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**Tourist and second home user awareness and perception of
invasive alien species – cases of Ruka and Saariselkä**

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Title of the thesis: Tourist and second home user awareness and perception of invasive alien species – cases of Ruka and Saariselkä			
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Abstract: <p>The purpose of this master's thesis is to study the awareness and perception of invasive alien species within the target groups of tourists and second home owners. In addition, the target groups' awareness of biosecurity measures and willingness to implement them in their own travel behaviour is studied. The study area consists of two tourism destinations in northern and northeastern Finland, Ruka and Saariselkä.</p> <p>The theoretic framework of the study is based on the concepts of invasive alien species, biodiversity and biosecurity, and the relationship between invasive alien species and tourism. The study is carried out through a mixed methods approach, where the analysed data consists of both quantitative and qualitative data sets including a questionnaire and an interview. Of these data sets, the qualitative interview data is the basis for the thematic analysis used to address the research questions, whereas the quantitative questionnaire data is utilised mostly as a characterisation of the target groups and the general distribution of their views on invasive alien species. Finally, the data sets are discussed in relation to each other as well as previous literature on the subject to arrive at the conclusion.</p> <p>The results of the study indicate that the awareness of invasive alien species, their pathways of spread and impacts is low within both target groups. The majority of the respondents were familiar with the basic concept of invasive alien species but lacked deeper understanding of the issues involved. Similarly, the awareness of the relationship between invasive alien species and tourism was low within the target groups. This lack of knowledge was mentioned as one of the reasons for not taking up biosecurity measures in travel behaviour.</p> <p>The respondents were generally interested in taking up biosecurity practices, given that they were provided sufficient information on what to do and why. Easily accessible and understandable information was seen to be crucial in order to engage tourists and second home owners in biosecurity practices.</p>			
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1 Introduction

The ongoing globalisation taking place in recent decades has improved connections and infrastructure and drastically increased the movement of people and trade goods. This includes not only the intentional movement and dispersal of people and other species, but also the unintentional dispersal of living organisms (Hall, 2010). These organisms, including animals, plants, insects, and pathogens that did not previously exist in a certain environment are called alien species or non-native species. In case these species are able to start reproducing in the new environment, they become established species in that environment, and if they start to spread aggressively or cause any kind of harm, be it ecological, economic or a threat to human health, they are deemed invasive alien species (Keller et al., 2011). Because of these threats posed by invasive alien species, many countries have taken up so-called biosecurity measures to try and prevent the spread and establishment of threatening species.

As invasive alien species are by definition spread through human-mediated pathways (Syke, 2023) it is no surprise that tourism, an industry built on human mobilities on local and global scales, is one of the major forces contributing to the spread of invasive alien species (Hall, 2010). The effect tourism has on the spread is not only due to increased connectivity, but also in combined effect with the growing number of visitors and the environmental disturbance associated with tourism (Hall, 2010), as well as global warming opening up travel opportunities in places that were considered too remote or otherwise undesirable in the past (Anderson et al., 2015). The effect of invasive alien species in the context of tourism is not one-way. As Hall (2011) stated, tourism is both a contributor to the spread and simultaneously being affected by these species, as they are often capable of transforming the environment they establish themselves in.

Acknowledging the role tourism as an industry has on the spread of invasive alien species, it is concerning that the industry may be unaware of its contribution on the issue and role in biosecurity management, or more concerningly, not interested in taking part in biosecurity management despite possessing the required knowledge and experience (Hall, 2007). Additionally, a number of studies has presented the finding that tourists themselves seem to not be aware of the issue or the threats posed by invasive alien species, or their own contribution to the spread of alien species as tourists (Sharp et al., 2012; Smith & Kraaj, 2020; Barendse et al., 2016; Ansong & Pickering, 2015; Lovelock et al., 2022). This

undoubtedly prevents them from taking part in biosecurity efforts or making informed decisions regarding their travels to help control the spread of potentially harmful species.

Although some previous literature on the visitor awareness on invasive alien species exists (see Lovelock et al., 2022; Smith & Kraaj, 2020; Barendse et al., 2016), most studies on the relationship between invasive alien species and tourism address the industry as a general concept, while very little attention is paid to the views and understanding of the visitors. The purpose of this study is to address this research gap by assessing the awareness of tourists on invasive alien species and their impacts, as well as their awareness on biosecurity measures and their willingness to take part in these efforts. The data to carry out the analysis is collected from two study areas in northern and northeastern Finland, from the tourist destinations of Ruka and Saariselkä. The study follows a mixed method approach, where the collected data consists of two different data sets acquired through a questionnaire and an interview. Both methods were designed to find answers to two separate research questions, stated as follows:

1. What is the awareness of tourists and second home owners and users on the invasive alien species and their impacts in Ruka and Saariselkä regions?
2. What is the awareness of tourists and second home owners and users on biosecurity measures and how willing are they to implement them in their own behaviour?

The first question strives to find out the awareness of the target groups on invasive alien species as a phenomenon, their knowledge of local invasive species and their impacts and pathways of spread, whereas the second research question addresses their knowledge and understanding of the efforts undertaken to prevent the spread of these species. Finally, the respondents' willingness to take part in these measures is enquired. These questions are formulated to provide new information on the potential role of these stakeholders in the introduction and spread of invasive alien species. By examining their views and behaviours the study attempts to understand how their choices might contribute to the introduction and spread of invasive alien species within the study area. This information may further aid in the creation and implementation of biosecurity measures required to control and mitigate the impacts of invasive alien species, as well as promote responsible tourism in the target area.

The study is structured so that firstly a comprehensive outlook on previous literature on invasive alien species, biodiversity, and biosecurity, as well as the relationship between invasive alien species and tourism is presented. After this, the study areas are introduced,

followed by an explanation of the methods used and a presentation of the collected data. The results are then discussed in a manner that utilises the quantitative data acquired from the questionnaire as a characterisation of the target groups, whereas the results from the interviews provide the primary data for the thematic analysis used to draw the final conclusions. In addition, potential issues and limitations of the study will be discussed. Finally, future opportunities for similar studies will be considered.

2 Invasive Alien Species

The movement and migration of different species, such as plants, mammals and pathogens are not a modern phenomenon, but it can be seen to be greatly affected by human mobilities and associated technologies in the modern era. This influence has provided means for the intended or unintended introduction of species into environments in which they did not exist before, often resulting in dire ecological, economic, and social consequences (Hall, 2019). As these species are not native to these new areas, they are referred to as *alien species*, often also non-native species. In order to become established in a new area, a species undergoes several steps: first it must be carried through a *pathway*, which most often is a human-mediated process that enables the movement of species from an area to another, and survive the transit period; the survived species can then become *established* in the new area if it escapes or otherwise evades human intervention, and starts reproducing; if the species then spreads aggressively and causes notable ecological, economic or human health impacts it is deemed *invasive* (Keller et al., 2011). This chapter will provide an overview of invasive alien species, starting with definition and relevant figures, continuing to their pathways of spread and impacts. Finally, an overview of the situation in the context of the Nordic region is presented.

2.1 Definition

Invasive alien species are defined by the European Commission (2016) to be animals, plants, or other organisms, such as pathogens, that are introduced through intentional or unintentional spread to areas and ecosystems where they are not normally found, leading to various negative economic, ecological, and social consequences, further explained in section 2.3. The number of alien species in Europe has been estimated to be up to 12 000 species, of which 10 – 15 % are reported to be invasive (European Commission, 2016). The extent of their spread is all-encompassing: Alien species can be found in every type of habitat, both terrestrial and aquatic, including all major taxonomic groups, from plants, mammals, amphibians and fish to fungi, bacteria, and other micro-organisms (European Commission, 2016). In the context of Europe, a list of 149 worst alien species, meaning those with the highest environmental and socioeconomic impact, has been proposed to include 54 plants, 49 invertebrates, 40 vertebrates and six fungi (Nentwig et al., 2018). Among the species with highest perceived impact are Canada goose (*Branta canadensis*), Norway rat (*Rattus norvegicus*), muskrat (*Ondatra zibethicus*), Sika deer (*Cervus nippon*), Reeve's muntjac (*Muntiacus reevesi*), crayfish (*Procambarus clarkii*), the varroa mite (*Varroa destructor*),

silver wattle (*Acacia dealbata*), red sage (*Lantana camara*), kudzu (*Pueraria lobata*) and water hyacinth (*Eichhornia crassipes*) (Nentwig et al., 2018). Of these 11 species, four have been found in Finland: Canada goose (*Branta canadensis*), Norway rat (*Rattus norvegicus*), muskrat (*Ondatra zibethicus*) and the varroa mite (*Varroa destructor*) (Vieraslajit.fi, n.d.). These introductions are not slowing down, quite the opposite: according to Hulme (2015) they are increasing at an almost exponential rate. This increase can be attributed to the growth of global trade and transportation of people and trade goods, but also to ecological factors relating to environmental and climate change, urbanization and loss of native habitats and species (Hall, 2019). These synergies within global changes are exacerbating the existing invasions and facilitating new ones, resulting in escalated extent and impacts of alien species (Pyšek et al., 2020)

2.2 Pathways of spread

Although alien species have been introduced to Europe for centuries, their numbers have risen exponentially in the last decades, primarily due to increased trade and travel (European Commission, 2016). This dramatic acceleration of new species exchanges is seen to be resulting particularly from the growth and closer integration of the global economy (Perrings et al., 2010), which has opened pathways for people and goods alike. International tourist trips and the developed transport connectivity between locations, together with growing distances travelled between source regions and destinations offer major opportunities for the distribution of new alien species (Tatem et al., 2012).

The ways in which invasive alien species spread to a new area are manifold. The Convention on Biological Diversity (2014) has proposed three major mechanisms in which alien species may spread to new areas: importation of a commodity, arrival of a transport vector, and spread from a neighboring region. These mechanisms can be further divided into six principal pathways: release, escape, transport-contaminant, which are related to transport of a commodity, transport-stowaway, which relates to transport vector, and corridor and unaided spread that relate to the natural spread from neighboring regions (Convention on Biological Diversity, 2014). Release refers to the intentional introduction of live alien organisms for some predetermined purpose, such as erosion control or fishing and hunting; escape is the movement of alien species from confinement, e.g. zoos or gardens, into natural environments; transport-contaminant refers to the unintended movement of organisms through international transport of commodities, including pests and diseases; transport-stowaway refers to the

moving of organisms attached to transporting vessels, most notable example being ballast water; corridors enable the natural spread of alien species following the construction of an infrastructure through which the organisms are able to move to new areas, such as canals or tunnels; unaided refers to any secondary movement resulting from foregoing pathways through human intervention (Convention on Biological Diversity, 2014). The aforementioned pathways can also be divided into unintentional and intentional introduction, though these refer to the final introduction rather than the initial intention: for example, an escape from confinement is categorized as unintentional even though the primary movement to confinement was intentional (Convention on Biological Diversity, 2014). This categorization is, however, very general, and the Convention on Biological Diversity (2014) encourages the creation of more descriptive and localized categorization for specific areas in order to prioritize pathways and respond and prevent the spread of new alien species.

According to the European Commission (2016), alien plants mostly spread by the pathway of escape from cultivation, for example gardens and farms, whereas the spread of freshwater alien species is often a consequence of intentional releases for aquaculture or recreational angling. Regional analyses of alien established floras have shown that usually more than half of the species were initially introduced for ornamental horticulture purposes (van Kleunen et al., 2018). This is not only specific to Europe, as Hulme et al. (2018) state that a comparison between the frequency of invasive alien species across the world indicates that most have originated from ornamental horticulture.

The relationship between pathways and possible impacts are to some extent dependent on the taxonomic group of the species: in a study by Pergl et al. (2017) it was found that plants introduced by pathways of release, corridor and unaided were disproportionately more likely to have ecological impacts as opposed to those introduced as contaminants. In the case of invertebrates, mammals and fish impacts were not associated with particular introduction pathways (Pergl et al., 2017). These differences existed in regard to impacts and pathways, however, for most taxa no major differences among pathways were found (Pergl et al., 2017). The pathways of introduction and the subsequent impacts may also be related in three ways (Essl et al., 2015): first, pathways that transport higher abundance of alien species are more likely to lead to establishment and the following impacts than pathways that facilitate the dispersal of fewer species or individuals; second, some pathways may introduce alien species to areas of conservation value, e.g. protected areas where impacts may be particularly significant (Anderson et al., 2015); third, certain pathways may introduce more damaging

species than others, especially when pathogens are introduced as contaminants of their hosts (Roy et al., 2012). In these cases, tourism is also a significant vector due to the potential of introduction of disease and other pathogens carried by tourists (Hall, 2019). Species also benefit from being able to spread through multiple pathways. In addition to benefiting from increased propagule pressure, the frequency with which a species is introduced to a site, combined with the number of individuals in each introduction event (Simberloff et al., 2013), it is also possible that alien species introduced through multiple pathways may be more ecologically versatile than those transferring through single pathways, or have a greater chance of being introduced to a wider range of habitats (Pergl et al., 2017).

As the introductions of alien species are increasing, driven by changing environments, the future of these introductions is uncertain. One of the major future challenges might be these social, technological, and environmental changes leading to fundamentally novel patterns of species introductions resulting in invasion risks by new types of plants and other species for which the understanding of previous invasions gives only partial guidance (Kueffer, 2010). One of the main threats is global climate change, which may render habitats more susceptible to alien species and less suitable for the native species (van Kleunen et al., 2018). It may also act as proxy for the creation of new pathways and corridors: the dissolution of the ice cap of the Arctic Ocean is opening new corridors between the Atlantic and Pacific Oceans and consequently allowing the movement of species, presumably both marine and terrestrial, through new routes of exploratory, cargo, fishing, and tourist vessels (Pyšek et al., 2020).

2.3 Impacts

According to Keller et al. (2011), a non-native species can be regarded as invasive if it causes notable impacts to its surrounding environment, other species, or human health. These impacts, their magnitude and direction can vary between different spatial scales as well as levels of ecological complexity (Vilá et al., 2011). Invasive alien species can thus cause impacts on all scales ranging from an individual to the atmosphere (Perrings et al., 2010). This section will consider the ecological impacts in the contexts of individuals, populations, and ecosystems as well as the impacts affecting human well-being alongside economic and cultural impacts.

Starting from the scale of individuals and populations, the first impacts are quite obvious. As they spread, often rapidly, into new areas, predatory species can feed on endemic species that do not possess the ability to protect themselves from the invasive species, like in the case of

predatory fish in lakes (Simberloff et al., 2013). Alien species also interact with native species through competition over resources and space, interbreeding, herbivory and introduction of disease (Keller et al., 2011; European Commission. 2016). In addition, invasive species can alter the genetic composition of native populations and change native animal behaviour (Pyšek et al., 2020). It is important to note that while the impacts caused by invasive alien species generally increase as the species spread and establish themselves, they can also impose changes and impacts as soon as they are introduced, for example new pathogens can affect the health of native animals, plants, or other organisms immediately when introduced to a new environment (Jeschke et al., 2014). This highlights the fact that the spread of invasive species does not need to be extensive or numerous to have grave consequences for the native populations. The impacts can also affect the native populations through changes primarily taking place in the physical environment: for example, some invasive species can remove or add physical structures and as a consequence alter the erosion regimes of the area or change habitat suitability for the native species (Simberloff, 2011).

All of the previously discussed impacts can further affect the local ecosystem as a whole, which can not only affect the species living in it, but also compromise the ability to provide ecosystem services such as pollination, water regulation and flood control (European Commission, 2016) by altering nutrient and contaminant cycling, hydrology, habitat structure and disturbance regimes (Pyšek et al., 2020). One of the concerning regime changes is the altered fire regimes, which can have serious repercussions for the ecosystems either depending on or not prepared for fires (Pyšek et al., 2020). All of these modifications imposed on the ecosystems by the invasive species are designed to strengthen their own position in the ecosystem and enhance their own persistence (Pyšek et al., 2020). Multiple studies have presented the finding that invasive alien species affect the native species richness and abundance negatively while simultaneously increasing the ecosystem productivity particularly in the context of plants (Vilá et al., 2011; Pyšek et al., 2012). While the plant species richness decreases following invasion, the abundance and richness of the soil biota more often seems to increase rather than decrease as a consequence of the invasion (Pyšek et al., 2012). As a result of these changes in the ecosystem, invasive alien species are able to alter the phylogenetic diversity across communities and affect trophic networks (Pyšek et al., 2020). For example, Vilá et al. (2011) found that alien plants have bottom-up impacts on higher trophic levels. These effects might depend on the degree of their dependence on these

alien plants as a food resource (de Groot et al., 2007), but they can also affect higher trophic level species indirectly by increasing habitat heterogeneity (Pearson, 2009).

The impact caused by invasive alien species is to some extent affected by the receiving habitat type. One example is protected areas and nature reserves, which seem to contain fewer invasive alien plants than their surroundings, for example Lonsdale (1999) found that nature reserves had one-half of the non-native fraction of sites outside these reserves. They are also able to act as barriers against invasions of alien plants (Foxcroft et al., 2013). However, this does not mean that they do not suffer from the impacts of invasive alien species or are immune to invasions: protected areas are often impacted on species and community levels due to alteration of habitats, regime shifts and through the transformation of native species abundance, diversity, and richness (Foxcroft et al., 2013). Another habitat of interest is island sites, as closed and hard-to-reach ecosystems are often regarded as especially vulnerable to the effects of invasive alien species. Whereas nature reserves seemed to contain significantly fewer alien species, island sites had nearly three times the non-native fraction of mainland sites (Lonsdale, 1999). It has thus been stated that islands receive more alien species, and the invasion can be more widespread in island sites compared to mainland sites (Gimeno et al., 2006). However, some studies offer differing results: Gimeno et al. (2006) also stated that in the case of observed species, 'in general there were not significant differences in local abundances between island and mainland locations' (p. 1559). This is also supported by Vilà et al. (2011) who found no greater impact on islands than on mainland ecosystems. Gimeno et al. (2006) suggested that at a local scale island systems do not appear to be more easily invaded than mainland systems, and in addition the aforementioned apparent success does not necessarily mean greater impacts at a local scale (Vilà et al., 2011).

The final ecological repercussion of invasive alien species is a particularly grave one: they can facilitate the extinction of local species. Since the 17th century, invasive alien species have contributed to almost 40 % of all animal extinctions for which the cause is known (Secretariat on the Convention on Biological Diversity, 2006). They are the second most common threat associated with species that have gone extinct since 1500 CE (Bellard et al., 2016). Invasive alien species are the most common threat linked with extinctions in three of the five taxa analysed by Bellard et al. (2016): amphibians, reptiles, and mammals. Additionally, they are the most common threat associated with vertebrate extinctions overall (Bellard et al., 2016). It has been noted by Bellard et al. (2016, p. 3) that 'alien species may often act in synergy with other extinction drivers - and indeed, most extinctions are

associated with more than one - but the impacts of alien species have been well documented in multiple contexts' (see Pyšek et al., 2017; Courchamp et al., 2003). In a more recent study by Blackburn et al. (2019) invasive alien species were named as the most frequent cause for the extinction of animal and plant species worldwide, ahead of hunting, harvesting and agriculture.

In addition to physical and ecological impacts, invasive alien species can also affect humans through the aforementioned impacts. Changes in ecosystems can cause major threats to human well-being particularly in areas where the opportunities for preventing and managing invasive alien species are limited (Pyšek et al., 2020). The direct threats imposed by invasive alien species include for example injuries caused by venomous species or the spread of diseases (Pyšek et al., 2020). The subsequent impacts following ecosystem change can be severe: according to Pyšek et al. (2020), invasive alien species can affect the material and intangible assets of a particular area in such magnitude that the local people have to abandon farming or fishing, i.e., their livelihoods, and emigrate elsewhere. Invasive alien species can also disrupt culturally and socially important structures and reduce the socially imposed values on affected landscapes and ecosystems (van Wilgen et al., 1996). However, these impacts on cultural and aesthetic values are difficult to assess since they are influenced by complex psychological and social processes that shape the collective and individual sense of what is valued (Kueffer & Kull, 2017). Finally, the economic impacts of invasive alien species are significant. In the EU alone, the costs caused by invasive alien species over the past 20 years come up to 12 billion per year, with the figure growing year by year (European Commission, 2016). The costs accumulate from removal of invasive species, damage to infrastructure and changes in economically important ecosystems, among other impacts (European Commission, 2016). However, it should be noted that in the economic context many alien species can be in fact beneficial, for example species introduced for fishing, hunting and tourism purposes (European Commission, 2016). This conflict between ecological and economic benefit is a major issue in the relationship between tourism and invasive alien species and will be discussed further in chapter 4, Invasive alien species and tourism.

In conclusion, the impacts of invasive alien species can be vast and serious. It should also be noted that not all of the possible impacts caused by invasive alien species are even known, due to them being difficult to evaluate, uncertain, delayed, and pervasive (Simberloff et al., 2013). For the vast majority of invasive alien species and the consequences of their

introductions no quantitative information is available (Jeschke et al., 2014), which means that despite being long and unsettling, the list of impacts presented here may be far from complete. The absence of comprehensive assessment limits the ability to generalize and predict where the impacts might be most damaging (Vilà et al., 2011) and further prioritize countermeasures. The timely interference and prevention are always more cost effective than eradication, which gets harder and more expensive with time (European Commission, 2016).

2.4 Invasive alien species in the Nordic region

The European continent's position as a centre of international trade over past centuries has resulted in it receiving a large number and diversity of alien species, of which many have become invasive and established, affecting all European habitats (Keller et al., 2011). The dominant pathways of alien species into Europe are mostly associated with accidental escapes from ornamental and horticultural activities (Arianoutsou et al., 2021), but in the case of the Nordic region additional significant pathways, such as agriculture, angling and other sporting activities, aquaculture and ballast water have been recognized, with the main pathways of introduction varying between different taxonomic groups (Nordic Council of Ministers, 2015). As stated in chapter 1.2, some of the species use more than one pathway of spread. It is also noted that for many of the alien species the pathways of spread are unknown, especially in the case of Norway (N of species with unknown pathway = 1486), which highlights the need for further study of the pathways to prevent future invasions (Nordic Council of Ministers, 2015). In the case of the Nordic region, the group with the largest number of alien species in the angiosperms, which have spread mainly through horticulture, agriculture, and transport (Nordic Council of Ministers, 2015).

The alien species' ability to spread is also dependent on the characteristics of the receiving region. In the case of Finland, Nummi (2000) states that the harsh climate prevents invasion of most southern species, but on the other hand the relatively low number of species in Finnish ecosystems can facilitate easier establishment of alien species, given that they are physiologically adapted to the northern conditions. The established alien species in Finland can be divided into three subgroups: ancient unintentional introductions, that were mostly introduced through early agriculture, such as the house mouse and many plants; historical intentional introductions intended to facilitate economic benefit, such as many game and fish species and garden plants; and lastly modern, mainly unintentional introductions which take place through modern technology and trade, for example species spreading through ballast

water (Nummi, 2000). Established alien species are fairly well documented on national and EU-wide scale, but it should be noted that because there is often a significant lag period between species introduction, establishment and spread, it is likely that these databases are lacking information on species that have been introduced but not yet established or invasive (Keller et al., 2011). It has also been shown that the number of introductions as well as the importance of different pathways vary over time: for example, in the Nordic region, the number of species introduced through agriculture and ballast water and sediments have decreased, whereas the importance of angling and sport has increased (Nordic Council of Ministers, 2015).

3 Biodiversity

According to the UN Environment Program's [UNEP] (1992) *Convention on Biological Diversity* biodiversity, or biological diversity, entails the variability of living organisms in an area, including terrestrial and aquatic systems and all organisms within these systems. This definition includes the relationships and diversity within species, between different species and between ecosystems. Biodiversity, the impending threat of biodiversity loss and necessary measures to conserve it have been one of the dominating topics in discussions of ecological sustainability for the past years, or even decades. Even though great local, national, and international attention has been given to the cause through strategies, action plans and policies, with some conservation success especially on the local scale, biodiversity and ecosystem functions and services are declining worldwide (IPBES, 2019). Direct and indirect drivers of this change have accelerated during the past decades, including factors such as pollution, invasive alien species and climate change, which on its own causes impacts from genes to ecosystems and further poses a growing risk together with other direct drivers (IPBES, 2019). In addition to altering habitats and the physical environment, climate change can also facilitate the loss of existing species and introduction of new ones through expansions of infrastructure (IPBES, 2019). This development is particularly concerning for remote and 'untouched' locations such as the Arctic region (Hall et al., 2010). The aforementioned changes can also lead to habitat loss, which is seen by some authors to be the greatest threat to biodiversity (Hanski, 2011). The changes relating to agriculture, built areas, infrastructure and the growing demand for resources pose a serious threat for natural habitats (Hanski, 2011): in an in-depth assessment of 388 habitat types in Finland nearly half were

classified as either endangered (n = 52), critically endangered (n = 57) or vulnerable (n = 77) (Kontula & Raunio, 2018).

The state of global biodiversity is monitored by the UN Convention on Biological Diversity [CBD]. As a part of the Strategic Plan for Biodiversity 2011 - 2020, the CBD introduced 20 Aichi biodiversity targets which strive to address and manage the current decline of global biodiversity (CBD Secretariat, n.d.). The targets address issues such as awareness, habitat loss and protected areas, among others (CBD Secretariat, n.d.). In addition, the targets also recognize the threat imposed by invasive alien species: Aichi Biodiversity target 9 states that “By 2020, invasive alien species and pathways are identified and prioritized, priority species are controlled or eradicated, and measures are in place to manage pathways to prevent their introduction and establishment.” (CBD Secretariat, n.d.). However, by 2020 it was evident that none of the goals would be fully met, further undermining efforts to achieve the UN Sustainable Development Goals and address climate change (Secretariat of the Convention on Biological Diversity, 2020). The failure to achieve the goals was credited to unsustainable patterns of production and consumption, population growth and technological developments, which in turn increased the impacts of land and sea use change, overexploitation, climate change, pollution, and invasive alien species (Secretariat of the Convention on Biological Diversity, 2020). The information from the national reports suggested that the committed countries were lacking in both ambition to address the Aichi targets and in the action required to reach the commitments.

If not just for the intrinsic value of diverse and dynamic ecosystems, the incentives to stop this decline are varied. Many of the services provided by nature are essential for human health and their decline threatens a good quality of life (IPBES, 2019). Examples of these services include food security through pollination and pest control, improved nutrition, and the provision of clean water (Secretariat of the Convention on Biological Diversity, 2020). Some of these services are fully irreplaceable, and while most of them can be replaced up to a certain point, human made replacements generally cannot provide the full range of benefits provided by nature (IPBES, 2019). According to the UNEP (n.d.) biodiversity loss could also exacerbate global climate change, endanger food security through land degradation, put humans and animals in closer contact resulting in greater risk of disease spread and cause enormous economic repercussions, including up to 577 billion US dollars at risk due to pollinator loss. In addition, the European Commission (2016) estimates that around 4.4 million jobs and 405 billion euros in annual turnover are directly dependent on healthy

ecosystems. The Secretariat of the Convention on Biological Diversity (2020) also notes that the projected decline in biodiversity will have a particularly detrimental effect on indigenous peoples and local communities, especially for the poor and vulnerable since they rely on biodiversity for their wellbeing.

In addition to direct repercussions affecting human population, biodiversity loss also reduces the efficiency by which ecological communities collect biologically essential resources, produce biomass, decompose, and recycle essential nutrients, leading to decrease in the stability of ecosystem functions through time (Cardinale et al., 2012). It is also noted that the impact of biodiversity is nonlinear and saturating, meaning that change accelerates as biodiversity loss increases (Cardinale et al., 2012). Loss of biodiversity across different trophic levels can influence ecosystem functions even more strongly than biodiversity loss within trophic levels: food web interactions have been shown to be key mediators of ecosystem functioning, and the loss of higher consumer can lead to reduced plant biomass, altered vegetation structure, fire frequency and spreading of diseases (Estes et al., 2011). However, in the case of many ecosystem services the relationship between biodiversity and the service has not been studied sufficiently to evaluate (Cardinale et al., 2012), which calls for the need of further research. In the case of species extinction, the following change in the ecosystem is determined by the biological traits lost: scenarios can vary from reduction of ecological processes to the opposite (Cardinale et al., 2012). Altogether, Cardinale et al. (2012, p. 61) state that ‘the impacts of diversity loss on ecological processes might be sufficiently large to rival the impacts of many other global drivers of environmental change’, including the impacts on primary productivity comparable to drought, climate warming, acidification, and elevated CO₂ among others (Hooper et al., 2012).

4 Biosecurity

One of the main threats for biodiversity is the introduction of invasive alien species and their subsequent impacts, such as altered habitats and species extinctions. The process of invasive alien species spreading and establishing themselves is often also referred to as *biological invasion*, which is especially associated with the notion of negative impacts and harm as a result of the introduction of these organisms, including different species, pests, and disease (Hall, 2019). It is evident that increased effort to biodiversity protection is needed, both on global scale through large-scale conservation efforts and global framework, as well as local scale biosecurity measures. *Biosecurity* refers to measures implemented to prevent the

degradation of biodiversity and threats such as biological invasion, ‘preventing introduction of harmful new organisms, and eradicating or controlling those unwanted organisms that are already present’ (Biosecurity Strategy Development Team, 2001, sec. 1.3, as cited in Hall, 2019). This response to manage and prevent biological invasion and establishment of invasive alien species can be broadly defined as the efforts in protection of a country’s, region’s or other defined location’s environmental, economic, and human health from harmful organisms (Hall, 2019).

Biosecurity is largely the responsibility of each independent country or region, but some agreements and international conventions exist to guide the adoption and utilization of biosecurity measures. Examples of these include the European Union Regulation 1143/2014 on Invasive Alien Species that binds every member country of the EU on the import and control of invasive alien species, the WTO *International Plant Protection Convention* [IPPC], that acts as the standard-setting body for border biosecurity (Pyšek et al., 2020) and the WTO *Agreement on the Application of Sanitary and Phytosanitary Measures* [SPS]. The latter two agreements address particularly the issue of free trade acting as a vector for invasive alien species and strive to negotiate a balance between free trade and biosecurity measures that can be seen as hindering, such as import quarantines (Pyšek et al., 2020).

4.1 Biosecurity management strategies

Nearly every country employs biosecurity measures to protect biodiversity and citizens from the effects of biological invasions (Pyšek et al., 2020). Different stages of the invasion process require different approaches to biosecurity measures. In most cases the most environmentally desirable and cost-effective way of controlling invasive alien species is prevention (Keller et al., 2007). Biosecurity practices related to prevention mostly take place at the borders of a country or a region and are often referred to as ‘border biosecurity’ (Pyšek et al., 2020). Border biosecurity includes measures such as inspections, quarantines, e.g., restrictions on what kind of goods can be brought in or out of a region or country, and sanitation measures at any point during a trip, for example in an airplane, at the airport or at the entry point of a protected area (Pyšek et al., 2020). Prevention can also take place before any contact at borders, such as constricting possible pathways and assessing risks for intentional imports (Simberloff et al., 2013). These measures ensure that minimal intentional or unintentional transfer of invasive alien species to the area takes place through trade, transport or human mobilities. The effectiveness of these measures has been studied, and for

example in New Zealand the rate of fungal plant pathogens has declined progressively through the use of phytosanitary controls at the border, such as X-ray machines and detector dogs (Sikes et al., 2018). Regulations on what can be brought over the border are largely determined by legislation concerning health, international trade, and environmental law (Hall, 2011). Controlled and potentially harmful goods can include plants, seeds, live animals, or their products among others.

If the invasive alien species are able to establish themselves despite previous attempts to prevent them, early detection, rapid response, and thorough eradication should follow (Simberloff et al., 2013). The next steps in biosecurity practices are surveillance, which attempts to locate and map out the distribution and possible impacts of a certain species, and appropriate methods of eradication (Pyšek et al., 2020). In the best-case scenario eradication is performed before the species in question are able to establish populations, however it is also possible to eradicate an established species, albeit much more costly and time-consuming (Pyšek et al., 2020). Despite the difficulties associated with eradication processes, eradication technologies have improved dramatically and resulted in promising accomplishments: of more than 1000 eradication attempts, 86% succeeded, including several long-standing invasions (Genovesi, 2011).

One way to support both prevention and eradication measures the education and involvement of the public, some authors insisting it is a prerequisite for success (see Novoa et al., 2017). It is crucial to involve and improve the knowledge and awareness of all parties concerned by or involved in the introduction and management of invasive alien species. According to Verbrugge et al. (2021), these parties include

1. policy makers and authorities of different spatial scales responsible for regulations, border control and reporting regarding invasive alien species,
2. nature and water managers who come across invasive alien species due to the nature of their job,
3. professionals working outdoors, including landscapers, foresters, gardeners among others,
4. retailers and traders of plants and animals, and
5. the general public, who can assist in detection and monitoring of invasive alien species.

The awareness raising of these key actors comprises species identification skills, knowledge of invasion processes, introduction pathways, potential impacts, and management options (Verbrugge, 2021). It also matters in what manner the awareness raising is carried out: Verbrugge et al. (2021) concluded that hands-on activities, such as workshops and games, worked better in increasing knowledge and awareness than just talks and pictures. Engaging the general public in the management of invasive alien species can have many benefits: the collected data through apps or collective databases (such as Vieraslajit.fi in Finland) is valuable for detecting, locating, and managing alien populations and raising awareness of the impacts of invasive alien species can increase acceptance of biosecurity measures (Pyšek et al., 2020).

4.2 Challenges in biosecurity management

The management of invasive alien species and biological invasion is particularly challenging due to several issues taking place on different scales over space and time (Hall, 2019). For example, the conditions under which biological invasion takes place are practically impossible to determine, there is a considerable time lag between introduction and spread termed the invasion lag, and the impact of invasive alien species is often increased as the populations spread further (Keller et al., 2011). In addition, the spread of new species is often at the hands of neighboring jurisdictions, so the management and prevention require international cooperation which might be difficult to achieve and uphold (Hall, 2019; Perrings et al., 2010). Lastly, the protection of biodiversity and restricting the means through which biological invasion takes place is also often at odds with economic benefit from increased trade (Hall, 2019), which may in economic growth-focused systems put the wellbeing of ecosystems into jeopardy.

One of the most pressing issues of biosecurity management is the ongoing environmental and climate change. Not only is it able to open new pathways of spread and transform habitat more suitable for alien species, such as in the situation in the Arctic region discussed above in chapter 1.2, but it may also challenge a great part of the current biosecurity regimes. The Arctic region again offers an example: the biosecurity regime of the region is highly concentrated on national parks and reserves which have been previously accessible to the public. However, as the reduction of sea ice and eased access for marine transport opens new routes and destinations, these new areas are exposed to invasive alien species while simultaneously not being covered by previous biosecurity regimes (Hall et al., 2010). It is

very likely that biological invasions around the globe will differ from past and current invasions in many respects that are influenced by global environmental change (Pyšek et al., 2020).

The management of each invasive alien species consists of a unique configuration of stakeholders, context, and issues, and due to this fact it is possible that in some cases the required collaboration between stakeholders may be difficult or even impossible (Novoa et al., 2018). It was noted in the previous chapter that the engagement and educating of all relevant stakeholders is crucial, but due to issues related to resources, both human and monetary, opportunities for engagement might be diminished (Novoa et al., 2018). For example, workshops and other hands-on activities might be costly to both organize and to attend, which poses limits on who can take part in these activities (Novoa et al., 2018). Inability to engage and educate stakeholders can prove to be a major hindrance in managing invasive alien species, since many stakeholders are often not aware of the range of impacts caused by invasive alien species and the potential benefits of their management, which subsequently leads to lack of collaboration and support for the management efforts (Courchamp et al., 2017).

The growth in international trade has been recognized to be one of the most influential factors in the spread of invasive species (Meyerson & Mooney, 2007). This is supported by the positive correlation between the economic activity of a country and the number of established invasive species present (Dalmazzone, 2000). These introductions can be the result of either unintentional spread through transport vectors or trade goods, or intentional introduction due to their economic value. Alien species have been intentionally introduced before as for example ornamental plants, crop species and for game and recreation purposes (Hulme, 2020; Hall, 2019). These species can have significant value to the national economy, which can lead to conflicts between different stakeholders and limit the options to manage these invasions (Hulme, 2020). These conflicts can escalate as far as to overturn existing management efforts. An example of this is the quarantine and sales ban of certain ornamental plant species. As mentioned before, one option to enforce biosecurity measures is to implement sales bans on species that have been deemed threatening. However, the ornamental plant industry opposition to these bans can be so heavy that species get dropped from legislation (Hulme et al., 2018). One option to foster cooperation and reduce restrictive legislation are voluntary codes of conduct that stress the role of corporate responsibility (Sethi, 2011). However, as these codes of conduct do not actually hold any consequence for non-compliance in terms of

bad publicity or brand image, no reliable auditing system whatsoever and no means of assessing how well the codes work, it could be argued that they are not very effective tool in biosecurity management (Hulme et al., 2018).

Traits like aesthetic properties, recreational value and economic value may render certain species as ‘acceptable’ in the eyes of some stakeholders (Hall, 2019; Hulme et al., 2018), and make these species valuable assets rather than detrimental, and consequently the impacts for the local biodiversity and surrounding species’ health might be overlooked (Simberloff et al., 2013). This underlines the different priorities different stakeholders possess: what is seen as detrimental by some, may be desirable for others. It should be noted that this issue should not be regarded as a simple confrontation of nature versus economy, but the differences of opinion may exist within different economic stakeholders (Jeschke et al., 2014). Another economic challenge regarding invasive alien species is that all the biosecurity measures have a certain cost, and that cost has to be balanced against the potential costs the management of the species inflict if they are able to establish (Perrings et al., 2013). Further, if the importance of early intervention is not recognized, policy makers and responsible authorities may not be willing to pay the costs to prevent invasion.

Despite some efforts to standardize biosecurity measures internationally, such as the SPS agreement, in the current form most biosecurity efforts take place on unilateral national level as opposed to coordinated international action (Perrings et al., 2010). Perrings et al. (2010) conclude that this level of coordination is not sufficient, and more proactive global coordination and cooperation is required to ensure efficient biosecurity measures at all scales. International coordination is needed particularly to identify common threats, implement prevention and management measures and to ensure that new invasions do not breach the weakest points in the biosecurity system (Perrings et al., 2010). The weakest points refer to the countries and regions with the least resources and the institutional and regulatory environment to weather invasions (Perrings et al., 2010). Even though some countries, namely Australia and New Zealand, are known for their extensive biosecurity measures, most countries would benefit from cooperative efforts at the global level, especially cost-wise (Perrings et al., 2010). In addition to identifying and managing global pathways of spread, international collective action could allow for the mobilization of resources to strengthen the weakest links in the chain (Perrings et al., 2010).

5 Invasive Alien Species and Tourism

Previous chapters have established the fact that increased trade and extended trading networks are one of the main vectors of spread for invasive alien species. This also includes the trade in tourism services (Hall, 2011). Tourism is recognized as a pathway for invasive alien species across the globe (Anderson et al., 2015), and either directly or indirectly can affect biodiversity through changes in vegetation, soil, and wildlife, or through new biological invasions (Tolvanen & Kangas, 2016) which represent the second most significant cause of species extinction (Bellard et al., 2016). These changes are a result of tourism-related disturbances, such as trampling, land use change or construction of infrastructure (Tin et al., 2009), and tourism seems to be the obvious culprit of alien species invasions: a campsite survey in Northern Finland showed that alien plant species grew mostly in the disturbed areas of the campsites (Kangas et al., 2007), while alien species were not observed to have established in undisturbed areas (Tolvanen & Kangas, 2016). While the tourism industry is notorious for its effect on climate change, it has been estimated that the proportional contribution of tourism to biological exchange is even greater (Hall, 2015). The ecological changes imposed by existing and increasing tourism pressure may also be enhanced by global climate warming (Hall, 2010), through for example increase of (alien) species under changed weather and climate conditions, changed species interactions and enhanced plant regeneration rates through the increase of tolerant species (Tolvanen & Kangas, 2016).

To conclude, the collective impacts of tourism on biological invasions are constructed of the increasing connectivity on both global and local scales, growing number of visitors and the associated environmental disturbance (Hall, 2010). These impacts are amplified by global warming allowing access to places that were considered too remote before, such as in the polar regions (Anderson et al., 2015).

5.1 Impacts of biological invasions on tourism

According to Hall (2011, p. 259), ‘substantial evidence suggests tourism is both a contributor to as well as being affected by the movement of undesirable alien species’. As stated before, invasive alien species can have significant economic repercussions on different sectors such as agriculture, fishing, and forestry, but also on tourism (Hall, 2011). The change imposed on other sectors could also affect tourism through their importance as environmental services supporting the tourism industry (Hall, 2011). In addition to these services, biodiversity in

itself has intrinsic value and is vital for tourism, as landscapes and wildlife are important attractions for tourism (World Tourism Organization, 2010). Even though a large share of tourism is dependent on biodiversity, many tourism functions are actively harming local biodiversity, mostly through land conversion, overexploitation of resources, pollution and the deliberate or accidental introduction of invasive alien species (World Tourism Organization, 2010). The subsequent impacts of biological invasions can affect both the destination and the visitors, as possible impacts include the loss of indigenous biodiversity and further the perceived naturalness, loss of attraction species and limits on tourist access or movement in order to protect the destination area (Hall, 2007). The attempts to reduce the risk of biological invasions can therefore have substantial effects on tourism and human mobility on all scales, as the standard means of preventing the spread of invasive alien species is to restrict access, or in the most severe cases quarantine or deny access altogether (Hall, 2011).

5.2 Impacts of tourism on biological invasions

As opposed to invasive alien species' impact on tourism, much more extensive is the literature on tourism's effect on the spread of invasive alien species. It has been suggested that tourism contributes to biological invasion in three ways:

1. by providing justification for deliberate introduction of new species,
2. by being a vector for accidental biological invasion, and
3. by disturbing habitat and consequently facilitating the establishment of invasive alien species (Hall & Baird, 2013).

An example of the first contribution, deliberate introduction, can be found at tourist resorts with ski slopes. As ski slopes are prone to erosion, some alien species, namely fast-growing grasses, are introduced for soil stabilization (Kangas et al., 2009). These species may be chosen as they are already well adapted to local conditions, but their establishment is aided also by fertilization, which usually gives them a competitive advantage over native species (Hagen et al., 2014). Due to these advantages, it is theoretically possible that the introduced species spread further along the ski slopes and hiking trails into surrounding areas (Kangas et al., 2009). Kangas et al. (2009) found that the introduced seed mixture species had not spread to adjacent forest, but they note that due to invasion lag, the broader establishment of alien species may take decades. This also applies to alien plants introduced as amenities for their aesthetic values. To survive in a certain area, the species must be adapted to local conditions,

which means that they have higher chances of establishing themselves in the wild (McDougall & Cavieres, 2023).

The ability of tourism to act as a vector for accidental biological invasion is known. The vectors through which tourism carries alien species are varied, but largely consist of different means of transport and recreational mobilities. Transport vehicles such as airplanes, cars and ships are able to carry species and propagules on a global scale, after which some of these propagules can be carried in shoes, clothes, or equipment to recreational areas, including protected areas and national parks (Anderson et al., 2015). Together with the habitat disturbance caused by common recreational activities, such as hiking or mountain biking, the chance of facilitating invasion is further increased (Jauni et al., 2014). It should be noted that while species do move naturally, such processes are relatively slow and happen at evolutionary rates (Hall, 2015). The current issue has to do with the increased rate and scale at which the species exchange takes place, especially through increased leisure travel (Hall, 2015; 2007). Certain types of tourism may assist biological invasion in previously isolated ecosystems: for example, ecotourism has been found to carry and introduce new pathogens to and from remote ecotourism locations (Hall, 2015).

Biological invasions can take place via several tourism related activities such as camping and hiking, but the especially prominent effects are caused by tourist resorts, which can transform wilderness environments into urban-like areas and promote the spread of invasive alien species (Tolvanen & Kangas, 2016). The construction of resorts and the change in land use involves the removal of natural vegetation and topsoil together with its soil biota with grave consequences for the recovery of native vegetation (Hudek et al., 2020) and the establishment of alien species (McDougall & Cavieres, 2023). In the case of ski resorts, many resorts are expanding their services by providing hiking and bike trails (McDougall & Cavieres, 2023), which exposes new areas to recreation impacts (Tolvanen & Kangas, 2016).

5.3 Industry and tourist awareness

Protecting biodiversity in tourism destinations is a group effort between all stakeholders, but arguably the tourism industry holds the greatest responsibility. Therefore, it is concerning that as Hall (2007) stated, the tourism industry may be unaware of its role in biosecurity management. That is, beyond the perceived inconvenience they believe tourists may encounter while crossing borders where biosecurity measures are enforced (Hall, 2007). In addition, taking precautions does not seem to be always an issue of knowledge: Hall (2009)

observed that in the case of expedition operators who already had the knowledge and experience with biosecurity in locations where their enforcement was a prerequisite for operation, did not enforce these precautions in other locations with no such prerequisites. It also seems that as biosecurity measures are often concentrated at national or regional borders, the tourism operators seem to think this level of enforcement is sufficient (Hall, 2007). However, these borders are permeable, and operators should not rely on their sole protection, especially if the tourism attractions in question are dependent on biosecurity resources (Hall, 2007).

A number of studies have been conducted on the visitor's and the public's awareness of invasive alien species. The common finding seems to be that the general awareness of invasive alien species is low, and most visitors to a natural location were only slightly familiar with invasive alien species and even less on their impact (Sharp et al., 2012). The awareness of the tourists has been found low also within groups of trail runners (Smith & Kraaj, 2020), hikers (Barendse et al., 2016) and park visitors in general (Ansong & Pickering, 2015). Lovelock et al. (2022, pp. 3914) concluded that '[a]lthough visitors often travel to seek experiences associated with a high level of naturalness or wildness in destinations, they are not necessarily aware of environmental problems such as invasive plant species that significantly undermine the integrity of the natural environment and biodiversity'. However, the visitors are not a homogenous group, and the perceptions and attitudes are related to both place of origin and cultural background (Lovelock et al., 2022). There are significant differences between domestic and international visitors in levels of ecological knowledge about invasive species, with domestic visitors having greater awareness (Lovelock et al., 2022).

5.4 Management of invasive alien species in tourism context

The management of the spread of invasive alien species is tricky for a number of reasons. Firstly, the insufficient knowledge of both the visitors and the industry itself was discussed in the previous chapter. As such, the first obstacle in implementing biosecurity measures to tourism activities is the general lack of knowledge and understanding. To overcome this obstacle, better education for all stakeholders is needed, and education and social marketing campaigns should be significant biosecurity tools for tourism operations (Hall, 2015). In addition, for these campaigns to be effective, the educational and informative programs should be targeted at specific stakeholder groups (García-Llorente et al., 2008). It is known

that enhanced knowledge about the impacts of invasive alien species can influence attitudes towards their acceptability and higher rates of support for their management (Lovelock et al., 2022). Without sufficient knowledge, biosecurity measures could trigger unwanted reactions: for example, eradication of a certain species without considering public sentiment may trigger public opposition toward invasion controls, consequently hampering environmental and biosecurity management (Lovelock et al., 2022).

The second obstacle is the clash of interest between biosecurity and the economic profitability of the tourism sector. As stated before, the standard means to prevent the introduction or invasion of alien species is the restriction or complete denying access (Hall, 2011), which goes against the very idea of tourism. As within other fields of trade, protecting biodiversity is often at odds with the economic benefit alien species offer. Many alien species offer substantial socio-economic benefits, for example fish species introduced for sport fishing (Hall, 2015). This creates further opposition on biosecurity measures, such as control or eradication, and conflicts between different stakeholders (Shackleton et al., 2019). Another conflicting factor is the perceived aesthetic of species and the public's willingness to support their removal. For example, Lindemann-Matthies (2016) showed that with the increasing appeal of a certain invasive species, agreement for its removal within the public decreased.

5.5 Second homes and invasive alien species

Second home tourism is a large phenomenon in Finland: in 2022, there were 509 652 second homes (Suomen virallinen tilasto [SVT], 2023), with roughly half of the population having access to a second home (Voutilainen et al., 2021). As a tourism activity, particularly one often taking place in a natural environment, second home tourism can affect the surrounding ecosystem just like other types of tourism (Hiltunen, 2007). Possible effects include increase in land degradation, fragmentation, disturbance, and pressure in environmentally sensitive areas (Hiltunen, 2007). They also pose a risk for the spread of invasive alien species.

In a recent review, Novoa et al. (2023) presented five main reasons why second home tourism might endanger the state of natural biodiversity at the sites of second homes. Firstly, second homes may increase propagule pressure in remote locations through multiple pathways (Novoa et al., 2023). This risk is amplified by second homes' possible location near natural landmarks and protected areas, which often leads to increased infrastructure and transport networks in the area (Long & Hoogendoorn, 2014). Secondly, second homes can be a source of introduction for invasive species, especially ornamental plants (Novoa et al., 2023).

Similarly, to the grasses sown at ski slopes, these plants benefit from gardening practices, such as fertilization, which might increase their opportunities for establishment (Dehnen-Schmutz et al., 2007). Third reason is connected to the second one: as the primary home of the second home owners are often located far away, they often prefer to cultivate plants that are low maintenance, e.g. tolerate well different conditions (Padullés Cubino et al., 2016). Unfortunately, these traits are often associated with high invasive potential (Novoa et al., 2023). The fourth reason concerns the issue of awareness and attitudes. Just like tourists as a general group, second home owners may have different levels of awareness, perceptions, and attitudes regarding invasive alien species (Novoa et al., 2023). The importance of stakeholder knowledge and understanding in invasive alien species management has been underlined in chapters 3.1 and 4.3. As with other industries, management of biological invasions depends on the knowledge and support of stakeholders (Novoa et al., 2018). Lastly, second homes might constitute a barrier for the management of invasions, since the irregular presence of the owners makes it harder to gain entry to second homes and their gardens and engaging them in citizen science projects or other attempts to increase knowledge (Novoa et al., 2023).

As stated before, increasing the public's knowledge of invasive alien species and their impacts is crucial. Long and Hoogendoorn (2014) presented the finding that the second home owners' and users' perception of their impacts on the environment is not necessarily accurate, largely downplaying the impacts caused by second home tourism. Understanding the actual impacts and their repercussions might affect the tourists' actions and willingness to mitigate the impacts, as well as increase the support for biosecurity practices (Long & Hoogendoorn, 2014), which is why education and engagement are the most effective tools in managing environmental impacts, including biological invasions.

6 Study areas

This study explores the awareness and perception of tourists and second home owners and users on invasive alien species in two different study sites: Ruka ski resort and tourism centre in the municipality of Kuusamo, north-eastern Finland, and Saariselkä outdoor resort in the municipality of Inari in Finnish Lapland. Both destinations are generally known for their focus on winter sports and nature-based tourism, offering diverse activities such as hiking, fishing, mountain biking and different safaris. The most prominent difference lies in the tourists visiting these destinations. Looking at the recorded overnight stays in 2022, Ruka appears to be slightly more popular and receives mostly domestic tourists, while Saariselkä attracts more international tourists (Visitory, 2023a; Visitory, 2023b).

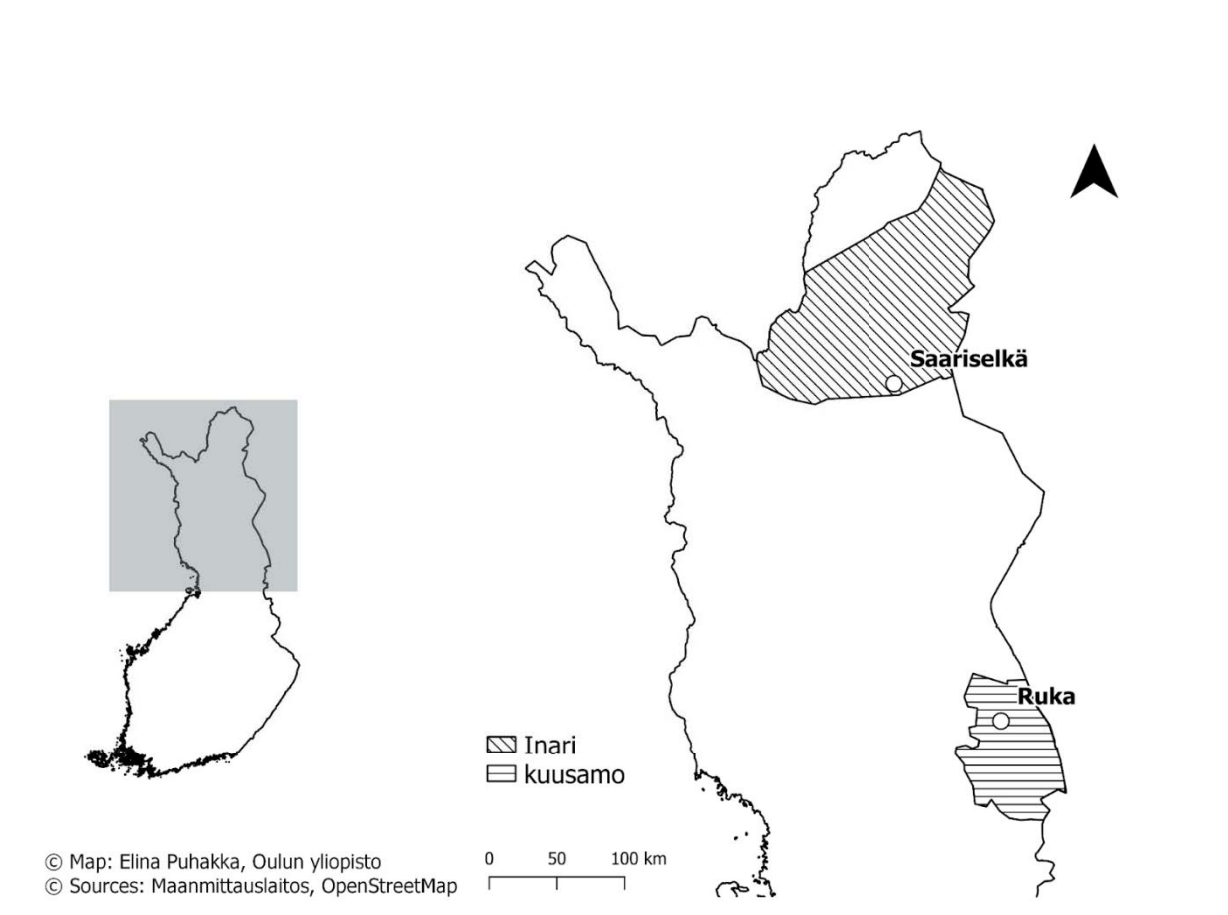


Figure 1: Locations of the study areas Ruka, Kuusamo and Saariselkä, Inari

6.1 Ruka, Kuusamo

The first study area, Ruka, is located in the municipality of Kuusamo. Kuusamo is located in the north-eastern part of Finland bordering Russia (figure 1). The area of Kuusamo is 5 809 km², of which 830 km² consists of rivers and lakes (Kuusamo Town, n.d.). The population in 2020 was 15 162 inhabitants, with population density being 3,3 inhabitants per km². The population of Kuusamo has been in continuous decline since 1996 (Tilastokeskus, 2022).

The nature in Kuusamo is diverse and rich and characterized by coniferous forests, canyonlike valleys and rapids. There are several protected areas, the most well-known being the Oulanka national park, which also extends to Salla municipality (Luontoon.fi, 2023a). The Finnish Biodiversity Info Facility (2023) database reports overall 8 967 species across taxa in Kuusamo, of which 27 species are recognized as alien species. Examples include the Japanese rose (*Rosa rugosa*), muskrat (*Ondatra zibethicus*) and the Persian hogweed (*Heracleum persicum*) among others (Finnish Biodiversity Info Facility, 2023).

The average annual temperature in Kuusamo is 0 °C, with approximately 200 days of snow cover (Kuusamo Town, n.d.). Kuusamo is also one of the snowiest areas in Finland, with average snow cover up to 80 – 90 centimetres (Kuusamo Town, n.d.). The Ruka Ski resort is one of Finland's most popular ski resorts with over 14,7 million euros in ski pass sales in the winter season 2021-2022 (Ruka.fi, 2023).

Tourism is an important part of the region's economy. In 2020 the tourism sector employed 625 locals full time (Ruka.fi, 2023), which made up 11 % of the local workforce at the time (Tilastokeskus, 2020). Kuusamo receives approximately million visitors annually, bringing in 117,8 million euros in direct tourism income in 2020 (Ruka.fi, 2023). There are approximately 12 000 beds available to tourists (Ruka.fi, 2023), in addition to over 7 500 privately owned second homes (Tilastokeskus, 2023). In 2022, Kuusamo had 636 000 registered overnight stays, with 529 000 (83 %) them being domestic visitors and 107 000 (17 %) international visitors (Visitory, 2023a). It should be noted that stays in rented or privately owned second homes are not being registered (Ruka.fi, 2023).

Even though Ruka and the greater Kuusamo area are widely known for the winter sport opportunities, the diverse nature offers activities such as hiking, fishing, mountain biking, and curiosities like bear watching. In recent years, the focus has shifted more towards year-around

tourism instead of peak seasons, since tourism and the resulting effects on the local economy in Kuusamo are highly seasonal (Kauppila, 2016).

6.2 Saariselkä

Saariselkä is a tourism destination in Finnish Lapland, located 250 kilometres north of the Arctic Circle in the Inari municipality (figure 1). It is the northernmost outdoor resort and offers activities throughout the year: cross-country skiing, reindeer and husky safaris, hiking, fishing, and hunting (Lapland North, n.d.). The resort also acts as a gateway to Urho Kekkonen national park, which is the second largest national park in Finland (Lapland North, n.d.).

Inari is the largest municipality in Finland by area but in 2022 had only 7 047 permanent inhabitants with population density of 0,47 inhabitants per km² (Inarin kunta, n.d.). The area is characterized by fells surrounded by coniferous forests (Luontoon.fi, 2023b). The average annual temperature is –0,7 °C (Ilmatieteen laitos, n.d.). Approximately 72,2 % of the area consists of different protected areas (Inarin kunta, n.d.). The Finnish Biodiversity Info Facility (2023) database reports 960 different species across taxa in the Saariselkä region, of which three are recognized alien species: the Nootka lupine (*Lupinus nootkatensis*), the garden lupin (*Lupinus polyphyllus*) and the Dermestid beetle (*Reesa vespulae*).

Saariselkä is the most important tourism destination in Inari: in 2022, out of 536 000 overnight stays in Inari 334 000 (62 %) took place in Saariselkä region (Visitory, 2023b). Out of these overnight stays in Saariselkä 170 000 (51 %) were domestic and 164 000 (49 %) international visitors, with the majority of foreign nationality visitors being British, French, and German (Visitory, 2023b). As with the case of Ruka, stays in privately owned second homes are not registered, nor are visits with no overnight stays. Similarly, Saariselkä also has an apparent peak season in December, with the overnight stays approximately three-fold compared to the summer months (Visitory, 2023b).

7 Data and methods

The data in this study consists of two different data sets: semi-structured interviews, that represent the qualitative data, and a questionnaire which constitutes the quantitative data of the study. Such a method where both qualitative and quantitative methods are utilized is called mixed method research (Creswell & Plano Clark, 2018). It is designed to provide a method of data processing that both utilizes the strengths of each method, while simultaneously overcoming the issues associated with them, thus supporting each other rather than existing as independent methods and data sets (Creswell & Plano Clark, 2018). Despite different forms of data collection, the interviews and questionnaires largely dealt with the same themes and questions and had the same target group of tourists of domestic and international origin as well as people who either owned a second home in the area or had access to one. The purpose of utilizing two different methods of data collection was to obtain both general and descriptive data of the target group, as well as deeper and detailed understanding of their awareness and perception, which might not be attainable through rigid and more controlled questionnaires.

The interviewees and the respondents filling out the questionnaire were ensured anonymity and strictly scientific purpose of the usage of their data and answers before any interview and in the introduction of the questionnaire. Some respondents may have been hesitant to give out their socio-demographic information, so to ensure the comfort of every respondent and interviewee, they were assured that they were allowed to skip any question they felt necessary. Since questions in the questionnaire could not be left blank, a chance to check “prefer not to answer” was provided.

Both data collection methods were carried out simultaneously while at the study sites. Data collection of the physical copies of the questionnaire and the interviews took place in two different destinations and timeframes: November 2022 in Ruka and in December 2022 in Saariselkä. The share of data collected from Saariselkä is slightly larger, which could be accounted for the field work in Ruka taking place outside of the season peak, leading to fewer tourists, especially in the case of international visitors.

7.1 Questionnaire

The first data set of the study, the questionnaire was designed to collect information on three main themes: the target group’s general knowledge about invasive alien species and the

phenomenon's connection to tourism activities, their personal views, opinions and perception, and their willingness to partake in biosecurity actions in the future. The main part of the questionnaire contained three sets of statements in the respective themes, and the respondent chose their answer from a Likert-scale ranging from *strongly disagree* to *strongly agree*. After the main part, respondents were asked to fill in their socio-demographic information and questions regarding their potential second home ownership.

The questionnaire was distributed through various methods. Firstly, the participants were approached in public spaces of high tourist traffic, such as the village centre in Ruka and popular nature attractions, such as Pieni Karhunkierros in Ruka and Aurorantupa in Saariselkä. After initial inquiries about their status as tourists and willingness to participate in a survey, they were asked to either fill out a physical form or identical online version through Webropol survey platform. The second method was door-to-door collection in areas where the density of rental cottages and apartments was high. The number of physical questionnaires collected through these methods came up to 135, as only two respondents opted for the online version. As a third method of data collection, a link to the online version of the questionnaire was distributed in Facebook on open and private groups directed at visitors and second home owners at the destinations. This included groups *Mitä Rukalla tapahtuu?*, *Ruka/Kuusamo vuokrattavat/myytävät mökit ja huoneistot*, *Posion ilmoitustaulu*, *Puskaradio Kuusamo*, *Utsjoki*, *Saariselkä*, and *Suuntana Pohjois-Norja*. The questionnaires were open continuously from 14.11.2022 to 2.1.2023. The number of questionnaires collected through these links was 103, with one entry deemed unusable. The final number of collected questionnaires is thus 239, of which 89 were submitted by second home owners. Both the physical copies and the online version had Finnish and English versions, and roughly about a quarter of the questionnaires were submitted by some other nationality than Finnish.

The data from the physical copies of the questionnaires was transferred to identical form in Webropol to be converted into a spreadsheet for further analysis. No changes were made to the data, including for example typing errors. The data from the questionnaires will be treated mostly as a background statistic for the target group involved in the data collection. Key figures from variables such as age, employment status and income information among others will be used to characterize the target group and act as a base for more in-depth analysis of the interview data. The results of the survey will be discussed in chapter 7, questionnaire results.

7.2 Interview

The second data set, semi-structured interviews were intended to deepen the understanding of the data acquired from the survey. While the questionnaire dictates what kind of questions the respondents may answer, the semi-structured interview was chosen to allow more free flowing conversation, more information, and additional anecdotes about the themes. Every interview was shaped according to the interviewees initial level of knowledge, their interest in the subject and their status as either second home owner or a visitor.

The interviews followed the same thematic pattern laid out in the previous chapter. To begin with, interviewees were asked about their knowledge about invasive alien species, and provided with a short introduction to the subject, including some examples of the most well-known in Finland. The next part discussed the interviewee's perception and views on the connection between invasive alien species and tourism activities, including their own part in spreading or preventing the establishment of invasive alien species. In the third part interviewees were provided with information about biosecurity measures and asked about their awareness and views on ongoing and potential measures, and their willingness to take part in these measures. Lastly, the same set of socio-demographic information was collected as in the questionnaire. The length of the interviews ranged from four minutes and 22 seconds to 14 minutes and 30 seconds, with most of the interviews lasting around eight minutes. After the interviews every interview was transcribed by the interviewers to ensure correct transcription.

The number of semi-structured interviews in total is 46, where the number of tourists is 29 and the number of second home owners is 17. The number of interviews is significantly lower than the number of questionnaires, which underlines the advantage of mixed method approach: while interviews can provide more in-depth data, it is much harder to collect. At first, many respondents were presented with the option of either interview or questionnaire, and the majority of them opted for the questionnaire. Because of this, the approach was adjusted to only asking for either or to ensure the sufficient collection of both data types. All of the interviews were collected randomly by approaching people, inquiring whether they were locals or tourists and asking for an interview. All of the interviews were conducted in Finnish and all except one of the interviewees were Finnish by nationality, with the single foreign interviewee being Estonian. While some interviewees took part in the interview alone, most interviews included multiple people at once, for example couples or families.

This dynamic often led to more in-depth answers when interviewees in the same interview discussed the themes with each other and not only with the interviewer.

For the analysis of the qualitative data the interviews are grouped into “tourists” and “second home users or owners”. The interview transcripts are read and coded: similar answers or keywords mentioned in the interview are noted, gathered, and ultimately assigned into a group or theme with other excerpts of similar coding. In this case this is done “manually”, without using any kind of qualitative analysis softwares. If it seems necessary or beneficial for the analysis, these themes can be grouped again into bigger overarching themes. After the coding is complete, the created themes are analysed using thematic analysis.

8 Questionnaire Results

The results of the questionnaire will be discussed in four parts. First, the background information and socio-economic factors are laid out in order to characterize the sample and the nature of their stay in the study areas. After this, the chapter follows the same thematic structure as the questionnaire, as the three main themes of awareness, perception and behaviour regarding invasive alien species will be discussed. In the online form it was mandatory to fill all fields in order to submit the questionnaire, but in the case of physical forms respondents might have skipped questions, either accidentally or deliberately, which has led to some missing data entries. However, with the small number of missing entries, 0 - 9 depending on the question, the effect is minor.

8.1 Socio-economic information

The questionnaire included questions regarding the background information and the socio-economic status of the respondents. A slight majority, 134 respondents identified as female (57,0 %), with 96 male respondents (40,9 %) and one respondent choosing the option 'other' (0,4 %). Four respondents (1,7 %) preferred not to disclose their gender. None of the age groups included were significantly greater than others. The biggest age group was 18 - 25 years old (21,9 %). Similar in sample size, 36 - 45 years old accounted for 17,6 %, 56 - 65 years old for 16,3 % and over 65 years old for 15,9 % of the respondents. The share of under 18 years old was 0,9 % with only two respondents.

Over three quarters of the respondents (75,5 %) were Finnish by nationality, with the second largest groups of British and French respondents each constituting 5,6 % of the sample. Other respondent nationalities included German (2,6 %), Chinese (1,3 %), Italian (1,3 %), Belgian (0,9 %), Dutch (0,9 %), Japanese (0,9 %) and Korean (0,9 %). With one respondent (0,4 %) from each country, the rest of the respondents originated from Australia, Azerbaijan, Brazil, Czech Republic, India, Ireland, Malta, Singapore, Somalia, Spain and Ukraine.

Most of the respondents possessed higher education, as 33,8 % of the respondents had completed a bachelor's degree, and 30,3 % a master's degree. 3,8 % of the respondents had a doctorate. Roughly a third of the respondents stated high school or vocational school (29,1 %) as the highest completed level of education, with four respondents (1,7 %) choosing comprehensive school. One respondent (0,4 %) chose the option of 'kansakoulu', which preceded the Finnish comprehensive school system. Two respondents (0,9 %) chose the

option 'other'. As for employment status, 44,0 % of the respondents were employed full-time. The second biggest groups were retired (19,7 %) and trainee or student (17,9 %). 8,5% of the respondents were entrepreneurs, 6,8 % were employed part-time, and 1,3 % were unemployed. Four respondents (1,7 %) chose the option 'other'. When asked about estimated combined annual household income after taxes, half of the respondents stated either under 50 000 € (27,8 %) or 50 000 € - 74 999 € (22,2 %). This question had the most 'prefer not to answer' -responses, with 35 respondents (15,2 %) not wanting to disclose their income information.

The next part of the background information included questions about the nature and logistics of the trip. Most respondents (83,6 %) stated 'leisure' as the purpose of their visit, followed by work purposes (7,8 %) and visiting family or relatives (3,0 %). Four respondents (1,7 %) travelled for studies and nine respondents (3,9 %) chose the option 'other'. Most of the respondents (63,6 %) arrived by car, followed by plane (19,5 %) and public transport (12,1 %). As for the type of accommodation, the most popular choices included the respondent's own second home (36,1 %) or a rental cottage (34,8 %). 40 respondents (17,4 %) stayed in a hotel or other type of accommodation company, 11 (4,8 %) stayed with friends or family and 16 respondents (7,0 %) answered 'other'. The respondents were also asked about the length of their visit. The number of nights stayed varied from zero to 270, with several respondents reporting multiple months stays. The mean of nights spent at the study area was 14,9 with standard deviation of 33,3, while median and mode both came up to six nights (N = 220).

Just over a third (37,6 %) of the respondents owned a cottage, timeshare, or other kind of holiday apartment in the area. Out of these respondents, almost half (47,7 %) had owned the cottage, timeshare, or other holiday apartment in question for over 10 years. 27,3 % had owned the second home for 1 - 5 years, and 12,5 % each for 6 - 10 years or for less than one year.

8.2 Awareness

The first questionnaire part regarding invasive alien species began with questions about the initial knowledge of the terminology. When asked whether the respondents were familiar with the term 'invasive alien species' prior to the questionnaire at hand, 80,3 % of the respondents claimed to be familiar with the term, with 13,0 % of the respondents not familiar and 6,7 % of the respondents unsure. Further, when respondents were asked whether they had heard about actions that can be taken to prevent the spread of invasive alien species, 65,4 % of the

respondents answered 'yes'. 24,1 % of the respondents were unfamiliar with said actions and 10,5 % unsure.

The second part of the section concerning awareness consisted of a set of statements regarding the respondents' perceived awareness and knowledge on the subject. The respondents were able to choose their answer from a 5-step Likert scale ranging from 'strongly disagree' to 'strongly agree' according to the standing best representing them or their opinion on the statement. The first statement 'I can recognize invasive alien species in the wild well' divided the sample in two: roughly half of the respondents either disagreed (36,0 %) or strongly disagreed (12,3 %) with the statement, while the other half either agreed (34,3 %) or strongly agreed (7,2 %). The remaining 10,2 % neither agreed nor disagreed.

The respondents' confidence in their theoretical knowledge on the impacts of invasive alien species was rather higher: 45,6 % of the respondents agreed and 16,9 % strongly agreed that they are aware of the impacts invasive alien species inflict on the native biodiversity, while 19,8 % of the respondents disagreed and only 4,6 % strongly disagreed with the statement (Figure 2). The same trend continued with the statement 'I am aware of the processes through which invasive alien species spread', although confidence was not as high as with the previous statement: roughly half of the respondents either agreed (43,9 %) or strongly agreed (8,0 %) with the statement. 27,0 % percent of the respondents disagreed and 8,0 % strongly disagreed. With both statements, 31 respondents (13,1 %) neither agreed nor disagreed.

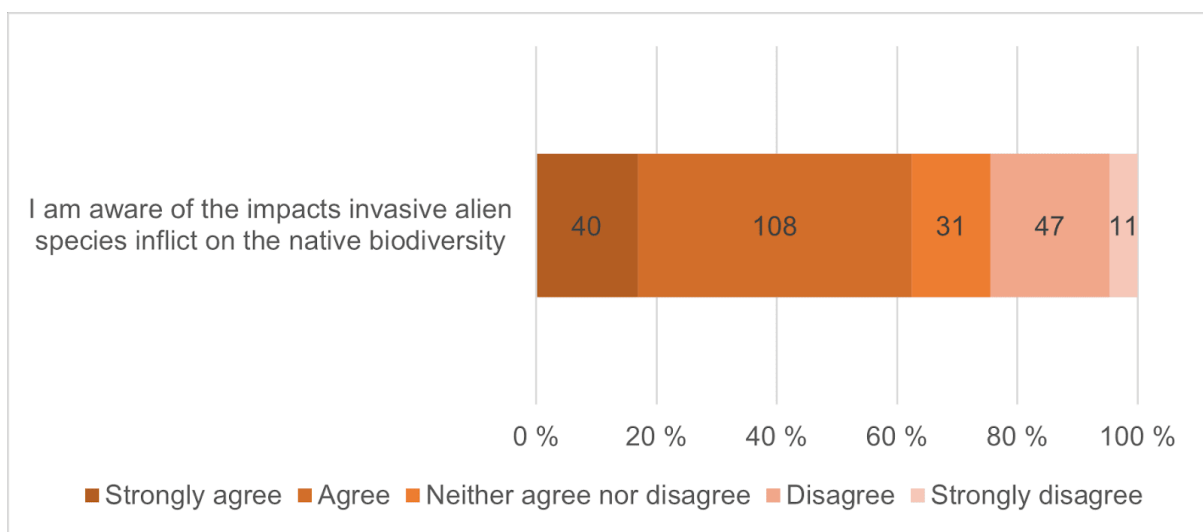


Fig. 2: Respondents perceived awareness on the impacts of invasive alien species on native biodiversity (N = 237).

The following two statements concerned the respondents' awareness of the relationship between invasive alien species and tourism. The results of these statements are visualized in figure 3. In the case of the statement 'I am aware of the impact of tourism on the spread of invasive alien species', responses were more disagreeing than agreeing: in total 44,7 % of the respondents either disagreed (34,9 %) or strongly disagreed (9,8 %). However, this majority was only slight, as 33,2 % of the respondents agreed with the statement and 6,0 % strongly agreed. This trend continued, slightly stronger, in the next statement 'I am aware of the actions that an individual tourist can take to prevent the spread of invasive alien species', with nearly half of the respondents disagreeing (35,0 %) or strongly disagreeing (12,7 %) with the statement.

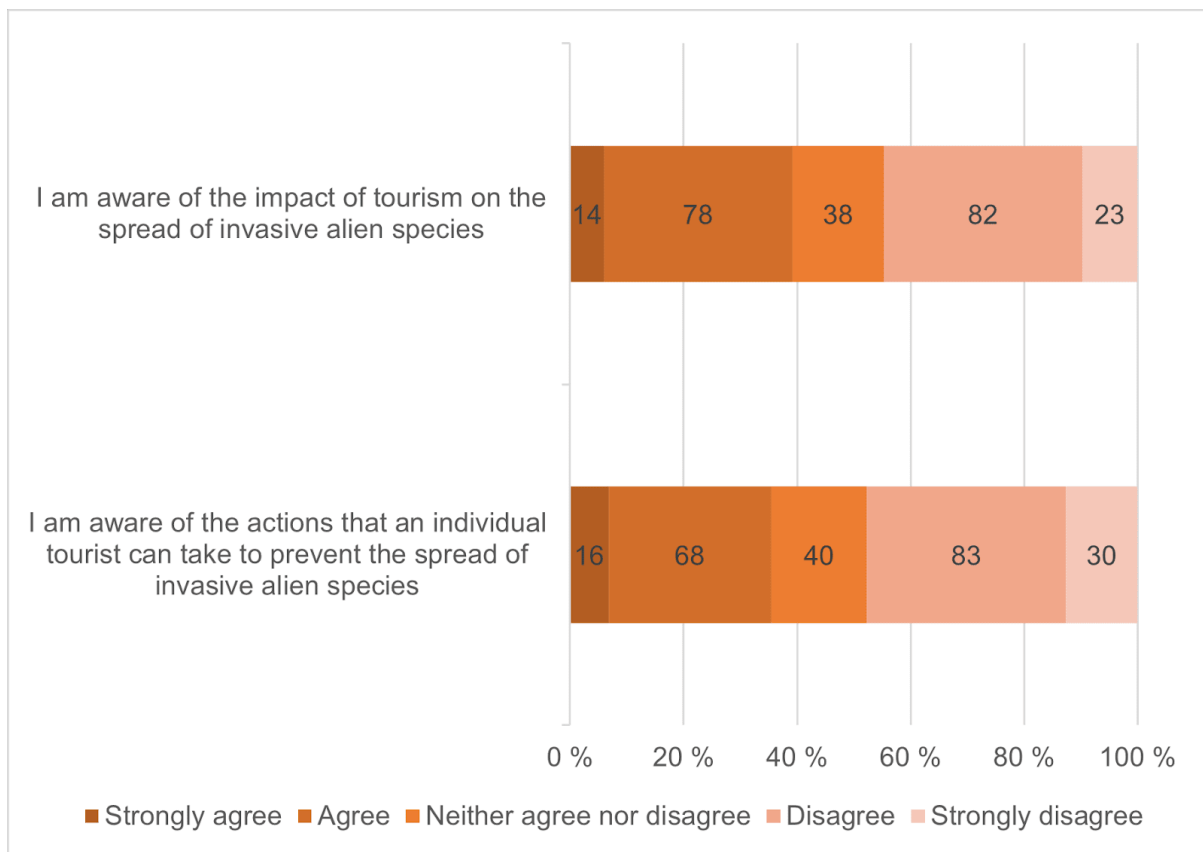


Fig. 3: Respondents perceived awareness of the relationship between tourism and invasive alien species (N = 273 - 275).

On a more general level in the next statement the respondents appeared more confident in their knowledge: just under half of the respondents either agreed (41,2 %) or strongly agreed

(5,9 %) with the statement ‘I am aware of the actions that can be done on the regional or national level to prevent the spread of invasive alien species’. On the contrary to the two preceding statements, this statement was not limited to the scope of tourism. Lastly, the respondents were well aware of their own potential influence on the matter: the statement ‘an individual person can influence the spread of invasive alien species’ received an overwhelming agreement with 45,8 % of the respondents agreeing and 37,4 % strongly agreeing with the statement. 8,8 % of the respondents expressed a neutral opinion, while only 12 respondents (5,0 %) disagreed and seven respondents (2,9 %) disagreed strongly.

8.3 Perception

The second set consisted of statements regarding the perception and personal views and opinions of the respondents about invasive alien species. The first three statements regarded the respondents’ perception and opinions on invasive alien species and biodiversity. The distributions of responses to these statements are visualized in figure 4. The first statement, ‘it is important to protect biodiversity’ was met with nearly unanimous opinion: 92,1 % of the respondents either strongly agreed (72,0 %) or agreed (20,1 %) with the statement, with 2,1 % disagreeing and 3,8 % strongly disagreeing. Five respondents (2,1 %) expressed a neutral opinion. The next statement directed the subject towards invasive alien species by stating ‘invasive alien species are a threat to the local biodiversity’. The distribution of responses resembled that of the previous statement, although certainty seemed to decrease and the share of neutral opinions increased: 23 respondents (9,6 %) neither agreed nor disagreed, while 46,0 % of the respondents strongly agreed and 38,1 % agreed with the statement. Eight respondents (3,3 %) expressed strong disagreement with the notion of invasive alien species threatening the local biodiversity. The trend continued with the third statement ‘I think more action should be taken to prevent the spread of invasive alien species’, where again the share of neutral opinions grew to 36 respondents (15,1 %), while agreement remained high: 42,3 % of the respondents agreed and 35,1 % strongly agreed with the statement.

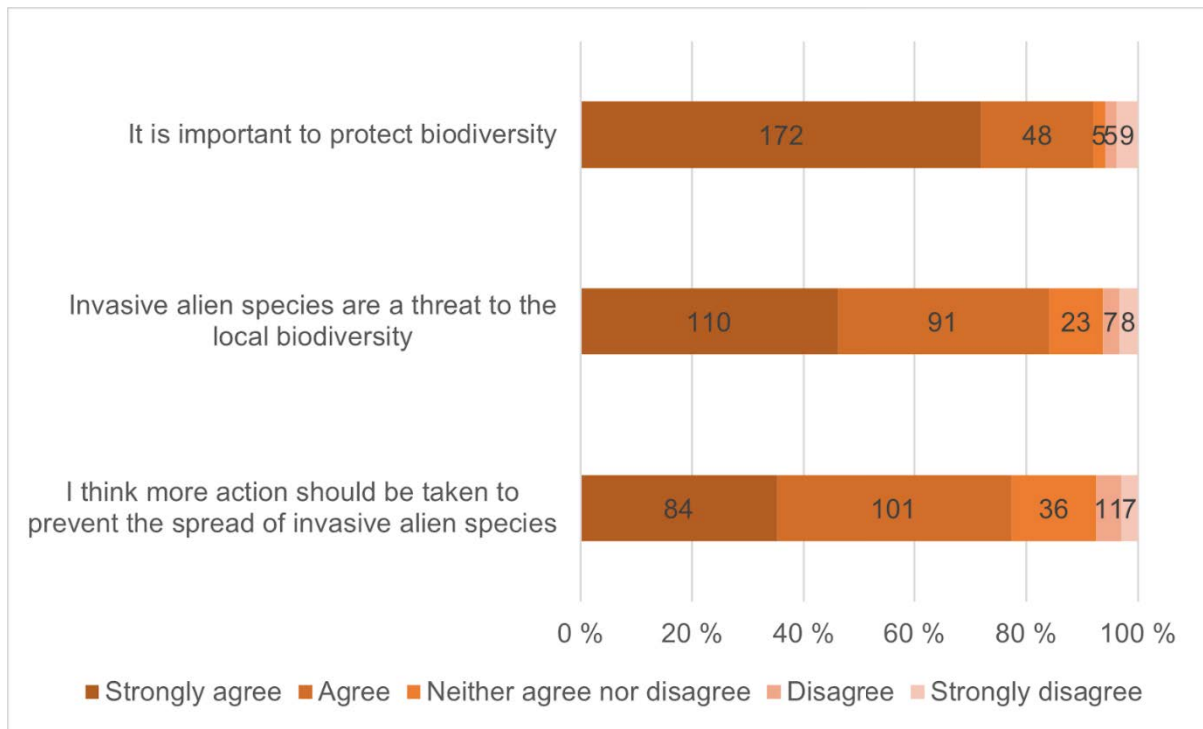


Fig. 4: Respondents' perception and opinions on invasive alien species and biodiversity (N = 239).

The remaining statements in this set concerned the information about invasive alien species available to tourists and second home owners. As with the previous statements, the responses are heavily concentrated on the other end of the spectrum, as visualized in figure 5. When asked whether the respondents had seen or heard information about invasive alien species or their impacts directed to visitors and second home owners, 37,7 % of the respondents disagreed strongly and 36,0 % disagreed. 16,3 % of the respondents either agreed (14,2 %) or agreed strongly (2,1 %) with the statement. Ten percent of the respondents did not agree or disagree. The majority of the respondents also disagreed when presented with the statement 'there is enough information about invasive alien species and their impacts directed to visitors and second home owners': 42,7 % of the respondents disagreed and 22,6 % disagreed strongly with the statement. The share of neutral opinions increased to 50 respondents (20,9 %) while 13,8 % of the respondents either agreed (9,2 %) or strongly agreed (4,6 %) with the statement.

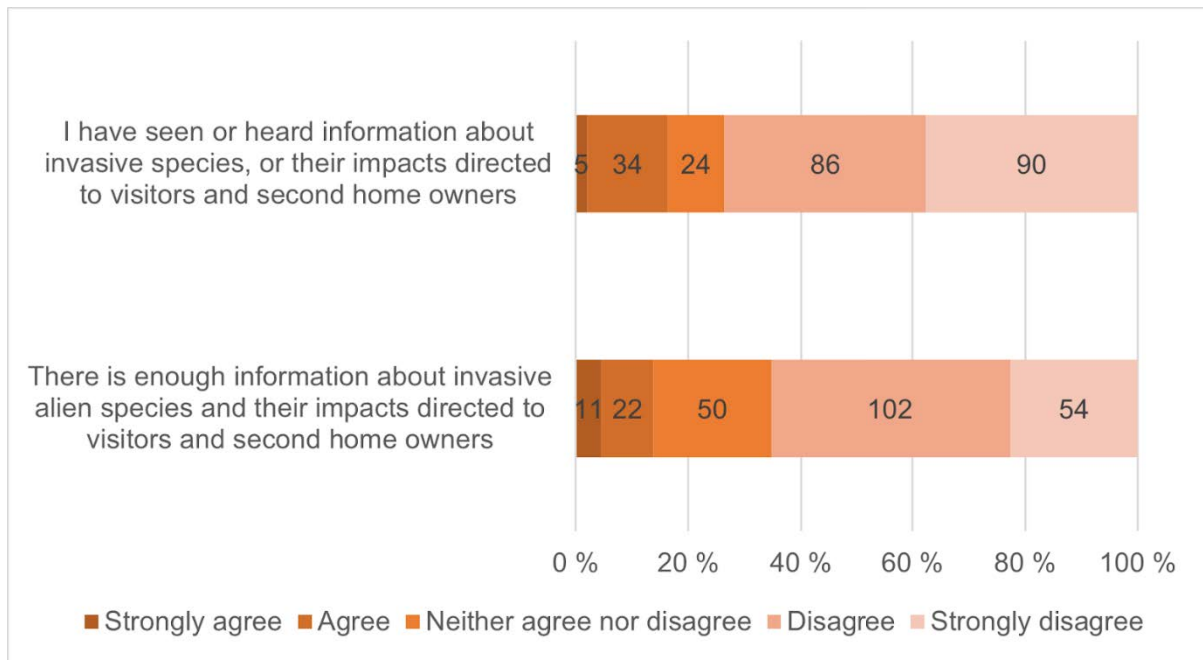


Fig. 5: The respondents' perception of information about invasive alien species available to tourists and second home owners (N = 239).

8.4 Behaviour

The third set of statements dealt with the actions to prevent the spread of invasive alien species and the respondents' willingness to take part in these actions. In the first three statements the responses are again similar in distribution, as can be seen in figure 6. The first statement 'I am ready to take actions to prevent the spread of invasive alien species during my next trip', meaning in this case the choices an individual traveller can make before and during their trip, was met with 41,4 % of the respondents strongly agreeing and 40,1 % agreeing. 3,8 % of the respondents disagreed and four respondents (1,7 %) disagreed strongly. The next statement 'I am willing to participate in actions that prevent the spread of invasive alien species [...] for example at the airport, on organized tours etc.' refers to voluntary actions initiated by some other entity than the tourists themselves. The distribution of responses remained roughly the same as within the previous statement, with combined agreement remaining at over 80 % of the respondents. Similarly, nearly 80 % of the respondents felt that the methods to prevent the spread of invasive alien species, namely biosecurity measures, should be legally required and enforced. 6,3 % of the respondents opposed the legal enforcement with 3,8 % disagreeing and 1,7 % strongly disagreeing with the statement.

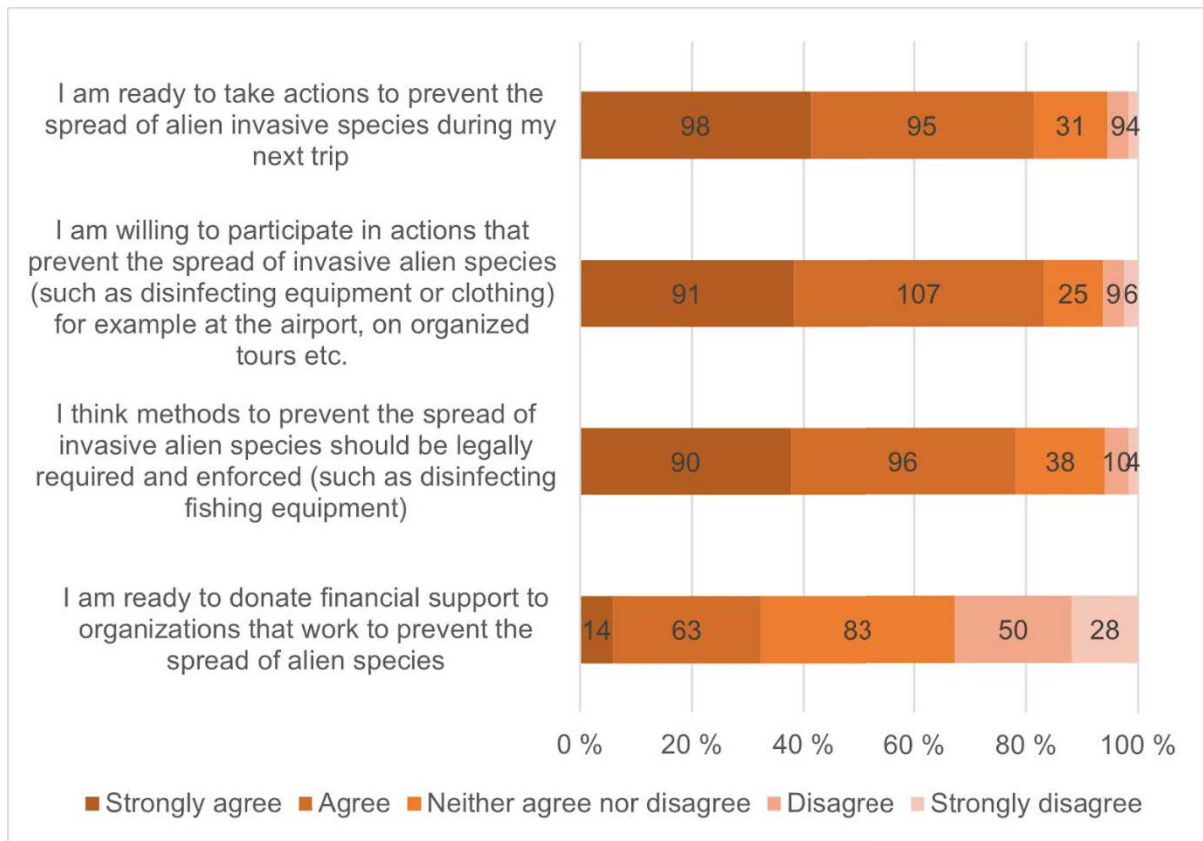


Fig. 6: Respondents' views on the actions to prevent the spread of invasive alien species and willingness to partake in said actions (N = 239).

The most notable shift happens when expressing the willingness to support prevention measures financially: the share of strong agreement decreased to 5,9 % percent of the respondents, while the share of those expressing a neutral opinion increased to 34,9 % of the respondents, between two- or three-fold compared to previous statements in the set. Similarly, the share of those strongly disagreeing with the statements increased to 11,8 % of the respondents, experiencing an increase of roughly ten percentage points compared to the previous three statements. Similar trend can be seen with those disagreeing with the statement: whereas for the previous three statements the share of those disagreeing ranged from 3,8 % - 4,2 %, readiness for financial support faced 21,0 % of the respondents disagreeing (Figure 6).

The respondents were also inquired about their interest in and willingness to use an app to identify invasive alien species. Nearly a third (31,1 %) of the respondents reported to have used such an app or otherwise searched information about invasive alien species online before. Furthermore, over half of the respondents expressed their willingness to use such app in the future, while 13,9 % of the respondents were not interested.

9 Interview results

Similar to the results of the questionnaire, this chapter laying down the results of the interviews will progress in four parts thematically identical to the previous chapter. To begin with, interviewees' background information regarding socio-economic factors and the trip details are presented. Next, the coded interview results are presented in regard to awareness, perception and behaviour and intent. Unlike in the case of the questionnaire, the results are discussed for tourists and second home owners and users separately. This is due to the coding process revealing that interview discussions often took form depending on whether the interviewee was a second home owner or not, and thus making it beneficial to discuss these groups separately. As the questionnaires served only as a descriptive statistic for the target group as a whole, no deeper quantitative analysis was performed in order to analyse the two groups separately. This was also restricted by the sample sizes, as the share of second home owners within the sample as a whole was relatively low, compromising the credibility of any quantitative analysis.

9.1 Socio-economic information

In regard to background information and socio-economic factors, the interviewees were asked the same questions as in the questionnaire. The combined number of interviewees is 46, out of which 17 are second home owners or users and 29 are tourists. The gender distribution within both groups was predominantly female: out of the second home owners or users 65 % were women, whereas the share of women in the tourist group was 55 %. The most prominent age group within second home owners and users was 46 - 55 years olds (29,4 %), followed by over 65 years olds (23,5 %). As for the tourists, the biggest age group was 56 - 65 years olds (44,8 %), followed by 26 - 35 years olds (20,7 %). 99 % of the second home owners and users were Finnish by nationality, with one Estonian interviewee. All of the interviewees in the tourist group were Finnish by nationality.

53 % of the second home owners and users had completed some degree of higher education, with 29,4 % having a bachelor's degree and 11,8 % each having master's degree or doctorate. 35,3 % were high school or trade school graduates. As for the tourist group, 67,9 % had a higher education with either bachelor's degree (39,3 %), master's degree (17,9 %), university of applied sciences degree (7,1 %) or a doctorate (3,6 %). In the second home owner and user group, the majority of the interviewees were working, either in a full-time job (47,1 %) or as an entrepreneur (5,9 %), while a bit under third (29,4 %) were retired. As for the tourists, 65,5

% of the interviewees had a full-time job. The share of retired interviewees was slightly lower at 20,7 %. The distribution in combined annual household income varied. 41,2 % of the second home owners or users did not want to disclose their income information. For the remaining, the most common income class was 50 000 € - 74 999 € at 23,5 % of the whole group. The tourists, however, did not mind sharing their income information, as only three (10,3 %) interviewees preferred not to answer the question. The most common income class was again 50 000 € - 74 999 € with a share of 27,6 % of the interviewees, with the remaining classes of over 125 000 €, 75 000 € - 99 999 € and under 50 000 € each consisting of 20,7 % of the group.

The interviewees were asked slightly differing questions about their trip, depending on which group they belonged in. Nearly everyone in both groups stated leisure as the purpose of their visit, except two interviewees (6,9 %) in the tourist group, who stated 'other' as the purpose. Every interviewee in the second home owner or user group had arrived by car, whereas the tourist group had slightly more variation: in addition to those who arrived by car, 13,8 % had used public transport and 6,7 % had travelled by plane. The mean duration of the trip in the second home owner and user group was 10,2, with a range from two nights to 45. Three interviewees (18 %) did not want to disclose the duration of their trip. The median stay was seven nights and mode of the stays four nights. As for the tourist group, the mean stay was 8,2 nights, out of range of one night to 60. The median stay was five nights and the mode two nights. Lastly, the interviewees were asked about their accommodation. Majority of the tourists (58,6 %) were staying in a rental cottage with 27,6 % staying in a hotel or other type of accommodation company. Two of the tourists (6,9 %) were staying with friends. As for the other group, the questions concerned the second home they owned or had access to. Majority of the interviewees (64,7 %) owned or had access to a timeshare, while equal shares of 17,6 % owned or had access to a cottage or some other kind of holiday apartment. The years they had owned the second homes ranged from half a year to 13 years, with the mean being 4,3 years and median four years.

9.2 Second home owners' and users' interviews

9.2.1 Awareness

After the questions regarding their trip, the interviewees were asked questions regarding their initial awareness on invasive alien species. To begin with, the interviewees were asked whether they were familiar with the term, and if so, asked if they could give any examples.

All of the interviewees stated that they were familiar with the term. The most common examples given were the Lupin (*Lupinus polyphyllus*) and Japanese rose (*Rosa rugosa*). These two examples were mentioned together or separately in six of the interviews, four times in Ruka and twice in Saariselkä. In the case that the interviewee could not give any examples, they were read a short information paragraph on invasive alien species and given a few examples by the interviewer. The subject was then expanded by inquiring if the interviewee was familiar with invasive alien species' impacts on the local nature and landscape. A common impact that the interviewees mentioned was the invasive alien species' ability to occupy habitat area and suppress native species:

“The original species that have been typical for that area disappear. [Invasive alien species] displace what should be there.” Interviewee #34

“There is a reason why they are harmful, is just that, when they occupy the living space and when they are spreading so effectively, so it is killing the surrounding nature and the different parts of nature, or as if to wither them, because they take all the minerals and other things from the ground.” Interviewee #36

“But it kind of destroys the prevailing vegetation, for example if you think about plants, Lupin also occupies and takes the vitality from others.” Interviewee #40

The most common vectors and pathways of species dispersal were fairly well recognised, although primarily on the individual scale. The most common examples mentioned were overall human influence, seed dispersal through clothes or equipment, gardens, and plant trading. However, many interviewees were rather unsure about their knowledge, despite giving factually accurate answers.

“Someone has seen a lovely Lupin abroad and taken it home and put it in the flowerbed and that's it.” Interviewee #43

“[...] plants at least spread from the seed like this or kind of via wind, but of course they are also taken, I mean, if you perhaps carry them somewhere.” Interviewee #44

“Then, of course, people carry them in their shoes, for example you have walked in southern Finland or even abroad and then you walk with the same shoes again there in the north.” Interviewee #45

Many interviewees also mentioned natural ways of species dispersal, which shows that the difference between an invasive alien species, defined by human-mediated spread, and naturally occurring introduced species may not be clear.

“On the other hand, also the seeds and probably the salmon move along the rivers all by themselves.” Interviewee #34

Where the interviewees were prepared to give examples of the impacts and pathways of invasive alien species on a general level, the knowledge on the relationship between invasive alien species and tourism was much more scarce. Most interviewees simply stated that the relationship exists but were unsure of their knowledge on the subject. If the interviewee gave examples, they often took the ways discussed in the previous question and extended those to include pathways between different countries. All the examples given related to individual tourists, and none of the interviewees considered the role of for example transport vessels or businesses in the tourism industry.

“Well, I suppose they can spread from one country to another via tourism, probably that is how they have also come here to Finland, those invasive alien species, I think so.”
Interviewee #30

“Probably it has, maybe probably plants, because maybe you can carry them in shoes...”
Interviewee #43

The interviewees did, however, come up with varying examples regarding how an individual tourist can try and prevent the spread of invasive alien species through tourism activities. Much like the previous examples, these too were limited to ideas concerning the tourists' ability to transport invasive plants and their seeds.

“Well, at least perhaps by not collecting them, Lupins, from nature and taking them as a souvenir to someone in another place. That's all I can think of.” Interviewee #30

“Well, in principle, yes, not to walk with the same shoes there in Lapland that you have used in Australia, or at least disinfect those shoes in between.” Interviewee #45

“So, you do not collect anything from nature, and you don't take them anywhere nor bring them here.” Interviewee #47

9.2.2 Perception

The next part of the interview consisted of questions regarding the interviewees' perception of invasive alien species. One of the major common themes found was that the majority of the interviewees thought that the state should take action to control the spread of invasive alien species, although the knowledge of biosecurity measures currently taking place was low:

“I have no idea. Well, that disinfection thing is familiar from the fishing trip, but I do not, I do not really know anything else, and I have never come across anything like that while traveling in Finland or somewhere else.” Interviewee #38

“I have no idea. I hope they [the state] take action.” Interviewee #42

Many interviewees associated biosecurity measures with Australia, particularly through a certain TV show, *‘Border Security: Australia’s Front Line’*. The show was used as an example of biosecurity measures in four separate occasions, where interviewees referred to the strict policies of Australian customs. However, while Australia was seen as a model example of invasive alien species control, it was also seen as an exceptional case:

“Australia is a bit different case, so you have to be careful not to take anything there, but I don’t think tourism is such a bad thing [in spreading invasive alien species]. [...] Well, of course, it is always good to take action, but my knowledge is not good enough to know how to implement them. Some Australia-style entry checks feel over-sized and impossible here.” Interviewee #46

9.2.3 Behaviour

Most of the interviewees were generally interested in the subject and expressed willingness to improve their knowledge and subsequently make more informed choices during their travels and everyday life. When the interviewees were asked whether they would be willing to participate in actions that attempt to prevent the spread of invasive alien species, every interviewee answered affirmatively.

“Yes, in principle, if the risk is real, then yes. It is already familiar from work, that you do not go from one barn to another in the same shoes, or at least you disinfect them in between.” Interviewee #45

“Yes, of course, if I find some that I consider a real threat and possible, that I have, let’s say fishing gear, so that every time the waterway changes, so then I do something like this [disinfecting].” Interviewee #46

The main issue recurring in the interviewee answers was the general lack of knowledge. Many interviewees expressed willingness to take part in preventative measures during their trips, but simultaneously said that they did not know what exactly they could do. While the interviewees could give some examples of preventative measures, many could not name any. Several interviewees felt that better understanding of the reasoning behind biosecurity measures could improve the willingness to participate.

“[...] there is not enough information, that hey, why this is a good thing to do. Then the threshold of course rises, but if there were easy facilities, so of course, they would want to do their best in the matter, yes.” Interviewee #36

“Yeah, but probably information, I guess, that people do not know what actions have impacts on what, so that by improving the awareness by target groups, because not everyone understands the message in the right way [...]” Interviewee #44

One of the ways to improve knowledge is the use of the internet and mobile apps. The potential of an informational app was brought up by the interviewer, and the interviewees were asked about their willingness to utilize such tools. The interviewees were generally interested in the idea of a mobile app to help identify invasive alien species and provide information about their control and eradication, given that the app would be easily accessible and easy to use.

“Well, yes, I could use [an app], but I had never thought of such a thing before.” Interviewee #38

“Well, for sure, if it is given to travellers in a way that it is not too complicated [...]” Interviewee #36

In addition to being open to the idea of an app, few interviewees mentioned that they had already tried to look up information on the internet. The motivations ranged from identifying the species in question to finding information about ways to remove and dispose of them.

“Yes, when I have seen some species here, I have checked what it is. I have [used the internet] to identify invasive alien species.” Interviewee #47

“I have looked for information on the internet, just last summer I was looking for information about this Japanese rose, how I can identify it and that information about how to dispose of it [...]” Interviewee #31

9.3 Tourists’ interviews

9.3.1 Awareness

In the case of awareness, the level of knowledge within the two groups were fairly similar. Nearly all of the interviewed tourists were familiar with the concept of invasive alien species, and the scope of their impacts was understood to the same extent as with the second home owners and users: the species were most often characterized as aggressively spreading plants that occupy habitat and hog nutrients from the native species. Again, the examples given mostly included the Japanese rose (*Rosa rugosa*) and Lupin (*Lupinus polyphyllus*). In addition to the species already mentioned by the second home owners, some additional species, such as the Spanish slug (*Arion vulgaris*) and the Himalayan balsam (*Impatiens glandulifera*) came up in the interviews with the tourists.

“Yes, lupines destroy these natural plants and flowers that used to be on the roadsides in the old days, lupines are spreading here. Nothing else grows there, anymore. Similarly, the Japanese rose has been spreading, for example, in the archipelago. Then it kills everything else there and then there is only the rose and nothing else growing. It’s the same with that one snail, it eats everything.” Interviewee #11

“Well, of course they occupy habitat from normal Finnish vegetation. That’s the biggest problem for sure. All the time. The Himalayan balsam, at least in our city, it’s a problem that it has appeared a little everywhere even though it has been tried to prune it out, but it always comes back.” Interviewee #26

Unlike in the case of the second home owners, the interviewees in the tourist group were much more knowledgeable in the relationship between invasive alien species and tourism. The impact of tourism was often mentioned in the initial discussion about the pathways and methods of species dispersal before the relationship was brought up by the interviewer. Much like in the case of the second home owners, the tourists too were hesitant in their answers and expressed their perceived ignorance, despite again giving factually correct examples, albeit at a very superficial level.

“At least, they spread via the wheels of a car or a tractor. I have noticed that when [a plant] is found somewhere, soon it is also there, so it is forest roads and the like. But I guess that in the same way tourists can also spread, and ships. Aren't those crabs traveling somewhere in these waters?” Interviewee #28

“I guess humans have brought at least some of them and planted them, and they may also come with the travellers.” Interviewee #12

The interviewees were also asked whether they were aware of the actions that the state takes in order to control the spread of invasive alien species. In this regard the knowledge was rather scarce. Most interviewees stated that they believed that the state has some regimes to control and prevent the establishment of these species but had not seen or heard about any kind of implementation, nor did they know what kind of actions could be implemented.

“I cannot say anything, at least I have not received any information that something like that would be implemented, probably it does, but I do not think it would be very common knowledge, at least.” Interviewee #18

“I do not know if they are implemented, or I do not know what to say about that. I guess [the implementation of actions in Finland] is slight, or I do not know, but I feel so.” Interviewee #18

9.3.2 Perception

Even though the tourists' current understanding of the state's attempts at controlling invasive alien species was rather lacking, they held the common opinion that the state should indeed work towards the control and eradication of said species. With equal unanimity several interviewees pointed out that it is also the individual's responsibility to do their part in the control of potentially harmful species:

“In my opinion, it is not helpful however much the state does, if individuals do not implement it, so I think that it starts more so at the individual level, the practical implementation, but then again it will probably depend on a state how extensive the measures are, so possibly some associations should be given resources for their activities, so that they can tell more about the issue or provide information or other things, perhaps in that way.” Interviewee #5

“It is that border control, one important thing that exists, but I do not really know anything else. Well, regulations have been required and restrictions and so on, so, their control, but then the implementation is pretty much left to the individuals. So not everything can be controlled, but one should take into account all the regulations and restrictions.”

Interviewee #6

The general consensus was that one of the state’s responsibilities is to provide enough accessible and comprehensive information on the subject. This need presented itself again when discussing the potential relationship between tourism and invasive alien species. Even though many of the interviewees were already, to some extent, aware of the relationship, many others struggled to find the connection.

“... I do not know how, what foreign you could bring from there. I cannot say. Probably, I am not really ready [to take action], but if I had knowledge, then sure.” Interviewee #12

“Well, from abroad, but I doubt the Finns themselves [spread invasive alien species].”

Interviewee #27

One of the themes emerging from the conversations was the tourist group’s scepticism towards the actual implementation of the measures towards the control of invasive alien species. These doubts arose especially while discussing the individual traveller’s efforts on these actions.

“Well, I guess if you set some [guidelines] that you should wear different footwear or something, wash the footwear or clothes. I don't know who's going to do that, but maybe that way.” Interviewee #11

“Well, I suppose you could take [control measures] into account, but I don't think anyone does...” Interviewee #11

“[...] there are now some regulations, for example about the crayfish traps, that they must be disinfected if you put them somewhere, well, I do not know if people follow them. What else, probably nobody disinfects fishing gear, at least not in Finland.” Interviewee #11

9.3.3 Behaviour

Unlike within the second home owners and users, the willingness to participate in biosecurity measures was much more divided. On the other hand, many interviewees expressed their willingness to learn more about the subject and abide by the guidelines and regulations, for

example by using an app designed to help identify invasive alien species, or by disinfecting their belongings and equipment. Once again, it was emphasized that participation required sufficient and easily accessible information.

“Yes, if I just have clear information about how I can do it, that is not in such a way that, well, when I go to the place, I am told that ‘you should have done it’, if I have not been told in advance. But if I know, for example, that if I travel in Finland from Southern Finland to Northern Finland, and I have been told nicely ‘pay attention to these things when you travel there’, then of course. They are small things that you can influence.”

Interviewee #5

“Well, probably now that there has already been this COVID-19 spreading before, if they now set that kind of [guideline] that you have to disinfected at airports and bus stations and also if you are moving within Finland, I would firmly believe it.” Interviewee #25

“It's okay to disinfect and it's been done, for example when we went to Australia they did disinfect, they're very strict, yeah. Yes, if it helps.” Interviewee #28

“Well, for sure I would take a look at [an app], if I suspected some, some species, if it is that or not. If it is easy to check, so of course it helps, if, yeah, it is quickly checked on the phone.” Interviewee #26

However, some participants held the opinion that the proposed measures, such as disinfecting, were too extreme and unnecessary. One justification offered by the interviewees was that they simply did not believe they as tourists were able to spread invasive alien species:

“[...] but for example we do not, we do not spread.” Interviewee #30

“It feels quite an extreme option [to disinfect luggage], ... I do not know. Somehow, I feel like, I think that now I do not bring anything with me. Well, the only thing is, of course, in some shoes some seeds could basically come, but that it is the only thing, I feel that I could, yeah, okay, check if there are any” Interviewee #19

10 Discussion

As can be seen from the previous two chapters showing the results of both quantitative and qualitative data, the results of the questionnaire and the interview largely support each other. As was intended, the questionnaire provided a more extensive overview of the sample, and the interview afforded a deeper understanding and explanations for the questions. Through the familiar thematic structure of awareness, perception, and behaviour, this chapter will discuss the data results in relationship with each other and with the previous research, and by drawing conclusions from the combined data attempts to answer the research questions stated in the introduction.

10.1 Awareness on invasive alien species

As mentioned before, the questionnaire results are only able to portray the participants' own perceived awareness on the subject, and not the factual level of their knowledge and awareness. This does cause some level of untrustworthiness, and therefore the results from the questionnaire cannot on their own answer to the first research question regarding the visitors' and second home owners' awareness. It is impossible to determine whether the participants' have answered the questions truthfully, or if their level of perceived knowledge is in line with their actual knowledge. However, by comparing the results acquired from the questionnaire and the more in-depth interview results, some assumptions can be made on the relationship between the perceived and factual awareness, if major discrepancies emerge, i.e., if they think they know more than they actually do. Identifying this potential gap can be helpful in determining action plans to improve knowledge on the subject. In light of the nature of the questionnaire, the first research question, 'what is the awareness of tourists and second home owners and users of invasive alien species and their impacts in Ruka and Saariselkä region', will be discussed mainly through the results provided by the interviews, with reflection to the results on perceived awareness gathered from the questionnaire data.

Both data sets showed that most of the participants in the questionnaire and the interview were aware of the existence of invasive alien species, but their knowledge and understanding, both self-perceived and apparent, were superficial in most cases. As opposed to the extensive range of pathways, impacts, species, and taxa discussed before through previous studies, the range of examples given and discussed by the participants was often very narrow. Species-wise, these examples included the most common invasive alien plants in Finland, species of

predatory animals and a certain species of fish, all of which have been fairly often discussed in the Finnish media in the past years. A notable find is also that while most of the participants were able to give examples, all of these were either plants, animals, or fish. Not one participant brought up or discussed the existence of more ‘invisible’ species, such as insects or pathogens. However, this does not come as a surprise, as most of the general discussion around invasive alien species concentrates on these more apparent and in a way more tangible species.

The range of invasive alien species’ impacts recognised by the participants was also much more narrow compared to the extensive list of impacts discussed in chapter 2.3. The impacts brought up in the interviews mainly consisted of those the participants might have witnessed themselves, such as the Lupin or Japanese rose occupying habitat space from native species by for example hogging nutrients. Thus, the awareness of impacts remained on a very local level despite the possible impacts taking place on all scales ranging from an individual to the atmosphere (Perrings et al., 2010). The participants did not bring up any ecological impacts taking place on broader spatial or temporal scales, such as the change in the genetic composition of native populations (Pyšek et al., 2020), disturbance in the local ecosystem services (European Commission, 2016), or the increased risk of species extinction (Bellard, Cassey & Blackburn, 2016). Similarly to the ecological impacts, the participants did not seem to be aware of the social or economic impacts caused by invasive alien species, such as changes in landscapes (van Wilgen, Cowling & Burgers, 1996) and ecosystem services facilitating livelihoods such as farming or fishing (Pyšek et al., 2020). Additionally, the interviewees did not seem to be aware of invasive alien species’ ability to transform their surroundings to better facilitate subsequent invasions (Simberloff, 2011).

The results on the participants’ awareness on the pathways through which invasive alien species spread presented similar findings as with the impacts. Again, the participants were able to give some examples on possible pathways, but the knowledge was very superficial and restricted to a small scale. Just over half of the questionnaire’s respondents felt that they were aware of the processes through which invasive alien species spread, but this confidence was not apparent in the interviews. However, there is a liability in the respondent’s interpretation of the statement: they could have agreed with the statement regardless of whether they were able to think of one pathway of spread or ten. Thus, the questionnaire statement offers an understanding of the respondent’s perceived awareness, rather than absolute knowledge of the respondent’s factual level of awareness. In that sense, the

interviews can offer a more realistic viewpoint. Most of the examples given related to humans carrying seeds or propagules on their person: seed dispersal in shoes and intentional transfer of plants for aesthetic purposes were the most common examples given. Thus, the idea of human movement facilitating other species movement was generally understood. However, the examples were often given with hesitancy and uncertainty, which underlines the lack of knowledge in this regard. One interviewee mentioned the ‘wheels of a car or a tractor’ and ‘ships’ as a possible pathway of spread, but otherwise transport was not recognized as a major pathway, despite its major role in propagule dispersal (Convention on Biological Diversity, 2014).

The previous literature presents undeniable evidence that the increased human mobilities, including tourism, have greatly accelerated the spread of invasive alien species. However, the tourists themselves did not seem to be highly aware of the issue. Similarly to the previous results, the participants’ awareness of the relationship between invasive alien species and tourism was low. Many participants were again very hesitant in their answer, and explicitly expressed that they ‘thought’ or ‘guessed’ that the relationship exists but were not sure about the actual processes or pathways of spread. Interestingly, the tourist group seemed to be more knowledgeable on the relationship than the second home owners, mentioning tourism mobilities as one of the possible pathways of spread before the issue was brought up by the interviewer. It would be interesting to know if this trend would repeat in a larger sample size, and if so, where does this difference originate from, and if there is statistical correlation between tourist status and greater awareness of the relationship. When asked about the connection between tourism and the spread of invasive alien species, many interviewees repeated the same examples they gave previously on the impacts and pathways, and simply extended their scale from national to international. Again, all of these examples related to an individual tourist as the vector of spread: not one participant mentioned the impact of for example tourism businesses or transport vessels.

It also seems that some of the participants were not aware of the difference between invasive alien species and naturally introduced species, even though the Finnish language separates the two (*vieraslaji* vs. *tulokaslaji*). The difference is in the driver of the spread: invasive alien species are characterized by the human-mediated spread, whereas naturally introduced species are often historical and have migrated without human involvement due to changes in environment and climate conditions (Syke, 2023). It is possible that the participants’ opinion on invasive alien species is affected by this misconception, as many introduced species have

become an established and accepted part of Finnish nature as a whole. If these two concepts are understood as one, the harmful nature of invasive alien species might be downplayed, and acceptance towards them subsequently increased.

Another question to consider is the type of second homes in this instance. Ruka and Saariselkä are both highly concentrated resort-type destinations. This is also apparent in the data, where the majority of the interviewed second home owners had access to a timeshare as opposed to a cottage type second home in a more secluded area. It would be interesting to study whether the type of the second home affects the awareness and perception of invasive alien species, as timeshares are often located in resorts with no access to a yard or a garden of its own. Potential research questions could for example discuss the following questions: Does taking care of one's own garden or yard influence the perception of invasive alien species, or increase the knowledge about the phenomenon? Does having a second home in a secluded, more natural area influence said perception or awareness, as opposed to a highly concentrated and city-like resort? Here, the groups of tourists and second home owners were studied separately due to the variety of themes emerging from the interviews. Would the themes and conclusions drawn from the second home owner and user group interviews be similar to the ones presented here if the majority of the interviewees owned a cottage instead, or would they create a new group altogether?

This chapter has attempted to provide an answer to the first research question regarding the tourists' and second home owners' and users' awareness of invasive alien species and their impacts in Ruka and Saariselkä regions of Northern Finland. In conclusion, it became apparent from the interviews that the awareness at present, both perceived and apparent, was low or superficial on invasive alien species, their impacts and pathways of spread, which is in line with previous studies on the subject (see Sharp et al., 2012). The participants were familiar with the term itself and the general definition of invasive alien species, and could give examples of some of the species, mainly plants and small predatory animals. However, the range of given examples was narrow and did not include species from the more 'invisible' taxa. Regarding the impacts and pathways of spread, the awareness was again superficial, but not non-existent. Participants were generally aware of the effects they would have seen themselves, but not of those with more complicated and time-consuming ecological repercussions. Their knowledge about the relationship between invasive alien species and tourism concentrated mainly on the individual tourists, rather than the industry as a whole. Thus, on all parts, tourists and second home owners and users possess an elementary level of

awareness on invasive alien species, but there are plenty of opportunities for improvement. Even though the questionnaire included international participants, the interviews only provided insights for the awareness of domestic tourists. It has been established by Lovelock et al. (2022) that the knowledge and awareness of domestic tourists on invasive alien species seems to be higher than that of international tourists, which would have also been interesting to study within this particular case, had there been international interviewees.

10.2 Awareness on biosecurity and behaviour

As the first research question dealt with the travellers' awareness on invasive alien species and their impacts, the second research question deals with their awareness on biosecurity, its implementations, and their willingness to implement biosecurity measures in their own behaviour. To discuss these themes, the participants were asked questions about biosecurity measures on national, industry-wide, and personal scale.

Regarding the participants' awareness on current and potential biosecurity measures, the results were much like those discussed in the previous chapter. The questionnaire showed that almost 80 % of the respondents felt that the methods to prevent the spread of invasive alien species should be legally required and enforced. This view was shared by the interviewees, as most of the interviewees thought that on the national scale the states should be responsible for preventing the spread of invasive alien species. However, when asked, they were able to give hardly any examples on what the actions to achieve this would entail. The examples mentioned included border control, mandatory disinfecting of fishing equipment and distribution of accessible information on the subject. Some participants mentioned applying of regulations and restrictions but did not specify what these actually entailed. Many interviewees also expressed uncertainty on what should be done by the state: Australia was often used as an example of a state executing biosecurity measures, but a couple of the interviewees felt that prevention measures similar to those of Australia would be excessive and out of place in the case of Finland. When asked what an appropriate level of intervention would then be, the interviewees simply stated they did not know.

While the awareness on the states' contribution to the control of invasive alien species was low, the general opinion seemed to emphasise the responsibility of the individuals instead. Many interviewees noted that the state's efforts are insignificant if the individuals do not follow the regulations set by the state. The views on an individual's ability to influence the spread, or rather to control said spread, were generally high. The interviewees were again

able to give examples of the actions an individual can take in the context of tourism and travel. However, these examples discussed straightforward actions regarding what can either be done or left undone in the destination, for example check one's footwear, not to bring anything with you and other actions discussed before in the interviews. For every interviewee, the act of travelling seemed to still be a given. Not one of the interviewees discussed actions or options on a broader scale, including choosing the destination based on the threat of invasive alien species, such as avoiding remote, protected or otherwise vulnerable areas, travelling to local or nearby destinations, or reducing travelling altogether.

An unexpected result regarded the travellers' attitude towards biosecurity measures, both driven by external forces and internal motivations: several interviewees expressed anxiety towards these measures or their success. Some interviewees felt that any kind of biosecurity measures within the tourism industry, at least at their particular destination, were unnecessary since they did not believe they could spread invasive alien species through their activities, or that invasive alien species could pose any kind of threat to the area. It might be of interest to note that these kinds of opinions were only present in the tourist interviews, and not within the second home owners and users. Others then believed that even though some kind of measures and regulations were put into place, people would not follow them, thus making them irrelevant. It therefore seems that for at least a part of the participants, biosecurity is not a functional tool to prevent the spread of invasive alien species. What remains unknown is whether this anxiety stems from the participants' mistrust in others, in their own ability to have an impact, or both.

Despite some differing opinions presented in the previous paragraph, the interviewees were generally interested in taking part in biosecurity measures, both independent and those initiated by others, for example transport providers or tourism businesses. This was also apparent in the questionnaire, where roughly only a fifth of the respondents were either opposed to or unsure about taking actions to prevent the spread of invasive alien species. The only apparent hindrance was money, which was apparent in the questionnaire: the respondents were drastically less willing to offer financial support for organisations working to prevent the spread of invasive alien species, as opposed to otherwise taking part in required actions.

The most prominent finding regarding the participants' behaviour was the general lack of information available. Almost 75 % of the questionnaire respondents claimed that they had

not seen information about invasive alien species or their impacts directed at visitors or second home owners, and roughly two thirds of the respondents felt that there is not enough such information available. The same notion was apparent in the interviews as well. Many interviewees expressed their willingness to participate in biosecurity activities but claimed that they were not knowledgeable enough to act accordingly. The interviewees called for easy to understand and easily accessible information, both on invasive alien species in general and especially directed toward tourists. It was also noted that the information and education should be given in a friendly manner, rather than through shaming tourists for not already knowing. What also needs to be considered is the type of information and the ways through which it is spread. On the other hand, the information provided should be general enough to be easily understood and accessible, but the downside of general knowledge is that it can prove to be too broad, in which case the target audience gets only a superficial overview of the issue, or too distant to actually conceptualise the repercussions on different destinations. An example of the latter could be seen in the interviews, where some interviewees recognised the harmful nature of invasive alien species but seemed to think that it only mattered in the context of somehow ‘special’ places, such as Australia. On the other hand, more specific information, for example such focused on a specific species or a destination, could provide more meaningful information in the tourism context, as the visitors could learn about the actual impacts on the area, rather than general examples of possible repercussions of invasive alien species as a whole. This could help to conceptualise the local effects of the phenomenon and provide specific tools to prevent it. None of these types of information could be said to be superior to the other, but rather they should be utilized in co-operation and in support of each other.

Seeing as the media was mentioned as an important source of information, and the majority of the species mentioned by the interviewees were such that are often present in the Finnish media and news, the role of media as an information outlet is indisputable. News and other media articles are often more accessible and visible to an ordinary tourist than specific campaigns or initiatives, and ‘bite-sized’ snippets of information can be easier to digest than for example national program documents or other type of official or academic documents regarding the issue. The eye-catching nature of some media outlets could also make the information more interesting: how likely are ordinary people scrolling on their phone to click a headline stating ‘*National strategy on invasive alien species*’, versus ‘*This invasive alien species is spreading in your area – see how you can prevent it*’? This kind of easily accessible

and understandable, although inevitably more concentrated and narrower, information could reach more of the ordinary tourists and improve their knowledge of specific species and their impacts at the destination.

As mentioned above, the different types of information should support each other. Thus, the quick and concise snippets need to be supported by reliable and extensive sources of information, should the reader want to learn more about the subject. The common thing between these sources is that to improve their success in providing information they should be easily understandable also to people who are not previously familiar with the subject. As for invasive alien species present in Finland, there is for example *vieraslajit.fi*, a site listing every known invasive alien species present in Finland providing information about the species including description, identification, impacts and distribution, as well as information on how to prevent the spread of the species and an option to report observations. The site is also available in English and Swedish. This type of information could also be developed into an app with additional features, such as AI-based identification from a picture. As seen from the results, the participants were generally interested in using an app should it exist, and roughly a third had already search information from the internet, such as *vieraslajit.fi* mentioned above. However, according to the participants, in order to utilize the app, it should be once again easily accessible, easy to use and easy to understand.

This chapter has attempted to answer the second research question regarding the tourists' and second home owners' awareness of biosecurity measures, and their willingness to take part in these measures. As presented above, the results follow largely those of the first research question, showing that the participants were fairly poorly aware of biosecurity measures, both those currently taking place and those that could potentially be implemented. The reason for this was claimed to be lack of information. The lack of information and subsequent knowledge was then also reflected in the willingness to take personal action: the reasons and motivations are naturally always subjective, but in some cases the unwillingness to act could stem from the inadequate knowledge and understanding of the possible threats imposed by invasive alien species. An example of this are the respondents who felt no need for biosecurity measures since they did not think that firstly, the tourists within Finland could spread any species, and secondly, that those species could have any significant impacts on the area. It is a subject for following studies to find out whether the opinion of these participants would change after receiving comprehensive information and education on the subject. To conclude, the production and distribution of accessible, interesting, and understandable

information should be prioritised to improve the understanding and inclusion of ordinary tourists and second home owners in controlling the spread of invasive alien species.

11 Conclusion and implications

The purpose of this study was to study the awareness of tourists and second home owners and users on invasive alien species and their impacts, specifically in a tourism context, as well as the tourists' and second home owners' awareness on biosecurity measures and their willingness to take part in biosecurity efforts. The study was carried out through two different data collection methods, a questionnaire and an interview, which both provided useful data for analysis. However, there were some liabilities regarding the acquired data. Firstly, the data from the questionnaires represents both domestic and international tourists, whereas the interviews only represent the views of domestic tourists and second home owners. Therefore, as the interviews provided the primary data used for thematic analysis, the results presented here cannot be seen to represent the views of international visitors, although they are included in the data collected through the questionnaire. It is acknowledged that in order to make this study more consistent, either the interviews should have included international participants, or the data from the international respondents should have been excluded from the questionnaire data. As of now, the questionnaire data is treated as a fairly homogenous group defined only by their traveller status (as opposed to that of a permanent resident). However, Lovelock et al. (2022) stated that the place of origin and cultural background both influence the attitudes and perceptions of the tourists, and it might have been worthwhile to study whether the place of origin had statistically significant effect on the views of the respondents. This scope of study would have required a larger number of respondents, especially international, which might have been difficult to achieve seeing as at one of the study areas only a handful of international respondents were reached.

The second liability is inherent in interview-type data collection: it is impossible to know whether the respondents speak the truth. Especially within topics concerning 'responsibility' or 'sustainability', the interviewees might feel the need to answer in a certain way to put themselves in good light, or they might over- or underestimate their own abilities, awareness, or knowledge. This is why the results presented here represent a mix of the respondents' perceived awareness and the interviewer's impression of their actual knowledge judged by the conversations between the interviewer and the interviewee. However, in this study those factors seemed to align in most cases: those who claimed to have poor knowledge were often unable to provide multiple or varying examples, whereas those who claimed to be

knowledgeable on the subject were much more prepared to discuss the issue and express comprehensive understanding of the matter.

The third and final restriction is the length of the interviews. As stated before, the length of the interviews varied from four minutes and 22 seconds to 14 minutes and 30 seconds, which is a very short timeframe for an interview. Longer and consequently more in-depth interviews would have provided a better understanding of the perceptions of the interviewees and allowed for wider set of questions and conversations altogether. However, the ability to hold longer, in-depth interviews would have required a whole different set-up: the existing interviews were gathered by approaching people outside and in public spaces in late autumn and winter, which imposed restrictions on the length of the interviewees so that the interviewees would not get cold or otherwise uncomfortable. Many people declined an interview pleading poor weather or being cold.

Despite these restrictions, the results present fairly uniform findings. The majority of the respondents in Ruka and Saariselkä were familiar with the concept of invasive alien species, but their understanding of their impacts, pathways of spread, and the variety of species was generally limited. So was the understanding of the relationship between spread of invasive alien species and tourism. When discussing tourism's influence, the interviewees only discussed their own influence as individual tourists, discussing examples such as carrying seeds in one's footwear. Although this is a perfectly correct and good example, the interviewees seemed to fail to recognize the role of tourism as an industry, including the impacts caused by tourism activities, resorts, and transport.

Similarly, the awareness on biosecurity measures was rather superficial. The interviewees mostly recognised import and export restrictions and disinfecting of fishing equipment. The frequent mentions of the latter could be explained by the proximity of the fishing rivers of Norway, where disinfecting is mandatory due to the control of invasive salmon parasite *Gyrodactylus salaris*. Another recurring theme were the biosecurity measures carried out in Australia. Multiple people said that they were mostly aware of biosecurity due to a TV show about the customs of Australian airports, although they did feel that measures of that level would be over the top in case of Finland, and not necessary. Still, they were unable to provide examples or ideas of suitable level of measures.

These results suggest that the general level of knowledge in both instances, invasive alien species and biosecurity, is low. It has been stated before that sufficient inclusion of all

stakeholders is essential in managing the issue and creating ways to control the spread of invasive alien species. To address the issue of insufficient knowledge of tourists and second home owners, the main takeaway is to provide easily accessible information through platforms that reaches the ordinary tourist and second home owners and is easy to understand and absorb. Since some of the interviewees questioned the harmfulness of invasive alien species, especially more comprehensive information on invasive alien species' impacts on ecological, cultural, and economic systems could be beneficial in increasing the acceptance of the control and implementation of biosecurity measures.

Due to reasons presented above, this study can be considered lacking or incomplete up to a point, which only presents a variety of themes to be studied in the future. Some interesting directions of study were already stated in previous chapters, such as the deeper differentiation between international and domestic tourists, deeper differentiation between tourists and second home owners and the significance of the type and location of the second home. Additional themes could include for example the viewpoint of protected areas, or awareness levels of tourists seeking different tourism experiences, like hikers or sports tourists and resort or spa visitors and wellness tourists. Although the issue of tourism and invasive alien species has been studied from different focus points and in different research areas globally, more information is needed to increase the knowledge in Finnish context in order to find viable ways to control the tourism-mediated spread of invasive alien species.

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Appendix 1: Questionnaire

Dear Sir/Madam,

This questionnaire is a part of a study where we examine the awareness of visitors, operators and policy-makers on the impacts of tourism on Invasive Alien Species and biodiversity protection. This study is primarily for research purposes, but our results will also help make better decisions about biodiversity protection and invasive alien species management. Your valuable inputs contribute to an academic research project in this area. Please take approximately 2-5 minutes to complete this questionnaire. **This questionnaire is completely anonymous, and your response will be treated in confidence and will only be used for academic purposes.**

If you have any questions or comments about the questionnaire, you can contact us.

We would like to thank you cordially in advance for filling out this questionnaire.

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Mandatory questions are marked with an asterisk (*).

1. Were you familiar with the term *invasive alien species* before this questionnaire? *

- Yes
- No
- I am not sure

2. Before this questionnaire, had you heard about actions that can be taken to prevent the spread of invasive alien species? *

- Yes
- No
- I am not sure

3. Please choose the option that best represents you or your opinion.

	Strongly disagree	Disagree	Neither	Agree	Strongly agree
It is important to protect biodiversity *	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Invasive alien species are a threat to the local biodiversity *	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
There is enough information about invasive alien species and their impacts directed to visitors and second homeowners *	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I have seen or heard information about invasive species, or their impacts directed to visitors and second homeowners *	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I think more action should be taken to prevent the spread of invasive alien species *	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I can control whether invasive alien species spread through my activities *	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

4. Please choose the option that best represents you or your opinion.

	Strongly disagree	Disagree	Neither	Agree	Strongly agree
I can recognize invasive alien species in the wild well *	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am aware of the impacts invasive alien species inflict on the native biodiversity *	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am aware of the processes through which invasive alien species spread *	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am aware of the impact of tourism on the spread of invasive alien species *	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am aware of the actions that an individual tourist can take to prevent the spread of invasive alien species *	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am aware of the actions that can be done on the regional or national level to prevent the spread of invasive alien species *	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
An individual person can influence the spread of invasive alien species *	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

5. Please choose the option that best represents you or your opinion.

	Strongly disagree	Disagree	Neither	Agree	Strongly agree
I am ready to take actions to prevent the spread of alien invasive species *	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am willing to participate in actions that prevent the spread of invasive alien species (such as disinfecting equipment or clothing) for example at the airport, on organized tours etc. *	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I think methods to prevent the spread of invasive alien species should be legally required and enforced (such as disinfecting fishing equipment) *	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am ready to donate financial support to organizations that work to prevent the spread of alien species *	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

6. Have you ever gone online or used an app to identify invasive alien species? *

- Yes
- No

7. Would you be willing to use an app to identify invasive alien species in near future? *

- Yes
- No
- I don't know

Please choose the option (1 per question) that best represents you. Answer these questions based on your current or most recent trip.

8. Gender *

- Male
- Female
- Other
- Prefer not to answer

9. Year of birth *

10. Current place of residency *

11. Nationality *

12. Highest level of education *

- Comprehensive school
- High School Graduate or Trade/Vocational School Graduate
- Bachelor's Degree
- Master's Degree
- Doctorate Degree
- Other

13. Employment status *

- Part-time job
- Full-time job
- Entrepreneur
- Unemployed
- Housewife / househusband
- Retired
- Trainee / Student
- Other

14. Combined annual household income before taxes (approximate) *

- Under 50 000 €
- 50 000 € - 74 999 €
- 75 000 € - 99 999 €
- 100 000 € - 124 999 €
- Over 125 000 €
- Prefer not to answer

15. Do you own a cottage, timeshare or other kind of holiday apartment in Sodankylä, Inari or Utsjoki municipalities e.g., in Saariselkä? *

- Yes
- No

16. If yes, how long have you owned this cottage, timeshare or other kind of holiday apartment?

- Less than 1 year
- 1-5 years
- 6-10 years
- Over 10 years

17. Type of accommodation on the trip *

- My own second home
- Staying with friends and relatives
- Rental cottage
- Hotel or other type of accommodation company
- Other

18. Duration of stay (nights) *

19. Purpose of the visit *

- Leisure
- Work
- Studies
- Visiting family or relatives
- Other

20. How did you travel to this destination? *

- Car
- Public transport
- Plane
- Other

21. How many times have you visited in Sodankylä, Inari or Utsjoki municipalities e.g., in Saariselkä including this or the most recent visit? *