provide a way to understand the ecological-cultural dynamics that follow the process of semiotic fitting.

### **4.3 Actor-network theory**

As we have seen, agencies and networks of relationships between different agents has been a growing area of focus in ecological-cultural approaches in invasive ecology (e.g. Robbins 2004, Larson 2007; Mayerson, Mooney 2007; Pfeiffer, Voeks 2008; Ritvo 2017; Lubell *et al.* 2017) and conservation ecology (e.g. Opdam *et al.* 2006; Jepson *et al.* 2011; Bennett, Satterfield 2018). Similarly, semiotic fitting is a model that offers a way to explore semiotic capacities of agents in making and maintaining functional and communicative relationships in ecosystems (Kull 2020). Ecosemiotic application of semiotic fitting would suggest that these agencies and relationships in ecosystems include humans and human cultural structures as well as material conditions that both limit and facilitate semiotic activities in ecocultural communities (Maran, Kull 2014; Maran 2020).

In this thesis I will apply core elements from actor-network theory (ANT) in the methodological framework of this thesis to approach the role invasive species in what I suggest as a process of ecosemiotic fitting, an ecological-cultural view on fitting as a network-process, and as community structuring. In other words, the concept of semiotic fitting extended into the ecosemiotic sphere together with actor-network theory offers a

semiotic model to understand the roles of white-tailed deer and *rosa rugosa* as invasive species in two ecocultural communities in Southern Finland.

Rather than an unified theory, ANT can be understood as a research attitude characterized by a portfolio of conceptual and methodological premises, perspectives and frameworks (Latour 2005; Michael 2017; Blok *et al.* 2020). The basis of ANT began forming in late 1970's and throughout 1980's among scholars in the field of sociology and more precisely Science and Technology Studies (STS) as a constructivist approach that aimed to overthrow the primacy of social domain in the construction of knowledge (Latour, Woolgar 1986 [1979]; Law, Mol 1995; Michael 2017; Blok *et al.* 2020). To describe this alternative view as simultaneously constructivist and realist, Latour (1993: 11) highlights a double process of translation and purification in science; one one hand, in the area of purification, fundamental ontological dichotomies (such as nature/culture) are put in place for an efficient representation of knowledge, and on the other hand, in the area of translation, there are continuous "hybrid networks" that, when translated, enable the purification. Identifying this connection makes science modern, ignoring it makes science only imagine modernity (leading into the famous title of his 1993 book *We have never been modern*). The ontological shift that ANT suggests is a one towards relations, or "relational materiality" (Law 1999), that is, ontological entities can be discursive and material hybrids, and they are what they do to, with and under the influence of other entities. Thus ANT has its early beacon in semiotics as emphasizing the materiality of signification (Muniesa 2015) in that it attempts to tell how "entities take their form and acquire their attributes as a result of their relations with other entities" (Law 1999: 3). Indeed, early synonyms included material semiotics (Law, Mol 1995: 280). Especially Law (e.g. 2009) has later continued emphasizing the semiotic aspect of ANT, although the connection between the two has also been downplayed (Farias, Mützel 2015).

The relational aspect is apparent in the usage of the term actor in ANT. Actor in ANT vocabulary can be seen following the actant model of narration in the semiotic approach by Algirdas Julien Greimas (Law 1999; Muniesa 2015) that relocates the capacity to make an effect from agents to the mediating processes (Greimas, Courtés 1986 cited in Law 1999: 226). Hence, an agent is not an actor, nor is an actor "the source of action but the moving target of a vast array of entities swarming towards it" (Latour 2005: 46). In other words, action practiced by an actor is a condensation of relations between different things, objects, artifacts, ideas, motivations, movements, coming together, thus the term

actor-network. Emphasizing the statement that actors are never acting alone, Law (1992: 5) writes of the term actor as “patterned network of heterogeneous relations, or an effect produced by such a network”.

Studying a case of scallop conservation in St. Brieuc Bay in Western France, Michel Callon (1984) discussed science as an asymmetrical process of “translations” between nature and social, whereby several strategies are used in fixing representational models in place. However, as Callon (ibid.) shows, scientific adventure based on translations in stylistic, theoretical and methodological ways can have unexpected and problematic outcomes. What ANT suggests, according to Callon (ibid., 200-201) are studies based on principles of (1) agnosticism, which suggests total freedom of actors to analyze themselves or their surroundings without censorship, without having their identities fixed in place by the researcher; (2) generalised symmetry, which requires the usage of one repertoire of scientific vocabulary to describe and explain natural and cultural, human and nonhuman on the same analytic level; and (3) free association, which urges to “follow the actors” and pay close attention to how they “build and explain their world”. Most radically, Callon (1984: 204-205) proposed scallops as nonhuman actors by observing how the core research question of whether a certain scallop species is able or willing to accept new behaviour initiated a whole organization of different actors to establish relationships with each other. According to Law (2002: 91) in early propositions the actor-property of nonhumans was still based on them being “an effect of stable arrays of relations” without properly making much of a difference. Later Callon (1991) expanded the idea by highlighting the difference between passive and active relationships; in their acting, actors modify knowledge. This important distinction is elaborated also by Latour (2005) who further the idea by differentiating intermediaries and mediators. For Latour, intermediaries carry meaning without changing it; they are black boxes whose outputs can be expected by inputs. Mediators, however, causes changes:

Mediators [...] cannot be counted as just one; they might count for one, for nothing, for several, or for infinity. Their input is never a good predictor of their output; their specificity has to be taken into account every time. Mediators transform, translate, distort, and modify the meaning or the elements they are supposed to carry. [...] No matter how apparently simple a mediator may look, it may become complex; it may lead in multiple directions which will modify all the contradictory accounts attributed to its role. (Latour 2005: 39)

As noted, mediators are not the same as actors, rather they are one level of actor-networks that have relations with other actor-networks on another level – an interesting way to

describe mediators would be that they are interpretative (semiotic) and self-designing emergent processes or organizations (e.g. Hoffmeyer 2008: 4, 28, 258). In this thesis identifying and focusing on mediators has a key role in understanding the dynamics of semiotic fitting and the role of invasive species in fitting, to which I will return at the end of this chapter. As nodes or spaces of unpredictable and creative translations and transformations of meaning, mediators can be understood as closely connected with boundaries that are responsible for similar dynamics in the semiosphere. For example, for Callon (1991) both translations and boundaries are important notions in ANT: translations define and inscribe the relationships between actors, they provide historicity to actors and thus make up an important methodological point of focus. Boundaries are revealed in what Callon (*ibid.*, 148) calls “convergence” of a network, or more specifically, the level of mutual understanding between actors, which tends to weaken when new elements move into the network.

In practice, as proposed by Latour (2005), ANT account consists of four areas of uncertainties from which the researcher should feed from: First, social groups should be taken not as fixed but constantly in the making and re-making: “For ANT, if you stop making and remaking groups, you stop having groups” (*ibid.*, 35). Second, actors should be understood as not acting by themselves but by the influence of several agencies around them, thus, actions are nodes that become visible through the traces left by different agencies. Third, in Latour’s words (*ibid.*, 71), “any thing that does modify a state of affairs by making a difference is an actor –or, if it has no figuration yet, an actant”. In other words, objects have agency too. Fourth, social facts disappear and are replaced by “interesting agencies [that] are taken not exactly as object but rather as gatherings” (*ibid.*, 114). And fifth, from the perspective of research, what is produced in ANT accounts ought to be sensible and respectful to the fluidity of the actors that the account is about; following the traces of these actors and their relations is best achieved in textual accounts, since narratives and textual descriptions show actors in action, Latour (*ibid.*, 122-128) argues.

ANT has been criticised from many different angles. Primary criticism has been towards the position that anything, material or immaterial, can possess agency. Early criticism by Collins and Yearly (1992) noted that this flattening of ontology, on one hand, disrobes scientists from their expertise of interpretation, and, on the other hand, still includes the granting of agency to objects, an agential gesture by the researcher. Another perspective to the discussion of agency in ANT has been provided by the so-called Object-Oriented

Ontology (OOO). For example, Harman (2016) argues that while most ontological approaches undermine the reality of objects, ANT tends to “overmine” it by reducing anything that acts into actors thus losing objects into this monodimensionality all together while doing so. Another point – but connected to the previous – of criticism towards ANT has been about its assertion of the constant need for assembly and reassembly of social groups. For example, Elder-Vass (2015) has criticised this focus on temporally and spatially unique assemblages and the dismissal of their stability and continuity. Elder-Vass (ibid., 7) argues that, even if Law (2008) and Latour (2013) have later emphasized some aspects or introduced new concepts to address this critique, an underlying idea that social structures and phenomena need to be constructed and reconstructed again and again for them to survive is still integral part of ANT.

Taking a fairly open position to ANT as a methodological framework, I’m following a task set by Latour (2005: 136, italics original): “The task is to *deploy* actors *as* networks of mediations”. My focus on mediators in the analysis of the fitting of white-tailed deer and *rosa rugosa* has many different reasons. As discussed in chapter 1, invasive species acquire many different roles in different domains, which suggests that there are diverse and multiple boundaries that translate and render different meanings for invasive species. This vast area of potentialities that opens up is noted by Sayes (2013: 138):

Nonhumans that enter into the human collective are endowed with a certain set of competencies by the network that they have lined up behind them. At the same time, they demand a certain set of competencies by the actors they line up, in turn. Nonhumans, in this rendition, are both changed by their circulation and change the collective through their circulation. They act and, as a result, demand new modes of action from other actors.

Mediator is a description of actor-networks that highlights their dynamic and creative operation. Focusing on mediators means that in analysing the ecosemiotic fitting of white-tailed deer and *rosa rugosa* a strong emphasis is put on examining the unstable nodes or spaces where the information and knowledge of these species is translated, interpreted and transformed before being passed along in the network. The many ways which communities attempt to eradicate or control invasive species is a collective activity conditioned by dynamics of different factors. Approaching this assembly as a mediator that has an active role in transforming knowledge and meanings is a path forward in making the traces of social visible and thus the network, as Latour (2005: 128) argues.

Secondly, mediators can reveal both success and failure of communication and interpretation since “their input is never a good predictor of their output” (Latour 2005: 39). Again, in simple terms, invasive species eradication measures often combine cultural, technical, natural, administrative and legal elements, and whose collective conservation results are usually far from predictable (e.g. Jepson *et al.* 2011). If fitting (or unfitting) is to be described, it will become describable through mediators. Thirdly, mediators as gatherings of different human and nonhuman actors would align the approach to invasive species with an ecosemiotic perspective in the sense that ecosemiotics is a way to model ecological-cultural sign-mediated relations as not solely discursive and symbolic but having also a material basis (Maran 2020). Focusing on mediators that can combine any type of elements offers an interesting point of focus on the complexities of relationships as they are understood in ecosemiotic approach.

#### **4.4 Local knowledge**

Local knowledge is a difficult notion since both “local” and “knowledge” are highly unstable terms to use not only in the context of science but in the global scale political economy and cultural homogenization. But simply put, local knowledge refers to an empirical premise that knowledge production takes place in local settings (Turnbull 2008). It can be understood as based on experience that builds from everyday practices and constructs a logic that is meant to support day to day activities with the environment (Nazarea 2006). Conventionally local or traditional knowledge has had a role of otherness for modern knowledge: Concrete science and science (Lévi-Strauss 1962), tacit knowledge and scientific knowledge (Polanyi 1966), traditional knowledge and modern knowledge (Hube, Pedersen 1997). In the field of psychoanalysis, Kohut (1971) has made a corresponding distinction between “experience-near” and “experience-distant”. The former is a subjective-driven description of what the subject sees, feels and thinks (e.g. love), while the latter is a generalized and objectified description acceptable in communicating scientific claims. To make a biosemiotic connection, Uexküll’s Umwelt-model is fundamentally local knowledge, and so is the linguistic interpretation of the I-nature (Kull 1998).

The usage of local knowledge in this thesis is based on what Pilgrim and Pretty (2010) have called ecocultures. In other words, the focus in this thesis is the construction

and mediation of knowledge in the closely connected local ecological and cultural systems. Local knowledge is an important component in ecocultures: it is a collective body of knowledge of the local environment and local social memory which is reused and modified to provide guidance for “actions towards the natural world” (ibid., 6). Local knowledge is constructed in regular interactions with the physical surroundings, and as such can mediate cultural understandings to sustainability of environmental management (ibid., 7), such as invasive species management. Moreover, on a local scale, Rapport and Maffi (2010: 104) argue, there is potential for an increasingly detailed knowledge of the dimensions that contribute to the changes of social-ecological systems.

The role of local knowledge has been often discussed in invasion ecology and in environmental conservation and protection. Even if invasive species is a global phenomenon, species acquire the role of invasive in the local ecosystems. Locality in this sense is exactly what is used in range-based evaluation criteria, sometimes with precise measurements or based on more general geographical barriers (Richardson *et al.* 2000; Pyšek *et al.* 2002).

Locality matters in invasive species management since isolated ecosystems, such as islands, are most vulnerable to negative impacts of invasions (Simberloff 2009). At the same time, because invasive species management can cause different encumbrances if done in the proximity of human settlements, a large number of these projects have taken place in unpopulated sites (Oppel *et al.* 2010). Where these projects have been implemented in populated sites, lack of local communication and ownership has been seen as being linked with failures in implementation of eradication projects (Campbell, Donlan 2005). If such eradication projects are to be implemented in areas of higher human population, a need for integrating sensitivity to local human conditions and local knowledge has been widely identified (Cáceres-Escobar *et al.* 2019). From the perspective of invasion research, García-Llorente *et al.* (2008), for example, have shown the importance of integrating local knowledge and local stakeholders in invasive research that is aimed at informing management operations. More importantly, these example studies show the large variability and diversity in local settings and different dimensions that affect local perception of invasive species (for example, whether informants are landowners or regular visitors). Santo *et al.* (2017) focused on the knowledge of invasive species by private landowners. Using a framework of local ecological knowledge (LEK) in quantitative data collection they conclude that no unified set of local knowledge may emerge, landowners differ in their



prioritization of the relevance of invasion issues, and that novelty of invasion may result in lack of perceived threat. Sundaram *et al.* (2012) and Firm *et al.* (2017) have demonstrated that local and scientific knowledge together can open new paths in both understanding reasons for invasions as well as contribute in sustainable and effective protection efforts.

Local knowledge can also be suited in the general framework of ANT. According to Asdal (2020: 339) actors in ANT have a local specificity: “It is always about *that* river, *those* trees, *this* pack of wolves.” Scale, Asdal (*ibid.*, 339–340) continues, is allowed in ANT as an empirical aspect, and nature is given freedom to move and circulate (made real) in descriptions and representations. Asdal (*ibid.*, 340) writes:

So the interesting question here, from an ANT perspective, is not so much if nature is local, national or global but the extent to and the means by which nature is enabled to move from one locale to another locale and the means, quite precisely, by which nature is made available to us.

From this perspective ANT scholars Law and Lien (2012) are able to describe the situatedness or textures of Atlantic salmon farming in Norway. In their case, “[a] salmon is not general but *specific*” (*ibid.*, 366). In a similar spirit, nature can be understood not as general but specific, local and situated.

These aspects provide a background for the qualitative research method of semi-structured interviews with local people that have a strong linkage to the environment. In the case of this thesis the informants all own or have rented land (e.g. cultivation or housing) in the locations that are ecologically distinct and identifiable. In the first case study, perceptions and relationships with local people and white-tailed deer are studied with semi-structured interviews on Skärlandet Island in Southern Finland coastal area. In the second case study, perception and relationships with locals and *rosa rugosa* are studied in Hanko, the Southernmost town of Finland.

## **5 Methods and material**

### **5.1 Semi-structured interviews**

I have chosen semi-structured interviews (Newing 2011: 101-104) as a primary method for collecting the material for this study. Predefined topics for the interviews (annex 1) were chosen to cover the relationship of the interviewee with his or her physical surroundings (questions 1-3), encounters and perceptions of the particular invasive species (questions 4-6), interpretations of the meaning of the species for the interviewee and in the community (questions 7-10), sense of agencies in the relationship between the interviewee and the species (questions 11-13), and general ideas and opinions of invasive species (14).

My main channel to reach the voluntary interviewees in my focus areas was to post interview requests on several Facebook groups which are dedicated as shared informal communication platforms in these communities. From my previous working experience in an environmental NGO as well as general understanding of the tense discussions around invasive species, especially around white-tailed deer and *rosa rugosa*, I assessed that my request should include an option to reply in private messages, email or phone. I posted my requests twice with 1-2 week(s) between the posts. In the requests I emphasised the aspect of direct experiences with the species, but also that no expertise on either of the species is needed. As a result of these requests, six people from Skärlandet island and three people from Hanko contacted me privately, seven via private messages on Facebook, one with a public reply to one of my posts and one via email. I contacted five interviewees from Skärlandet island directly by phone after my first few interviews in which the interviewees proposed these people as having a stakeholdership in the topic. I reached three additional interviewees from Hanko by contacting via email the shareholder association of Tåktom conurban area, a collective ownership and management body of the land and water areas of the conurban area of the town of Hanko. Four additional interviewees were reached by either following the propositions by other interviewees or by directly, face-to-face,

respectfully approaching the owners of the property on which I observed *rosa rugosa* growths in my focus area.

In total, my interview material in this thesis consists of eleven interviews from Skärlandet island focusing on white-tailed deer and eleven interviews from Hanko focusing on *rosa rugosa*. The interviews lasted from 45 minutes to 2 hours and were largely conducted in the proximity of the living surroundings of interviewees. Three interviews were conducted in the public or shared location in the community where my focus species were visibly present. Most interviews were conducted outdoors, three indoors. A notable aspect regarding my interviews is that in my initial requests I did not emphasize that the interviews should be conducted strictly between me and the single interviewee. On four occasions there were a couple attending the interview, and on one occasion a couple and two of their adult children. There are three observations that can be made of this: Firstly, the people that volunteered to be interviewed are all residents in the communities and thus have a strong physical connection with the land and the environment in the communities. Secondly, there is an implication that the connection between the experience towards my focus species derives strongly from a stakeholdership on the land property. In other words, my focus species are perceived also through a collective experience based on the shared land ownership. And thirdly, encountering an unknown person can be a pulsating experience for many and sharing the situation with familiar people is often a reassuring factor.

The interviews were recorded and transcribed using a hybrid technique: I first ran the audio through a speech-to-text AI software after which I corrected the errors that occurred during the automated transcription process while listening to the recordings at enhanced speed. I then processed the material by identifying the key themes and words in the material that reflect the functional and/or communicational match between my focus species and the interviewees. In the second cycle of processing the transcriptions I used Atlas.ti to code the material (Saldaña 2013) based on the methodological framework of actor-network theory and more precisely in order to identify the mediator-actors that are made to act by their constitutive elements and that make other actors act as well in unpredictable ways (Latour 2005: 46) in the mentioned functional and communicational relationships. Finally I analyzed these actors-networks and the relationships of actor-networks in different layers, or “substructures” (Lotman 2005: 216) of ecological-cultural semiotic system or ecosemiosphere, in my focus communities.

## 5.2 Participatory observations

Two events of participatory observations provide supportive secondary material in my thesis. Firstly, I attended white-tailed deer hunting day in mid-November 2020 on Skärlandet with one of the two hunting clubs on the island. The aim in this participatory observation was to collect field notes and photographs on how the local hunting practices in the club were organized and what functional and communicational links the human and nonhuman actors formed with the white-tailed deer during the hunting. The hunting day took place on 15th November from sunrise to sunset in eight locations, five on the main island, two on Torsö island (one of the neighbouring large islands connected with Skärlandet with a small bridge) and one on a smaller island close to the mainland reachable only by small boats. The club that hosted my visit consists of local landowners and their family members. 14 people of different ages and genders participated in the hunting day. Having no prior experience in hunting, I was given a simple role as driver, that is to walk in a synchronized line formation with several other drivers and produce noise to drive any white-tailed deer individuals towards a designated shooting area. From their annual quota of deer hunting permits that are allocated to local hunting clubs in all the game administration areas in different regions, the club had in total five permits left. During the day four white-tailed individuals were shot and killed, one in the early hours of the hunting and three almost simultaneously in the very last run of the day.

Secondly, I attended a volunteer work event to eradicate *rosa rugosa* in Granskär island, one of the small islands off the coast of Hanko peninsula, on 10th of October 2020. The event took place over two days, but I was only able to attend the first day. These annual volunteer work weekends are dedicated to eradicate *rosa rugosa* on the small islands in Finland's south-west archipelago from Hanko peninsula to Tammisaari region or alternatively on some mainland sites. Volunteer work events are organized in cooperation with the local environmental conservation association in Tammisaari region and Metsähallitus, the Finnish state-owned enterprise responsible for managing state-owned nature areas as well as economic use of state-owned forests. I attended the event as a volunteer worker and my field notes and photographs from the day are used in this thesis as

a supportive material about how the practical manual work to dig out, rip off and destroy rosa rugosa growths happens as well as how such community volunteer work is organized and what functional and communicational links are formed between humans and rosa rugosa.

## 6 Analysis

### 6.1 Fitting of white-tailed deer on Skärlandet

With an area of roughly 1350 hectares, Skärlandet is one of the biggest islands in the inland archipelago in the south-western part of Finland. It is located 10 kilometers south of Tammisaari, a coastal town located 90 kilometers west from the capital Helsinki (see, Annex 1, maps). In 2010 it was estimated that 190 people lived on the island permanently, and 564 temporarily, for example during weekends and holiday seasons (Auri 2010: 106).

Skärlandet is an example of the historical agricultural areas in the inland archipelago in the Gulf of Finland. According to written documentation, Skärlandet has been permanently settled at least since the 14th century but some estimates suggest that the area has had inhabitants since the Middle-Ages. The inhabitants of the island have cultivated and grazed the area for several hundred years, and therefore almost one fourth of all traditional biotopes that have formed by grazing within the municipal region are found on Skärlandet. (Munsterhjelm *et al.* 2005)

Many of the historical villages (e.g. Skåldö, Kopparö, Sommarö) as well as the large estates (e.g. Backa, Nabben, Grevö) today still organize the residential and agricultural structure and land ownership on the island. Some of the families on the island have lived and practiced agriculture there for several generations.

Ecologically Skärlandet belongs to the hemiboreal floral region with dominantly oak, juniper and pine forests around the historical grazing and agricultural fields. Its coastal meadows are rich in flora typically found in deciduous forest zones, and in general the area is diverse in flora and fauna. Several post-glacial processes, such as land uplift and formation of fladas and glo-lakes, have created and maintained the diversity together with the cultural biotopes that have formed over the long history of grazing. The Baltic Sea has a strong influence on the climate in the area and is especially noticeable towards the autumn

when the warm sea maintains mild temperatures longer than in other parts of Southern Finland. (Munsterhjelm *et al.* 2005)

Because of the unique ecological and cultural history, in 2002 the town of Tammisaari began a process to secure the conservation of these traditional ecological and cultural values of Skärlandet, and in 2007 the Ministry of Environment accepted the application by the town of Tammisaari to establish a nationally valuable landscape management area on the island.<sup>6</sup> This conservation category is an extension from what are known as nationally valuable landscapes by including active planning and management of these traditional landscapes and increasing their funding opportunities. Only five such areas have been awarded this status.<sup>7</sup> Nearly all of Skärlandet's landscape is integrated into this programme.

The general outlook of the landscape on the island is mosaic-like, including larger forest areas, smaller forest patches and different sized cultivated fields and grazing meadows filling the spaces between forest areas. Old sheds and barns oversee the open landscape, and the residential areas are found mainly in the more forested areas of the island and closer to the shore. The eastern edge of the island is a home for a large Kopparö caravan park area (65 hectares) owned by a subsidiary of the Union of Salaried Employees. Kopparö has a tradition of being a members-only recreational site for decades but some 4-5 years ago it was opened to non-member users.

Skärlandet itself is reachable only by private boats or by a ferry which operates between the mainland and the North-Eastern corner of the island. Running non-stop (apart from unscheduled and scheduled breaks) it regulates the outgoing and incoming car traffic and it is common to encounter groups of cars heading for or coming from the ferry on an otherwise quiet main road that runs through the island.

According to the locals, white-tailed deer started regularly appearing on Skärlandet around 1980's with some occasional sightings already in late 1970's. This is aligned with the more general expansion of white-tailed deer population from their original site of introduction towards the South-Western coastal areas in Finland over the course of the

---

<sup>6</sup> Ministry of Environment 2007. Ympäristöministeriön päätös 26.6.2007 [In English: Decision by the Ministry of Environment 26.6.2007. My translation]. Available at [https://ym.fi/documents/1410903/38439968/skarlandet\\_perustamispaatos-8CD4BA20\\_C612\\_4166\\_A2D5\\_159CBB0CC63E-30295.pdf](https://ym.fi/documents/1410903/38439968/skarlandet_perustamispaatos-8CD4BA20_C612_4166_A2D5_159CBB0CC63E-30295.pdf). Accessed on 15.4.2021.

<sup>7</sup> Ministry of Environment, nd. Maisemanhoitoalueet vaalivat maaseutumaisemien kulttuuri- ja luontoarvoja [In English: Landscape management areas cherish the cultural and natural values in rural landscapes. My translation]. Available at <https://ym.fi/maisemanhoitoalueet>. Accessed on 10.4.2021.

decades following its arrival (Kairikko, Ruola 2005: 68-69). At least one study has been conducted on social and ecological impacts of white-tailed deer in the broader archipelago region. Niemi and Nyman (2013) reported diverse and in many occasions a conflicting picture of the human perception of the species. The size of the population raised some flags but perceptions, knowledge and opinions regarding the ecological and social impacts were strongly divided (*ibid.*, 34).

As described in chapter 3, white-tailed deer is a selective browser and its foraging behaviour is a central semiotic activity for the species. Foraging behaviour makes white-tailed deer actively perceive, recognize and interpret feeding opportunities and assess predation danger. This makes the species highly mobile in the landscape, and therefore opens up events of encounter, communication and negotiation with humans on the island. This “gathering” (Latour 2005: 114) becomes a key mediator that will be followed in analyzing the fitting of white-tailed deer.

Ecosemiotics can provide a starting point here into conceptualizing how human perception and interpretation of white-tailed deer can be understood as a process of perception, linguistic interpretation and matching this understanding with a cultural understanding (Kull 1998; Maran 2015). The accounts by the interviewees on their initial encounters with white-tailed deer on Skärlandet recall the species mostly as exciting, beautiful and slender sight, for example: “Well, they were pretty, looking at you with their great blinking eyes and moving around so smoothly” (Interviewee, 57) and “It was summer when I saw them. That is when they are at their finest, beautiful and slim, and the pelage was shining in the sun” (Interviewee, 67). The cultural interpretation of the species has always relied strongly on its ecological-cultural hybridity as an untamed wild animal and as a systematically introduced game animal into the country. In other words, in its later dispersal, white-tailed deer has always carried along the brand of its own history. Among the locals the narrative of its origins is well-known today, although no unified narrative on its particular emergence on Skärlandet exists.

On Skärlandet, the interpretation is also strongly derived from indexical sign-relationship between the increasing sightings and perceived changes in the environment. For example disappearance of certain flowers, berries and mushrooms and structural signs such as damaged trees (due to bucks rubbing their antlers against the trees as interspecific communication) and path formations reported by several interviewees are connected with the emergence of white-tailed deer. Another strong indexical relation exists



among the local interpretations between the appearance of white-tailed deer and the disappearance of elk from the island from the 1980's onwards as well as increase in lynx sightings in the past few years. Following Lotman's (1990) description of the inner dynamics of the semiosphere, one environmental change is interpreted with another environmental change in the ecosemiosphere, that is, an observation of a change in the environment can become interpreted with the support of a similar change; disappearance of a species with emergence of another. Also, many interpretations are derived from cultural knowledge, especially the understanding that deer species host and transport castor bean ticks which function as vectors for diseases and viruses such as Lyme and tick-borne encephalitis (TBE).

This indexical aspect contributes to the translation process of problematization as one of the strategies in fixing the representational model of white-tailed deer in place (Callon 1984) foraging as an actor is tightly connected with the size of the population and the spatial distribution of the foraging pressure. To put it more simply, the relevant uncertainties that influence how foraging of white-tailed deer on Skärlandet is defined in order to move things and humans around are the questions: what does the species eat, how many are eating and where do they eat.

### **6.1.1 Measures to control and prevent foraging**

The uncertainties above set in motion diverse translations in the network of actors. In order to control foraging many local property-owners have begun constructing fences either around particular plants or small garden patches that they want to protect or around the whole property to restrict the access of white-tailed deer completely. One interviewee had invested in a game animal fence around the whole property but installed it upside down. The idea, the interviewee described, is that when you would normally have larger mesh size on top and smaller on the ground level to prevent also small animals (rabbits, for example) from passing, turning the fence upside down allows the smaller animals to pass through.

White-tailed deer uses different strategies to encounter fences depending on the size and the technology used. Physically, when needed, it is able to jump over fences as high as 2,4 meters, which has been witnessed in studies (verCayteren *et al.* 2006) and by the locals on Skärlandet. One interviewee had witnessed the deer being capable of using its chub to

push the fencing around plants to reach its edible parts. In one account, the interviewee had learned from a source in the Finnish Wildlife Agency<sup>8</sup> that a simple yellow ribbon around an area would deter the deer but described this effect lasting only a week or so in practice. Several interviewees referred to their knowledge that white-tailed deer are poor in visually assessing close distances and had therefore modified their fences in either placing another fence within the primary fence. Often there is only a vague description of where the knowledge is acquired from implying a relatively unorganized local knowledge regarding white-tailed deer.

Such a dynamic dialogue between humans and white-tailed deer on Skärlandet could be understood in the semiotic framework of functional cycle and the formation of different natures that derives from this process as described by Kull (1998). By constructing fences in the landscape or around particular plants in the garden not only protect them from white-tailed deer foraging but excludes and decontextualizes these plants and areas from their surroundings. Putting in place such specific boundaries construct an additional layer of nature, one which is strongly or even purely defined in the controversial interaction between humans and white-tailed deer. On a more general level, this layer could be seen as a substructure, or a secondary modeling system, in the ecosemiosphere and can become on one hand independent sign-system but on the other hand definable by other substructures. In another case, a particular fenced garden area was designed and constructed by the property-owner according to aesthetic inspiration from a historical roundpole fence for which the wood was acquired and transported from the childhood region of the property-owner. Here the fence was given not purely practical but also aesthetic requirements and the aesthetics was derived from the Scandinavian and Baltic cultural heritage.

A completely different response to white-tailed deer foraging behaviour has been to control it by engaging in different feeding practices. On one hand, there is a more formal practice of feeding white-tailed deer on Skärlandet which happens in the general framework of game animal management. As a formalized practice in game management it is particularly used in enhancing the survival of game species through harsh winters and thus maintaining a desired population level as well as in a more practical way to spatially and

---

<sup>8</sup> The Finnish Wildlife Agency is an independent governmental institution. Among public administrative tasks, it “promotes sustainable game husbandry, supports the activity of game management associations, and sees to the implementation of wildlife and game policy.” (Finnish Wildlife Agency, nd. Available at <https://riista.fi/en/game-administration/finnish-wildlife-agency/>. Accessed on 12.5.2021)

temporally control the foraging for different purposes (Hewitt 2011: 96). As Henke (1997) has shown, white-tailed deer feeding is a highly effective means to alter its behaviour in game management. This is an important aspect in fitting since it means that there is a strong potentiality of a match in the biological needs of white-tailed deer and the cultural needs of humans.

On Skärlandet there are feeding spots that are operated under the framework of game animal management, but there is an interesting history of systematic and organized informal feeding which has been motivated by increasing the close interaction between humans and white-tailed deer. For example, two interviewees from separate locations on the island recall:

I admit that we fed them at some point. We thought they were so fascinating and we kind of wanted to have more of it. We had a plastic tray in the backyard where we put leftover skins from apples and potatoes, and we even went to buy real fodder from an agricultural store. We wanted them to return so that we could observe them. (Interviewee, 67)

There was this one doe that was wandering around here already in the beginning when we arrived. We put up a feeding machine there, between the trailers in a patch of forest. I started getting closer and closer to this doe and at some point it allowed me to feed it from the hand. We named it and then there was almost like a competition among people here who gets to feed it. It kind of became our pet and every autumn we were afraid that it might get shot. (Interviewee, 60)

The increasing interactions between humans and white-tailed deer in the US, especially in green suburban and semi-rural environments, has been suggested as approaching mutualistic relationships which are consistent with domestication of prey animals by prehistoric humans (Messner 2011). However, foraging behaviour of white-tailed deer includes also interspecific communication that organizes the relationships in herds. Witnessing the aggressiveness by the dominant bucks during feeding, can result in human reinterpretation of interaction of feeding the animal: “The larger bucks in the herd began clanking around with their antlers and behaved aggressively towards the does and fawns. It was kind of puzzling for us, and it was hard to observe. We thought that maybe this is not for us, it suddenly felt like tampering with nature” (Interviewee, 67).

Both of these processes on Skärlandet presented here either come together or fall apart depending on the biophysical abilities and semiotic capacity of white-tailed deer in recognizing and choice-making. Following Jepson *et al.* (2011), different actions in management and control of white-tailed deer foraging on Skärlandet are reflected in the diversity of thoughts, hopes, fears and aspirations in other actors. In the points discussed

above, thoughts and hopes put on the technical tools in controlling white-tailed deer foraging largely depend on the appropriate response of the white-tailed deer. The same applies in the future visions on how human and white-tailed interactions should unfold.

At the same time, taking the next step in following the chosen mediator, the resonance of white-tailed deer foraging extends further in the network. Resembling “human patterned behaviours” the perspectives above lead into what Robbins (2004: 147, 153) describes as broader ecological-cultural levels that construct the “histories of invasions”. What Robbins proposes is a view on how invasions are “prepared” in a network that extends, changes and modifies itself. The focus by Robbins is to reveal broader conditions under which invasions can occur, but equally important perspective would be to understand the same conditions and networks constantly organizing and reorganizing themselves, i.e. writing the history as it unfolds.

For example, in mid-2010 the Union of Salaried Employees as the owner of Kopparö began implementing changes in order to develop the area. The members-only policy was removed and parts of the area were opened to non-member users that could now acquire long or short term spots for their trailers. Soon after the social heterogenization, complaints regarding white-tailed deer feeding practices resulted in an official prohibition ordered by the owner of the area. However, the lucrativity of Kopparö from the perspective of the white-tailed deer has also been maintained by other human processes that mirror the social change that has come to decrease it. For example, one dimension of the long-term development plan by the owners of Kopparö has been to increase the amount of users. Implementing the plan has meant taking some areas of the 65 hectare property into more efficient use and cutting deciduous trees to both create new space and at the same time to increase the amount of sunlight in these newly created spaces as well as in the areas already in use. These freshly cut deciduous trees tend to offer nutritious food for white-tailed deer which are today often spotted feeding on the freshly fallen and uncollected branches. Such events could be seen as a reconstruction of invasiveness of white-tailed deer in which all three dimensions of preparations come into play. Firstly, taking new land in use and clearing trees causes landscape disruptions of previously unavailable resources now becoming accessible. Secondly, Kopparö saw a divergence in how different stakeholders redefined the desirability of white-tailed deer. And thirdly, economic motivations have driven the development of the recreational area, and opened the area to new users and their aspirations in their experience in the area.

### **6.1.2 White-tailed deer foraging and commercial agriculture**

Another translation emerges when white-tailed deer foraging happens on the larger commercial cultivations on the island. For the commercial large-scale farmers on Skärlandet the construction of designated game fences is perceived as a nonviable option. The physical abilities of white-tailed deer to jump over fences as high as two meters means that the construction of suitable fences could result in escalating costs in material, installation and maintenance. Just the material costs for a larger-scale solution can rise up to several thousand euros according to calculations made by one of the interviewees. Thus, little can be done to physically prevent white-tailed deer access to these fields on Skärlandet. Different alternatives that rely on the knowledge of white-tailed deer perceptual capacities have been tried among the farmers in physically preventing the entrance of the species in large-scale cultivations, for example ribbons of certain coloration and different types of scarecrows, but are found ineffectual.

A chosen strategy has been simply to find, by trial and error, a crop plant that either is not recognized by white-tailed deer as food or which has some natural properties that would prevent the foraging. For example some farmers on Skärlandet have shifted from growing oat to growing barley which, due to having naturally long sharp awns, theoretically could prevent foraging. However, barley grows its sharp awns in its later growth stages, and new barley cultivations are often consumed by white-tailed deer already in their young stage. Such uncertainties that are created between white-tailed foraging selections and crop selections by the farmers is another area of constant negotiation that is influenced by several other “preparative” actors. On one hand, commercial agricultural practice is a subject to larger economic developments that extend from Skärlandet to national and international level. The development of cereal producer prices influence the calculated economic loss caused by white-tailed foraging among other causes of crop loss, such as geese foraging and climatic conditions. Crop losses are compensated by state-governed financial instruments and in recent years few of the farmers have applied and received such compensations. On Skärlandet the question of viability in acting to receive compensations for crop loss is also superimposed with the conservation programme for managing the nationally valuable landscape. Since its implementation the latter conservation programme has become a key

source of income for the farmers on Skärlandet influencing the economic role of commercial cultivation. One of the interviewees said that the subsidy received in the framework of the conservation programme nowadays forms the main source of income.

Yet, the capacity of practicing agriculture as a livelihood is also a question of freedom and meaningfulness in acquired professional skills and thus a question of preserving identity for many of the interviewees against the foraging pressure by white-tailed deer. For example:

I just try not to cultivate what they clearly like eating. You got to have something, you got to have fodder for the cattle. But I guess you just live with the losses. Sometimes it bothers to see a large herd feeding on your oat field, you might see 30 individuals there. It's been a kind of numbing process to adjust to having more and more of them coming. But you get used to it slowly, you cannot really do anything about it. (Interviewee, 57)

I wish they would all be shot away. So that I can make an impact, sow crops and do what I want to do, that I get paid for farming. One of my neighbours had just built a house and began farming peas and beans in the yard. He was harrying away a buck for the whole night until he just fell to sleep. In the morning everything was gone. The damn buck never got tired. (Interviewee, 61)

As described, white-tailed deer foraging is encountered in many places on Skärlandet. Ecologically white-tailed deer foraging has been so influential in the US that the species is considered as a keystone species (Waller, Alverson 1997; Greenwald *et al.* 2008; Hummel *et al.* 2018). This would raise the question whether the same influential role extends to the cultural sphere as cultural keystone species (Garibaldi, Turner 2004). As mentioned earlier white-tailed deer's original introduction to the estate of Laukko is preserved in the nicknaming of white-tailed deers as Laukko deer, and in the municipality of the introduction it has become the official symbolic animal. In its original region of introduction, white-tailed deer is interpreted not just indexically but also symbolically. This symbolic dimension is lost in the interpretations of the species on Skärlandet, where white-tailed deer has gained a strong role as game species, being today more or less the only game species in the region.

### **6.1.3 Hunting as collective strategy of control**

Many elements described so far as responses to white-tailed deer foraging turn towards the translation between foraging and hunting. As mentioned in chapter 3, white-tailed deer is

managed in Finland under the framework of game animal management. Other invasive mammal species that are listed as nationally harmful invasive species, such as the raccoon dog (*Nyctereutes procyonoides*) and the american mink (*Neovison vison*), are managed under the Invasive Alien Species Act making their hunting more free and directly as eradication by killing.

Hunting as a community-wide activity in managing white-tailed deer is also a highly dynamic space or a gathering of several different actors and hunting itself can be understood as mediator-actor which is in close relationship with white-tailed deer foraging. Hunting itself obviously has a long history but hunting white-tailed deer is a relatively new phenomenon, officially beginning in Finland in 1960 (Kairikko, Ruola 2005: 80). On Skärlandet the first white-tailed deer was shot in the early 1980's. In the case of white-tailed deer, hunting becomes an even more complex system of management since there are two functions given to the hunting: one is the idea of hunting as cultural practice and the other is to manage an invasive species population.

Among the interviewees there is a strong expectation put on the local hunting practices that, when hunted more, the white-tailed deer population will decrease and the negative impacts of foraging will diminish. This expectation, however, relies on a simple assumption that hunted amounts *can* be increased. Such assumption resembles the complex network described in Callon (1984) where the success in conservation of scallops came down to assumptions on actor identities and the direction of their actions. Especially the latter point as an integral uncertainty regarding actors is emphasised by Latour (2013: 158). Against this background, hunting faces several challenges in addressing the demands of which direction should the action be pointed at. Physical limitations often influence the hunter's accessibility of white-tailed deer refugia among many other challenges (Brown *et al.* 2000) which on Skärlandet island are often geographically challenging forest islands and patches that can have steep slopes formed in combination of glacial processes, such as erratic rocks, and the soil and rocks removed and piled during the clearing of the fields for cultivation. Driving white-tailed deer out from these areas can be a laborious act, especially on Skärlandet that is characterised by a diverse selection of these suitable refugia for the deer. For example, during my participation in the day of hunting, my own slow and tricky ascend to one of these patches during one of the runs resulted only in what seemed as a controlled and steady descent of a deer individual down the slope and into the opposite direction to which it was being driven. Even with guns, maps and radios, the natural

landscape structures conditionalize the physical performance of humans during the hunt. On the other hand, Skärlandet as the larger main island is surrounded by a fragmented collection of smaller islands which serve as important habitats and refuges for white-tailed deer, especially during its breeding. During the winter, these islands are easily accessed over the ice, and during the ice-free seasons by swimming which is a predation-avoidance skill white-tailed deer is known to master well (e.g. DeYoung, Miller 2011). Accessing these small islands with a group of hunters is easily as tricky as accessing the refugia on the main island, not to mention the transportation of the carcasses out from these islands.

There are also cultural systems that can either facilitate or hinder the hunting of white-tailed deer. For example, the choice of hunting technique does not necessarily reflect the most efficient way to decrease the population. While being more effective, shooting the deer during its feeding can pose ethical considerations among the community or among the hunters. The hunting practice on Skärlandet is not simply an invasive species management but also a social practice with deeper connections in the ecocultural system with informal norms, values and traditions. Also formal regulations and institutions such as law and land ownership can also have unexpected outputs when applied especially in white-tailed deer hunting on Skärlandet and its surrounding islands. For example, according to the law on hunting in Finland “[i]t is not permitted to shoot an animal within 150 metres of an inhabited building without the express permission of the owner or holder of the building”<sup>9</sup>. On small islands that hold several small properties it is nearly impossible to be able to hunt without a written permission from all the property owners and the collection of these permits must be done individually, in person and annually. In many locations this procedure is impossible because of the lack of resources of small hunting clubs, as one of the interviewees described. Brown *et al.* (2000: 801) noted that hunting white-tailed deer is a practice highly influenced by these site-specificities especially in suburban and semirural contexts where there are several landowners in smaller areas, more closed spaces, different cultural norms around hunting and local governance structures. For example, in Finland, in order for the hunting club to be given a permit to hunt small cervid species in the first place it needs leasing contracts with property owners and these contracts need to add up to 500 hectares of unified land area.

---

<sup>9</sup>Hunting Act 1993. English translation. Available at [https://www.finlex.fi/en/laki/kaannokset/1993/en19930615\\_20130206.pdf](https://www.finlex.fi/en/laki/kaannokset/1993/en19930615_20130206.pdf). Accessed on 15.2.2021.



Especially the uncertainty surrounding the size of the population on Skärlandet poses an additional layer of challenges in hunting. The amount of cervid hunting permits received by local clubs is rendered in a process whereby local clubs send their population size estimations to be processed by different local, regional and national game administration bodies, which then allocate permits regionally from which they are applied locally. Formerly there was just one large hunter's club on Skärlandet but due to different opinions on population estimations and how white-tailed deer hunting should be organized accordingly resulted in a group of local landowners detaching and creating a new club a few years ago. Many white-tailed deer properties are found at the core of the interpretations of what happened and which of the group wanted what, for example whether the permits should be used in shooting bucks or does. This question itself is a target of ecological-cultural elements: white-tailed deer is famously fecund species, and one doe can produce even 30 offsprings during its lifetime (McShea 2012), however deer bucks tend to be generally selected in hunting for many cultural reasons, such as for trophies (Batavia *et al.* 2018). Male-biased hunting has been witnessed also among elk in Nordic countries (Kekkonen *et al.* 2016). For the hunting to be practiced on Skärlandet depends on white-tailed deer population while the population in ecological terms has become dependent on hunting due to the fact that no significant predation pressure is imposed on the population on Skärlandet. Hunting as replacing predation can be understood here as exemplifying the process of ecosemiotic fitting, since it is an ecocultural-level assembly that has a certain capacity to make and maintain functional relationships between agents.

#### **6.1.4 Foraging as ecosemiotic fitting**

White-tailed deer foraging as a mediator travels in the Skärlandet community and makes many other actors do things (Latour 2005: 59). On one hand, from an ecosemiotic perspective, the perception and interpretation of new species can be analyzed in the framework of Peircean triadic sign-relations. The impact of white-tailed deer foraging on Skärlandet foregrounds the indexical dimension in interpreting human relationship with the species. As mentioned, this indexical interpretation in the ecosemiosphere is strongly connected with many other ecological-cultural changes. Especially the local phenomenon of emergence of different types of fences have become strongly contextualized by the

particular dialogue between white-tailed deer foraging and humans creating a substructure in ecosemiosphere which has become a strong environmental sign in the ecoculture. When aligned with network-focused approaches in conservation and invasive species management white-tailed deer foraging creates complex dynamics in the local ecological-cultural network. Semiotic, or ecosemiotic, fitting of white-tailed deer as the agent's capacity in making and maintaining functional relationships in the community can thus be approached with following a key element of its ecosemiotic agency, its foraging behaviour. This can be reflected with the different mechanisms of semiotic fitting described by Kull (2020: 15-16) and can be seen corresponding to the associative indexical mechanism of fitting. One reason for the mechanism of indexical fitting having a strong role when it comes to white-tailed deer is that in local ecocultures there are different ways how human cultures interact with the local environment. The concept of ecoculture attempts to grasp not only symbolic systems such as traditions, memories and values, but also iconic and indexical practices and behaviours (Pilgrim, Pretty 2010: 11). Invasive species enters into rich local worlds. Thus, depending on the agency of the invasive species or its "mediatorship" in these networks certain mechanisms of fitting are foregrounded.

As seen here, fitting can be understood as a very localized process as it becomes defined by often unique local ecocultural conditions. On Skärlandet island the particular nationally valuable landscape conservation programme reshuffles the income basis of local livelihoods which influences the perceived harm – not necessarily by reducing it but shifting the interpretation from economic domain to cultural. Because of these unique networks, it can be expected that white-tailed deer foraging as a mediator can have unique impacts in different local ecocultures in Finland, which provides another perspective to the classification as locally harmful invasive species. Skärlandet is not subject only to changes expected to be seen in Southern Finland due to global environmental change, such as increase in mild autumn seasons and snow-poor winters, but also different ongoing local social and cultural changes that can influence, as "preparations", in how the ecocultural community responds to white-tailed deer foraging. An interesting aspect is what Robbins (2004) has described as diverging social species valuations and its unpredictable consequences in invasive species interpretation. A question arises whether this local heterogenization of thoughts and aspirations can influence what Pilgrim and Pretty (2010) have proposed as a notion of ecocultural resilience towards emergence of new invasive species.

## 6.2 Fitting of *rosa rugosa* in Hanko

Hanko is a coastal town and a municipality in Hanko peninsula region in the south-western corner of Finland. Geographically the whole peninsula itself is relatively narrow and long and stretches some 45 kilometers into the Baltic Sea from the mainland, but is mostly characterised by its outermost part where the town of Hanko and its conurban parts are located. Today Hanko has a population of some 8000 people of which almost half are Swedish-speaking Finns. As a general trend, the population in Hanko has been steadily decreasing for decades, from around 12 000 in 1980 to 8500 in 2017.<sup>10</sup>

Due to its location in relation to the busy marine traffic of the Baltic Sea, Hanko has a long history as a strategic port town for both international trade and military use. Some historical sources suggest that the tip of Hanko peninsula was an important station for the Hanseatic League already in the 13th century (Berndtson *et al.* 1895). First records of military presence and fortifications in Hanko reach back to the 17th century, but especially the two world wars meant turbulent times for the town. In 1940 Hanko was handed over to Soviet Union, and permanently recaptured a year later in 1941. On the other hand Hanko has a history as a popular summer resort destination largely thanks to its lengthy natural sandy beaches and dunes that cover the majority of the southern shore.<sup>11</sup>

Today the port and the industry around it as well as tourism still compose the main economic sectors of the town. The port of Hanko was originally founded in 1873 and is still very much operational today serving mainly trade.<sup>12</sup> On the other hand the natural sandy beaches and dunes make Hanko a popular summer destination for domestic and international visitors, and tourism has an annual turnover of 51 million euros for the town. Thus, beaches and beach-related activities such as sailing, wind- and kitesurfing and diving form key themes in the tourism strategy of Hanko.<sup>13</sup>

---

<sup>10</sup> Statistics Finland, nd. The official census of Hanko 1980-2017. Available at <https://pxnet2.stat.fi:443/PXWeb/sq/daea5f33-0d4c-4c0c-b1da-bac854103ef5>. Accessed on 12.4.2021.

<sup>11</sup> Town of Hanko, nd. Historiallinen Hanko [In English: Historic Hanko. My translation]. Available at <https://visithanko.fi/teemasivu/hanko-kautta-aikojen/>. Accessed on 12.4.2021.

<sup>12</sup> Port of Hanko, nd. Hangon Satama Oy. Available at <https://portofhanko.fi/hangon-satama-oy/>. Accessed on 12.4.2021.

<sup>13</sup> Town of Hanko, nd. Hangon kaupungin matkailustrategia 2012–2020 [In English: Tourism strategy of Hanko 2012–2020. My translation]. Available at <https://visithanko.fi/infosivu/hangon-kaupungin-matkailustrategia-2012-2020/>. Accessed on 12.4.2021.

Ecologically Hanko peninsula is the beginning point of one of the biggest terminal moraine ridges of Salpausselkä in Southern Finland that was formed during the most recent glacial retreat some 10 000 years ago (Hellemaa 1998). Similarly to Skärlandet, Hanko is located in the hemiboreal vegetation zone but due to these edaphic conditions Hanko is dominated by coniferous trees, especially the scots pine (*Pinus sylvestris*) and the norwegian spruce (*Picea abies*) (Raivio 1988). Ecologically these sandy beaches and dunes have very distinct species compositions and specialist species due to the demanding conditions such as large variations in water level, winds, temperatures, moisture and salinity. Beaches and dunes in Hanko are considered unique, diverse and valuable biotopes in Finland and also more broadly in the context of Nordic region (Finnish Environment Institute 2009).

According to written documentation the first feral *rosa rugosa* shrubs in Hanko region were found near the conurban area of Tvärminne in 1945 (Kunttu *et al.* 2016), but it is suggested that the species was spreading in Hanko already in the 1930's (Hammarström, Grönholm 2003, cited in Aspelund, Rytteri 2010: 5). Kunttu, P. and Kunttu, S-M. (2017) surveyed *rosa rugosa* sites in the broader archipelago region and found 205 dispersal sites on a large variety of islands. They (*ibid.*, 105) noted that, due to its diverse dispersal capacities, *rosa rugosa* can potentially have multiple different “invasion pathways” (see Hulme *et al.* 2008) in the Baltic Sea region. Today *rosa rugosa* can be found in Hanko in several different sites along the beach and to a lesser degree on different spots around the town. The largest areas of *rosa rugosa* growths in Hanko has been measured as covering several hectares (Aspelund, Rytteri 2010).

As mentioned earlier, ecologically *rosa rugosa* is considered a superior competitor due to its strong dispersal capacity which can make its growths expansive and dense. The beaches of Hanko appear to strongly correspond to the native *rosa rugosa* habitats in Northeast Asia as described by Bruun (2005). The important ecological-cultural role of the beaches and dunes in Hanko therefore becomes also the domain of diverse negotiation between *rosa rugosa* and humans. In Hanko the habitat selection of *rosa rugosa* together with its strong traits in dispersing and persisting in these habitats is a key mediator that sets in motion diverse responses and actions by other actors in the network. Thus, the habitat selection of *rosa rugosa* will be followed in this analysis.

Many of the interviewees recall having a memory of *rosa rugosa* already from their childhood or youth. As mentioned in chapter 3, the species was widely planted in public spaces for many decades in Finland for many different purposes. These memories by the

interviewees often include a physical encounter, for example getting hurt by the thorns or playing the game of putting the hairy tickly seeds on other's back through the shirt neckline – or even eating its berries as a kissel dessert. On the other hand, the perception of *rosa rugosa* has a strong iconic dimension in physically altering the human spatial perception and orientation. The descriptions of *rosa rugosa* by the interviewees often emphasise perceiving or noticing its presence or emergence in familiar spots that have a traditional function in accessing or enjoying the beach and the sea. For example:

It has so insidiously just invaded the beach. I remember picking and using its berries in the 1980's a lot and that was really nice. I never paid too much attention to it. We have always had this opening here which we have used to get to the beach but now it's a lot of work to keep this area open.  
(Interviewee, 69)

In several such descriptions, *rosa rugosa* overgrowths that begin to cover for example familiar paths and passages also surpasses a certain threshold after which the shrubs become perceived. This threshold could be connected with the understanding that local human knowledge of environment has a strong dimension of tacit knowledge (Polanyi 1966) and in the case of *rosa rugosa* this dimension makes it very difficult to pinpoint the invasion process or stages of invasion (e.g. Lockwood *et al.* 2007: 9) as it appears to humans. The encounter between *rosa rugosa* habitat selection and human modeling of the physical environment constitutes a key area of dialogue. Especially since on the beaches of Hanko *rosa rugosa* is perceived as an entity belonging to somewhere between the 0- and 1-nature and coming into conflict with how it has been culturally produced (2-nature) and categorized (Kull 1998) for example in urban environments. According to Magnus and Remm (2018: 321) interpretation of invasive species in urban environments depends largely on “the cultural model and orientation that the city embodies, as this determines the characteristics of the species which influence their acceptance and disapproval in a particular place”. In Hanko the cultural model has two distinct but intimately intertwined dimensions which can be seen as sub-structures interacting in the semiosphere under material conditions: the constructed environment and the sandy beaches. Switching between these dimensions is emphasized by the interviewees as an important motivation to live in the town: “The sea makes the nature here very powerful and lively. You have this kind of nature and such beaches right in your backyard, but then you have all the services available in ten minutes if you need them” (Interviewee, 67).

The close proximity of the sandy beaches and the urban environment in Hanko is unique and creates a very close ecological-cultural relationship that organizes the ecocultural local practices and values. For example, a plan to develop one of the town's commercial ports in the 1970's and a golf course construction project on a shore-side property in the conurbation of Tåktom in the 1990's both generated large citizen movements that opposed them. The interviewees describe a strong local ideology of shared ownership of the beaches – an idea which is also perceived compatible with a more general cultural and legal value system of public access rights, or “everyone's rights”, in Finland, i.e. the right to enjoy outdoor pursuits regardless of who owns or occupies an area. Moreover, the ecocultural idea of free and public beaches has been encoded into many formal documents, such as the town's strategy of tourism as well in the town's zoning master plan from 2012.<sup>14</sup>

In the framework of ecosemiosphere, beaches in Hanko have two strong meaning-structures as the local sense of ownership of the town and in the marketing and branding for tourism. This also implies a fundamental semiotic differentiation process of Self and Other (Lotman 1975) that relates to the conceptualization of the beaches. *Rosa rugosa* habitat selection moves in relation to these two structures by its capacity to change the iconic interpretation of the beach environment. As for the material conditions that influence the semiotic processes the geological factors and natural processes have also shaped the shoreline in a way that intertwines with meanings that humans attach to the beaches. Characteristic in the structure of the beach landscape in Hanko are the multiple distinct embayments between small capes that have formed by diverse processes such as land uplift, erosion and sand accumulation. Each of these embayments have distinct formal or informal names (e.g. Plagen, Bellevue, Kolaviken) and characteristics among the locals. In recent decades some of these bays have seen their own formal management and usage plans that often include both cultural (recreational use) and ecological aspects, especially a plan for *rosa rugosa* eradication (Ahola 2017).

### **6.2.1 *Rosa rugosa* and property ownership**

---

<sup>14</sup> FCG Finnish Consulting Group 2021. Hangan kaupunki: Kantakaupungin yleiskaava, selostus [in Finnish]. Hanko. Available at [https://www.hanko.fi/files/2214/Yleiskaava\\_selostus.pdf](https://www.hanko.fi/files/2214/Yleiskaava_selostus.pdf). Accessed on 10.4.2021.

One key relationship in the network is between the “open beaches” idea discussed above and ownership of private sea-side properties that are largely focused on the shores of the two conurban areas of Tåktom and Tvärminne. According to the interviewees the beaches closer to the town center have seen a strong increase in use by tourists and short-term visitors as well as entertainment activities such as partying and different events. This development in the public beaches in the town has resulted in some seeking more quiet beach use further down the shore. As one interviewee noted: “Tulliniemi is kind of different, it’s hard to describe. And then we have these beaches closer to the town, such as Plagen, but they are like drinking bars on a beach” (Interviewee, 74).

The town has been developing the public accessibility and ecological conditions of these beaches that are further away from the center to facilitate diversifying social use as well as to react to the ecological threats of *rosa rugosa* overgrowth on some beaches. As a consequence of the encounters between different beach users seeking quiet areas and private-property owners in Tåktom has increased. Due to its habitat selection on dunes between the foreshore and the yards, *rosa rugosa* forms a dense hedgerow and fulfills the wish for privacy by the property-owners, at least to some extent. A property-owner describes for example:

I think it can be accepted that people walk along the beach, but in order to allow that we feel like some kind of visual obstruction is needed. The name of this visual obstruction is *rosa rugosa*. (Interviewee, 66)

However, there are more functional relationships formed between *rosa rugosa* and the property-owners than just the fence-function. The interviewees describe the species’ capacity to block some of the wind from the sea but also being shallow enough to maintain the open view to the sea. One interviewee described that there is a balance between maintaining enough cover and maintaining the view.

The shrubs here are usually a bit shallower, now they’ve grown to cover the sea too much. But when the shrubs are lower you can normally see with the side eye when people are walking on the beach. It’s kind of difficult since the law protects our privacy but the distance to the beach is long enough so I have to yell fairly loud and I really wouldn’t want to. (Interviewee, 67)

From the perspective of actor-network theory, one question that arises is whether *rosa rugosa* functional relationships with the property-owners are easily switched with any other species or an artificial construction. Or in other words, whether *rosa rugosa* habitat selection

in this case is simply an intermediary whose output is relatively well predicted by its inputs (Latour 2005: 39). However, also the biology and morphology of *rosa rugosa* itself (capacity for efficient utilization of the rough terrain, density and height of the shrubs) as well as the biological community structure (no strong competitors or limiting factors) on Hanko beaches makes it possible for the species to ecologically match with the needs of humans. Moreover, for some, the appearance of *rosa rugosa* also plays a major part:

Those *rosa rugosa* shrubs were here before us. They pretty much suggested how the yard should be kept. They are like flowering islands, and the irregular and wavy shapes just fit in this landscape. And the odour from the flowers is really strong and enjoyable when the wind from the sea carries it here. (Interviewee, 65)

This multidimensional matching would be an example of the modern synthesis of invasiveness compressed by Robbins (2004: 141) as “right plant, right place, right time”. Using the framework of social, political and economic preparations acting behind invasions argued by Robbins (*ibid.*), there are strong implications of what Robbins calls “feedback loops” and “alliances” that are in play in preparing the context for *rosa rugosa* invasion. A key patterned human behaviour here is the usage or modification of environmental structures to increase personal privacy. As the social preparation there has been a clear divergence in perceived desirability of *rosa rugosa* against the perception of its obstructive impact for the recreational usage of the beaches. And particularly in the ecoculture of Hanko this intertwines intimately with economic valuation of the accessible beaches and dunes as key resources in tourism. According to Hammarström and Grönholm (2003, cited in Aspelund, Rytteri 2010: 5) some present *rosa rugosa* growths most likely have their origins in a deliberate introduction in the 1930’s on the dunes between a private property and the beach. This strongly suggests that at least some of the functions of *rosa rugosa* today matched the human needs already in the past. A clear opportunity for an alliance between *rosa rugosa* and the property-owners has not only been formed but also maintained as continuously beneficial for both parties.

In general the history of *rosa rugosa* as invasive species in Hanko corresponds well with the cases described by Robbins (2004) in his examinations of jurema plant *Mimosa tenuiflora* and mesquite *Prosopis juliflora*. In these examples Robbins places “expansive invasive coverage” in the center of focus and sketches the feedback loops that construct the context for its invasion. More particularly, the emergent property of invasiveness is apparent in that the process of ecosemiotic fitting as interpretation of functional relations that



happens in ecological-cultural networks can result in a variety of new situations. In Robbins' (ibid., 151-152) words, "even desirable plants can be considered weeds under certain conditions" – and vice versa. This is also described by Magnus and Remm (2018) who describe how the models of urban environments include a semiotic ecological-cultural distinctions between Self and Other and invasive species can become translated in this boundary.

### **6.2.2 Rosa rugosa eradication in Hanko**

A third key actor in the network is the conservation activities in Hanko that aim to manage *rosa rugosa* by eradication. Some of these activities have been large scale public projects that have mobilized professional contractors specialized in eradicating invasive species, heavy machinery and volunteers regularly in different locations since at least the end of 1990's. Some projects are funded by the state but organized by the local environmental NGOs and carried out by a group of volunteers, especially on the smaller islands off the shore. In addition, some citizens and landowners have also begun eradicating *rosa rugosa* voluntarily. As discussed in chapter 3, *rosa rugosa* sales were banned already in 2019 and a ban on its cultivation will enter into force on 1st of June 2022. Responsibility for eradication, according to law, is on the owner or the occupant of the property.

Ecologically *rosa rugosa* is considered very difficult to eradicate due to several factors that influence the success of preventing its regrowth. Depending on the location and the size of the growths, typical techniques that are used are digging up and extermination of the roots, regularly cutting the stems, grazing or herbicides (Weidema 2006). Being highly resilient and able to regrow from very small pieces of roots, digging up the roots completely can consume large amounts of resources in the form of heavy machinery and manual labour as well as due to the probable need for annual repetitive work. In describing one of the larger projects in Hanko, Aspelund and Rytteri (2010) calculated the annual costs summing up to some 18 000 euros per hectare for the initial eradication over a two year period. However, they (ibid.) expected the costs to drop for the subsequent work.

The perception of these larger eradication projects on the public beaches has been diverse among the interviewees. In some cases the eradication of *rosa rugosa* is just one aspect in restoring the sunny and dry xerothermic habitats; simultaneous removal of trees is

ecologically justified (Aspelund, Rytteri 2010) but can be perceived as radically altering the landscape: “I personally don’t want to go there anymore. It’s just too open now when all those trees are gone too” (Interviewee, 74). Also the sheer scale and force needed for some eradication projects appears disproportionate in some accounts by the property-owners: “It looked like a bedlam with all the excavators coming and going” (Interviewee, 60). One particular incident that several interviewees recall happened when the pictures of eradication by herbicides in one location in Hanko emerged in a news magazine. The pictures that accompanied an article showed a particular herbicide called glyphosate being sprayed on *rosa rugosa* shrubs on the beach. Few of the interviewees contacted the public administration to raise their concerns of what impacts these herbicides would have not only for other species but for the water table that in the moraine-rich soil in Hanko is an important and respected natural resource among the locals.

Also the keystone impact of *rosa rugosa* can have diverse impacts in the species composition on the beaches and dunes in Hanko. In some cases these domains can be confronted. For example, with human relationships with some of the ant species whose populations and dispersal are closely connected with increases and decreases in xerothermic habitats. A rare ant species on the dunes in Hanko, *Myrmica constricta*, has been regressed due to the covering effect of *rosa rugosa* (Ahola 2017: 27-28). Another ant species that shares these habitats, *Formica cinerea*, is considered ecologically as rare but culturally problematic since it can be aggressive (ibid, 29) and often prevent human recreational use (Interviewee, 74). On the other hand many interviewees perceive that *rosa rugosa* can more directly facilitate other species, for example providing suitable cover for snakes under the shrubs or increasing amounts of bees foraging on the flowers. These indexical sign-relations create another layer in interpretation of *rosa rugosa*. For example: “My neighbours have said that there are a lot of viper snakes under *rosa rugosa* shrubs so one should not go there with dogs and children. So we just have not really used half of the beach” (Interviewee, 50) and “There is this wide public concern about pollinators and if you walk close to these *rosa rugosa* shrubs in the summer you hear this huge buzz” (Interviewee, 60). However, as self-reflected by the latter interviewee, the background for emphasising these ecological keystone effects is the maintenance of its function of providing visual cover. As such, following again Kull (1998), the interpretation (1-nature) of *rosa rugosa* keystone capacities simply matches well with the functions evaluated against a cultural background (3-nature). Eradication of a species that has been introduced by the state administration or the previous

generations and that has exactly due to its invasiveness matched well with ecocultural valuations can open up a further opportunity for the emergence of an additional nonhuman conservation actor (Jepson *et al.* 2011). As one of the interviewees noted:

From the perspective of a citizen it appears somehow impetuous since the state has been planting it and fairly recently too. Now you suddenly prohibit it by law and order everyone to destroy it. I actually feel like a sense of civil disobedience is surfacing. (Interviewee, 66).

Aspelund and Rytteri (2010), in their description of the *rosa rugosa* eradication project in Hanko in 2009, noted that during the work stage an opinion piece by a well-known local novelist emerged in the local newspaper as a critical opinion towards *rosa rugosa* eradication. They (*ibid.*, 7) observed that such an event might have had an impact on the enthusiasm of the local volunteers to participate in the project. This observation contributes to the ecocultural perspective that, similarly to white-tailed deer in Skärlandet, *rosa rugosa* fitting is a very local ecocultural process. The sharp difference is that *rosa rugosa* is considered a nationally invasive species and its eradication is supported by the law on invasive species whereas white-tailed deer hunting as management is still local and the calculations that determine the local population size is also a local initiative. *Rosa rugosa* on the beaches and dunes in Hanko is fulfilling its fundamental biological function of selecting these habitats. A particular feature here is that in its native habitat the functional community relationships that *rosa rugosa* maintains are often limiting factors (see chapter 3). And as mentioned also in chapter 3, this is also applicable with the ecocultural role of *rosa rugosa* as being harvested for many popular human uses. The idea of ecosemiotic fitting as an extension or an application of semiotic fitting (Kull 2020) becomes apparent especially with analysing the role of *rosa rugosa* in Hanko. Kull (*ibid.*, 15-16) describes the mechanisms of fitting as driven by the semiotic capacities of the species and from this perspective the fitting of *rosa rugosa* would happen through imprinting, or by the organism's "recognition window". Elsewhere Kull (2016) has defined recognition window as the organism's capacity to make distinctions in reproduction and, as such, being a fundamental element in the biosemiotic concept of species. However, ecosemiotic fitting here distributes the agency of *rosa rugosa* throughout the network enabling the analysis of fitting without a major lowering of semiotic threshold in respect to any of the species (Eco 1976; Nöth 2000).

### **6.2.3 Habitat selection as ecosemiotic fitting**

*Rosa rugosa* in Hanko can be understood as ecosemiotically fitting by its habitat selection. As such it is aligned with the mechanism of imprinting suggested as the main mechanism of fitting for vegetative organisms by Kull (2020). However, ecosemiotic application of fitting should be understood as a network-process that includes human cultural structures and the semiotic potentialities of the material environment in the process. From this perspective the habitat selection of *rosa rugosa* is an agency that is distributed into the relationships between different agents in the community.

In Hanko *rosa rugosa* habitat selection on the sandy dunes and beaches is interpreted by humans against the ecological-cultural model of these environments. A particularly strong ecocultural ideal in Hanko is described as the idea of open, shared and by many ways used beaches. As discussed, this idea is not purely arbitrary cultural image but is made possible by semiotic potentiality of the material environment: for example, the different embayments in Hanko enable human linguistic distinctions and choice-making in the cultural interpretation of the beaches. This ecological-cultural interpretation creates the necessary conditions for negotiating the design of the different activities on the beaches. This encounter between public designing and usage and *rosa rugosa* habitat selection is one of the key events of translation (Callon, Latour 1981: 279), or the process of fitting that is manifested in this relationship. On one hand, the cultural model of human-accessible beaches carries the ecocultural hopes and demands, but on the other hand the resilience of habitat selection by *rosa rugosa* determines the boundaries of the negotiation. As pointed out, development plans, funding and public discussion are needed in the translation. As a second key event of translation *rosa rugosa* habitat selection and the increased need for privacy for the shore-side property-owners form what Robbins (2004) calls an alliance in invasions. This could be understood as a strong translation where the persuasive dialogue creates a very strong functional and communication link between the property-owners and *rosa rugosa*. As noted earlier, this linkage is perceived and interpreted as powerful enough to act as a form of resilience against the perceived changes in the beach use by the local people. Moreover, the encounter between the two translations show how ecosemiotic fitting affects these ecological-cultural communities: As described earlier in this analysis, a feedback loop is created between beach development, increased usage, increased need for privacy, the maintenance of *rosa rugosa* shrubs and re-dispersal of the species. As an official

response, the management of *rosa rugosa* dispersal in Hanko can be relatively costly and needs to be highly organized in order to be successful. The relationship between the two key events of translations with the general project of eradication of *rosa rugosa* backed by ecological research and legal frameworks forms another translation, which is driven strongly by the ecological knowledge of the harmful impacts of *rosa rugosa* on the particularly vulnerable Hanko beaches. The local dimension of fitting is emphasised here, since the uniqueness of beach and dune habitats in Hanko, and in Finland in general, contribute not only ecologically but also culturally to the interpretation of *rosa rugosa* as invasive species. Because of the local ecological-cultural process of making and maintaining functional and communicational relationships, *rosa rugosa* fitting and land ownership becomes entangled on different levels: On one level, in Hanko the private and personal land ownership can interpret *rosa rugosa* as ally and thus accept the species as part of the Self. On another level, reflected on the local shared land ownership *rosa rugosa* can become interpreted as a local Other. But on a third level, local shared land ownership can recognize *rosa rugosa* as Self when reflected on national level land ownership. This construction of not only physical boundaries and divisions but also cultural boundaries is another type of impact of ecosemiotic fitting of *rosa rugosa* in Hanko.

## Conclusions

In the first part of this thesis, I have offered a perspective into ecological, cultural and integrated approaches to invasive species. As discussed in chapter 1, there has been a visible shift in research towards understanding different agencies that influence on why invasions occur and what implications this has for ecology in the era of anthropogenic environmental change.

Semiotics can contribute to understanding sign-processes that are involved in the emergence of novel species in ecosystems where they have not been previously present. In this thesis, I have focused on one such approach, namely semiotic fitting (Kull 2020) in approaching the phenomenon of invasive species. However, since the phenomenon is highly complex and can take positions in both biological and cultural dimensions, I have extended semiotic fitting into including humans and human cultural structures as agents in what I've called in this thesis as ecosemiotic fitting. The most important contribution of the concept ecosemiotic fitting is that it enables to analyse agencies as being distributed in the relationships throughout the local ecocultural network rather than being understood just as a capacity of the organism itself. Furthermore, invasive species is a broad category of species usually defined by human-introduction beyond geographical barriers and by ecological, social and economic impacts. Therefore, I have mobilized concepts from actor-network theory (ANT) in order to bring different species as well as ecological and cultural aspects into one analytical framework; following ANT by distributing the agency into the local networks of relationships means that in this thesis ecosemiotic fitting is effectively a network-process rather than a description of the agent's capacity.

Analyzing the fitting of two different species, white-tailed deer and *rosa rugosa*, from this perspective in two localities in Southern Finland, Skärlandet island and Hanko, reveals dynamic networks of human and nonhuman actors that move, reshape, resist and form strong or weak alliances in the processes of translations. In the case of white-tailed deer, its foraging behaviour becomes a mediator that present how the species ecosemiotically fit into these communities and how the fitting influences these communities,

while the same process happens when the habitat selection of *rosa rugosa* is followed as a key mediator. There are especially two interconnected findings, which I want to emphasize: Firstly, analyses in this thesis reveal that white-tailed deer foraging behaviour and *rosa rugosa* habitat selection can almost perfectly match with human behaviour and that these alliances of patterned behaviours can make and maintain functional ecological-cultural relations between these agents in the communities. This process of localized fitting is not simply about formation of social and political interest groups but also about mutualisms that have ecological characteristics and which are mediated by signs. Secondly, in both cases the cultural processes such as divergence in social valuation of species, shifting land ownership structures, seasonal human movements and recreational landscape uses have an impact in the capacity for humans to respond to the ecological pressures caused by invasive species – regardless of the response.

Some of the aspects that could explain these tensions has been discussed in Jepson *et al.* (2011) as emergence of different complex conservation actors. However, from an ecosemiotic perspective, there is also the question of how environmental changes and changing species compositions around humans and human cultures are interpreted. While white-tailed deer on Skärlandet still carries a strong brand of novel species in the area, *rosa rugosa* has been around in Hanko for a relatively long period of time but culturally it has been very recently re-coded by invasive species discourse as totally opposite to its historical interpretation – effectively forcing a certain novelty and reinterpretation for the species. The subjective and community-level engagement in interpretation or reinterpretation of these species is a very unstable process from which new social tensions can emerge or old social tensions resurface. Moreover, my role as a researcher in these communities occasionally appeared as being utilized in advancing political objectives: I observed some of my interviewees having gained knowledge of my study via an organized group that has begun raising awareness of the negative impacts of the species but which was not directly revealed to me during the interviews.

Also, ANT as an analytical framework can pose a challenge in limiting the scope of analysis, since, as Latour (2005: 133) writes, “everything is data” when ANT is mobilized. In the analysis in this thesis I have attempted to limit the analysis in actors that remain visible and active in my material. Especially many linkages between the local and national scale discourses as well as many of the ethical considerations have not been sufficiently analyzed in this thesis. Terminology and language used in describing invasive species and

invasiveness as a phenomenon have emerged in everyday language fairly recently, and these changes in discourse would be an interesting topic for further study. Also, it should be noted here that both white-tailed deer and *rosa rugosa* are species that are well-known in Finland and easily perceived by humans, while many harmful invasive species can remain largely outside human everyday perception, for example arthropods. This poses a challenge for the applicability of ecosemiotic analysis on invasive species.

In both cases described here there undoubtedly are deeper and increasingly complex relations behind the surface that is barely scratchable in this thesis. For example, it would be interesting to understand the movement and landscape usage of white-tailed deer individuals on Skärlandet and map these foraging behaviours with human systems and human landscape structures to understand better the patterns of contacts between humans and white-tailed deer on the island. In the case of Hanko, the trending domestic tourism and the approaching deadline for the change of the legal status of *rosa rugosa* could be an interesting dynamics to follow in the future.



## References

- Abrahams, Brent; Sitas, N.; Esler, Karen J. 2019. Exploring the dynamics of research collaborations by mapping social networks in invasion science. *Journal of Environmental Management* 229: 27–37.
- Ahola, Aapo (ed.) 2017. *Hoito- ja käyttösuunnitelma: Kolaviken, Hanko* [In English: Management and use plan: Kolaviken, Hanko. My translation]. Faunatican raportteja 4/2017.
- Aikio, Sami; Pusenius, Jyrki 2021. *Valkohäntäpeurakanta talvella 2020–2021: Arvio Suomen valkohäntäpeurakannan koosta ja rakenteesta ja kuvaus kanta-arvion laskentamenetelmästä* [In English: White-tailed deer population during the winter of 2020–2021: Estimations of the Finnish population size, structure and a description of methodology of the population estimate. My translation]. Luonnonvarakeskus.
- Alonso, William 1995. Citizenship, nationality and other identities. *Journal of International Affairs* 48(2): 585–599.
- Anderson, Roger C.; Corbett, Erica A.; Anderson, M. Rebecca; Corbett, Gail A.; Kelley, Timothy M. 2001. High white-tailed deer density has negative impact on tallgrass *Prairie Forbs*. *The Journal of the Torrey Botanical Society* 128(4): 381–392.
- Andersson, E.; Koivisto, Ilkka 1980: Valkohäntäpeuran talviravinto ja vuorokausirytmii [In English: White-tailed deer winter nutrition and circadian rhythm. My translation]. *Suomen Riista* 27: 84–92.
- Asdal, Kristin 2020. Is ANT equally good in dealing with local, national and global natures? In: Blok, Anders; Farías, Ignacio; Roberts, Celia (eds.), *The Routledge Companion to Actor-Network Theory*. London, New York: Routledge, 337–344.
- Aspelund, Paula; Rytteri, Terhi 2010. Kurtturuusu uhkaa hiekkarantojen ja dyynien eliöyhteisöjä – tapaus Hangon Furuviik [Rosa rugosa threatens ecological communities on sandy beaches and dunes – case of Furuviik, Hanko. My translation]. *Lutukka* 26: 4–9.
- Auri, Elina 2010. *Ilman kiinteää tieyhteyttä olevat pysyvästi asutut saaret* (Työ- ja elinkeinoministeriön julkaisuja. Alueiden kehittäminen 26.). Työ- ja elinkeinoministeriö. [In English: Permanently inhabited islands without fixed road connection. Publications by the Ministry of Employment and the Economy. Development of regions 26. My translation].

- Baker, Paul T. 1969. Human adaptation to high altitude. *Science* 163(3872): 1149–1156.
- Baker, Robin R. 1978. *The Evolutionary Ecology of Animal Migration*. London: Hodder and Stoughton.
- Baldwin, James Mark. 1896. A new factor in evolution. *The American Naturalist* 30(354): 441–451, 536–553.
- 1902. *Development and Evolution, Including Psychophysical Evolution, Evolution by Orthoplasia, and the Theory of Genetic Modes*. New York: Macmillan.
- Barrett, Spencer C. H. 2015. Foundations of invasion genetics: the Baker and Stebbins legacy. *Molecular Ecology* 24(9):1927–1941.
- Baskin, Yvonne 1998. Winners and losers in a changing world: Global changes may promote invasions and alter the fate of invasive species. *BioScience* 48(10): 788–792.
- 2002. *A Plague of Rats and Rubbervines: The Growing Threat of Species Invasions*. Washington, Covelo, London: Island Press.
- Batavia, Chelsea; Nelson, Michael P.; Darimont, Chris T. Paquet, Paul C.; Ripple, William J.; Wallach, Asian D. 2018. The elephant (head) in the room: A critical look at trophy hunting. *Conservation Letters* 12(1): e12565.
- Bazzaz, Fakhri A.; Chiariello, Nona R.; Coley, Phyllis D.; Pitelka, Louis F. 1987. Allocating resources to reproduction and defense. *BioScience* 37(1): 58–67.
- Belcher, C. R. 1977. Effect of sand cover on survival and vigor of *Rosa rugosa* Thunb. *International Journal of Biometeorology* 21: 276–280.
- Bennett, Nathan J.; Satterfield, Terre 2018. Environmental governance: A practical framework to guide design, evaluation, and analysis. *Conservation Letters* 11(6): e12600.
- Berkes, Fikret; Folke, Carl (eds.) 1998. *Linking Social and Ecological systems: Management Practices and Social mechanisms for Building Resilience*. Cambridge, New York: Cambridge University Press.
- Berkes, Fikret; Colding, Johan; Folke, Carl (eds.) 2003. *Navigating Social-Ecological Systems: Building Resilience for Complexity and Change*. Cambridge, New York: Cambridge University Press.
- Berndtson, A. (ed.) 1895. *Hangon kaupunki ja kylpylaitos. Käsikirja kylpyvieraita ja matkailijoita varten* [In English: Town of Hanko and baths. Manual for bath quests and travellers. My translation]. Helsinki: Wentzel Hagelstam.

- Binggeli, Pierre 1994. The misuse of terminology and anthropometric concepts in the description of introduced species. *Bulletin British Ecological Society* 25(1): 10–13.
- Blaustein, Richard J. 2001. Kudzu's invasion into Southern United States life and culture. In: McNeely, Jeffrey A. (ed.), *The Great Reshuffling: Human Dimensions of Invasive Alien Species*, Gland, Cambridge: IUCN, 55–62.
- Blok, Anders; Fariás, Ignacio; Roberts, Celia (eds.) *The Routledge Companion to Actor-Network Theory*. London, New York: Routledge.
- Blossey, Bernd; Nötzold, Rolf 1995. Evolution of increased competitive ability in invasive nonindigenous plants: a hypothesis. *Journal of Ecology* 83(5): 887–889.
- Bodin, Örjan 2017. Collaborative environmental governance: Achieving collective action in social-ecological systems. *Science* 357(6352): eaan1114.
- Boer, Edu 2013. *Risk assessment: Rosa rugosa Thunb. ex Murray*. Leiden: Naturalis Biodiversity Center. Retrieved from: <https://www.cabi.org/ISC/FullTextPDF/2012/20127201203.pdf>. 21.4.2021.
- Boivin, Nicole; Crassard, Rémy; Petraglia, Michael D. (eds.) 2017. *Human Dispersal and Species Movement: From Prehistory to the Present*. Cambridge: Cambridge University Press.
- Boudouresque, Charles F.; Verlaque, Marc 2002. Biological pollution in the Mediterranean Sea: invasive versus introduced macrophytes. *Marine Pollution Bulletin* 44(1): 32–38.
- Brown, James H.; Sax, Dov F. 2004. An essay on some topics concerning invasive species. *Australian Ecology* 29: 530–536.
- Brown, Tommy L.; Decker, Daniel J.; Riley, Shawn J.; Enck, Judy W. Lauber, T. Bruce; Curtis, Paul D.; Mattfeld, George F. 2000. The future of hunting as a mechanism to control white-tailed deer populations. *Wildlife Society Bulletin* 28(4): 797–807.
- Brunson, Mark W.; Tanaka, John 2011. Economic and social impacts of wildfires and invasive plants in american deserts: lessons from the great basin. *Rangeland Ecology & Management* 64(5): 463–470.
- Bruun, Hans Henrik 2005. Biological flora of the British Isles: *Rosa rugosa* Thunb. Ex Murray. *Journal of Ecology* 93: 441–470.
- Buchanan, Brett 2008. *Onto-Ethologies: The Animal Environments of Uexküll, Heidegger, Merleau-Ponty, and Deleuze*. New York: New York University Press.
- Cáceres-Escobar, Hernán; Kark, Salit; Atkinson, Scott C.; Possingham, Hugh P.; Davis,

- Katrina J. 2019. Integrating local knowledge to prioritise invasive species management. *People and Nature* 1(2): 220–233.
- Cadotte, Marc W. 2006. Darwin to Elton: early ecology and the problem of invasive species. In: Cadotte, Marc W.; McMahon, Sean M.; Fukami, Tadashi (eds.) 2006. *Conceptual Ecology and Invasion Biology: Reciprocal Approaches to Nature*. Dordrecht: Springer, 15–34.
- Callaway, Ragan M.; Ridenour, Wendy M. 2004. Novel weapons: invasive success and the evolution of increased competitive ability. *Frontiers in Ecology and the Environment* 2(8): 436–443.
- Callaway, Ragan M.; Cipollini, Don; Barto, Kathryn; Thelen, Giles C.; Hallett, Steven G.; Prati, Daniel; Stinson, Kristina; Klironomos, John 2008. Novel weapons: invasive plant suppresses fungal mutualists in America but not in its native Europe. *Ecology* 89(4): 1043-1055.
- Callon, Michel 1984. Some elements of a sociology of translation: domestication of the scallops and the fishermen of St Brieuc bay. *The Sociological Review* 32(1): 196–233.
- 1991. Techno-economic networks and irreversibility. In: Law, John (ed.), *A Sociology of Monsters: Essays on Power Technology and Domination*. London, New York: Routledge, 132–164.
- Campbell, Karl; Donlan, Josh C. 2005. Feral goat eradications on islands. *Conservation Biology* 19(5): 1362–1374.
- Carboni, Marta; Münkmüller, Tamara; Gallien, Laure; Lavergne, Sébastien; Acosta, Alicia; Thuiller, Wilfried 2013. Darwin’s naturalization hypothesis: scale matters in coastal plant communities. *Ecography* 36: 560–568.
- Carey, Michael P.; Sanderson, Beth L.; Barnas, Katie A.; Olden, Julian D. 2012. Native invaders – challenges for science, management, policy, and society. *Frontiers in Ecology and the Environment* 10(7): 373–381.
- Carthey, Alexandra J. R.; Banks, Peter B. 2014. Naïveté in novel ecological interactions: lessons from theory and experimental evidence. *Biological Reviews* 89(4): 932–949.
- Cavalli-Sforza, Luigi L.; Feldman, Marcus W. 1981. *Cultural Transmission and Evolution: A Quantitative Approach*. Princeton: Princeton University Press.
- Chaloupka, M. Y.; Domm, S.B. 1986. Role of anthropochory in the invasion of coral cays by alien flora. *Ecology* 67: 1536–1547.

- Chew, Matthew K.; Hamilton, Andrew L. 2011. The rise and fall of biotic nativeness: A historical perspective. In: Richardson, David M. (ed.), *Fifty Years of Invasion Ecology: The Legacy of Charles Elton*. Oxford, West Sussex, Hoboken: Blackwell Publishing, 35–49.
- Chew, Matthew K. 2006. *Ending with Elton: Preludes to Invasion Biology*. Arizona: Arizona State University.
- Coates, Peter A. 2006. *American Perceptions of Immigrant and Invasive Species: Strangers On the Land*. Berkeley, Los Angeles: University of California Press.
- Coletta, John W. 2015. Semiotic modeling: a pragmaticist's guide. In: Trifonas, Peter Pericles (ed.), *International Handbook of Semiotics*. Dordrecht, Heidelberg, New York, London: Springer, 951–980.
- Collins, H. M.; Yearley, Steven 1992. Epistemological chicken. In: Pickering, Andrew (ed.), *Science as Practice and Culture*. Chicago: Chicago University Press, 301–326.
- Côté, Steeve D. 2011. Impacts on ecosystems. In: Hewitt, David G. (ed.), *Biology and Management of White-tailed Deer*, Boca Raton, London, New York: CRC Press, 379–398.
- CP = Peirce, Charles S. 1931–1958. *Collected Papers of Charles Sanders Peirce*. Cambridge: Harvard University Press. [Vols. 1–6, Hartshorne, Charles; Weiss, Paul (eds.), 1931–1935; vols. 7–8, Burks, A. W. (ed.) 1958. In-text references are to CP, followed by volume and paragraph numbers].
- Crawford, Hewlette S. 1982. Seasonal food selection and digestibility by tame white-tailed deer in central Maine. *The Journal of Wildlife Management* 46: 974–982.
- Crosby, Alfred W. 1986. *Ecological Imperialism: The Biological Expansion of Europe, 900–1900*. New York: Cambridge University Press.
- Daehler, Curtis C. 2001 Darwin's naturalization hypothesis revisited. *The American Naturalist* 158(3): 324–330.
- Darwin, Charles R. 1859. *On the Origin of Species by Natural Selection: or, the Preservation of Favored Races in the Struggle For Life*. London: Murray.
- Davidson, Amy M.; Jennions, Michael; Nicotra, Adrienne B. 2011. Do invasive species show higher phenotypic plasticity than native species and, if so, is it adaptive? A meta-analysis. *Ecology Letters* 14(4): 419–431.
- Davis, Mark A.; Thompson, Ken 2000. Eight ways to be a colonizer; two ways to be an

- invader: a proposed nomenclature scheme for invasion ecology. *Bulletin of the Ecological Society of America* 81: 226–230.
- Davis, Mark A.; Thompson, Ken; Grime, Philip J. 2001. Charles S. Elton and the dissociation of invasion ecology from the rest of ecology. *Diversity and Distributions* 7: 97–102.
- Davis, Mark A. 2003. Biotic globalization: does competition from introduced species threaten biodiversity? *Bioscience* 53: 481–489.
- 2006. Invasion biology 1958–2005: The pursuit of science and conservation. In: Cadotte, Marc W.; McMahon, Sean M.; Fukami, Tadashi (eds.) 2006. *Conceptual Ecology and Invasion Biology: Reciprocal Approaches to Nature*. Dordrecht: Springer, 35–64.
- Davis, Mark A.; Chew, Matthew K.; Hobbs, Richard J.; Lugo, Ariel E.; Ewel, John J.; Vermeij, Geerat J.; Brown, James H.; Rosenzweig, Michael L.; Gardener, Mark R.; Carroll, Scott P.; Thompson, Ken; Pickett, Steward T. A.; Stromberg, Juliet C.; Del Tredici, Peter; Suding, Katharine N.; Ehrenfeld, Joan G.; Grime, J. Philip; Mascaro, Joseph; Briggs, John C. 2011. Don't judge species on their origins. *Nature* 474: 153–154.
- Demarais, Steve; Strickland, Bronson K. 2011. Antlers. In: Hewitt, David G. (ed.), *Biology and Management of White-tailed Deer*, Boca Raton, London, New York: CRC Press, 107–146.
- Dennett, Daniel C. 1995. Darwin's dangerous idea. *The Sciences* 35(3): 34–40.
- DeYoung, Randy W.; Miller, Karl V. 2011. White-tailed deer behaviour. In: Hewitt, David G. (ed.), *Biology and Management of White-tailed Deer*, Boca Raton, London, New York: CRC Press, 311–351.
- di Castri, Francesco 1989. History of biological invasions with special emphasis on the Old World. In: Drake, James A.; Mooney, Harold A.; di Castri, Francesco; Groves, Richard H.; Kruger, F.J.; Rejmánek, Marcel; Williamson, Mark (eds.). *Biological Invasions. A Global Perspective*. SCOPE 37. Chichester: John Wiley & Sons, 1–30.
- Dirr, Michael A. 1978. Tolerance of seven woody ornamentals to soil-applied sodium chloride. *Journal of Arboriculture* 4(7): 162–165.
- Drake, James A.; Mooney, Harold A.; di Castri, Francesco; Groves, Richard H.; Kruger, F.J.; Rejmánek, Marcel; Williamson, Mark (eds.) 1989. *Biological Invasions. A Global Perspective*. SCOPE 37. Chichester: John Wiley & Sons.

- Dunlap, Thomas R. 1997. Remaking the land: the acclimatization movement and anglo ideas of nature. *Journal of World History* 8(2): 303–319.
- Eco, Umberto 1976. *A Theory of Semiotics*. Bloomington, London: Indiana University Press.
- Ehrlich, Paul R.; Raven, Peter H. 1964. Butterflies and Plants: A Study on Coevolution. *Evolution* 18: 586–608.
- Elder-Vass, Dave 2014. Disassembling Actor-network theory. *Philosophy of the Social Sciences* 45(1): 100–121.
- Elton, Charles S. 1958. *The Ecology of Invasions by Animals and Plants*. London: Chapman & Hall.
- Emirbayer, Mustafa; Mische, Ann 1998. What is agency? *American Journal of Sociology* 103(4): 962–1023.
- Emmeche, Claus 2001. Bioinvasion, globalization, and the contingency of cultural and biological diversity: some ecosemiotic observations. *Sign Systems Studies* 29(1): 237–263.
- Erkamo, Viljo 1949. Rosa rugosa Thunb., ein für Europa neuer Neophyt. *Archivum Societatis zoologicae botanicae fennicae Vanamo* 3: 123.
- Ernst, W. H. 1998. Invasion, dispersal and ecology of the South African neophyte *Senecio inaequidens* in The Netherlands: from wool alien to railway and road alien. *Acta Botanica Neerlandica* 47: 131–151.
- Eser, Uta 1998. Assessment of plant invasions: theoretical and philosophical fundamentals. In: Starfinger, Uwe; Edwards, K; Kowarik, Ingo; Williamson, Mark (eds.). *Plant Invasions: Ecological Mechanisms and Human Responses*. Leiden: Backhuys Publishers, 95–107.
- Essl, Franz 2006. Species factsheet: Rosa rugosa. *Delivering Alien Invasive Species Inventories for Europe (DAISIE)*. Retrieved from: [https://web.archive.org/web/20171224081100/http://www.europe-aliens.org/pdf/Rosa\\_rugosa.pdf](https://web.archive.org/web/20171224081100/http://www.europe-aliens.org/pdf/Rosa_rugosa.pdf). 20.4.2021.
- Facciola, Stephen 1990. *Cornucopia: A Source Book of Edible Plants*. Vista: Kampong Publications.
- Falk-Petersen, Jannike; Bøhn, Thomas; Sandlund, Odd Terje 2006. On the numerous concepts in invasion biology. *Biological Invasions* 8: 1409–1424.
- Fahring, Lenore 2003. Effects of habitat fragmentation on biodiversity. *Annual Review of Ecology, Evolution, and Systematics* 34: 487–515.

- Fariás, Ignacio; Mützel, Sophie 2015. Culture and actor network theory. In: Wright, James D. (ed.), *International Encyclopedia of the Social & Behavioral Sciences*. Amsterdam: Elsevier, 523–527.
- Finnish Environment Institute 2009. *Nordic nature – trends towards 2010: Ecologically diverse sandy seashores under threat*. Retrieved from <https://www.syke.fi/download/noname/%7B5DFC5B9E-4BD5-4C50-BB3E-C83F106935D6%7D/95166>. 10.4.2021.
- Firn, Jennifer; Ladouceur, Emma; Dorrough, Josh 2017. Integrating local knowledge and research to refine the management of an invasive non-native grass in critically endangered grassy woodlands. *Journal of Applied Ecology* 55(1): 321–330.
- Fletcher, J. Darl; Shipley, Lisa A.; McShea, William J.; Shumway, Durland L. 2001. Wildlife herbivory and rare plant: the effect of white-tailed deer, rodents and insects on growth and survival of Turk’s cap lily. *Biological Conservation* 2001: 229–238.
- Frank, David M. 2019. Disagreement or denialism? “Invasive species denialism” and ethical disagreement in science. *Synthese*.
- Fremstad, Eli 1997 Fremmede planter i Norge. Rynkerose – *Rosa rugosa* [in English: Alien plants in Norway. Japanese Rose – *Rosa rugosa*, Bruun, H. Hans, trans.]. *Blyttia* 55: 115–121.
- Fridley, Jason D. 2011. Biodiversity as a bulwark against invasion: conceptual threads since Elton. In: Richardson, David M. (ed.). *Fifty Years of Invasion Ecology: the Legacy of Charles Elton*. Oxford, West Sussex, Hoboken: Blackwell Publishing, 121–130.
- Frost, Samantha 2016. *Biocultural Creatures: Toward a New Theory of the Human*. Durham, London: Duke University Press.
- García-Llorente, Marina; Martín-López, Berta; González, José A.; Alcorlo, Paloma; Montes, Carlos 2008. Social perceptions of the impacts and benefits of invasive alien species: Implications for management. *Biological Conservation* 141(12): 2969–2983.
- Garibaldi, Ann; Turner, Nancy 2004. Cultural keystone species: implications for ecological conservation and restoration. *Ecology and Society* 9(3): 1.
- Gbedomon, Rodrigue C.; Salako, Valère K.; Schlaepfer, Martin A. 2020. Diverse views among scientists on non-native species. *NeoBiota* 54: 49–69.
- Gause, Georgii Frantsevich 1934. *The Struggle For Existence*. Baltimore: Williams &



- Wilkins.
- Goodale, Eben; Beauchamp, Guy; Magrath, Robert D.; Nieh, James C.; Ruxton, Graeme D. 2010. Interspecific information transfer influences animal community structure. *Trends in Ecology & Evolution* 25(6): 354–361.
- Goodenough, Anne. E. 2010. Are the ecological impacts of alien species misrepresented? A review of the “native good, alien bad” philosophy. *Community Ecology* 11(1): 13–21.
- Gould, Stephen Jay 1998. An evolutionary perspective on strengths, fallacies, and confusions in the concept of native plants. *Arnoldia* 58(1): 3–10.
- 2002. *The Structure of Evolutionary Theory*. Cambridge, London: Harvard University Press.
- Gubeljic, Mischa; Link, Simone; Müller, Patrick; Osburg, Gunther 2000. Nature and Second Nature in McDowell’s Mind and World. In: Willaschek, Marcus (ed.), *John McDowell: reason and nature: lecture and colloquium in Münster 1999*. Münster: LIT-Verlag, 41–50.
- Gurevitch, Jessica; Padilla, Diana K. 2004. Are invasive species a major cause of extinctions? *Trends in Ecology and Evolution* 19(9): 470–474.
- Greenwald, Katherine R.; Petit, Lisa J.; Waite, Thomas A. 2008. Indirect effects of a keystone herbivore elevate local animal diversity. *The Journal of Wildlife Management* 72(6): 1318–1321.
- Greimas, Algirdas J.; Courtés, Joseph 1986. *Sémiotique. Dictionnaire raisonné de la théorie du langage* (vol. 2). Paris: Hachette.
- Groves, Richard H. 1986. Invasions of Mediterranean ecosystems by weeds. In: Dell, B.; Hopkins, A. J. M.; Lamont, B.B. (eds.), *Resilience in Mediterranean-type Ecosystems*. Dordrecht: Junk, 129–145.
- Gröning, Gert; Wolschke-Bulmahn, Joachim 1992. Some notes on the mania for native plants in Germany. *Landscape Journal* 11: 116–126.
- 2004. The native plant enthusiasm: ecological panacea or xenophobia? *Arnoldia* 62(4): 20–29.
- Hall, Marcus 2003. Editorial: the native, naturalized and exotic – plants and animals in human history. *Landscape Research* 28(1): 5–9.
- Hammarström, Katja; Grönholm, Peik 2003. *Furuvikin hoito- ja käyttösuunnitelma* [In English: Management and use plan for Furuvik. My translation]. Hanko:

Hangon kaupunki.

- Hanski, Ilkka 1999. *Metapopulation Ecology*. New York: Oxford University Press.
- Haraway, Donna 2003. *The Companion Species Manifesto: Dogs, People, and Significant Otherness*. Chicago: Prickly Paradigm Press.
- Harman, Graham 2016. *Immaterialism: Objects and Social Theory*. Cambridge, Malden: Polity Press.
- Hattingh, Johan 2001. Human dimensions of invasive alien species in philosophical perspective: towards an ethic of conceptual responsibility. In: McNeely, Jeffrey A. (ed.), *The Great Reshuffling: Human Dimensions of Invasive Alien Species*. Gland, Cambridge: IUCN, 183–194.
- Heffelfinger, James R. 2011. Taxonomy, evolutionary history, and distribution. In: Hewitt, David G. (ed.), *Biology and Management of White-tailed Deer*. Boca Raton, London, New York: CRC Press, 3–42.
- Hellemaa, Pirjo 1998. *The development of coastal dunes and their vegetation in Finland (Fennia 176)*. Helsinki: University of Helsinki Department of Geography.
- Henke, Scott E. 1997. Do white-tailed deer react to the dinner bell? An experiment in classical conditioning. *Wildlife Society Bulletin* 25(2): 291–295.
- Hill, Avery P.; Hadly, Elizabeth A. 2018. Rethinking “native” in the anthropocene. *Frontiers in Earth Science* 96(6): 1–3.
- Hierro, José L.; Maron, John L.; Callaway, Ragan M. 2005. A biogeographical approach to plant invasions: the importance of studying exotics in their introduced and native range. *Journal of Ecology* 93(1): 5–15.
- Hobbs, Richard J.; Huenneke, Laura F. 1992. Disturbance, diversity, and invasion: implications for conservation. *Conservation Biology* 6(3): 324–337.
- Hoffman, John H.; Moran, Vincent C.; Zimmermann, Helmut G. Impson, Fiona A. C. 2020. Biocontrol of a prickly pear cactus in South Africa: Reinterpreting the analogous, renowned case in Australia. *Journal of Applied Ecology* 57(12): 2475–2484.
- Hoffmeyer, Jesper 1996. *Signs of Meaning in the Universe* (Haveland, Barbara J., trans.). Bloomington, Indianapolis: Indiana University Press.
- 1997. Biosemiotics: towards a new synthesis in biology. *European Journal for Semiotic Studies* 9(2): 355–376.
- 2003. Origin of species by natural translation. In: Petrilli, Susan (ed.), *Translation Translation*. Amsterdam, New York: Rodopi, 329–346.

- 2008. *Biosemiotics: An Examination into the Signs of Life and the Life of Signs* (Hoffmeyer, Jesper, Favareau, Donald, trans; Favareau, Donald, ed.). Scranton, London: University of Scranton Press.
- Hubbell, Stephen P. 2001. *The Unified Neutral Theory of Biodiversity and Biogeography*. (Monographs in Population Biology 32). Princeton: Princeton University Press.
- Huber, Toni; Pedersen Poul 1997. Meteorological knowledge and environmental ideas in traditional and modern societies: the case of Tibet. *The Journal of the Royal Anthropological Institute* 3(3): 577–597.
- Hufbauer, Ruth A; Torchin, Mark E. 2007. Integrating ecological and evolutionary theory of biological invasions. In: Nentwig, Wolfgang (ed.) *Biological Invasions*. Berlin: Springer, 79–95.
- Hulme, Philip E.; Bacher, Sven; Kenis, Marc; Klotz, Stefan; Kühn, Ingolf; Minchin, Dan; Nentwig, Wolfgang; Olenin, Sergej; Panov, Vadim; Pergl, Jan; Pyšek, Petr; Roques, Alain; Sol, Daniel; Solarz, Wojciech; Vilà, Montserrat 2008. Grasping at the routes of biological invasions: a framework for integrating pathways into policy. *Journal of Applied Ecology* 45: 403–414.
- Hummel, Stephanie L; Campa, Henry; Winterstein, Scott R. 2018. Understanding how a keystone herbivore, white-tailed deer impacts wetland vegetation types in Southern Michigan. *The American Midland Naturalist* 179(1): 51–67.
- Isermann, Maike 2008a. Expansion of *Rosa rugosa* and *Hippophaë rhamnoides* in coastal grey dunes: Effects at different spatial scales. *Flora* 203: 273–280.
- 2008b. Classification and habitat characteristics of plant communities invaded by the non-native *Rosa rugosa* Thunb. in NW Europe. *Phytocoenologia* 38(1/2): 133–150.
- Janzen, Daniel H. 1980. When is it coevolution? *Evolution* 34(3): 611–612.
- 1985. On ecological fitting. *Oikos* 45(3): 308–310.
- Jeltsch, Florian; Bonte, Dries; Pe'er, Guy; Reineking, Björn; Leimgruber, Peter; Balkenhol, Niko; Schröder, Boris; Buchmann, Carsten M.; Mueller, Thomas; Blaum, Niels; Zurell, Damaris; Böhning-Gaese, Katrin; Wiegand, Thorsten; Eccard, Jana A.; Hofer, Heribert; Reeg, Jette; Eggers, Ute; Bauer, Silke 2013. Integrating movement ecology with biodiversity research - exploring new avenues to address spatiotemporal biodiversity dynamics. *Movement Ecology* 1(6).
- Jepson, Paul; Barua, Maan; Buckingham, Kathleen 2011. What is a conservation actor? *Conservation and Society* 9(3): 229–235.

- Kairikko, Juha K.; Ruola, Jaakko 2005. *White-tailed Deer in Finland*. Jyväskylä: The Finnish Hunter's Association.
- Kapitza, Katharina; Zimmermann Heike; Martín-López, Berta; von Wehrden, Henrik 2019. Research on the social perception of invasive species: a systematic literature review. *NeoBiota* 43: 47–68.
- Keane, Ryan M.; Crawley, Michael J. 2002. Exotic plant invasions and the enemy release hypothesis. *Trends in Ecology & Evolution* 17(4): 164–170.
- Kekkonen, Jaana; Wikström, Mikael; Brommer, Jon E. 2012. Heterozygosity in an isolated population of a large mammal founded by four individuals is predicted by an individual-based genetic model. *PLoS ONE* 7(9): e43482.
- Kekkonen, Jaana; Wikström, Mikael; Ala-Ajos, Ilkka; Lappalainen, Veli; Brommer, Jon E. 2016. Growth and age structure in an introduced and hunted cervid population: white-tailed deer in Finland. *Annales Zoologici Fennici* 53(1–2): 69–80.
- Kie, John G.; Bowyer, R. Terry 1999. Sexual segregation in white-tailed deer: density dependent changes in use of space, habitat selection, and dietary niche. *Journal of Mammalogy* 80: 1004–1020.
- Kie, John G.; White, M. 1985. Population dynamics of white-tailed deer (*Odocoileus virginianus*) on the Welder Wildlife Refuge, Texas. *The Southwestern Naturalist* 30: 105-118.
- Kitching, Roger L. 2011. A world of thought: 'The Ecology of Invasions by Animals and Plants' and Charles Elton's life's work. In: Richardson, David M. (ed.). *Fifty Years of Invasion Ecology: the Legacy of Charles Elton*. Oxford, West Sussex, Hoboken: Blackwell Publishing, 1–10.
- Kjellsson, Gösta; Simonsen, Vibeke; Ammann, Klaus (eds.) 1997. *Methods for Risk Assessment of Transgenic Plants: II. Pollination, Gene-Transfer and Population Impacts*. Basel: Birkhäuser.
- Kohut, Heinz 1971. *The Analysis of the Self: A Systematic Approach to the Psychoanalytic Treatment of Narcissistic Personality Disorders*. Madison: International Universities Press.
- Kotov, Kaie; Kull, Kalevi 2011. Semiosphere is the relational biosphere. In: Emmeche, Claus; Kull, Kalevi (eds.), *Towards a Semiotic Biology: Life is the Action of Signs*. London: Imperial College Press, 179–194.
- Kull, Kalevi 1998. Semiotic ecology: different natures in the semiosphere. *Sign Systems*

- Studies* 26(1): 344–371.
- 2016. The biosemiotic concept of species. *Biosemiotics* 9: 61–71.
- 2020. Semiotic fitting and the nativeness of community. *Biosemiotics* 13: 9–19.
- Kunttu, Panu; Kunttu, Sanna-Mari 2017. Distribution and habitat preferences of the invasive alien *Rosa rugosa* (*Rosaceae*) in archipelago sea national park, SW Finland. *Polish Botanical Journal* 62(1): 99–115.
- Kunttu, Panu; Ryttylä, Terhi; Kunttu, Sanna-Mari 2016. Vieraslaji kurtturuusu leviää saaristossa: Nykytila ja torjuntakeinot [In English: Invasive species *rosa rugosa* spreads in the archipelago: Current state and prevention means. My translation]. *Luonnon Tutkija* 4: 165–177.
- Kurto, Arto; Helyranta, Leena 1998. *Helsingin kasvit: Kukkilta kiviltä metsän syliin* [In English: Plants of Helsinki: From flowering rocks into the arms of the forest. My translation]. Helsinki: Helsingin kaupungin ympäristökeskus and Yliopistopaino.
- Lammi, Esa 2010. *Elisaaren ja Rövassin lehtojen Natura-alueen hoito- ja käyttösuunnitelma 2010* [In English: Management and use plan 2010 for the groves of Elisaari and Rövas. My translation]. Ympäristösuunnittelu Enviro Oy.
- Lampinen, Raino; Lahti, Tapani 2009. *Kasviatlas 2008* [In English: Plant atlas 2008. My translation]. Helsinki: Helsingin yliopisto, Luonnontieteellinen keskusmuseo, and Kasvimuseo.
- Larson, Brendon M. H. 2007. An alien approach to invasive species: objectivity and society in invasion biology. *Biological Invasions* 9: 947–956.
- 2010. Reweaving narratives about humans and invasive species. *Études Rurales* 185: 25–38.
- Latour, Bruno; Woolgar, Steve 1986 [1979]. *Laboratory Life: The Construction of Scientific Facts*. Princeton: Princeton University Press.
- Latour, Bruno; Callon, Michel 1981. Unscrewing the big leviathan; or how actors macrostructure reality, and how sociologists help them to do so? In: Knorr-Cetina, Karin; Cicourel, Aaron C. (eds), *Advances in Social Theory and Methodology: Toward an Integration of Micro- and Macro-Sociologies*. London: Routledge and Kegan Paul, 277–303.
- Latour, Bruno 1987. *Science in Action: How to Follow Scientists and Engineers Through Society*. Cambridge: Harvard University Press.

- 1993. *We Have Never Been Modern*. Cambridge: Harvard University Press.
  - 2005. *Reassembling the Social: An Introduction to Actor-Network-Theory*. New York: Oxford University Press.
  - 2013. *An Inquiry into Modes of Existence: An Anthropology of the Moderns* (Porter, Catherine, trans.). Cambridge, London: Harvard University Press.
- Law, John; Mol, Annemarie 1995. Notes on materiality and sociality. *The Sociological Review* 43(2): 274–294.
- Law, John; Lien, Marianne E. 2012. Slippery: field notes in empirical ontology. *Social Studies of Science* 43(3): 363–378.
- Law, John (ed.) 1991. *A Sociology of Monsters: Essays on Power Technology and Domination*. London, New York: Routledge.
- Law, John 1992. Notes on the theory of the actor-network: ordering, strategy, and heterogeneity. *Systems Practice* 5: 379–393.
- 1999. After ANT: complexity, naming and topology. *The Sociological Review* 47(1): 1–14.
  - 2002. Objects and spaces. *Theory, Culture & Society* 19(5/6): 91–105.
  - 2008. On Sociology and STS. *The Sociological Review* 56(4): 623–649.
  - 2009. Actor network theory and material semiotics. In: Turner, Bryan S. (ed.), *The New Blackwell Companion to Social Theory*. Hoboken: Wiley-Blackwell, 141–158.
- Leopold, Aldo 1933. *Game Management*. New York: Charles Scribner's Sons.
- Lévi-Strauss, Claude 1962. *The Savage Mind* (Weidenfield, George, Nicholson Ltd., trans.). Chicago: Chicago University Press.
- Lim, T. K. 2014. Rosa × rugosa. In: Lim, T. K., *Edible Medicinal and Non Medicinal Plants* (Volume 8, Flowers). Dordrecht: Springer, 682–699.
- Lockwood, Julie L.; Hoopes, Martha F.; Marchetti, Michael P. 2007. *Invasion Ecology*. Malden, Oxford, Carlton: Blackwell Publishing.
- Lodge, David M.; Williams, Susan; MacIsaac, Hugh J.; Hayes, Keith R.; Leung, Brian; Reichard, Sarah; Mack, Richard N.; Moyle, Peter B.; Smith, Maggie; Andow, David A.; Carlton, James T.; McMichael, Anthony 2006. Biological invasions: recommendations for U.S. policy and management management. *Ecological Applications* 16(6): 2035–2054.
- Lotman, Juri M. 1975 [1969]. On the metalanguage of a typological description of culture. *Semiotica* 14(2): 97–123.

- 1990. *Universe of the Mind: A Semiotic Theory of Culture* (Shukman, Ann, trans.). London, New York: I.B. Tauris.
  - 2005. On the semiosphere (Clark, Wilma, trans.). *Sign Systems Studies* 33(1): 215–239.
  - 2009. *Culture and Explosion*. (Clark, Wilma, trans; Grishakova, Marina, ed.) Berlin: De Gruyter Mouton.
  - 2011. The place of art among other modelling systems (Pern, Tanel, trans.). *Sign Systems Studies* 39(2/4): 249–270.
- Lovell, Nadia (ed.) 1998. *Locality and Belonging*. London, New York: Routledge.
- Lubell, Mark; Jasny, Lorien; Hastings, Alan 2017. Network governance for invasive species management. *Conservation Letters* 10(6): 699–707.
- Lust, John B. 1974. *The Herb Book*. New York: Bantam Books.
- Lyotard, Jean-François 1984. *The Postmodern Condition: A Report on Knowledge*. Manchester: Manchester University Press.
- MacArthur, Robert H.; Wilson, Edward O. 1967. *The Theory of Island Biogeography*. Princeton: Princeton University Press.
- Mack, Richard N.; Simberloff, Daniel; Lonsdale W. Mark; Evans, Harry; Clout, Michael; Bazzaz, Fakhri A. 2000. Biotic invasions: causes, epidemiology, global consequences, and control. *Ecological Applications* 10(3): 689–710.
- Mack, Richard N.; Lonsdale W. Mark 2001. Humans as global plant dispersers: getting more than we bargained for: current introductions of species for aesthetic purposes present the largest single challenge for predicting which plant immigrants will become future pests. *BioScience* 51(2): 95–102.
- Mack, Richard N. 2001. Motivations and consequences of the human dispersal of plants. In: McNeely, Jeffrey A. (ed.), *The Great Reshuffling: Human Dimensions of Invasive Alien Species*. Gland, Cambridge: IUCN, 23–34.
- Magnus, Riin; Remm, Tiit 2018. Urban ecosemiotics of trees: why the ecological alien species paradigm has not gained ground in cities? *Sign Systems Studies* 46(2/3): 319–342.
- Maran, Timo; Kull, Kalevi 2014. Ecosemiotics: main principles and current developments. *Geografiska Annaler: Series B, Human Geography* 96(1): 41–50.
- Maran, Timo 2002. Ecosemiotic basis of locality. In: Sarapik, Virve; Tüür, Kadri;

- Laanemets, Mari (eds.), *Koht ja paik / Place and Location II*. Eesti Kunstiakadeemia Toimetised 10. Tallinn: Eesti Kunstiakadeemia, 68–80.
- 2007. Towards an integrated methodology of ecosemiotics: The concept of nature-text. *Sign Systems Studies* 35(1/2): 269–294.
- 2012. Fitness. In: Favareau, Donald; Copley, Paul; Kull, Kalevi (eds.), *A More Developed Sign. Interpreting the Work of Jesper Hoffmeyer* (Tartu Semiotics Library 10). Tartu: Tartu University Press, 147–149.
- 2019. Deep ecosemiotics: forest as a semiotic model. *Recherches sémiotiques / Semiotic Inquiry* 38(3)/39(1-2): 287–303.
- 2020. *Ecosemiotics. The Study of Signs in Changing Ecologies*. Cambridge: Cambridge University Press.
- 2021. The ecosemiosphere is a grounded semiosphere. A Lotmanian conceptualization of cultural-ecological systems. *Biosemiotics* 14(1).
- Maron, John L.; Vilà, Montserrat 2001. When do herbivores affect plant invasion? Evidence for the natural enemies and biotic resistance hypotheses. *Oikos* 95(3): 361–373.
- Mayerson, Laura; Mooney, Harold A. 2007. Invasive alien species in an era of globalization. *Frontiers in Ecology and the Environment* 5(4): 199–208.
- McNeely, Jeffrey A. (ed.) 2001. *The Great Reshuffling: Human Dimensions of Invasive Alien Species*. Gland, Cambridge: IUCN.
- McShea, William J. 2012. Ecology and management of white-tailed deer in a changing world. *Annals of the New York Academy of Sciences* 1249: 45–56.
- Messner, Timothy C. 2011. White-tailed deer management strategies and domestication processes. *Human Ecology* 39: 165–178.
- Michael, Mike 2017. *Actor-Network Theory: Trials, Trails and Translations*. Los Angeles, London, New Delhi, Singapore, Washington DC, Melbourne: Sage.
- Ministry of Agriculture and Forestry 2007. *Suomen ilveskannan hoitosuunnitelma* [In English: Management plan for the lynx population in Finland. My translation].
- 2019. *Government Decree on Managing the Risk Caused by Alien Species (704/2019)*. Retrieved from: <https://www.finlex.fi/en/laki/kaannokset/2019/en20190704.pdf>. 20.4.2021.
- Mittelbach, Gary G.; McGill, Brian J. 2019. *Community Ecology*. Oxford: Oxford University Press.
- Molles, Manuel C. 2016. *Ecology: Concepts and Applications*. New York: McGraw-Hill



Education.

- Mooney, Harold A.; Mack, Richard N.; McNeely, Jeffrey A.; Neville, Laurie E.; Schei, Peter Johan; Waage, Jeffrey K. 2005. *Invasive Alien Species: A New Synthesis*. SCOPE 63. Washington, Covelo, London: Island Press.
- Muniesa, Fabian 2015. Actor-network theory. In: Wright, James D. (ed.), *International Encyclopedia of the Social & Behavioral Sciences*. Amsterdam: Elsevier, 80–84.
- Munsterhjelm, Gustav; Seppänen, Raija; Sandbacka, Maria (eds.) 2005. *Maisema-alue: Skärlandet. Hoito- ja käyttösuunnitelma* [In English: Landscape area: Skärlandet. Management and use plan. My translation]. Tammisaari: Tammisaaren kaupunki. Retrieved from: <https://www.ymparisto.fi/download/noname/%7b8EA40A81-FF70-4DAD-9DCD-525E8E6750E7%7d/31328>. 10.4.2020.
- Mäekivi, Nelly; Maran, Timo 2016. Semiotic dimensions of human attitudes towards other animals: A case of zoological gardens. *Sign Systems Studies* 44(1/2): 209–230.
- Nagy, Kelsi; Johnson, Philip David II (eds.) 2013. *Trash Animals: How We Live with Nature's Filthy, Feral, Invasive and Unwanted Species*. Minneapolis, London: University of Minnesota Press.
- Nakanishi, H.; Fukumoto, H. 1994. Zonation of coastal vegetation and depositional topography in Aomori Prefecture, northern Honshu, Japan. *Hikobia* 11(4): 575–586.
- Nazarea, Virginia D. 2006. Local knowledge and memory in biodiversity conservation. *Annual Review of Anthropology* 35: 317–335.
- Newing, Helen 2011. *Conducting Research In Conservation: Social Science Methods And Practice*. London, New York: Routledge.
- Niemi, Milla; Nyman, Madeleine 2013. *Valkohäntäpeuran ekologiset ja sosiaaliset vaikutukset Tammisaaren saariston kansallispuistossa ja sen lähialueilla*. (Metsähallituksen luonnonsuojelujulkaisuja. Sarja A 204) [In English: Ecological and social impacts of white-tailed deer in the Tammisaari archipelago national park and nearby areas (nature conservation publications by Metsähallitus. Series A 204). My translation]. Metsähallitus. Retrieved from: <https://julkaisut.metsa.fi/assets/pdf/lp/Asarja/a204.pdf>. 10.4.2020.
- Niemivuo-Lahti, Johanna (ed.) 2012. *Finland's National Strategy on Invasive Alien Species*. Helsinki: Ministry of Agriculture and Forestry.
- Nowak, Renata; Olech, Marta; Pecio, Lukasz; Oleszek, Wiesław; Los, Renata; Malm, Anna

2014. Cytotoxic, antioxidant, antimicrobial properties and chemical composition of rose petals. *Journal of the Science of Food and Agriculture* 94(3): 560–567.
- Nuñez, Martin A.; Simberloff, Daniel 2005. Invasive species and the cultural keystone species concept. *Ecology and Society* 10(1): r4.
- Nöth, Winfried 2014. The topography of Yuri Lotman’s semiosphere. *International Journal of Cultural Studies* 18(1): 1–17.
- 2000. Umberto Eco’s semiotic threshold. *Sign Systems Studies* 28: 49–60.
- OECD 2020. *All Hands In? Making Diversity Work for All*. Paris: OECD Publishing.
- Opdam, Paul; Steingröver, Eveliene; Rooij, Sabine van 2006. Ecological networks: A spatial concept for multi-actor planning of sustainable landscapes. *Landscape and Urban Planning* 75(3–4): 322–332.
- Oppel, Steffen; Beaven, Brent M.; Bolton, Mark, Vickery, Juliet; Bodey, Thomas W. 2010. Eradication of invasive mammals on islands inhabited by humans and domestic animals. *Conservation Biology* 25: 232–240.
- Paine, Robert, T. 1969. The Pisaster-Tegula interaction: prey patches, predator food preference, and intertidal community structure. *Ecology* 50(6): 950–961.
- Park, Daniel S.; Feng, Xiao; Maitner, Brian S.; Ernst, Kacey C.; Enquist, Brian J. 2020. Darwin’s naturalization conundrum can be explained by spatial scale. *PNAS* 117(20): 10904–10910.
- Patten, Bernard C.; Odum, Eugene P. 1981. The cybernetic nature of ecosystems. *The American Naturalist* 118(6): 886–895.
- Pfeiffer, Jeanine M.; Voeks, Robert 2008. Biological invasions and biocultural diversity: linking ecological and cultural systems. *Environmental Conservation* 35(04): 281–293.
- Pearce, Fred 2015. *The New Wild: Why Invasive Species Will Be Nature’s Salvation*. Boston: Beacon Press.
- Peretti, Jonah H. 1998. Nativism and nature: rethinking biological invasion. *Environmental Values* 7: 183–192.
- Petrilli, Susan; Ponzio, Augusto 2015. Language as primary modelling and natural languages: a biosemiotic perspective. In: Valmezova, Ekaterina; Kull, Kalevi; Cowley, Stephen J. (eds.), *Biosemiotic Perspectives on Language and Linguistics*. Heidelberg, New York, Dordrecht, London: Springer International Publishing, 47–77.

- Pilgrim, Sarah; Pretty, Jules (eds.) 2010. *Nature and Culture: Rebuilding Lost Connections*. London: Earthscan.
- Pimentel, David; Lach, Lori; Zuniga, Rodolfo; Morrison, Doug 2000. Environmental and economic costs of nonindigenous species in the United States. *Bioscience* 50: 53–65.
- Poe, Melissa R.; Norman, Karma C.; Levin, Phillip S. 2014. Cultural dimensions of socioecological systems: key connections and guiding principles for conservation in coastal environments. *Conservation Letters* 7(3): 166–175.
- Polanyi, Michel 1966. *The Tacit Dimension*. London: Routledge and Kegan Paul.
- Power, Mary; Tilman, David; Estes, James A.; Menge, Bruce; Bond, William J.; Mills, Scott L.; Daily, Gretchen; Castilla, Juan C.; Lubchenco, Jane; Paine, Robert 1996. Challenges in the quest for keystones: Identifying keystone species is difficult-but essential to understanding how loss of species will affect ecosystems. *BioScience* 46(8): 609–620.
- Pretty, Jules 2002. *Agri-Culture: Reconnecting People, Land and Nature*. London, Sterling: Earthscan.
- Pringle, Robert M. 2005. The origins of the Nile perch in Lake Victoria. *BioScience* 55(9): 780–787.
- Poutanen, Jenni 2020. *Insights From Unseen Individuals – Using Non-invasive Approaches to Study Population Biology of White-tailed Deer in Finland*. (Turun yliopiston julkaisu – Annales Universitatis Turkuensis 367). Turku: University of Turku.
- Pullin, Andrew S. 2002. *Conservation Biology*. Cambridge: Cambridge University Press.
- Pyšek, Petr; Richardson, David M.; Rejmánek, Marcel; Webster, Grady L.; Williamson, Mark; Kirschner, Jan 2004. Alien plants in checklists and floras: towards better communication between taxonomists and ecologists. *Taxon* 53(1): 131–143.
- Raivio, Suvi 1988. The peninsular effect and habitat structure: bird communities in coniferous forests of the Hanko Peninsula, southern Finland. *Ornis Fennica* 65: 129–149.
- Rapport, David; Maffi, Luisa 2010. The dual erosion of biological and cultural diversity: implications for the health of ecocultural systems. In: Pilgrim, Sarah; Pretty, Jules (eds.), *Nature and Culture: Rebuilding Lost Connections*. London: Earthscan, 103–122.
- Rhodes, Olin E.; Scribner, Jr. Kim T.; Smith, Michael H.; Johns, Paul E. 1985. Factors

- affecting the number of fetuses in a white-tailed deer herd. *Proceedings of the Annual Conference of the Southeastern Association of Fish and Wildlife Agencies* 39: 380–388.
- Ricciardi, Anthony; Cohen Jill 2007. The invasiveness of an introduced species does not predict its impact. *Biological Invasions* 9: 309–315.
- Ricciardi, Anthony; MacIsaac, Hugh J. 2008. The book that began invasion ecology. *Nature* 452: 34.
- Richardson, David M.; Pyšek, Petr; Rejmánek, Marcel; Barbour, Michael G.; Panetta, Dane F.; West, Carol J. 2000. Naturalization and invasion of alien plants: concepts and definitions. *Diversity and Distributions* 6: 93–107.
- Richardson, David M. 2011. Introduction. In: Richardson, David M. (ed.), *Fifty Years of Invasion Ecology: the Legacy of Charles Elton*. Oxford, West Sussex, Hoboken: Blackwell Publishing, xii–xix.
- Ritvo, Harriet 2014. Migration, assimilation and invasion in the nineteenth century. In: Frawley, Jodi; McCalman, Iain (eds.), *Rethinking Invasion Ecologies from the Environmental Humanities*. Oxon, New York: Routledge, 52–80.
- 2017. Invasion/invasive. *Environmental Humanities* 9(1): 171–174.
- Robbins, Paul 2004. Comparing invasive networks: cultural and political biographies of invasive species. *The Geographical Review* 94(2): 139–156.
- Rooney, Thomas P. 2001. Deer impacts on forest ecosystems: a North American perspective. *Forestry* 74: 201–208.
- 2009: High white-tailed deer densities benefit graminoids and contribute to biotic homogenization of forest ground-layer vegetation. *Plant Ecology* 202: 103–111.
- Rotherham, Ian; Lambert, Robert (eds.) 2011. *Invasive and Introduced Plants and Animals: Human Perceptions, Attitudes and Approaches to Management*. Washington: Earthscan.
- Russell, Leland F.; Zippin, David B.; Fowler, Norma L. 2001: Effect of white-tailed deer (*Odocoileus virginianus*) on plants, plant populations and communities: A review. *The American Midland Naturalist* 146: 1–26.
- Ryttäri, Terhi 1998. Kurtturuusu – miljoona, miljoona ruusua. In: Kurtto, Arto; Helyranta, Leena (eds.), *Helsingin kasvit: Kukkivilta kiviltä metsän syliin* [In

- English: Rosa rugosa – million, million roses. In: Plants of Helsinki: From flowering rocks into the arms of the forest. My translation], Helsinki: Helsingin kaupungin ympäristökeskus and Yliopistopaino, 18.
- Sakai, Ann K.; Allendorf, Fred W.; Holt, Jodie S.; Lodge, David M.; Molofsky, Jane; With, Kimberly A.; Baughman, Syndallas; Cabin, Robert J.; Cohen, Joel E.; Ellstrand, Norman C.; McCauley, David E.; O'Neil, Pamela; Parker, Ingrid M.; Thompson, John N.; Weller, Stephen G. 2001. The population biology of invasive species. *Annual Review of Ecology and Systematics* 32: 305–332.
- Saldaña, Johnny 2013. *The Coding Manual for Qualitative Researchers*. Los Angeles, London, New Delhi, Singapore, Washington DC: Sage.
- Salupere, Silvi; Torop, Peeter 2013. On the beginnings of the semiotics of culture in the light of the Theses of Tartu-Moscow School. In: Salupere, Silvi; Torop, Peeter; Kull, Kalevi (eds.), *Beginnings of the Semiotics of Culture*. Tartu: University of Tartu Press, 15–37.
- Sánchez-García, F. J.; Machado, V.; Galián, J.; Gallego, D. 2017. Application of the eco-field and general theory of resources to bark beetles: Beyond the niche construction theory. *Biosemitics* 10: 57–73.
- Santo, Anna R.; Guillozet, Kathleen; Sorice, Michael G.; Baird, Timothy D.; Gray, Steven; Donlan, C. Josh; Anderson, Christopher B. 2017. Examining private landowners' knowledge systems for an invasive species. *Human Ecology* 45: 449–462.
- Savidge, Julie A. 1987. Extinction of an island forest avifauna by an introduced snake. *Ecology* 68(3): 660–668.
- Sax, Dov F.; Brown, James H. 2000. The paradox of invasion. *Global Ecology & Biogeography* 9: 363–371.
- Sax, Dov F.; Gaines, Steven D. 2003. Species diversity: from global decreases to local increases. *Trends in Ecology & Evolution* 18(11): 561–566.
- Sayes, Edwin 2013. Actor-network theory and methodology: just what does it mean to say that nonhumans have agency? *Social Studies of Science* 44(1): 134–149.
- Schama, Simon 1995. *Landscape and Memory*. New York: Knopf.
- Sebeok, Thomas A. 1986. *I Think I Am a Verb: More Contributions to the Doctrine of Signs*. New York: Plenum Press and Springer.
- Sebeok, Thomas A.; Danesi, Marcel 2000. *The Forms of Meaning: Modeling Systems*

- Theory and Semiotic Analysis* (Approaches in Applied Semiotics 1). Berlin, New York: Mouton de Gruyten.
- Semenenko, Aleksei 2012. *The Texture of Culture: An Introduction to Yuri Lotman's Semiotic Theory*. New York: Palgrave Macmillan.
- Seppänen, Janne; Forsman, Jukka T.; Mönkkönen, Mikko 2007. Social information use is a process across time, space, and ecology, reaching heterospecifics. *Ecology* 88(7): 1622–1633.
- Shackelford, Nancy; Hobbs, Richard J.; Heller, Nicole E.; Hallett, Lauren M.; Seastedt, Timothy R. 2013. Finding a middle-ground: The native/non-native debate. *Biological Conservation* 158: 55–62.
- Shantz, Homer L. 1906. A study of the vegetation of the Mesa region east of Pike's Peak: The Bouteloua Formation, II. development of the formation. *Botanical Gazette* 42(1): 179–207.
- Shea, Katriona; Chesson, Peter 2002. Community ecology theory as a framework for biological invasions. *Trends in Ecology and Evolution* 17(4): 170–176.
- Shine, Richard; Brown, Gregory P.; Phillips, Benjamin L. 2011. An evolutionary process that assembles phenotypes through space rather than through time. *PNAS* 108(14): 5708–5711.
- Shrader-Frechette, Kristin 2001. Non-indigenous species and ecological explanation. *Biology and Philosophy* 16: 507–519.
- Simberloff, David; Stiling, Peter 1996. How risky is biological control? *Ecology* 77(7): 1965–1974.
- Simberloff, Daniel; Von Holle, Betsy 1999. Positive interactions of nonindigenous species: invasional meltdown? *Biological Invasions* 1: 21–32.
- Simberloff, David 2003. Confronting introduced species: a form of xenophobia? *Biological Invasions* 5: 179–192.
- 2005. Non-native species *do* threaten the natural environment! *Journal of Agricultural and Environmental Ethics* 18: 595–607.
- 2009. We can eliminate invasions or live with them. Successful management projects. *Biological Invasions* 11: 149–157.
- 2011a. Non-natives: 141 scientists object. *Nature* 475: 36.
- 2011b. Charles Elton: neither founder nor siren, but prophet. In: Richardson, David

- M. (ed.). *Fifty Years of Invasion Ecology: the Legacy of Charles Elton*. Oxford, West Sussex, Hoboken: Blackwell Publishing, 11–24.
- 2013. *Invasive Species: What Everyone Needs To Know*. New York: Oxford University Press.
- 2018. Chapter 12: Nature, culture, and natureculture: the role of nonnative species in biocultures. In: Rozzi, Ricardo; May Jr., Roy H.; Chapin III, F. Stuart; Massardo, Francisca; Gavin, Michael C.; Klaver, Irene J.; Pauchard, Aníbal; Nuñez, Martin A.; Simberloff, Daniel (eds.), *From Biocultural Homogenization to Biocultural Conservation* (Ecology and Ethics 3). Cham: Springer, 207–218.
- Simberloff, David; Martin, Jean-Louis; Genovesi, Piero; Maris, Virginie; Wardle, David A.; Aronson, James; Courchamp, Franck; Galil, Bella; García-Berthou, Emili; Pascal, Michel; Pyšek, Petr; Sousa, Ronaldo; Tabacchi, Eric; Vilà, Montserrat 2013. Impacts of biological invasions: what's what and the way forward. *Trends in Ecology and Evolution* 28(1): 58–66.
- Skytén, R. 1978. Sand- och dynsträndernas vegetation och dess nedslitning. *Nordenskiöld-samfundets tidskrift* 38: 37–49.
- Sorvig, Kim 1994. Natives and nazis: an imaginary conspiracy in ecological design. *Landscape Journal* (13): 58–61.
- Soulé, Michael E. 1990. The onslaught of alien species, and other challenges in the coming decades. *Conservation Biology* 4(3): 233–240.
- Spencer, Herbert 1864. *The Principles of Biology*. London, Edinburgh: Williams and Norgate.
- Stefanowicz, Anna M.; Zubek, Szymon; Stanek, Małgorzata; Grześ, Irena M.; Rozej-Pabijan, Elżbieta; Błaszowski, Janusz; Woch, Marcin W. 2019. Invasion of *Rosa rugosa* induced changes in soil nutrients and microbial communities of coastal sand dunes. *Science of The Total Environment* 677: 340–349.
- Stenberg, Merja 1991. *Pensaiden menestyminen tiealueilla* (Tielaitoksen selvityksiä 61) [In English: Success of bushes in road areas (Finnish Road Administration's reports 61). My translation]. Helsinki: Tiehallitus.
- Subramaniam, Banu 2001. The aliens have landed! Reflections on the rhetoric of biological invasions. *Meridians* 2(1): 26–40.
- 2014. *Ghost Stories for Darwin: The Science of Variation and the Politics of Diversity*. Urbana, Chicago, Springfield: University of Illinois Press.

- Sundaram, Bharath; Krishnan, Siddhartha; Hiremath, Ankila J.; Joseph, Gladwin 2012. Ecology and impacts of the invasive species, *Lantana camara*, in a social-ecological system in South India: perspectives from local knowledge. *Human Ecology* 40: 931–942.
- Thompson, John N. 2005. *The Geographic Mosaic of Coevolution*. Chicago, London: Chicago University Press.
- Tielaitos 1996. *Tieympäristön kasvillisuus* (Tielaitoksen selvityksiä 21) [In English: Vegetation of the road environment (Finnish Road Administration's reports 21). My translation]. Helsinki: Tielaitos.
- Torchin, Mark E.; Mitchell, Charles E. 2004. Parasites, pathogens, and invasions by plants and animals. *Frontiers in Ecology and the Environment* 2(4): 183–190.
- Tošić, Jelena 2012. Migration, identity, and belonging: anthropological perspectives on a multidisciplinary field of research. In: Messer, Michi; Schroeder, Renee; Wodak, Ruth (eds.). *Migrations: Interdisciplinary Perspectives*. Vienna: Springer, 113–116.
- Turnbull, David 2008. Knowledge systems: local knowledge. In: Selin, Helaine (ed.), *Encyclopaedia of the History of Science, Technology, and Medicine in Non-Western Cultures*. Dordrecht: Springer, 1198–1203.
- Uexküll, Jakob von 1982 [1934]. Theory of meaning. *Semiotica* 42(1): 25–82.
- Ueyama, Yoshitaka; Hashimoto, Seiji; Nii, Hiromichi; Furukawa, Kiyoshi 1990. The essential oil from the flowers of *Rosa rugosa* Thunb. var. plena Regel. *Flavour and Fragrance Journal* 5(4): 219–222.
- Uspenskij, Boris A.; Ivanov, Vjacheslav V.; Toporov, V. N.; Pjatigorskij, Aleksandr M.; Lotman, Juri M. 1973. Theses on the semiotic study of cultures (as applied to Slavic texts). In: Eng, Jan van der; Grygar, Mojmír (eds.), *Structure of Texts and Semiotics of Culture*. Hague: Mouton, 1–28.
- Van Deelen, T. R.; Kaiser, P.; Watt, M. A.; Craven, S. R. 2007. Quintuplet fetuses from a white-tailed deer (*Odocoileus virginianus*) in Wisconsin. *American Midland Naturalist* 157: 398–400.
- Verhoef, Herman A.; Morin, Peter J. (eds.) 2010. *Community Ecology: Processes, Models, and Applications*. New York: Oxford University Press.
- Vernadsky, Vladimir I. 1998[1926]. *The Biosphere*. New York: Copernicus.
- Waddington, C. H. 1968. Towards a theoretical biology. *Nature* 218: 525–527.
- Waller, Donald M.; Alverson, William S. 1997. The white-tailed deer: a keystone herbivore.



- Wildlife Society Bulletin* 25(2): 217–226.
- Warren, Charles R. 2007. Perspectives on the ‘alien’ versus ‘native’ species debate: a critique of concepts, language and practice. *Progress in Human Geography* 31(4): 427–446.
- Webb, David, A. 1985. What are the criteria for presuming native status? *Watsonia* 15: 231–236.
- Weidema, Inger 2006. NOBANIS – Invasive Alien Species Fact Sheet: *Rosa rugosa*. Retrieved from: [https://www.nobanis.org/globalassets/speciesinfo/r/rosa-rugosa/rosa\\_rugosa.pdf](https://www.nobanis.org/globalassets/speciesinfo/r/rosa-rugosa/rosa_rugosa.pdf). 10.4.2021.
- Wikström, Mikael 2018. *Metsästyksenjohtajan perustaidot: Valkohäntäpeuran biologia*. [In English: Basic skills of a hunting leader: white-tailed deer biology. My translation]. Suomen riistakeskus.
- Williamson, Mark; Fitter, Alastair 1996. The varying success of invaders. *Ecology* 77(6): 1661–1666.
- Wilson, Edward O. 1992. *The Diversity of Life*. Cambridge: Harvard University Press.
- 2002. *The Future of life*. New York: Knopf.
- Wu, Cheng-shun, Yi, Wang; Zhao, De-xiu; Sun, Shou-wei, Ma, Ya-ping; Chen, Jian 1985. The main chemical components of the essential oil from *Rosa rugosa* Thunb. *Journal of Integrative Plant Biology* 27(5): 510–515.
- Young, Ashley M.; Larson, Brendon M. H. 2011. Clarifying debates in invasion biology: a survey of invasion biologists. *Environmental Research* 111: 893–898.
- Zhang, Shuping; Isermann, Maike; Gan, Wenhao; Breed, Martin 2018. Invasive *Rosa rugosa* populations outperform native populations, but some populations have greater invasive potential than others. *Scientific Reports* 8(5735): 1–8.

## Kokkuvõte

### **Valgesaba-pampahirve ja kurdlehise kibuvitsa ökosemiootiline sobitumine invasiivsete liikidena Lõuna-Soomes**

Invasiivseteks võõrliikideks peetakse liike, mida inimesed on viinud üle geograafiliste tõkete ja mis on hakanud avaldama mõju vastuvõtvas ökosüsteemis (Lockwood *et al.* 2007). Magistritöö kirjanduse ülevaade näitab, et neid mõjusid saab tõlgendada positiivse, negatiivse ja neutraalsena ning teisalt nii ökoloogilise kui kultuurilisena. Invasiivseid võõrliike võib mõista kui evolutsioonilist jõudu, väljasuremise inimtekkelist põhjust, kultuuri kõrvalsaadust ja kui metsikut, kontrollimatut loodust, mis ohustab kultuuri.

See magistritöö keskendub valgesaba-pampahirve ja kurdlehise kibuvitsa ökoloogilis-kultuurilise rolli mõistmisele Lõuna-Soomes kahes kohalikus kogukonnas. Peamine analüütiline raamistik on semiootilise sobitumise mõiste (Kull 2020) mida laiendatakse, kaasates sobitumise lahutamatu jõududena inimesi ja inimeste kultuuristruktuure. Selleks kasutatakse toimimis-võrgustiku teooria (Callon 1984; Latour 2005; Law 2009) põhimõisteid, näiteks tõlked ja vahendajad. Samuti kasutatakse ökokultuuride ideed (Pilgrim, Pretty 2010) sobitumise kohaliku iseloomu käsitlemiseks.

Invasiivne võõrliik on ökosemiootiliste uuringute jaoks huvitav nähtus mitmemõõtmeliste ökoloogilis-kultuuriliste tõlgenduste tõttu. Näiteks põhjustavad need inimese semiootilise keskkonna ümberkujundamist. Magistritöö analüüs näitab, et valgesaba-pampahirvede söömiskäitumine ja kurdlehise kibuvitsa elupaikade valik võivad liikuma panna laiu ja keerulisi protsesse kogukonnas, mis võivad kohalikus kontekstis tekitada ootamatuid ökoloogilis-kultuurilisi liite ja tagasisideahelaid. Kui liigiomadused, näiteks valgesaba-pampahirvede tundlikkus sööda pakkumise suhtes, ja kultuuriväärtused, näiteks inimese tahe loodusega uuesti ühendust saada, sobivad hästi kokku, võib invasioon saadud tagasiside tõttu lokaalselt taastekkida. Sarnane tagasiside võib aset leida kurdlehise roosi suutlikkuse tõttu tekitada struktuurseid takistusi ja rannakasutajate vajaduse vahel privaatsuse järele. Magistritöö pakub, et ökosemiootiline sobitumine on kogukonnas jagatud agentsuse osavõtul toimuv võrgustikuline protsess. Rõhutatakse, et liikide, inimeste, kultuuri

struktuuride ja materiaalse looduse vaheliste suhete loomine ja säilitamine on mitmekihiline märkkiprotsess. Ökosemiootilisel sobitumisel võib olla oluline roll ökosüsteemide tervikkuses ja see võib olla funktsionaalsete suhete säilitamise lahutamatu mõõde.

**Annex 1:**  
**Semi-structured interview questions**

1. Miten olet päätynyt Skärlandetille / Hankoon?  
(How did you become a resident on Skärlandet / Hanko?)
  
2. Mistä pidät täällä elinympäristössäsi?  
(What do you like about the environment where you live?)
  
3. Mistä et pidä täällä elinympäristössäsi?  
(What do you dislike about the environment where you live?)
  
4. Voisitko kuvailla ensimmäistä kohtaamista valkohäntäpeuran / kurturuusun kanssa?  
(Would you describe your first encounter with white-tailed deer /rosa rugosa?)
  
5. Miltä nämä lajit näyttävät silmissäsi eli miten kuvailisit niitä?  
(How would you describe their appearance?)
  
6. Miten ne käyttäytyvät tai miten kuvailisit niiden ominaisuuksia?  
(How do they act here or how would you describe their traits?)
  
7. Mitä luulet, miksi nämä lajit ovat löytäneet tänne?  
(What do you think, why are these species found their way here?)
  
8. Mitä nämä lajit merkitsevät täällä yhteisössä ihmisille?  
(What do these species mean for the local community here?)
  
9. Ovatko nämä lajit muuttaneet jotain sinussa? Jos kyllä, niin mitä?  
(Have these species changed something in your life, and if so, what?)
  
10. Ovatko nämä lajit muuttaneet jotain täällä yhteisössä? Jos kyllä, niin mitä?  
(Have these species changed something in the community, and if so, what?)

11. Miten toimit niitä kohtaan?

(How do you act towards them?)

12. Miten saat tietoa näistä lajeista ja siitä, miten niitä kohtaan voi toimia?

(How do you acquire information about these species and how to act?)

14. Onko jotain mikä estää sinua toimimasta niitä kohtaan haluamallasi tavalla?

Are there things that prevent you from acting towards them as you would like to?

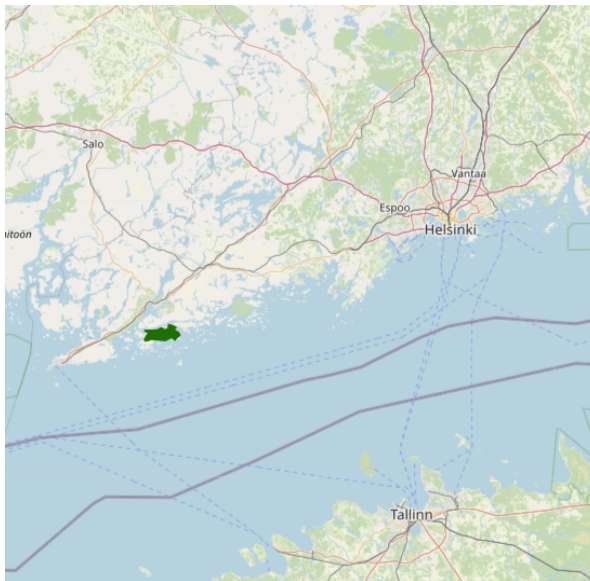
13. Miten haluaisit, että niitä kohtaan toimittaisiin täällä?

(How would you want the community to act towards them?)

14. Mitä ajattelet vieraslajeista yleisesti?

(What do you think about invasive species in general?)

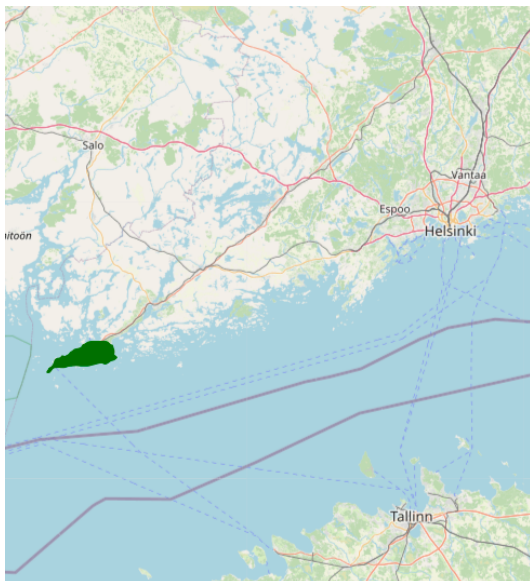
## Annex 2 Maps of the research areas



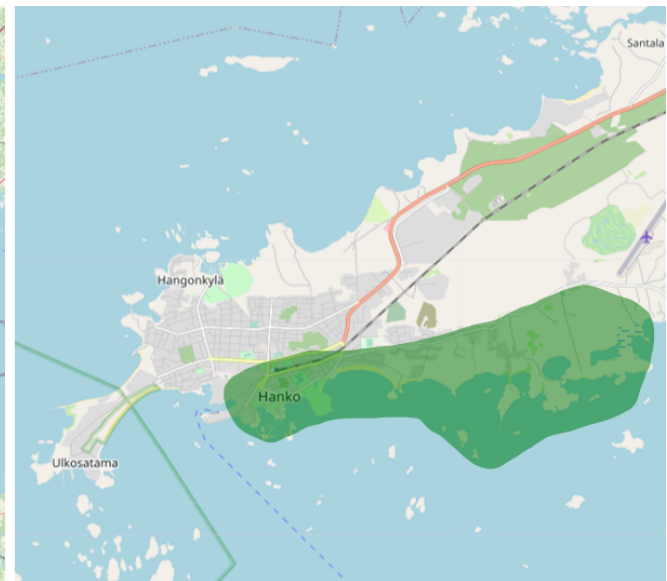
Map 1a. Location of Skärlandet (green overlay) in Southern Finland.



Map 1b. Rough study area on Skärlandet as green overlay.



Map 2a. Location of Hanko (green overlay) in Southern Finland.



Map 2b. Rough study area in Hanko as green overlay.

Map data copyrighted OpenStreetMap contributors and available from <https://www.openstreetmap.org>

**Non-exclusive licence to reproduce thesis and make thesis public**

I,

Felix Siivonen

*(author's name)*

1. herewith grant the University of Tartu a free permit (non-exclusive licence) to reproduce, for the purpose of preservation, including for adding to the DSpace digital archives until the expiry of the term of copyright,

**Ecosemiotic Fitting of White-tailed Deer and Rosa Rugosa as  
Invasive Species in Southern Finland**

*(title of thesis)*

Prof. Timo Maran

supervised by

*(supervisor's name)*

2. I grant the University of Tartu a permit to make the work specified in p. 1 available to the public via the web environment of the University of Tartu, including via the DSpace digital archives, under the Creative Commons licence CC BY NC ND 3.0, which allows, by giving appropriate credit to the author, to reproduce, distribute the work and communicate it to the public, and prohibits the creation of derivative works and any commercial use of the work until the expiry of the term of copyright.

3. I am aware of the fact that the author retains the rights specified in p. 1 and 2.

4. I certify that granting the non-exclusive licence does not infringe other persons' intellectual property rights or rights arising from the personal data protection legislation.

*author's name*  
*dd/mm/yyyy*

Felix Siivonen  
17/05/2021