Stakeholder Engagement in Invasive Alien Species Management – a Case Study in North-Brabant

A case study on the different perceptions and policies of the key stakeholders in North-Brabant regarding invasive alien species

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Abstract

Invasive alien species (IAS) are a major driver of global environmental change and can have a big influence on societies. With the development of IAS research, the role of stakeholder engagement is increasingly recognized as an important topic in IAS decision-making. Understanding the different perceptions and policies of stakeholders can help to increase awareness and understanding of the different opinions from various stakeholders, in order to facilitate a successful implementation of management practices.

This research will try to add to the body of literature on IAS management and aims to answer the question: *To what extent do North-Brabant stakeholders' perceptions and policies on invasive alien species in reinforce or contradict each other and how does this influence invasive alien species management?* In order to do so, a case study has been carried out, looking at the different perceptions and policies on IAS and IAS management of the key stakeholders involved with IAS decision making in North-Brabant.

The key stakeholders have been identified as the following parties:
Ministry of Agriculture, Nature and Food quality, 2), Netherlands Food and Consumer Product Safety, 3) Department of Waterways and Public Works, 4) Province of North-Brabant, 5) Municipality of Eindhoven, 6) Municipality of Tilburg, 7) Municipality of Breda, 8) State Forestry, 9) Water Authority Aa and Maas and 10) Water Authority Rivierenland. In-depth interviews, a literature review and a review of the most recent policy documents of the stakeholders have been carried out to identify the management implications of IAS-management in North-Brabant.

The data has shown that there is a lack of resources (people, finance and knowledge) among the stakeholders who are directly responsible for carrying out management interventions, such as the Municipalities, the Regional Water Authorities and State Forestry. This is mainly due to a lack of urgency, prioritizing and familiarity within the different organizations. Due to this lack of resources, IAS that cause social harm in the form of public health or IAS that cause economic harm get priority over IAS that only have an ecological effect. Moreover, stakeholders such as the Ministry of Agriculture, Nature and Food quality, Netherlands Food and Consumer Product Safety, and the Province of North-Brabant mostly provision resources towards stakeholders who focus on species that are on the Union List, which are only species causing ecological damage.

Due to the lack of resources, IAS are mostly tackled on a project-based manner. However, several different perceptions lead to implications in IAS-management. The data shows that when stakeholders perceive nature as dynamic and will find its balance, IAS obtain neotenic features or are widely spread then stakeholders are less likely to carry out management interventions. This leads to management implications as stakeholders indicate that they want to invest in tackling the problem of IAS, but will not take any measures as this will not have any effect in the long term when neighboring areas do not take appropriate measures as well. Stakeholders will take on a passive stand and start waiting for the other party to take action. The data also indicates that the lack of uniformity between the stakeholders results in IAS-management implications as well, as tackling the problem does not feel feasible

anymore. Stakeholders such as the Water Authorities and the municipalities are looking at other stakeholders such as the Province of North-Brabant to take the lead and provide practical policy measures and resources to efficiently tackle IAS. Collaboration between the stakeholders can also improve IAS-management in North-Brabant. However, so far there is no cooperation between the different stakeholders. Recently, measures have been put in to place to enhance the collaboration and increase stakeholder engagement.

Keywords:

Invasive Alien Species - stakeholder engagement – perception – policy – integrative governance

Preface and Acknowledgment

Before you lies the thesis: Stakeholder engagement in invasive alien species management – a case study in North Brabant. This thesis is written to fulfill the graduation requirements for the completion of my master's program: Environment and Society Studies at the Radboud university in Nijmegen.

Nature, biodiversity and climate are topics that I have always been passionate about. Therefor I find myself very fortunate that over the past years I had the opportunity to learn more about them by studying them and listening to very inspiring people in the field. This final research is not the end, but the start of a lifetime studying these topics.

My special thanks and appreciation to my supervisors Nowella Anyango- van Zwieten, Riyan van den Born and Helen Verploegen who were of great support. It is their critical feedback, excellent guidance, knowledge and experience that has guided me through the past few months.

Finally, I would like to thank my parents, sisters, and friends. Their encouraging words, trust and support got me through this challenging period.

I hope you enjoy reading,

Lieke Hoogestijn

Tilburg.

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Table of acronyms

AS	Alien Species
CBD	Convention On Biological Diversity
IAS	Invasive Alien Species
IG	Integrative Governance

1. Introduction

1.1. Problem Statement

Globalization brought us greater trade, transport, travel, and tourism. However, it also facilitated the introduction and spread of species that are not native to a certain area (Hulme P. , 2009). Invasive alien species (IAS) are a major driver of global environmental change and can have a big influence on societies. Although the introduction of alien species (AS) can bring benefits to specific sectors of society and produce economic profit, they may have far-reaching and harmful effects on biodiversity and natural resources for generations to come when they become invasive. When alien species are characterized as invasive, they threaten native biodiversity, transform ecosystems and alter habitats to a point of no reverse (Warren, 2007). IAS can also be a risk to the human health and have a significant social impact by endangering public health (Scalera, Genovesi, Essl, & Rabitsch, 2012). They can also cause serious economic damage. Their effects may include damage to agriculture, forestry, fisheries and water management (Scalera et al., 2012; Kettunen et al., 2009).

Numerous international instruments, binding and non-binding, have been developed to deal with certain aspects of the problem of IAS. The most comprehensive is the 1992 Convention on Biological Diversity (CBD) (see box 1), which calls on its parties -- 178 governments as of 2000 -- to "prevent the introduction of, control or eradicate those alien species which threaten ecosystems, habitats, or species" (Global Invasive Species Programme, 2000). As of 2010, only half of the parties to the Convention on Biological Diversity (CBD) have enacted national legislation relevant to IAS (Early, et al., 2016). Nowadays, those varied countries have policies in place to prevent the introduction and spread of IAS and to promote the resistance for alien species and solve the ecological, economic and social problems IAS can bring about (Warren, 2007). IAS management is needed to carry out these policies, manage their effects and stop the harm the IAS are causing (International Union for Conservation of Nature, 2021).

BOX 1: THE CONVENTION ON BIOLOGICAL DIVERSITY

The Convention on Biological Diversity (CBD) was established at the UN conference on Environment and Development in Rio de Janeiro in 1992. Since then, it has been ratified by 192 countries. The main objective of the convention is to ensure governments take action to ensure a sustainable future on all levels by conserving biodiversity, maintaining a sustainable use of biological resources and promoting the fair and equitable sharing of benefits from genetic resources. The governing body of the CBD is called the Conference of the Parties, or COP. It acts as the ultimate authority of all parties that have ratified the treaty. The COP meets every two years and during this meeting it reviews progress, sets priorities and commits to previously set work plans (Global Invasive Species Programme, 2000).

There is an ongoing debate within the scientific community regarding the most appropriate and effective strategies for managing IAS (Hulme, 2006; Meyerson & Mooney, 2007). Many IAS research and control measures still focus more on the technical and biological aspect rather than on the social aspect (Schackleton et al., 2018; Pysek et al., 2020; Gozlan,

Burnard, Andreou & Britton, 2013). This means that for several decades, IAS researchers addressed IAS via, for example, ecosystem process evaluation or by exploring the mechanisms underlying ecological disturbance (Pejchar & Mooney, 2017; Levine et al., 2003; Garcia-Llorente et al., 2011). However, more and more different studies explore the socio-economic and socio-ecologic dimensions of IAS (Bardsley & Edward-Jones 2007; Kumar Rai & J.S., 2020; Kannan, Shackleton, & Shaanker, 2013; Bremner & Park, 2007). This change is partly due to the recognition that IAS are one of the greatest threats to biodiversity, and a substantial contributor to global change (Naiman, 2017; Sala et al., 2000) and have effects on ecosystem services essential for human well- being (Pejchar & Mooney, 2017; Lis & Dukes, 2007).

With the development of the social side of IAS research, the role of stakeholder engagement is increasingly recognized as an important topic in IAS decision-making (Shackleton et al., 2018; Stokes et al., 2006; Garcia-Llorente et al., 2011; Novoa et al., 2017). This research defines a stakeholder as any individual, group or organization who is affected (positively or negatively) by invasive species, or who has the capacity to promote or limit the spread of invasive species. Stakeholders include the public/citizens (affected by and/or responsible for the spread and/or control of invasive species), researchers, government departments (responsible for the management of invaded areas or as policy makers), non-governmental organizations (NGO's) and businesses (Shackleton et al., 2018; Novoa et al., 2017). Stakeholder engagement is defined as the process of involving stakeholders (actors) in decision making, management actions and knowledge creation surrounding invasive alien species. Stakeholder engagement is important for understanding perceptions and practices, promoting awareness and social learning, building collaborative research, reaching consensus and agreements, solving conflicts, aiding prioritization and planning, and formulating co-management programs (Seastedt, 2014). It is encouraged to have a more integrative and collaborative engagement (Shackleton et al., 2018). This involves an improvement of management actions, interdisciplinary and transdisciplinary collaboration, and discussing practical policy suggestions for improving stakeholder involvement in invasive species management (Shackleton et al., 2018). There has been an increase in stakeholder engagement in invasive alien species management (Shackleton et al., 2018; Stokes et al., 2006; Garcia-Llorente et al., 2011; Seastedt, 2014) however, still many challenges stand in the way of effective invasive species management. For example, it is widely advocated that diverse knowledge and perspectives in the management of IAS should be taken into account. However, this might bring a potential conflict of interest (Shackleton et al., 2018; van Wilgen & Richardson, 2012) as utilizing AS can bring a positive economic effect by for example trading and selling AS. However, these species can become invasive at a later stage, becoming IAS Novoa et al., 2020). Stakeholders may also have different opinions about animal welfare, for example, is it justified to kill an animal because of its "invasive" label, as it is for the greater good of protecting the ecosystem (Inglis, 2020; Olszanska et al., 2016). Or, which methods can or cannot be used for combatting IAS. For example, the use of chemical pesticides (Pimentel, 2013) (Shackleton et al., 2018). Governments and institutions can have access to knowledge on the topic of IAS, but the lack of rules of interaction between multiple parties, different perceptions, and contradictory policies regularly stands in the way of effective decision making (Brunel et al., 2013).

1.2. Knowledge gap

There has been a growth of research on IAS and IAS management, however, until a decade ago, almost all of the research was conducted in the biological realm (Shackleton et al., 2018; Pysek et al., 2020; Gozlan et al., 2013). Humans are involved in the entire invasive process as they play a part in the introduction of IAS (intentional and accidental), suffer the consequences of IAS and they have the capacity to act and make decisions for managing the IAS. Therefore, IAS can be viewed as a socioeconomic and socio-ecological problem, one that requires sociological and economical solutions (Horan, Perrings, Lupi, & Bulti, 2002; Bardsley and Edward-Jones 2006;). The understanding of the human dimension of IAS management is critical in order to tackle the problems which are associated with IAS. In recent years there has been an increase in efforts to study public attitudes toward eradication and IAS management plans (Simberloff, 2005; Hulme, 2006; Bremner & Park, 2007). Other studies have looked at different ways to perform IAS risk analysis (Simberloff, 2003; Keller, Lodge & Finnof 2006) and emphasized the necessity of involving different sectors of society in the management of IAS (McNeely, Mooney, Neville, Schei & Waage 2001). However. relatively little attention has been focused on public attitudes toward IAS and the relationship between different stakeholders.

Therefore, there are still many gaps in our knowledge of prevention, control, eradication and management of IAS. The way in which different stakeholder groups identify the problems associated with invasive species and confront invasive species management under different policies remains poorly understood (García-Llorente et al., 2011). Consequently, a better understanding of IAS and perceptions toward them remains a vital and urgent issue which needs to be addressed as soon as possible. This research attempts to fill in the gap of stakeholder engagement research and argues that stakeholder engagement should be encouraged from the onset of any decision-making process as stakeholders have remarkably different perceptions about the impact that is caused by invasive alien species and different attitudes toward their introduction or eradication. A lack of cohesion between policy makers has been identified at the root of a widespread failure to develop and implement sustainable management practices for invasive alien species (Stokes et all, 2005; Shackleton et all, 2019; Dana et al., 2019). When stakeholders are engaged from the beginning, trade-offs involved in IAS management are directly addressed and successful implementation of management practices is facilitated (Kapitza et al., 2019; Vanderhoeven et al., 2017; Liu et al., 2011).

This research will contribute to the limited body of literature on IAS-management and stakeholder involvement, providing a case-study of the province of North-Brabant located in the Netherlands and researching IAS-management and understand this issue in a real world-setting.

1.3. Policy in the Netherlands

According to the Convention on Biological Diversity, each Member State should, as far as possible and appropriate, prevent the introduction of exotic species that threaten ecosystems and control or eradicate already established IAS (Wittenberg & Cock, n.d.). On the first of January 2015, The European Union, party of the CBD, issued the European

Invasive Alien Species Regulation which applies to all the member states of the European Union (which includes the Netherlands) (European union, 2014). Part of the European Invasive Alien Species Regulation is the Union list. This list contains the IAS for which each member state has the obligation to either prevent the species from entering or to control and eradicate the species which have already entered. Some of these species can also be found in the Netherlands. The national government is responsible for implementing this European regulation and there are various instruments and organizational structures in place for tackling the problem of IAS with a ministerial regulation (de Hoop, van der Loop, Matthews, van der Velde, & Leuven, 2017) the Dutch government has made the provinces responsible for taking control measures for most species on the Union list in their respective territories. Municipalities and water authorities take additional measures for possible IAS. In practice, mostly the municipalities and site management organizations are responsible for carrying out these measures (BrainPS Brabant, 2020). Previous research on the IAS policy in the Netherlands demonstrated that the implementation of measures is not going seamlessly, Rens Runhaar (2017), Associate Professor of Governance of Nature and Biodiversity at Utrecht University stated the following conclusion on IAS management in the Netherlands:

"It differs per actor how to view the usefulness and necessity of different measures. It often lacks a shared problem perception. Not all stakeholders have sufficient knowledge. According to the researchers, a better assessment framework is required to determine when any measures must be affected. In addition, the approach must be better substantiated and implementation support is essential." (Invasieve Exoten, n.d.).

This shows the many challenges that are still being faced, which portrays the need for more effective IAS management in the Netherland. This is also the foundation of the issue at hand regarding the IAS management in North-Brabant explained in the Case of Ravon in the section below.

1.4. Case study

This research is commissioned by Ravon, a research and advisory institution for the protection of amphibians, reptiles, and fish (Ravon, n.d.). For over 25 years, Ravon has been an independent non-profit conservation organization which, together with many volunteers, protects native reptiles, amphibians and fish and their habitats. Their mission is to protect species by understanding them through research and using this knowledge to advise, implement projects and steer towards better policy and legislation. Ravon wants to reverse the downward trend in biodiversity of the last century into a strong recovery. The aim is to achieve a sustainable population of native reptiles, amphibians and fish, spread out over their natural habitat in the Netherlands. This is a goal that may be compromised by the intervention of IAS. There are different stakeholders involved with regards to the problem of IAS (e.g., government, regional water authorities, nature and animal organizations and the public) and their diverse knowledge should be taken into account to find a solution. However, there are different and conflicting policies and perceptions when it comes to controlling of IAS. This gets in the way of effective invasive alien management and thus solving the problem of the ecological, but also social and economic damage IAS bring.

This research is part of a broader research of Ravon regarding aquatic invasive species that are causing harm to the biodiversity, such as the Mud-minnow and the Sunfish. These two fish species occur in isolated natural pools and small waters and pose as a direct threat to native fauna (Ravon, n.d.). Attempts have been made to remove the fish (such as manual removing). However, until now no method has proven to be effective. A possible new solution to the problem could be the use of biocides. Biocides are substances intended to destroy harmful and unwanted organisms, which may also cause a great number of disadvantages. Side effects could occur that may have an impact on public health and the environment (Guardiola, Cuesta, Meseguer, & Esteban, Risks of Using Antifouling Biocides in Aquaculture, 2012).

This research will focus on stakeholder engagement in IAS management in North-Brabant to get a deeper understanding in stakeholder involvement in IAS management. The province of North-Brabant is chosen in consultation with Ravon, mainly because of the many natural isolated pools and small waters that can be found in North-Brabant in comparison to other regions. These isolated waters especially are home to different IAS that pose a threat to the reptile and amphibian population. North Brabant may also be an interesting region as there is a lot of alternation between countryside and cities. IAS do not perceive borders which makes it all the more interesting to research IAS management in a province where many areas connect to each other.

Several stakeholders are involved with IAS-management of North-Brabant. However, this research will only focus on government departments (responsible for the management of invaded areas or as policy makers) and site management organizations, as they are direct responsible for IAS management in North-Brabant (this will be explained further in the method section). First of all, at national level the Ministry of Agriculture, Nature and Food Quality, the Netherlands Food and Consumer Product Safety Authority and The Department of Waterways and Public Works, which influence IAS management form the national level. Following the line of policy implementation, there is the province of North-Brabant to which nature policy has been decentralized. Other stakeholders involved in tackling IAs are the municipalities. The municipality of Eindhoven, Tilburg and Breda are the three largest municipalities in Noord-Brabant and will therefore be included in this case study. In addition, there are also several regional water authorities present in North-Brabant that are responsible for tackling IAS, such as Aa and Maas en Rivierenland. Lastly site management organizations such as the State Forestry are also included as they are responsible for carrying out the IAS measures. Other stakeholders such as nature and animal organizations, market and the public are not included, only stakeholders who are directly responsible for carrying out IAS management.

Management interventions have already taken place in North-Brabant, but those are mainly project-based. For example, the water crassula, a common invasive alien species in North Brabant, is intensively combatted. This plant is known for blocking waterways and ditches because they quickly overgrow. These plants are often mechanically removed by individual stakeholders. However, this action can be described as emptying the ocean with a thimble

because water crassula often returns, either by animals who transfer pieces of the plant to other water bodies, adjacent water overflowing which results in the plant being able to transfer to other water, or accidentally by humans. Another intervention which has already taken place is the use of pikes to fight the mud-middow. Pikes are introduced to the ecosystem to eat these fish; this is called biological control. Although the method is actually effective, it is not widely used because many stakeholders have reservations about biological control. There is the main fear that the remedy will eventually become worse than the disease. These two examples demonstrate that stakeholders may confront invasive species management differently. It is therefore interesting to look at North-Brabant to understand the issue thoroughly.

1.5. Research aim and sub-questions

To tackle the problem of IAS in North-Brabant, stakeholder involvement has to be more effective, as research shows it is encouraged to have a more integrative and collaborative engagement (Shackleton et al., 2014). This involves an improvement of management actions, interdisciplinary and transdisciplinary collaboration, and discussing practical policy suggestions for improving stakeholder involvement in invasive species management (Shackleton et al., 2014). Understanding perceptions of the different stakeholders and insight in the different policies can help to increase awareness and understanding for the differences in opinions between the different stakeholders in order to facilitate a successful implementation of management practices.

The research questions will be answered through the case study as this case will show how the different policies, perceptions and eventually management implications are shown and implemented in North-Brabant.

This research aims to map the different policies and perceptions of the stakeholders involved, concerning invasive alien management to provide Ravon with a better insight in the situation. Moreover, results and implications of this study can help stimulate a more integrative and collaborative engagement, which will help to facilitate collaboration between the different stakeholders. The research question is, therefore:

To what extent do North-Brabant stakeholders' perceptions and policies on invasive alien species in reinforce or contradict each other and how does this influence invasive alien species management?

Sub-questions:

- What are the main perceptions of the key stakeholders about IAS management?
- What are the main policies of the stakeholders and how do they relate to the implementation of the IAS management?
- What is the relationship between the perceptions and policies held by the different stakeholders?

1.6. Scientific and Societal relevance

The following section will discuss the relevance of this research. Firstly, the scientific relevance will indicate how the research will add to the existing academic literature. Secondly, the societal relevance will look at how the research will address societal issues.

1.6.1. Scientific relevance

First of all, as stated previously in paragraph 1.2, the way in which different stakeholder groups identify the problems associated with invasive species and confront invasive species management under different policies, remains poorly understood (García-Llorente et al., 2011). Consequently, a better understanding of IAS and perceptions and policies toward them remains a vital and urgent problem which needs to be addressed as soon as possible. This research will contribute to the limited body of literature on IAS-management and stakeholder involvement, providing a case-study of the province of North-Brabant and researching IAS-management in order to understand this issue in a real world-setting.

Second, within the Invasive species management discussion various researchers state that IAS management not only depends on biological and economic issues but also on how governance institutions influence cooperation from networks of stakeholders (Lublell et al., 2016). On one side of the discussion, there are researchers asking themselves whether stronger governance plays a beneficial role concerning IAS, stating that governance might even contribute to the problem. They state that the quality of governance within a country has implications for trade, tourism, transport, legislation, and economic development, all of which influence the spread of IAS. This means that an improvement in governance might result in an increase of the spread of IAS (Evans et al., 2018; Lotz & Allen, 2013). Moreover, one other side of the discussion states that regarding IAS-management the concept of governance has often a gap between theory and practice, for example, the tendency to be optimistic about the possibility of developing common understandings and collaborations between different interest groups/stakeholders (Schultz et al., 2015; Cleaver & Whaley, 2018). This research will add to this discussion by providing insights on integrative governance and governance participation within IAS-management in North-Brabant, while being aware of possible pitfalls such as the gap between theory and practice and policy fragmentation.

Lastly, this paper will also add to the animal rights discussion. There is a discussion in the academic community regarding the “invasive” narrative towards non-native species. On the one hand it states that the invasive species narrative, and with it the demonization of “invasive”, is morally wrong as it usually results in the unjust killing of the animal. At the heart of this issue is the problem that narrative oversimplifies what are very complex biological processes (Inglis, 2020; Warren, 2007; Larson, 2007). On the other hand, other researchers emphasize the nature and severity of threats that arise from "invasive" and should therefore be treated as such. They specifically disregard the intrinsic role of values in science, thereby reinforcing the “myth of a ‘value neutral science’” (Larson, 2007; Kaiser, 2000; Allen et al., 2001., Ludwig et al., 2001). Others in the academic community argue in favor of the term “invasive” species, as those species are filling in the ecological niches that are left by endangered or extinct species. As such, they may be a new hope of regenerating population numbers in de age of the Antropocene, which stand for the age of human caused

extinctions (Inligs, 2020; Pearce, Brouwn, Nerlich & Noteyko, 2015; Schlaepfer, Sax & Olden, 2011). In this research, the premise that a species which arrives into an ecosystem that it has not previously been a part of can cause damage to the ecosystem and other species is accepted. However, this research will add to the discussion whether the invasive species narrative can be flawed and if the systematic devaluing of animal life is a practice that is not morally justified.

1.6.2. Societal relevance

Effective IAS management is important, it helps to minimize the harm of invasive species on natural lands which encourages the health of native plants and wildlife. In particular, the economic and social effects of IAS can cause direct problems to society. The economic and social impacts of invasive species include both direct effects of a species on property values, agricultural productivity, public utility operations, native fisheries, tourism, and outdoor recreation, as well as costs associated with invasive species control efforts (NISIC, n.d.).

Stakeholders have different perceptions about the impacts and benefits caused by IAS. Their different attitudes towards their introduction and eradication should be considered when discussing their decision-making progress regarding management. In this way trade-offs involved in IAS-management can be directly addressed and successful implementation of management practices is facilitated (Garcia-Llorente et al, 2008).

2. Literature review and theoretical framework

This chapter outlines and reviews the relevant literature needed to answer the research questions. Firstly, contextual literature will be provided to give insights into the animal rights discussion and IAS management interventions to get a more thorough understanding on the issue of IAS. This will be followed by literature on the perception of stakeholders showing a framework used to investigate different perceptions on IAS. Lastly, the literature on integrative governance will supplement this literature and will provide insights into how to gain a better understanding of the stakeholders' policies and their relationship.

Note: not all elements of both frameworks are applied, as not all steps are relevant for this research (this will be explained in more detail per framework). However, it is recommended to apply certain steps in follow-up research. This will be further explained in the discussion.

After the literature review the theoretical framework will be presented, followed by the operationalization of the framework.

2.1. Contextualizing literature

First, relevant literature is identified to provide a better insight into the problem. While reviewing the literature on IAS, two themes emerged that provide context to the problem.

2.1.1. Animal rights discussion (context)

As is stated in the introduction, there is a discussion within the scientific community regarding the "invasive" narrative and the implications it has on animal rights and IAS-management. Moreover, this discussion can provide insights into the development of IAS perceptions and policies within North-Brabant as ethical considerations contribute to the way IAS are perceived (Shackleton et al., 2018). First of all, various researchers emphasize the nature and severity of threats that arise from "invasive" species. Invasive alien species can have a big impact on societies. Their impact may include damage to agriculture, forestry, and water management. They can also be a risk to human health and have a significant social impact. IAS threaten native biodiversity, transform ecosystems and alter habitats to a point of no return (Scalera et al, 2012; Warren, 2007). This does not mean that the negative impact that an IAS may have is not being recognized by other researchers, but they specifically disregard the intrinsic role of values in science (Larson, 2007; Kaiser, 2000) thus focusing solely on the technical and biological side of biological invasion. This side of the discussion has dominated for a long time as research on the biological side of IAS tarted to grow in the 1980s and 1990s, and only little research has been conducted on the ethical and social side of IAS (Shackleton et al., 2019; (Vaz, et al., 2017)Vaz et al., 2017)

Nowadays in the EU, there are policies in place to prevent alien species or, when the species already established itself, to control or eradicate it. For example, species on the Union list cannot be imported or sold anymore within a member state. Moreover, native species are

promoted and favored because of diverse motivations such as ecological, economic, moral, and aesthetic (Scalera et al., 2012; Kettunen et al., 2009). This has prompted many policies and costly actions, also in the province of North-Brabant, such as mechanically removing invasive alien plants, the draining of lakes and natural water pools to eradicate invasive alien fish (Oostermeijer, 2016). However, in recent years, researchers started to ask the question if those actions are based on sound foundations in regards to animal welfare (e.g. Inglis, 2020; Warren, 2007; Larson, 2007). No species is inherently good or evil. Warren (2007) states: "Every species is native somewhere and alien somewhere else, just as all have been colonizers at some time in the past ….. any attempt to define 'alien' and 'native' involves the drawing of lines, and it is often unclear". Warren argues that the justification of controlling and eliminating invasive species should not be their time, mode, and place of origin but their potential for causing damage (Warren, 2007). Other researchers also argue that invasion biologists should adopt a more objective and dispassionate stance towards invasive species (Larson, 2007; Collauti, 2014;). Adding to this discussion, various researchers state that the invasive species narrative, and with that the demonization of “invasive”, is morally wrong as it usually results in the unjust killing of the animal (Inglis, 2020; Abbate and Fisher, 2019). At the heart of this issue is the problem that narrative oversimplifies very complex biological processes. Terms as “invasive” are used to make complicated biological processes accessible for the general public, however, this entails the risk that it can be misappropriated.

This view has also received criticism, stating that it is often oversimplified and that researchers and managers are confronted with a full range of complex issues dealing with biological invasions. Invasion biologists might risk their objectivity or “embark on a slippery slope” with engaged concern about invasive species (Larson, 2007; Brown and Sax, 2004). Besides, Warren (2017) states that some societies rely on alien species to supply most of their resources and that those species are not invasive. However, mainstream literature on biological invasion shows that researchers and managers working in the field are aware of the conflicts of interests of alien species that are valued in their new range but become invasive (Simberloff, 2010; Crowley et al., 2017; Hanley & Roberts, 2019). Moreover, 'native' and 'alien' should be considered as different points on a continuum, rather than absolute polar opposites (Richardson et al., 2008).

Recent development in IAS research shows that humans are involved in the entire invasion process, from introduction to eradication. Humans have the capacity to act and make decisions for managing the IAS. Therefore, IAS can be viewed as a problem which requires sociological and economical solutions (Perrings et al., 2000, Bardsley & Edward-Jones, 2007). Understanding of the human dimension of IAS management is critical in order to tackle the problems that are associated with IAS. Detachment of the ethical and social considerations embodies an ideal of science that does not apply very well to invasion alien research (Larson, 2007).

2.1.2. IAS-management interventions (context)

With the introduction of the European Invasive Alien Species Regulation, three steps were promoted to manage IAS. Those steps are also dominate the existing literature (Hulme, 2006; Horan et al., 2002; Beninde et al., 2014) – prevention, eradication and control. This

paragraph will elaborate on those steps as it provides context to the different options the key stakeholders can make which influences IAS-management in North-Brabant.

The first step is to prevent the introduction, the so-called "prevention". Prevention is according to many researchers the first and most cost-effective strategy against IAS (Wittenberg & Cock, 2001; Burgiel et al., 2006). In the Netherlands, this is mainly the responsibility of national and international policies and is virtually invisible to many people. Risk analysis are performed to estimate which IAS are potentially harmful, and those species are actively kept out of the country, for example through trade bans, agreements on transport in which invasive alien species can spread (such as ballast water in cargo ships and the transport of mussel seed) and customs controls (Invasieve Exoten, n.d.).

If the introduction can no longer be prevented, then there are several strategies one can employ. Often it is desirable to eradicate the species quickly and completely, the "elimination". The most efficient would be to eradicate species as soon as possible so they do not become too widespread, however in practice IAS are often noticed relatively late (Rocamora & Henriette, 2015). Nevertheless, research shows that a monitoring which could use, for example, citizens science as a monitoring tool, may prevent this issue (Martinez-Cillero, et al., 2019; Poursanidis & Zenetos, 2013).

If eradication is no longer possible because the species has become too widespread, there is a lack of resources to completely eradicate the species or elimination is not desirable for other reasons, then the species must be controlled as much as possible. This is needed to prevent further expansion and loss of biodiversity, "isolating" and "protecting native wildlife". The transition between the different phases is gradual, at which different approaches can occur side by side (Invasieve Exoten, n.d.)

Three main approaches for dealing with IAS can be distinguished (Wittenberg and Cock, 2001). The most applied in the Netherlands, is mechanical control. In this method, animals and plants are mechanically removed from their habitat. Examples of mechanical control are, for instance, sawing off, digging, and fishing. Chemical methods are also extensively used. In the Netherlands biocides are used in agriculture to combat invasive species (CTGB, n.d.). However, the use of pesticides is declining in site management due to the growing negativity around chemicals in our society. Although biocides are often more effective and selective in the control of alien species, most of them are prohibited to use in water and nature due to public health concerns (BTO, 2019).

However, the use of biocides can be considered in exceptional cases. An example is the biodegradable fish pesticide rotenone. Although rotenone is also harmful to other aquatic animal species, the populations of these species are already under pressure as a result of the IAS. Several studies have shown that after rotenone treatment, the IAS have disappeared and the populations of native species are rapidly recovering (Sutherland, Dicks, Petrovan & Smith, 2020). The third group of control methods is biological control. This means that IAS are controlled with predators, herbivores, or pathogens. An example is implementing the pike into an ecosystem with invasive alien fish, as mentioned in the introduction. Pikes eat the fish to keep the population in check. Furthermore, pikes are cannibalizing animals which means that they also eat each other, as such they will not dominate quickly. Moreover, the

species that are deployed are highly selective for the unwanted IAS so that there is no danger that the introduced natural enemy will switch to native species (Invasieve Exoten, n.d.).

2.1.3. Perception on invasive alien management (relevant for the conceptual framework)

Understanding people's perceptions is crucial in order to understand support and resistance of management strategies to develop effective management strategies to maintain, preserve and improve biodiversity. The IAS perception model (figure 1) provides six factors that influence people perceptions. Insights in those factors help to understand the perceptions of the different stakeholders. This model provided by Shackleton et al. (2018) provides a clear and systematic way to get insight into the perceptions of the different stakeholders. This framework will be modified to fit this research.

This framework identifies six broad-scale dimensions that can influence IAS Perceptions; 1) attributes of the individual perceiving the IAS, 2) characteristics of the IAS, 3) effects of the invasion, 4) socio-cultural context, 5) landscape context and 6) institutional and policy context. Whether a stakeholder regard an IAS as problematic depends on the number of factors that influence their perceptions of the species and its effects. Each primary factor has its own underlying factors which are dynamic and interact with each other (Shackleton, et al., 2019).

1. Individuals. This means the understanding of how individuals perceive their environment. The individual value system and knowledge systems play an important role in informing people's perceptions. Emotional factors also weigh in and experience with IAS should also be taken into account to understand the context in which individuals' knowledge and value systems develop. In this study “individual” refers to the organisation (stakeholder) an it’s values and knowledge system in place.
2. Species. Perceptions are mental constructs of an object and they are influenced by the attributions of that object (the invasive alien species in this case). Important factors that need to be addressed are the traits of the species, their introduction status, and residence time.
3. Effects. The effects can be understood as the changes to a social-ecological system as a result of the IAS. The effects can be valued concerning economic, ecological, and social implications. The perceptions on the effect can also differ among stakeholders which might result in conflicts of interest.
4. Socio-cultural context. The social-cultural context are the factors that shape perceptions through the ways in which people interact with each other in the social realms of rules, traditions, practices, and ideas. The social-cultural context includes social institutions such as land tenure systems, cultural and religious norms, and the socio-economic development in a certain area (e.g., the different income classes). The socio-cultural context will be discussed in a contextual case-study description for all the stakeholders as they are all located within North-Brabant and thus in the same context.
5. Landscape context. The landscape context concerns itself with the landscape as areas of land containing different mosaics of patches and elements that often repeat

themselves. It describes the ecosystem type, land use, and cover. The landscape context will also be discussed for all the stakeholders as it is also similar for all the stakeholders in North-Brabant.

6. Institutional, governance & policy context. This indicator provides the policy and governance context that influence people's perceptions of IAS. This includes historical processes, institutional frameworks, and international agreements. In addition to providing the whole institutional, governance and policy context, theory about integrative governance will be provided in the next paragraph to supplement the IAS perception framework in the field of policy. Moreover, it will also provide more insight into the relationship between the different stakeholders and their perceptions and policies. Policies and its context will be described for each stakeholder individual.

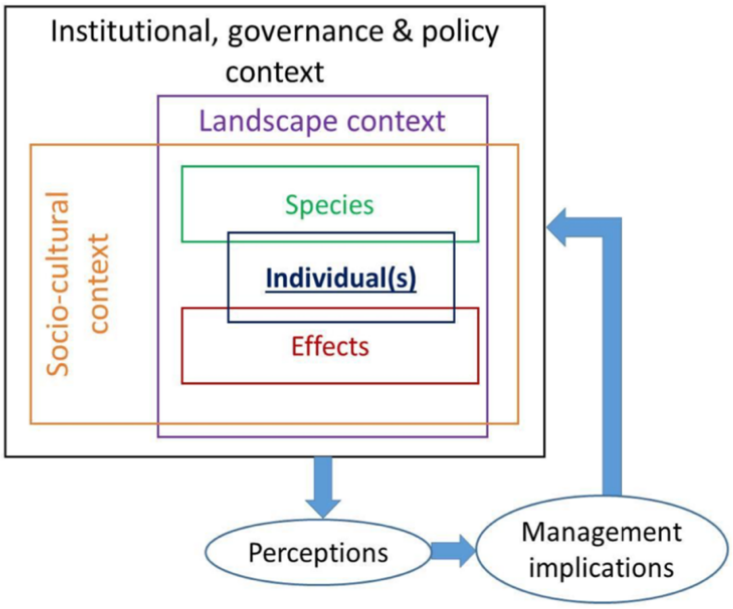

Figure 1: Conceptual framework of the primary factors that influence people's perception of IAS, Shackleton et all, 2019.

2.2.1. Integrative governance

Integrative governance (IG) is defined as the theories and practices that focus on the relationship between governance instruments and/or governance systems (Visseren-Hamakers, 2015) and can therefore provide more insight into the relationship between the different stakeholders and their perceptions and policies. Governance instruments include public, private, and hybrid policies and rules. A governance system can be defined as the total of instruments for a certain issue on a specific level of governance. The integrative governance framework will be utilized as it provides a clear overview of the process on how to analyze the interaction between different governance instruments and eventually determine the relationship. In the light of this research, "the relationship" signifies the ways in which policies reinforce or contradict each other. As stated in the introduction, there is a need for improvement of the management actions in invasive species management. The integrative governance framework will help to investigate this relationship between different stakeholders. The IG framework (figure 2) is focused on rules and policies of and beyond the state, as a focus on only government law wouldn't capture all relevant rules and policies. This framework adopts a broad interpretation of the law, as it also includes hybrid and private rules and policies, often made through a collaboration between multiple kinds of societal actors.

The framework includes three steps of analysis. Step 1) Analyzing the interactions between governance instruments. Step 2) Analyzing the performance of governance systems and step 3) explaining the performance of a governance system.

As this study focusses on the mapping of policies of the involved stakeholders, only the first step will be included in this research as it analyses the interactions between instruments. Steps 2 and 3 analyze the performance of governance systems, however, since the pilot project of Ravon in North-Brabant has not yet begun it is not possible to make statements about those steps. This is however recommended to do in further research. Step 1 will be further elaborated in context of this research:

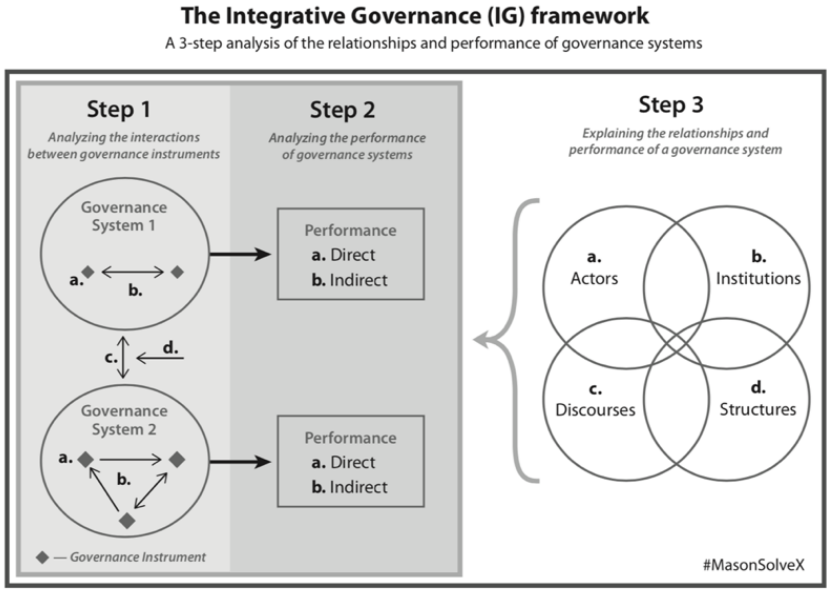

Figure 2: IG framework, source: Visseren-Hamakers, 2015

Step 1: analyzing the interaction between the different instruments. This first step is focused on the different policy instruments used by the key stakeholders. Policy instruments are the tools which can be used to achieve the policy goals and targets. The first step focuses on the policy instruments that need to be included in the analysis. The goal is to understand the

main characteristics of the relationship between the policy goals and the policy instruments. This means that analysis of individual rules and policies is necessary to capture the relationship between all instruments. The analysis is made through the following process:

a. Mapping the individual policy goals and instruments to be included in the analysis.
b. Analysing the relationship in pairs of instruments. According to Oberthür and Gehring (2006), the relationship between two governance instruments can be made up of several individual instances of interaction, such as a cognitive interaction or impact interaction.
c. Analysing the relationship among the stakeholders. In this step, the instruments are clustered into governance systems. From the analysis in step b a few types of interaction may occur (e.g.: a dominant type of interaction (cognitive, behavioral), a main direction of interaction, the dominant effect of the interaction, or evolution of main interactions over time.)
d. Mapping instruments aimed at managing the relationship. This step analyses initiatives or instruments that aim to improve the relationship in or between stakeholders.

2.2. Conceptual framework

The conceptual model (figure 3) integrates the theory on perceptions on invasive alien management and integrative governance and can be used to get a clear overview of the policies and perceptions of the different stakeholders. Step 1 of the integrative governance framework will be used to support the IAS perception framework. Not only does the Integrative governance framework provide a thorough insight into the policy side, but it also supports the framework on determining the perceptions on IAS in terms of defining the relationship of the different stakeholders, as the IAS perception model does not cover this. Thus, a combination of the two frameworks is needed to establish the relationship between the different policy instruments and perceptions of the stakeholders help to facilitate insight into IAS management in North-Braba

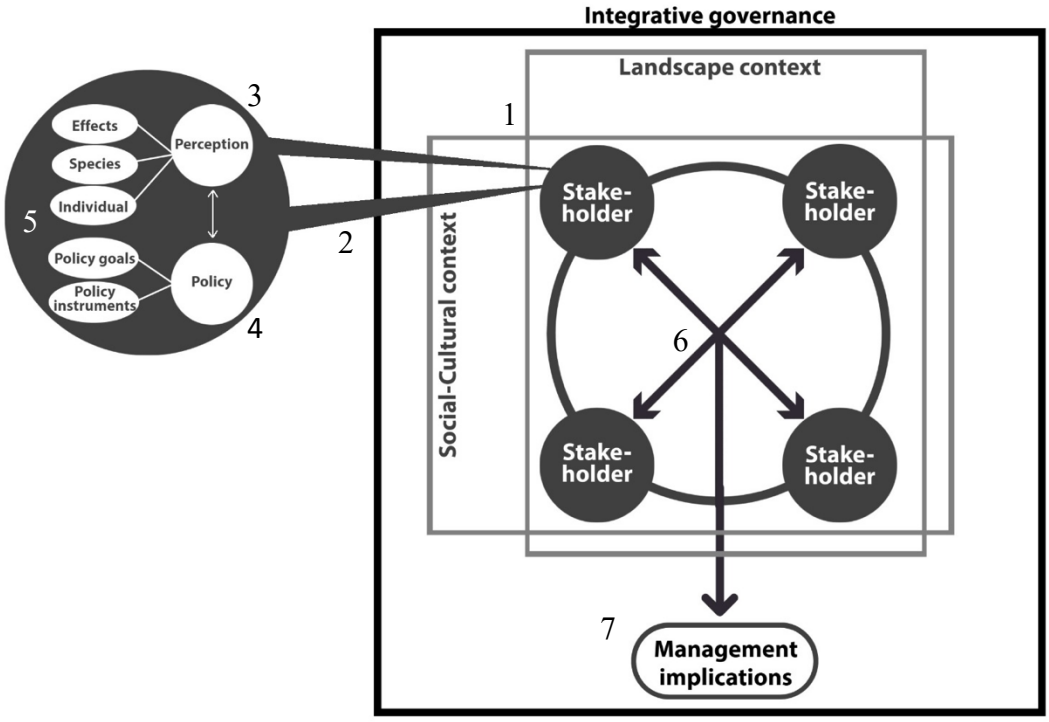

Figure 3: Conceptual model L. Hoogestijn, 2021

Figure 4 shows the conceptual model to answer the research questions. Fist an in-depth contextual understanding on the landscape context and the socio-cultural context of North-

Brabant is provided (1). After that, the position on invasive alien management is collected for the main stakeholders involved (2). This position is determined by perception (3) and policy (4). Perception is indicated by the effect of the invasive alien, the properties of the invasive alien, and the individual opinion of the actor. The policy is established by different policy goals and the policy instruments in place to reach this goal (5). After this has been mapped the interactions will analyzed (6) so the possible management implications can be illustrated (7). These interactions take place within an integrative governance system.

2.4. Operationalization

The following paragraph will provide the operationalization of the different concepts that will be researched to answer the research questions. First the indicators of the Socio-cultural context and the landscape context will be provided, followed by the indicators that are used for the primary factors Perception and Policy. The indicators are derived from the literature review.

2.4.1. Operationalization of the landscape-, and socio-cultural context Figure 4 shows the operationalization which provides the underlying indicators for landscape context and the socio-cultural context seen in the conceptual framework. It is important to address the landscape- and socio-cultural context in order to answer the research questions as it set the frames in which perceptions and policies develop. The indicators are derived from the literature review.

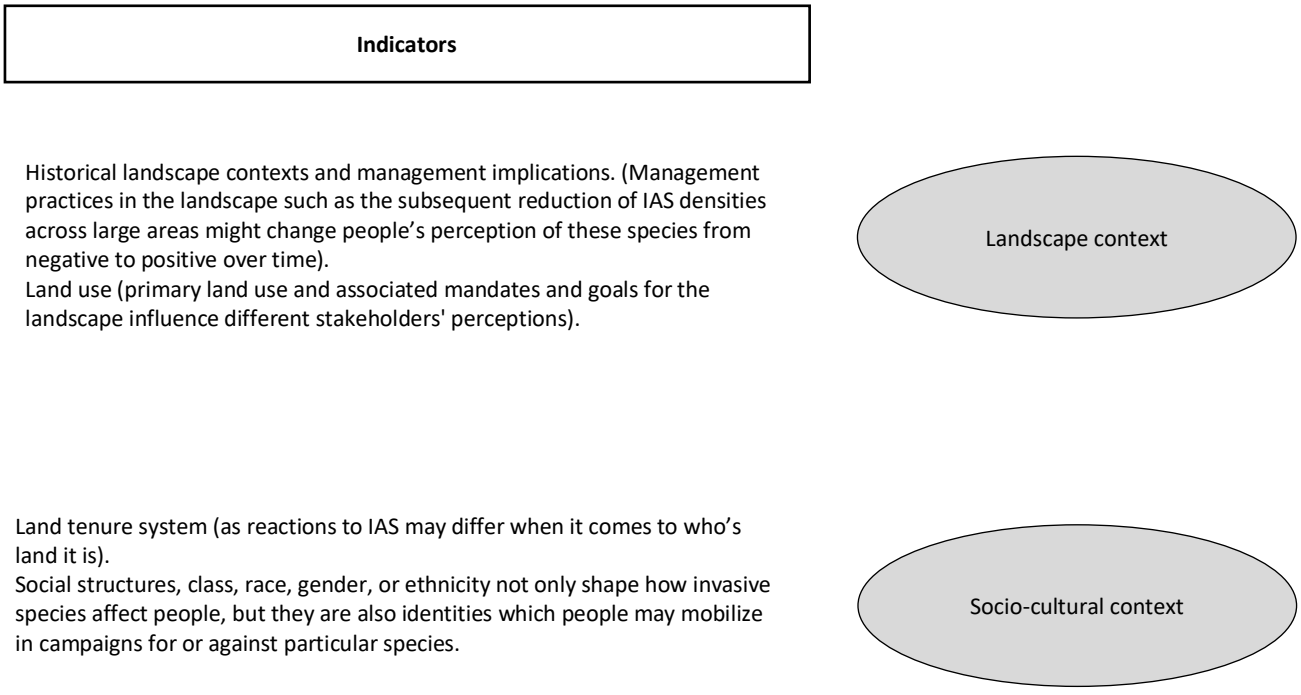

Figure 4: Operationalization op the landscape-, and sociocultural context

2.4.2. Perception and Policy

Figure 5 shows the operationalization which provides the underlying indicators for the primary factors of Perception and Policy seen in the conceptual framework. The indicators are derived from the literature review.

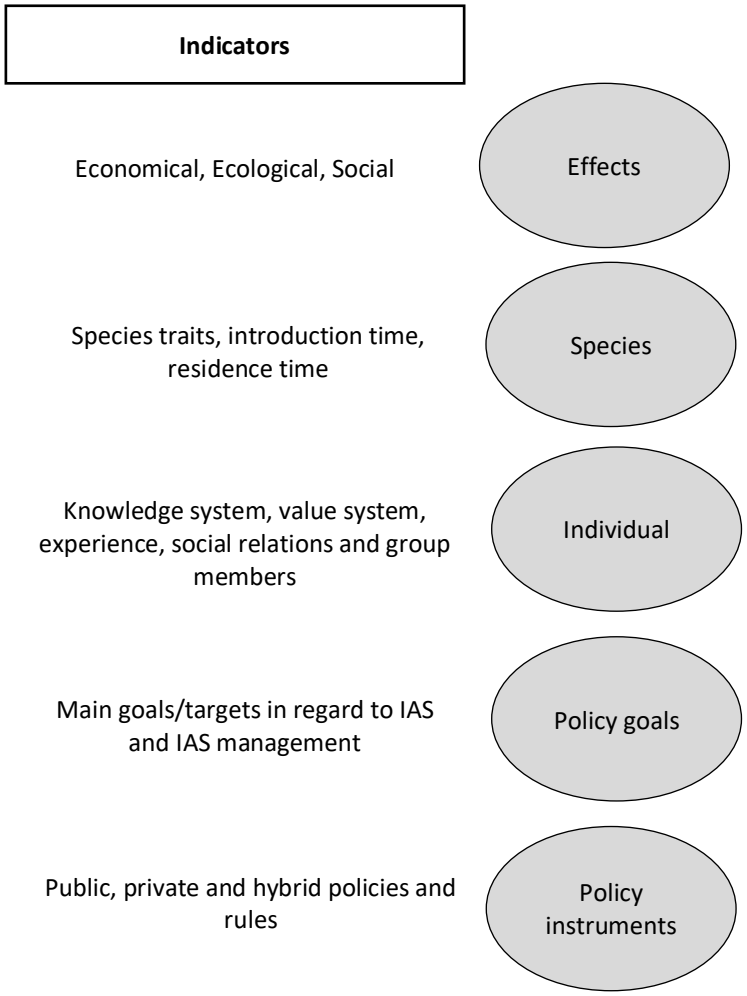

Figure 5: Operationalization L. Hoogestijn , 2021

3. Methodology

3.2. Research philosophy

The research philosophy shapes the way research is conducted and it indicates what the research can contribute to society (van Thiel, 2014). A researcher's philosophy consists of the ontological, epistemological and methodological perspective. These three elements guiding this research will be discussed.

Ontology
Ontology asks the question what exists in the human world that we can acquire knowledge about. The ontological perspective can be seen as a range from realism to relativism, where realism believes that one true reality exists and relativism believes that multiple realities exist. Ontology stands for what exists in the human world that we can acquire knowledge about (Moon & Blackman, 2014). In this research, a bounded relativism approach is applicable. Bounded relativism is characterized by mental constructs of reality that are equal in space and time within boundaries (Moon & Blackman, 2014). An implication is that a true reality does not exist. Each stakeholder group has its perception of the problem, shaped by its reality.

Epistemology
Epistemology asks the question; how do we create knowledge? And can be divided into 3 categories: 1) objectivism, meaning exists within an object. 2) constructionism, meaning is created form interplay between subject and object. 3) The subject imposes meaning on the object (Moon at all, 2014). The constructionism perspective is applicable for this research, as there is no objective “truth”. This epistemological position assumes human beings construct knowledge as they engage with it and interpret the world surrounding them.

Methodology
The last element is the methodological perspective which determines the philosophical orientation that guides the researcher’s actions and research (Moon & Blackman, 2014). The methodological perspective contains approaches that range from knowledge acquisition that is deductive, value-free and generalizable to knowledge acquisition that is inductive, value-laden and is contextually unique (Moon & Blackman, 2014). This research holds and social constructivism approach. This methodology assumes that different individuals construct the meaning of the same object or phenomenon in different ways. Each individual defines a problem in their own way and this problem needs to be understood.

3.2. Research design

To answer the research questions a case study will be carried out. As mentioned in the introduction, the case that will be discussed in this research will be that of of Ravon set in North-Brabant. There has been a development of (post-modern) social sciences stating the importance of looking for local timely and situated bounded narratives (Byrne & Callaghan, 2013). Case study research is an effective methodology to investigate and understand

complex issues within real-world settings. It aims to provide insights into how individuals and/or groups give meaning to their experience and constructions in their worlds (Mills, Durepos & Wiebe, 2010). The case study will provide and reflect on how theory is linked to practice. The theoretical concepts that are derived from the literature (see paragraph 2.3 and 2.4.) are researched and described for the key stakeholders that are provided in the section below. The theoretical concepts that are taken from the literature are added with insights from the case study. The case study is presented in chapter 4 and 5, the Findings and Result chapters and provides an in-depth analysis of the different concepts which influence IAS management in North-Brabant.

3.2.1 Case study design

Yin (2003), defines four basic types of design for case studies. Type 1) single case holistic design (one case with a single unit of analysis). Type 2) single case embedded design (one case with multiple units of analysis). Type 3) multiple case holistic design (multiple cases with each a single unit of analysis. Type 4) multiple case embedded design (multiple cases with each multiple units of analysis). This research uses type 2, a single case (embedded) design (figure 6), as this analysis focuses at different sub-units of a specific phenomenon. The type 2 analysis is used because investigating a single-case enables the researcher to have a deeper understanding of the exploring subject. Moreover, according to Gerring (2004) the more case studies a scientific article has, the more likely it is that it is confident in its representativeness. However, there would be less observation time for the researcher to study the cases and thus providing a less thorough understanding than when exploring a single case. This is in line with Siggelkow (2007) and Gustafsson et al. (2012) who argue that single case studies can describe the existence of a phenomenon more richly. Another rational for choosing this type of analysis is because the case of Ravon can be seen as a representative case where the objective is to capture the circumstances and conditions of IAS management in one certain area. The lessons learned are assumed to be informative about the experiences with IAS management in other places. Another advantage of an embedded case study is that it is particularly useful to confront rival interpretations and strengthen the internal validity (Yin, 2003).

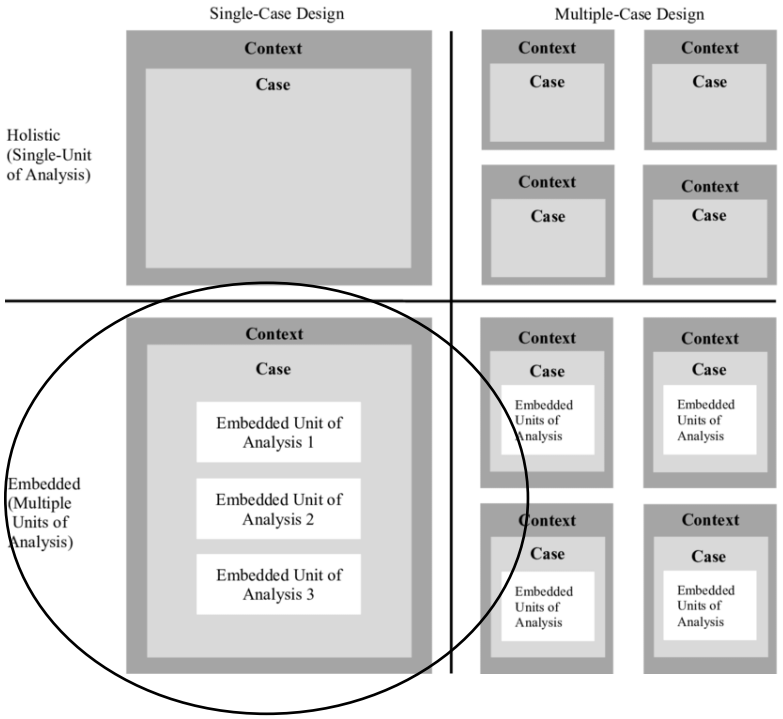

Figure 6: Four basic types of design for case studies. Source: Yin, 2003

3.2.2. Stakeholder selection in the case

The focus on the region of North Brabant has been selected in consultation with Ravon as stated in the introduction. This research defines a stakeholder as any individual, group or organization who is affected (positively or negatively) by invasive species, or who has the

capacity to promote or limit the spread of invasive species. Stakeholders include the public/citizens (affected by and/or responsible for the spread and/or control of invasive species), researchers, government departments (responsible for the management of invaded areas or as policy makers), non-governmental organizations (NGO's) and businesses (Shackleton et al., 2018; Novoa et al., 2017).

The selection of stakeholders started with identification through peer recommendation, expert advice, literature review (including scientific articles, newspaper articles, social media scientific articles) and meeting minutes with experts on IAS from Ravon. In this first selection, the following stakeholder were identified:

1) The National Government: Ministry of The Ministry of Agriculture, Nature and Food Quality and Department of Waterways and Public Work
2) Netherlands Food and Consumer Product Safety
3) The province of North-Brabant
4) Municipalities of North-Brabant
5) Site management/ nature organisations: Staatsbosbeheer, Brabantslandschap, Natuurmonumenten, Bosgroep Zuid-Nederland.
6) Water authorities: Aa en Maas, De Dommel, Unie van Waterschappen, Rivierenland
7) Species volunteers: Ravon, Stichting Bargerveen, Herpetologische studiegroep.
8) Animal protection organisations: WWF, Animal Protection, Stichting de Faunabescherming
9) Environmental organisation: Milieudefensie
10) Citizens

Secondly, this group of stakeholders is critically reviewed. Looking at the integrative governance framework, it is focused on rules and policies of and beyond the state. It adopts public, private and hybrid policies in the framework. In order to answer the research question, stakeholders who hold formal authority on IAS-management and thus are qualified to make decisions and produce these policies are included in the case-study. Simultaneously, these are also the stakeholders who are in possession of the necessary resources and therefor have the highest influence on the policy instruments which need to be included to get a thorough understanding of IAS-management in North-Brabant.

Looking at who holds the formal authority, the national government is responsible for implementing the European Regulation and has organizational structures in place for tackling the problem of IAS with a ministerial regulation (Hoop et al., 2017). The province is responsible for taking control measures for most species on the Union list in their respective territories. Municipalities and water authorities take additional measures in their own region for possible IAS. In practice, mostly the municipalities and site management organizations are responsible for carrying out these measures (BrainPS Brabant, 2020).

This resulted in the following 10 stakeholders included in this research:

1) The Ministry of Agriculture, Nature and Food Quality
2) Netherlands Food and Consumer Product Safety

3) Department of Waterways and Public Work
4) Province of North-Brabant
5) Municipality of Eindhoven
6) Municipality of Tilburg
7) Municipality of Breda
8) State Forestry
9) Water Authority Aa en Maas
10) Water Authority Rivierenland

Stakeholders were selected so the national government, the province, municipalities, water authorities and site-management organizations were represented. These stakeholders are chosen due to specific sampling through expert advice and literature study. The Ministry of Agriculture, Nature and Food Quality, The Netherlands Food and Consumer Product Safety and the Department of Waterways and Public Safety are included as they represent the national government and are responsible for IAS in the Netherlands. The Province of North-Brabant is included as the national government has delegated the responisbily of IAS management to the province. The municipalities of Tilburg, Breda and Eindhoven are included because they are the three largest municipalities of North-Brabant. State Forestry is selected as they are highly represented in North-Brabant. Water authority Aa en Maas en Water Authority Rivierenland are included of the four water autorities of North-Brabant. Those water authorities are chosen due to expert advice and availability to participate in the research.

3.3. Research methods, data collection and analysis

To collect the data the method of triangulation is used, as triangulation uses more than one method to understand a certain phenomenon thoroughly (Guion, Diehl & McDonald, 2011). This research adopts the method of data triangulation, using different sources of information to increase the validity of a study. To ensure data-triangulation, data has been gathered from 1) existing literature, 2) policy documents and 3) semi-structured interviews.

3.3.1. Literature Review

The literature review in chapter 2 serves as a base for this research. The conceptual model and operationalization of the theoretical concepts provide structure for the research and input for the interview guide. In addition, a literature review is will be used to provide the landscape-, and socio-cultural context.

Literature is analyzed in a systematic way. A systematic literature review identifies, selects and critically appraises research in order to answer a clearly formulated question (Mackenzie et al., 2012).

Searching is a critical part of conducting the literature review as it provides the evidence base of the research. Incomplete searches could lead to biased results. A systematic literature research needs to be comprehensive and unbiased. This means literature Is searched across a number of databases. This research also includes grey literature and

journals to ensure as many studies as possible are reviewed. Moreover, documents of three levels of governance are included to get an overall view on the policy implementation and policy instruments available: 1) International level (European Union), 2) National level (the Netherlands), 3) Local-level (Province of North- Brabant).

While selecting the document attention is paid to the following elements: 1) the publication dates. Especially when it comes to grey literature, as the European Invasive Alien Species Regulation came into force in 2015, which brought a change in IAS-management in the Netherlands. Grey literature for 2015 is being critically reviewed to see whether it is still applicable now. 2) the type of stakeholder producing the document and 3) the nature of the document.

3.3.2. Policy Documents

Each stakeholder has their own policy documents which provide information on the policy goals and instruments which are already in place in regard to IAS. These policy documents are reviewed to get a more thorough understanding in advance of the in-depth interviews. Policy documents are also used to supplement the primary factor of policies in the result section. For each stakeholder only the most recent policy documents are included with regard to IAS If this is not present, the general management plans and/or the nature policy plans are examined.

The following table will provide an overview of the reviewed documents/reports:

Table 1: Schematic overview of the policy document		
Stakeholder	Name document	Year
Ministry of Agriculture, Nature and Food Quality	NVWA-jaarplan 2021 (NVWA-year plan 2021)	2021
Netherlands Food and Consumer Product Safety Authority	NVWA-jaarplan 2021 (NVWA year plan 2021)	2021
Department of Waterways and Public Works	Beheer- en ontwikkelplan voor de Rijkswateren 2016-2021 (Management and development plan for the National Waters 2016-	2015
Province of North-Brabant	Plan van aanpak Invasieve exoten Noord-Brabant (Plan of approach invasive alien species North-Brabant)	2020
Municipality of Eindhoven	Groenbeleidsplan (Nature policy plan)	2018
Municipality of Tilburg	Perspectiefnota (Perspective memorandum)	2020
Municipality of Breda	Duurzaamheidsvisie Breda 2030 (Sustainability vision 2030)	2021
State Forestry	Dossier Flora en Fauna (Dossier Flora and Fauna)	n.d.
Water Authority Aa en Maas	Brabants Breed Plaagsoorten beleid 2021 (Brabant's wide pest species policy 2021)	2021
Water Authority Rivierenland	Brabants Breed Plaagsoortenbeleid 2021 (Brabant's wide pest species policy 2021)	2021

These policy documents are reviewed to gain a more thorough understanding of the policy goals and instruments regarding IAS management. These policy reports are reviewed in advance of the in-depth interviews and are used to supplement the results. Documents are reviewed using the indicator provided in paragraph 2.4.2. and special attention will be paid to: 1) mentioning IAS, 2) Including IAS-management through the formulation of policy goals/targets, 3) Policy instruments used to reach those goals (for example providing/using subsidy.

3.3.3. Semi-structured interviews

Semi-structured and in-depth interviews are conducted with each stakeholder (see table 2). Interviewees in this research have a position of policy maker, ecologist or have an executive function in the field. This research is conducted during the Covid-19 pandemic, meaning all interviews were held online via Zoom or through phone.

A semi-structured interview guide (see appendix 1) is used during the interviews. The interview will be semi-structured as there is a need to have insights into the perceptions and policies as seen in the conceptual framework to answer the research questions. However, there is not a strictly formalized list of questions. Instead, more open-ended questions will be asked, allowing for a discussion with the interviewee rather than a straightforward answer. This discussion is needed to get a clear insight into a stakeholder's perspective and the way they understand a certain problem (Goodman, 2001). The interview are in-depth interviews as in-depth interviews are useful when detailed information about a person's thoughts/behavior/perception needs to be explored (Goodman, 2001).

Table 2: Schematic overview of conducted interviews

Organisation	Referred to as
Ministry of Agriculture, Nature and Food	Ministry ANFC
Netherlands Food and Consumer Product	NFCPS Authority
Province of North-Brabant	The Province of North-Brabant
Municipality of Eindhoven	Municipality of Eindhoven
Municipality of Tilburg	Municipality of Tilburg
Municipality of Breda	Municipality of Breda
State Forestry	State Forestry
Department of Waterways and Public	Department of WPW
Water Authority Aa en Maas	Waterautority Aa and Maas
Water Authority Rivierenland	Waterautority Rivierenland

The interview guide is divided into the following topics to get a thorough and in depth understanding:
During the conversation we'll be discussing the following subjects:

1) Vision on nature management
2) Vision on invasive alien species
3) Policy and measures concerning invasive alien species
4) Roll of the constituency

Each interview is recorded with consent of the stakeholder. After the interviews, the recordings are transcribed manually and uploaded to the program Atlas.ti. The data gathered for the different stakeholders will be analyzed in a structured manner. It will be done the same way for every stakeholder, to create a clear overview. Thematic analysis, a method by Braun and Clarke (2006) is used to analyze the interviews. Thematic analysis is used for identifying, analyzing, and reporting patterns (themes) within data. The process of thematic analysis consists of 6 steps:

1. Familiarizing yourself with your data
   Transcripts were read thoroughly and memos were added to the document with initial thoughts about what is interesting about the data.
2. Generating initial codes
   The first round of coding is open-coding. when generating initial codes, work is done systematically through the data set, giving attention to each data item and finding interesting aspects in the data. In-vivo coding is also used to honors the participants' voice which is a very important aspect in social constructivism as each individual defines a problem in its own way.
3. Searching for themes

The first cycle of coding generates an array of individual codes associated with their respective data parts. This is used as input in the second round of coding where different codes are sorted into themes. Networks are used indicating connections and flows between the clusters of action they represent. The initial 134 codes were clustered or split where necessary.

4. Reviewing themes
   In this step, themes are refined and clustered.
   devised a set of candidate themes, and it involves the refinement of those themes.
5. Defining and naming themes
   After reviewing and clustering themes, they were refined and defined, resulting in 4 main themes: 1) Perception, 2) Policy goals and instruments, 3) Cooperation and relationship, 4) Policy bottlenecks.
6. Producing the report
   In the final step the data-analysis will provide input to answer the research questions. On request of the interviewees and due to anonymity, quotes used in this report are anonymized.

3.4. Validity and reliability of the research

Case study research has been criticized for its inability to support generalization and thus is considered to provide limited validity and value (Mills, Durepos & Wiebe, 2010). As this research adopts a constructionism perspective where the world is constructed by the specific actors which relates to a changing context, generalization (validity) and replicability (reliability) is difficult. To ensure validity and reliability appropriate methods will be used, to ensure the research is conducted carefully and consistently. Moreover, findings will be checked by Ravon.

The method of triangulation will be used to ensure the validity and reliability as the benefits of triangulation include “increasing confidence in research data, creating innovative ways of understanding a phenomenon, revealing unique findings, challenging or integrating theories, and providing a clearer understanding of the problem” (Thurmond, 2001, p. 254). These benefits largely result from the diversity and quantity of data that can be used for analysis. Thus, using in-depth interviews as well as a policy documents and reviewing literature adds depth to the results that would not have been possible using a single-strategy study, thereby increasing the validity of the findings.

4. Findings and Results: Landscape context and Socio-cultural context

This chapter will provide thorough understanding of the landscape- and socio-cultural context. These contexts set the frames in which perceptions and policies of the key stakeholders come-about (see paragraph 2.3: conceptual framework). First the landscape context will be discussed. The landscape context shows the landscape as areas of land containing different mosaics of patches and elements that often repeat themselves. It describes the ecosystem type, land use, and cover. The landscape context will be described as the type of landscape that is linked to the level of exposure and effect of an IAS (Shackleton et al., 2018). Secondly, the socio-cultural context will be discussed as the social-cultural context gives the factors that shape perceptions through the ways in which people interact with each other in the social realms of rules, traditions, practices, and ideas (Shackleton et al., 2018).

4.1. Landscape context

This paragraph serves the purpose to gain in-depth knowledge on the landscape of North-Brabant. A systematic literature review is conducted to get a thorough contextual understanding of de landscape context. Looking at paragraph 2.4, the following indicators will be discussed to explain this context: 1) Historical landscape contexts and management. 2) Land use.

4.1.1. Historical landscape context

The historical landscape context provides an overview of how the landscape of North-Brabant has developed over time. The management practices in the landscape will be discussed, such as the successful reduction of IAS densities across large areas as they might change people's perception of these species from negative to positive over time.

The landscape of North-Brabant has been formed in a series of geological processes. Around 1.8 million years ago the Netherlands was one large river delta. The land contained waving rivers crossing each other where sediment of sand and clay was deposited on the coastline. The landscape was bare, open and knew a tundra climate (Vos, 2011; van der Veen, 2019). Around 500 AD the Roman influence became present in North-Brabant. Their presence led to the development of roads, cities, trade and a vastly growing population. Rural settlement grew and started to systematically parcel the landscape into arable land to keep up with the population growth (van der Veen, 2019). Peat was minded for fuel and simultaneously channels were dug to drain the land. However, this exploitation of the land took its toll as the mining caused subsidence of the landscape and linked the peat areas to the dynamics of the sea (Vos, 2011) Parts of North-Brabant were not habitual anymore. Population number decreased and the agricultural sector fell back to the time begore Roman influence. After this, it took over 200 years before people started to transform the landscape on a large scale again. An important reason is because the silting of the salt marshes made it possible to slowly regain the landscape. When diking was introduced, it became possible for the west of North-Brabant to live closer to the rivers. This meant the cultivation developed the

landscape in large parcels of arable land. These parcels were a lot richer in comparison. with the sandy soils in the east of the Netherlands. Over time the cultivation of the landscape continues and an increase in population led to more and more demand for agricultural land. Large parts of forest were cut to provide timber for the iron mines (Bas, Pedroli & Borger, 1990). However, the way of farming lead to exploitation of the heather landscape, which resulted into to a bare sand landscape (van der Veen, 2019). In 1850, entire villages in Brabant were in danger of disappearing due to drifting sand. As a solution, large pine forests were planted to reduce the sand movement and almost made drift sand disappear. The invention of artificial fertilizer ensured that farmers could turn poor sandy in soils suitable for farming (Geertsma et al., 2011).

Over the years, the landscape of North-Brabant has changed due to alien species and IAS. Alien plants, birds, mammals, amphibians, reptiles, fish and invertebrates have established themselves in the landscape (CBS, 2020). Figure 7 shows the establishment of IAS in the Netherlands. As shown there has been a steep growth since the 1900 (Nederlandse Soorten, 2021). Many AS changed the landscape over time, however, most of those alien species are not invasive and, over time, many have started to be seen as native (CBS, 2020). Many indigenous trees and shrubs disappeared as a result of human activity. This was replaced by planting from other parts of Europe. In 2001 only 5% of the trees and shrubs in the Netherlands were of autochthonous origin. Since the foundation of Gene bank Sources for new nature in 2006, this number is increased to the percentage to approximately 7% to stimulate indigenous species in the landscape (Staatsbosbeheer, 2021).

North-Brabant also knows a steep growth in IAS. Figure 8 shows the number of Invasive alien species per 5 x 5 meter is provided, showing that most IAS are located in urban areas and stream valleys (Floron, n.d.)

Invasive alien species enter nature through human activity and are mostly from regions which have a similar climate to North-Brabant. Figure 9 shows the origin of alien species, showing that most species originate from Europe (Nederlandse Soorten, 2021). A major cause is the import of plants that are traded and sold in North-Brabant (Team Invasieve Exoten, NVWA, 2014). An example is the Japanese knotweed, one species that has received a lot of attention. It is known for the economic and social damage in North-Brabant as it causes disruptions to riverbanks and severely damages road surfaces.

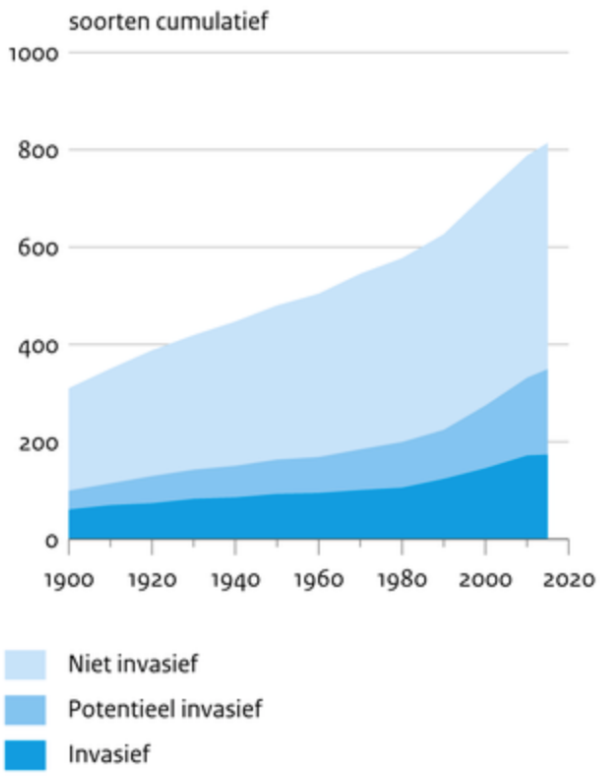

Figure 7: IAS in the Netherlands, source: Soortenregister, 2021,

People find this plant very beautiful and it is often sold in bouquets of flowers. As soon as they end up in nature in some way, they spread quickly (Andeweg, 2018).

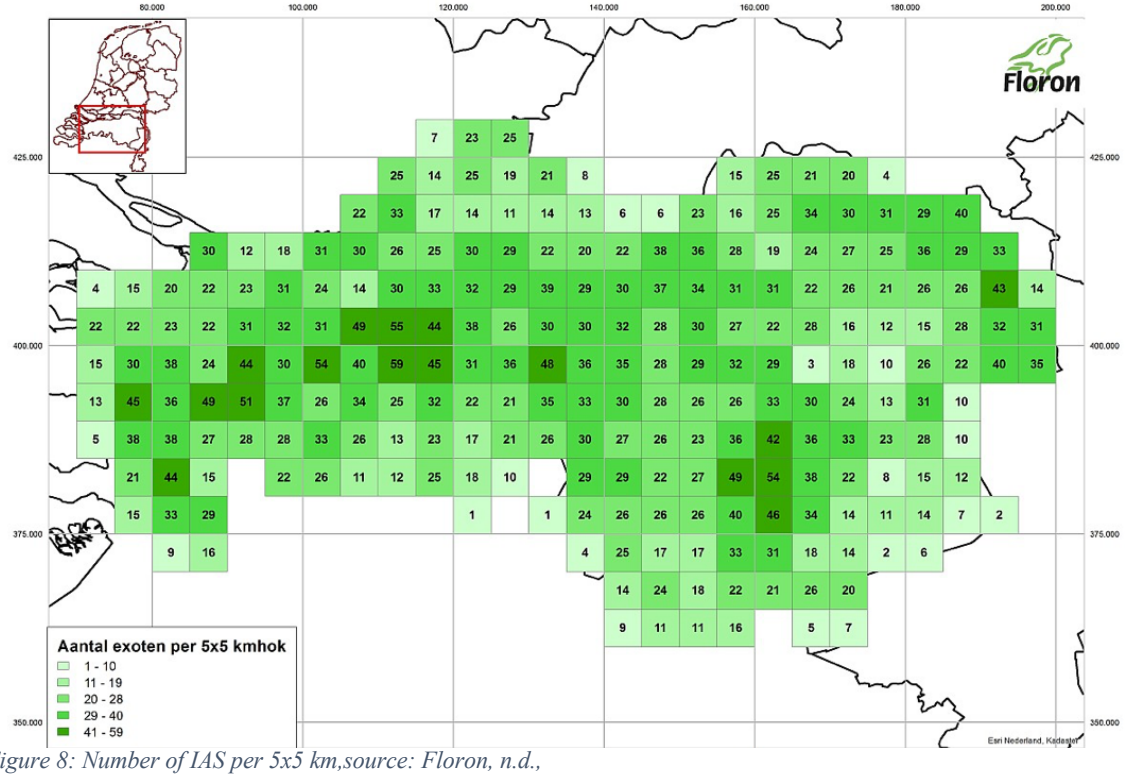

Figure 8: Number of IAS per 5x5 km,source: Floron, n.d.,

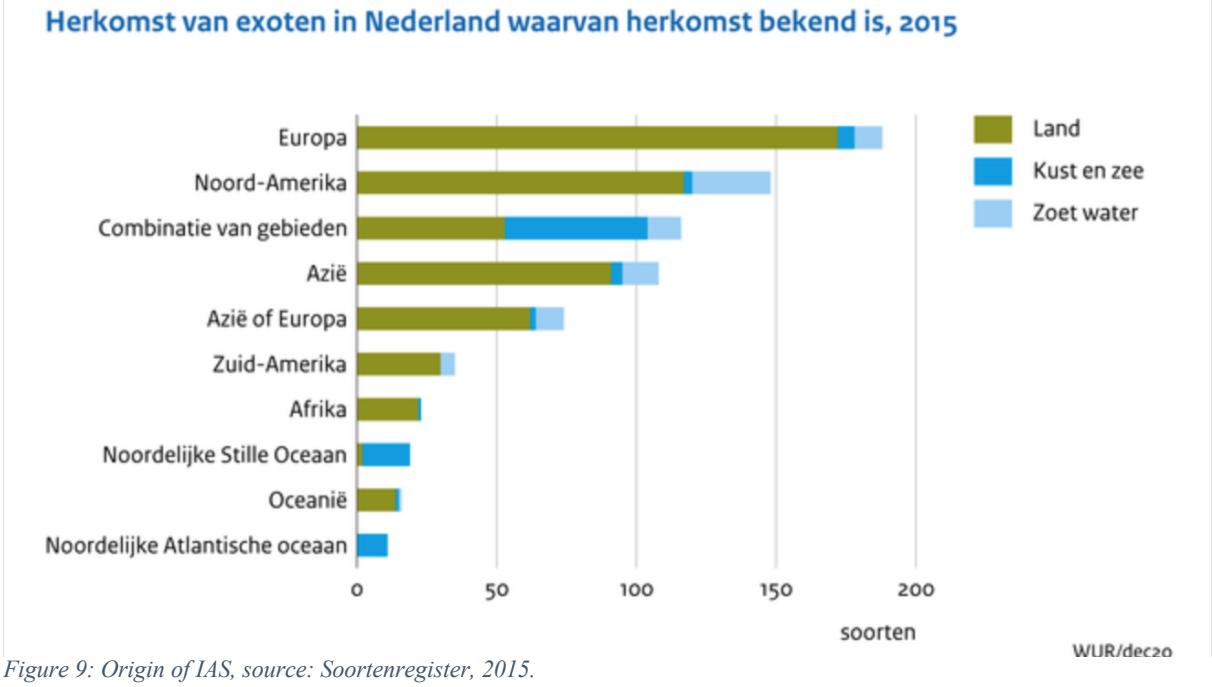

Figure 9: Origin of IAS, source: Soortenregister, 2015.

Another example of how invasive alien species entered North-Brabant is through professional fishermen or aquarium keepers. Fish such as the mud-minnow and the sunfish. are farmed and released in the water for fishing in North Brabant (Ravon, n.d.).

A third common cause of invasive alien species entering the landscape of North-Brabant is the release of animals into nature which were first held as pets (de Jong, n.d.). For example, North-Brabant experience many problems because of the letter turtle. According to European legislation, it has been prohibited since 2016 to trade, breed, restock or even transfer the animals to another person. Yet thousands of these animals are left in nature every year. The turtle is a threat to young birds, fish, frogs and amphibians (Ravon, n.d.)

4.1.2. Land use

Primary land use and associated mandates and goals for the landscape influence different stakeholders' perceptions.

Nowadays, North Brabant is mainly characterized by a mosaic pattern of the city, countryside and nature (figure 10) (CBS, 2020). These three areas alternate quickly. North-Brabant still has a large variation in agricultural landscapes. There is, among others, arable farming and open field vegetable cultivation, greenhouse horticulture, arboriculture, other horticulture and permanent cultivation. Moreover, dairy farming, pig farming and poultry farming is also present in North-Brabant (Venema et al., 2020). Besides the agricultural landscape, the Province of North-Brabant has many valuable nature reserves. Due to the variation in soil and geomorphology and, in connection with this, the mining history, a wide variety of ecosystems can be found in North-Brabant. From raised moors to shifting sands, from stream valleys to swamps and forests (Bas et al., 1990). The Natura 2000 is an important instruments and frameworks for protecting areas. There are various areas with valuable small-scale landscapes containing narrow river branches. (Geertsema et al., 2011). Natura 2000 is a European network of nature reserves and important pieces of nature. Located In North-Brabant are 20 Natura2000 areas and the province is responsible for the management of 17 of those (Provincie Noord-Brabant, 2009). Natura2000 areas receive extra protection because of the special and endangered plants and animals that inhabit them. The province is drawing up the management plans of these Natura2000 areas (Siebel, 2014).

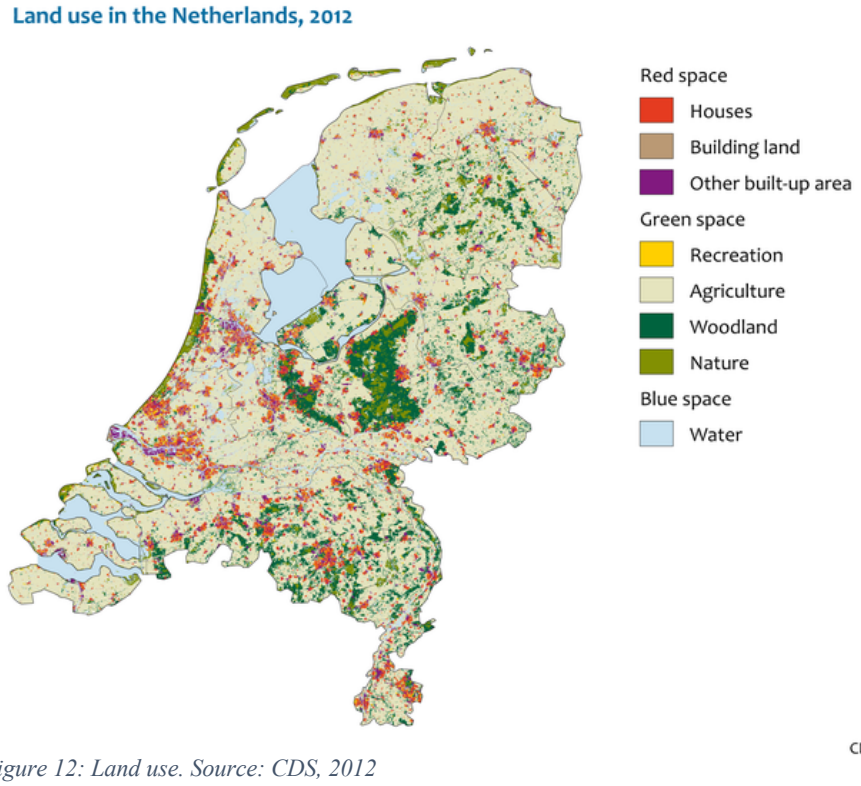

Figure 12: Land use. Source: CDS, 2012

The threat of IAS is increasing within Natura2000 areas (Siebel, 2014). In the most recent version of the action plan for invasive alien species (2020), the Province of North Brabant states that they have a legal obligation to take measures in Natura 2000 areas if the conservation objectives cannot be achieved due to invasive alien species. Control measures are included as much as possible in the regular management and restoration management required for the conservation of the habitats in Natura 2000 areas.

However, the quality of nature is declining in North Brabant in general, as for example, the number of butterflies and reptiles in the heathlands is making a sharp decline. This also applies to breeding birds of the open meadows and arable areas (Stumpel, 2004). Management interventions are needed to turn the tide. Plans have already been made by the Province of North-Brabant to expand nature reserves to stimulate nature, including agriculture. An important development is the management of the many natural pools and small waters in North Brabant (de Jong, n.d.). North-Brabant counts many of those pools and has therefore a special responsibility for their conservation (Provincie Noord-Brabant, 2020). Not only because of the amenity value for people, but also because these pools have many special species of plants, birds, amphibians and dragonflies. The natural pools and small waters in North Brabant were declining at a rapid pace, partly due to pollution of the water (van Dam et al., 2015). Monitoring has shown that species populations were declining at a rapid rate (Geertsema et al., 2011). In recent years, the province has carried out management interventions and a plan has been launched to restore the pools. They are dredged and the banks are cleared of vegetation. During this recovery several invasive alien species were encountered, such as the mud-middow and the sunfish, contributing to the decline of native species. Both of these are subsoilers that cause turbid water, which means that fewer aquatic plants can grow. To date, no structural plans have been made to tackle these invasive alien species. (Boogaard et al, 2021).

There are also successful management practices regarding IAS. Management practices in the landscape such as successful reduction of IAS densities across large areas might change people's perception of these species from negative to positive over time (Shackleton et al., 2019). According to the plan of action of the Province of North-Brabant (2020) and the Brabant Wide Pest Policy (2021) of the regional water authorities in North-Brabant, a common management strategy in North-Brabant is to control invasive plant species by including them into regular maintenance. An example is the management intervention on the Japanese hogweed. This plant is highly invasive, however, when the plant is mowed 4 to 5 times a year around the time it is 30/40cm tall, just before they form flowers, the plant will be exhausted as much as possible. The effect of this management method is positive, and many locations with Japanese hogweed have been stable for years (Braakhekke, 2017). However, when left untreated, Japanese Hogweed can cause enormous ecological, economic and social damage (Andeweg, 2017). A disadvantage is that this method is very labor intensive.

Another management intervention that has turned out to be very beneficial in North Brabant in recent years is the change in the landscape by creating nature-friendly banks (van Kessel et al., 2013; Klink, Schoor, van Rheede & Duijn, 2014; Verhofstad et al., 2021). Nature-friendly banks are banks where, in addition to the flood defense function, nature and landscape are mainly taken into account. From an ecological point of view, this bank is a

dynamic zone. The construction of nature-friendly banks can offer a good solution for an IAS (Lemmers, 2019). A good example is the approach to the American crayfish in North Brabant. They cause unstable banks, leaky storage quays, mobilization of nutrients and additional dredging (Angeler, David, Sánchez-Garrillo & Alvarez-Cobelas, 2001). As a result, the water quality deteriorates. Extra dredging means that water boards have to dredge more often or more intensely in order to maintain the desired water discharge capacity. In addition, invasive alien crayfish have a negative effect on biodiversity because they eat, amongst other things, aquatic and riparian plants, invertebrates or the brood of fish, thus hindering the ecological recovery of ecosystems. Eradication of widespread invasive crayfish species in regional water systems in the Netherlands is no longer considered feasible. Crayfish dig their burrows in banks below the water level. Research shows that nature-friendly banks are less suitable for crayfish to burrow, and when nature-friendly banks are constructed, fewer burrows are counted than in the semi-natural or non-nature-friendly banks. Native predatory fish that prey on crayfish include Perch, European catfish, Eel and Pike. Pike and Eel appear to benefit from nature-friendly banks as a residence or growing area (Lemmers, 2019).

4.2. Socio-cultural context

The socio-cultural context refers to the factors that shape perceptions through the ways in which people interact with each other in the social realms of rules, traditions, practices and ideas (Wilson et al., 2011; Shackleton et al, 2019). North-Brabant has 62 municipalities, 2544806 inhabitants of which 1146307 families. There is a steep inhabitant trend and the population consist of 50.1% male and 49.9% female (CBS, 2019).

4.2.1. Who owns the land?

Structural factors include social institutions and rules, such as land tenure systems. Reactions to IAS may differ depending on whether it is “on my land”, “on their land”, “on government land”, or “on conservation land”, depending on rules, traditions and covenants shaping land access and use (Shackleton et al., 2018). The government is still the largest landowner in North-Brabant. There are two types of land-ownership: 1) freehold (land is owned for an indefinite period of time) and 2) leasehold, which can be divided into two types of leaseholds, municipality and private (Gray, 2015). The overview beneath (figure 13) shows who owns the land in North-Brabant. On the left side number 1 indicates the organization who owns the most of the land, followed by the second largest landowner, and so on and so forth. The state (indicated by blue) dominates in the top 10, followed by nature organizations in light green and industry in red. See table 3 for the list of largest landowners in English. As seen in the overview, the municipalities are the largest landowners. Of the 30,000 hectares of land they own, 43% of this land consists of nature. This is followed by State Forestry and after that the large nature organizations such as Brabants Landschap and Natuurmonumenten (Krekels and Rietenbergen, 2021).

VOLGNUMMER	NAAM	Organisatie	Hectare	Aandeel natuur vs totaal in %
1	Gemeenten	Overheid	30.138	
2	Staatsbosbeheer	Overheid	27.613	
3	Brabants Landschap	Vereniging of stichting	15.198	
4	Natuurmonumenten	Vereniging of stichting	11.757	
5	De Staat (Defensie)	Overheid	4.839	
6	De Staat (Infrastructuur en Waterstaat)	Overheid	4.805	
7	ASR	Bedrijf	4.571	
8	Waterschappen	Overheid	3.226	
9	Provincie Noord-Brabant	Overheid	3.056	
10	De Staat (Rijksvastgoedbedrijf)	Overheid	2.221	

Figure 13: Land ownership in North-Brabant, source Krekels en Rietenbergen, 2021

Table.3: Land ownership in North-Brabant (Krekels and Rietenbergen, 2021)

Number	Name and organization
1	Municipalities (state)
2	State Forestry (state)
3	Brabant Landscape (nature organisation / foundation)
4	Nature Monuments (nature organisation/ foundation)
5	The state (Defence) (state)
6	The state (Departmenent of infrastructure and waterways) (state)
7	ASR (industry)
8	Water autorities (state)
9	Province of North-Brabant (state)
10	The state (Central Government Real Estate Company) (state)

4.2.2. Socio-economic development

The level of socio-economic development is another structural factor which determines the socio-cultural context. People of all income classes, in wealthy or impoverished regions, may be concerned with IAS. However, the kinds of issues and management challenges raised, and consequently the perceptions, tend to differ. For instance, between subsistence farmers in poor regions and gardeners in wealthy suburbs (Nuñez & Pauchard, 2009; Wilson et al.,

2011; Shackleton et al., 2018). Social structures such as class, race, gender or ethnicity, not only shape how invasive species affect people, but they are also identities which people may mobilize in campaigns for or against particular species (Shackleton et al., 2018). As can be seen in figure 14, North-Brabant has a relatively high socio-economic status compared to the rest of the Netherlands. This shows in the high employment rate as unemployment declined to 3,2% since 2019. The unemployment rate of North-Brabant is lower than that of the Netherlands, which is 3,4%. The average disposable income and average wealth is also higher compared to the rest of the Netherlands, and is on an upward trend (CBS, 2021). Of the nearly 500,000 hectares of land in North Brabant, approximately 232,000 hectares are cultivated land; this is 13 percent of the national acreage. In 2016, total agriculture and horticulture provided 6.3 billion euros in net added value and employment for almost 76,400 working years (Schel, 2020). However, IAS can have very negative effects on the agriculture sector, endangering the income of many people (Paini et al., 2016; Shah et al., 2020). For example, plant species such as Adoxophyes orana and Eriosoma lanigerum can cause major damage to agriculture and horticulture (invasieve-exoten, n.d.,).

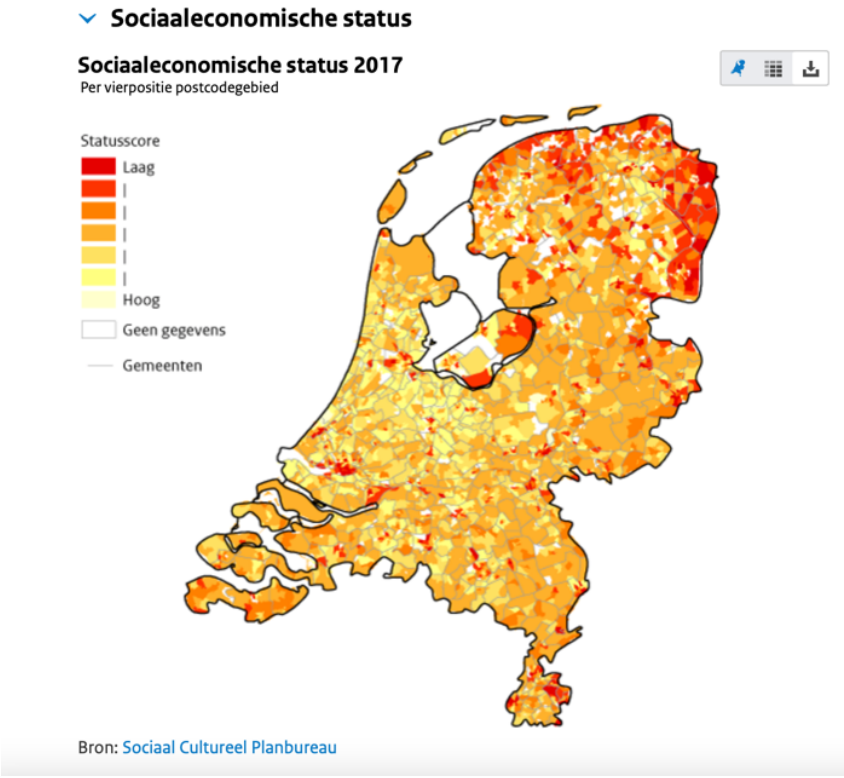

Figure 14: sociol-economic status. Source: Sociaal Cultureel Planbureau, 2017

4.2.3. Social value systems

Broader social value systems and social institutions are a third example of a structural factor that can influence perceptions. Individual value systems, as described earlier, are shaped by, and inform, broader societal ideologies; these may be broad cultural or religious norms and values, or specific ethical value systems adhered to by special interest groups such as biodiversity conservation or animal rights advocates (de Voogd, 2016). After the de-pillarization in the 1960s, a division between city, suburb and countryside became more and more apparent. The cities became more left-wing due to large numbers of students and migrants and a significant share of social housing, the prosperous suburban areas turned liberal-right and the countryside remained Christian-Democratic. A further differentiation arose through postmodern contradictions associated with lifestyles and value orientations. Roughly speaking, we see different types of Brabant coexisting. On the one hand, there are the successfully growing large cities, surrounded and connected by a series of prosperous, attractive, easily accessible and socially strong suburban and rural municipalities. Then we find the traditional socially strong rural municipalities where the faith is still high (Schmeets, 2014; de Voogd, 2016)

Sub-conclusion

Over the years IAS established themselves into the landscape of North-Brabant. IAS enter nature through human activity as they are sold, bred for fishing or kept as pets and released. most IAS are located in urban areas and stream valleys.

North-Brabant is characterized by city, countryside and nature alternating quickly. North-Brabant still has a large variation in agricultural landscapes and hold many valuable nature reserves. The Natura 2000 is an important instrument and creates a framework for protecting areas. In their most recent plan of action the province vows to take action if the conservation objectives cannot be achieved due to invasive alien species. However, in other objectives such as the conservation of natural pools and waters, IAS are not taken into account, even though they have a negative ecological effect contributing to the decline of other many native species.

However, examples have shown that with good management interventions even highly invasive species such as the Japanse Hogweed can be stabilized. Other management interventions such as the creation of nature friendly banks are also perceived as highly beneficial in regard to tackling IAS. Reactions to IAS might differ depending who's landit is. The government is still the largest landowner in North-Brabant. The municipalities are the largest landowners, followed by State Forestry, showing the large responsibility they have for IAS-management in North-Brabant.

North-Brabant has a relatively high socio-economic status compared to the rest of the Netherlands. However, as stated earlier, North-Brabant is also characterized by many agricultural landscapes, meaning IAS can have very different consequences in North-Brabant, bringing negative effects on the agriculture sector, endangering the income of many people

5. Findings and Results: Perception and Policy

To enrich the existing literature on invasive alien management this research aims to get a deeper understating of the perceptions and policies of the stakeholders involved by looking at the case of North-Brabant. A contextual understanding is given of the landscape context and the socio-cultural context. This chapter takes a closer look at the perception and policies of the key stakeholders that have been formed within this context with regard to IAS and IAS management. In-depth interviews are conducted to get a better and more thorough understanding of perceptions and policies of the key stakeholders and, as stated in the method section, policy documents are used to supplement where and if necessary.

The key stakeholders identified are: 1) Ministry of Agriculture, Nature and Food quality (Ministry ANFC), 2), Netherlands Food and Consumer Product Safety (NFCPS Authority), 3) Department of Waterways and Public Works (Department of WPW), 4) Province of North-Brabant, 5) Municipality of Eindhoven, 6) Municipality of Tilburg, 7) Municipality of Breda, 8) State Forestry, 8), 9) Water Authority Aa and Maas and 10) Water Authority Rivierenland.

The following chapter will provide answers to the sub-questions: 1) What are the main perceptions of the key stakeholders about IAS management? 2) What are the main policies of the stakeholders and how do they relate to the implementation of the IAS management? 3) What is the relationship between the perceptions and policies held by the different stakeholders? This is also the order this chapter will follow.

5.1. Perception

Understanding people's perceptions is crucial in order to understand behavior and to develop effective IAS management strategies to maintain, preserve and improve biodiversity. To perceptions of the stakeholders will be explained using the theoretical concept that is shown in paragraph 2.1.3. To answer sub-question one, an overview will be given of 1) Individual (organization), 2) Effects, and 3) Species. These factors will be explained to determine the perceptions of the stakeholders on IAS.

5.1.1. Individual (Organization)

The understanding of how individuals perceive their environment is primarily based on psychological approaches. The individuals draw on a number of concepts, such as beliefs, knowledge and values. Key factors that shape perceptions are some-one's; 1) knowledge system, 2) value-system and 3) experience. In social psychology the term 'belief' (the mental link between an object and attribute) highlights the subjective nature of knowledge. Beliefs and attitudes will often differ between individuals, but also between stakeholders (Shackleton et al., 2018; Novoa et al., 2017)

1. Knowledge system

Every organization has its own way of acquiring knowledge on the subject of IAS. Starting with the Ministry ANFC, the main source of knowledge is provided by the NFCPS Authority. Other sources of acquiring knowledge include information provided by species

organizations, universities and the Dutch Expertise Centrum for Alien Species. However, most knowledge and advise is acquired by consultation from the NFCPS. The NFCPS has a team dedicated to IAS. The Invasive Alien Species Team (TIE) is part of the Risk Assessment & Research Office (BuRO) within the NFCPS. The TIE supports the Ministry ANFC by providing knowledge and carrying out the policies regarding IAS. TIE mainly focuses on alien species that are harmful to nature, according to both the interviews and policy documents. But how does the NFCPS acquire its knowledge? The NFCPS Authority carry out and provides risk assessments in which the risk of a certain AS is estimated. According to the interviewee, they examine how quickly the species can spread, if the species is causing damage to nature and whether the species has already caused damage elsewhere. This is done in collaboration with scientists who search the literature for the knowledge that is already available about a certain species. An estimate is provided about the risk that the researched AS entails for the Netherlands. It is important to note that this mainly concerns species that pose a potential risk. Advice can also be given on species that have already established themselves and are already causing issues.

Guided mostly by science as well is the Department of WPM, according to the interviewee, experts on IAS from universities such as the Radboud university are asked to provide information about certain IAS. A recent example is research commissioned by the Department of WPM on crayfish which was provided by the Radboud University. Crayfish, an IAS, can bring great ecological, economic and social damage by digging in dikes which weakens them. Researchers are asked to map out the problem and give advice on what can be done about the issue.

The Province of North-Brabant acquires knowledge in a different way, mainly through presentations and attending seminars. Recently, interprovincial consultations have also taken place to discuss the approach to a certain IAS. The regional water authorities acquire knowledge in a similar way. The regional water authorities are provided with a budget to educate themselves on topics of their choice (which can be IAS). With this budget they can attend seminars and workshops. According to the interviewee, mostly practical knowledge on how to deal with a specific IAS is sought through self-study.

All the municipalities and state forestry acquire knowledge for the greater part through self-study and personal interest. This includes mostly reading grey literature through the internet. The knowledge-systems in place are perceived as very limited, according to all of the municipalities and State Forestry. A few issues were identified in the data analysis. First of all, the accessibility of knowledge is perceived as a problem by various stakeholders such as the state forestry, the municipality of Breda and the municipality of Eindhoven. Secondly, it is unclear where to obtain information. The data analysis showed that the municipalities and State Forestry, who are directly responsible for tackling IAS, also don't have anyone to turn to or are not facilitated by the organization to acquire knowledge.

"I often don't ask questions because I get more questions in return"

This quote highlights the perceived lack of knowledge on the matter within many organizations. When asked about a possible explanation on why the organizations do not facilitate the stakeholders in acquiring knowledge, the stakeholders indicated that the problem is either relatively new or there is lack of urgency in regard to IAS within the

organization. Another result from the data analysis shows that there is a need for more practical knowledge within the municipalities rather that knowledge about characteristics or the danger of a certain IAS. The questions: who is responsible for dealing with this species? And how do we do that as effectively as possible at low cost? are often featured.

2. Value system

Apart from the knowledge-system, the value-system of a stakeholder influences the way they perceive a species. From the data-analysis we can distinguish between implementing alien species in nature, the extent to which nature is dynamic or static and the well-being of the ecosystem over the well-being of the individual animal.

Considering the native/alien discussion and the implementation of alien species in nature, there are some differences between the stakeholders. For example, the municipality of Eindhoven and State Forestry indicate that they prefer using native species in nature because those benefit the native flora and fauna the most. In addition, the other stakeholders believe that the added value of alien species should not be underestimated and can be added in a new ecosystem. In this case, the interviewee refers to alien species and not invasive alien species. Eindhoven and State Forestry agree to the premises that AS are valuable, also considering at how many are implemented already, however, when development takes place in the outer areas of Eindhoven and in the areas of State Forestry, using native plant species is preferred, if this is possible. Looking at how nature is perceived, a difference between stakeholders comes forward. All stakeholders perceive nature as something dynamic. When nature is dynamic, it means that it changes over time. The opposite is static, which means that everything remains unchanged. Thus, nature is constantly changing as it always does. However, in regard to IAS, some stakeholders such as the municipality of Tilburg, the Ministry ANFC, and The Department of WPM are more 'optimistic' than the other stakeholder to the extent in which nature is dynamic, for example by stating that nature often finds its balance, and that in the past many AS were also categorized as native. However, this does not mean that there are less concerns about IAS. It might indicate implications for the management as these stakeholders are more likely to lean towards the "acceptance" strategy, which means there will be no management interventions for that IAS. This is already seen with, for example, the ring neck parakeet, an IAS that is left alone in the expectation that nature will eventually return to a natural balance. Although, this is only partly the reason, since the main reason the parakeet is not dealt with is because the public if fond of it, then removing it will only cause a lot of negative backlashes.

The other stakeholders such as the NFCPS Authority, Province of North-Brabant, the municipalities Breda and Eindhoven, State Forestry and the water authorities also view nature as dynamic. However, data-analysis shows they tend to focus on the idea that nature knows its limits. Moreover, the municipality of Breda, NFCPS Authority and water authority Aa and Maas emphasize that nature is dynamic, but that humans have an active role in accelerating this dynamic by introducing more IAS into areas and that more attention should be paid to this.

When a species has already established itself, all stakeholders provided the same answer: The importance of the ecosystem is preferred over the well-being of the individual animal,

meaning that an individual animal can and/or should be eliminated if an ecosystem can be saved through doing this. Although this is agreed upon by many stakeholders, this policy choice creates its own challenges, perceived by many stakeholders such as the Ministry ANFC the NFCPS Authority, The municipalities of Tilburg and Breda and the water authorities at first hand. A stakeholder may think that an invasive alien species should be removed from an ecosystem, but when it comes to an animal with neotenic features, backlash from society can be expected. This often results in a more “acceptance” strategy, also seen in the example of the ring band parakeet.

3. Experience

Another concept that is derived from the data, which has a big influence on the perception of IAS, is experience. The data showed that especially a negative experience of a species that is back after it has been removed leads to a different IAS management approach of the species, as a stakeholder indicated “*Why should I tackle them when they will be back soon*”. This is mainly described by the municipality of Tilburg, Breda and the water authorities. This led to stakeholders leaning more to the “acceptance” strategy. For example, seen in the case of the sunfish, a species that water authorities do not want to put resources into in order to eliminate them, as they are likely to return. So, when a species is removed and then re-enters the ecosystem, the strategy changes from "eliminate" to "accept" or "control". According to the data-analysis, when neighboring land-owners do not take measures, stakeholders can remove a species, but if their neighbor does not, the species comes back almost immediately. This evokes a sense of powerlessness that prevents IAS from being tackled.

5.1.2. Effects

Secondly, the factor “effects” will be discussed. Effects refer to the changes an IAS can bring to socio-ecological systems. An effect can be either positive of negative, and can be valued in ecological, economic and social implications (Shackleton et al., 2018).

First and foremost, the data-analysis shows that the ecological effect an IAS can bring is most apparent among all the stakeholders as a negative ecological effect is the most described effect associated with IAS. This is agreed upon all the stakeholders and is reflected in the initial definition of an IAS that is given by all of the stakeholders provided during the interviews. When asked about the definition of an IAS each stakeholder describes a negative ecological effect (suppressing native flora and fauna for example), while only the municipality of Tilburg and Water Authority Aa and Maas initially also refer to economic or social damage in their definition. When discussing other possible characteristics and effects of an IAS, economic damage and social damage are also mentioned. An example of a definition of one of the Water Authorities is:

“To me, an invasive alien species is a species that does not occur naturally in this region in the Netherlands and has few natural enemies and forms of cohabitation in our ecosystem. He enters a linked system on his own and turns it upside down because his growth is not inhibited”

According to the data analysis the economic effect can be divided into 1) a negative economic effect because of the damage of assets, or 2) a negative economic effect because of the costs of the removal of an IAS. The first negative economic effect was mostly mentioned by the Department of WPM and the water authorities, where IAS can affect assets, as for example the invasive water plants which clog machinery causing them to brake. IAS such as the American crayfish might also affect dikes through extensive digging, requiring repair so that they also do not endanger the safety of people. The second negative economic effect, discussed by the Ministry ANFC, the municipalities, state forestry and Water Authorities are the costs of removing IAS. depending on the IAS, it can be expensive to remove a species. For example, the mechanical removal of evening primrose, an invasive plant species, costs site management organizations approximately 150,000 euros for a 250-hectare piece of land. These costs only increase as the plant keeps coming back (Withagen et al., 2017). It is also emphasized by the Ministry ANFC and the Department of WPM that costs must remain proportional, and that, for example, millions should not be spent on taking in two invasive raccoons.

The most frequently mentioned negative social effect is the effect IAS can have on public health. Although this is a major concern for every stakeholder, the municipalities and the Water Authorities primarily have to deal with this on a larger basis in practice. Consider, for example, the giant hogweed, a plant that can leave burns on people. These plants can often be found in places where pedestrians come and cause many complaints from the population.

It can be concluded from reviewing the policy documents and the interviews that the Ministry ANFC, the NFCPS Authority and the Province of North-Brabant in practice focus more on the ecological effects of an IAS. Foremost because these parties follow the definition of EU, which state the following: *"Invasive Alien Species (IAS) are animals and plants that are introduced accidentally or deliberately into a natural environment where they are not normally found, with serious negative consequences for* their new environment" (EU, 2015).

However, the analysis has shown that IAS that address social harm in the form of public health or IAS that cause economic harm take precedence over IAS that only have an ecological effect with the other stakeholder. This mainly takes place locally where stakeholders do not have the resources to tackle all species, and then mainly focus on the species that cause more direct effects that have an effect on humans rather than on an ecosystem. This does cause dissatisfaction with many ecologists who see the negative ecological effect happening without anything being done about it. An explanation for this is political expectations.

"The management budget is very limited anyway, and you can only spend your money once and then you almost always do it in locations where the economic damage is greatest. At least, that's what politicians expect you to do, although we as ecologists may take a very different view."

This quote of one of the municipalities capturers the feeling of more stakeholders as it is expected from a political view to give a priority to species that have a negative social and economic effect.

The municipality of Breda, for example, indicates that the vast majority of the budget available for IAS is spent on ways to combat the oak processionary caterpillar, a caterpillar whose hairs burn as soon as it comes into contact with your skin. But as a result, IAS that cause ecological damage are not addressed because there is no budget left.

5.1.3. Species

Perceptions are mental construct of an object, and they are influenced by the attributed of that object. The theory determines three indicators to research the perception on the species: traits of the species, the residence time and the introduction time 9Shackleton et al., 2019).

The traits of a species influence how species are being perceived, which subsequently has consequences for the management that are carried out. An important trait that emerged during the data-analysis was to what extend a species is considered ugly and undesirable (or not). The Ministry ANFC, Province of North-Brabant, Municipality of Tilburg and Breda and Water Autority Rivierenland all indicated that when animals have neotenic features (big eyes and large heads), that are small, or fluffy or majestic, leads to a more positive view on the species as they are perceived cute of cuddly. On the other hand, species that provoke fear of disgust are perceived more negative. The sentience of a species also plays a role on how people view IAS management, definitely when it comes to control methods. Control methods that are lethal are more opposed when it comes to mammals and birds than with insects of fish. An example that came up with various stakeholders was the raccoon, or the ring-necked parakeet. Animals that are seen as fun and cute. This phenomenon is recognized by the Ministry ANFC, Province of North-Brabant, Municipality of Tilburg and Breda and Water Authority Rivierenland. This might provide implications with control measures. Cute and cuddly features have a significant impact on the public opinion on the species. When species with neotenic features are tackled, a stakeholder might a lot of negative feedback from the population. This is in contrast to, for example, an insect that is being addressed. Only the Department of WPM stated that the level in which an animal is perceived cute should have nothing to do with control measures being taken.

Various stakeholders such as the municipality of Breda and Tilburg and Water Authority Aa and Maas pointed out that there is another trait that influences the perception on the species, namely the visibility of the species. People tend to be more concerned and involved with objects, events or concern they encounter in their daily life. When a species is located in the city center the problem is noticed more quickly or more people experience discomfort on a more frequent basis than when the species is located far outside the city. However, this is not a rule of thumb, as for example, species that originate in the water are also less likely to be experienced as a problem (even though this is a body of water that many people walk past every day). After all, the problem takes place underwater and is therefore less noticeable. This is, amongst other things, supported by the following quote:

“It also takes place underwater, doesn't it? The most that bothers us is what we see or what other people see” – Respondent Aa en Maas

Another species trait influences the perception of the stakeholders is the residence time (the time a species appears in the ecosystems since the introduction). The residence time of an IAS is often seen hand in hand with "widespread".

“There are so many alien species, and if they are not that harmful, then we should just accept them. That's what we call a piece of acceptance”

The longer a species is here, the further the species has spread. This can evoke two feelings: on the one hand IAS are seen as a part of the landscape of North-Brabant, as if the species “belongs”. This feeling is mostly described by the Ministry ANFC and the municipality of Tilburg. On the other hand, the species can be seen as a problem that has become too big, as it evokes a feeling of "this makes no sense anymore, we can no longer eliminate the species". The problem does not feal feasible anymore. This feeling is mostly described the municipalities of Eindhoven and Breda, State forestry, Water Authorities Rivierenland and Aa and Maas.

Sub-conclusion

To answer sub-question one an overview is provided of the factors 1) individual (organization), 2) effects and 3) species which influence the perception of the main stakeholders.

We can see a difference in how knowledge is acquired on IAS. The ministry ANFC, the NFCPS and the Department of WPM are mostly guided by researches and science to obtain information of species. The province of North-Brabant and the Regional Water Authorities acquire knowledge in a different way. These stakeholders are also supported by the organization and are provided with a budget to attend workshops and seminars. This is in contrast to al the municipalities and state forestry who dominantly acquire knowledge through self-study and personal interest. This includes mostly reading grey literature through the internet. The knowledge-systems in place are perceived as very limited because of 1) the unclarity where to obtain knowledge and 2) the fact that stakeholders on the lower policy levels who are responsible for tackling IAS don’t have anyone to turn to or are not facilitated by the organization to acquire knowledge and.

We also see a contradiction in the way nature is perceived, as some stakeholders such as the Municipality of Eindhoven and State Forestry hold a more conservative view on nature and prefer native species when new nature need to be planted. All stakeholders perceive nature as dynamic, however we can see a difference where the municipality of Tilburg, Ministry ANFC, and the Department of WPM are more ‘optimistic’ than the other stakeholder as they rely more on the premise that in some cases nature will eventually finds it balance. The other stakeholders such as the NFCPS Authority, Province of North-Brabant, the municipalities Breda and Eindhoven, State Forestry and the water authorities also view nature as dynamic, but the risk that people accelerate this dynamic is emphasized. This might lead to management implications as some stakeholders will choose to “accept” a species and leave it alone sooner than others. When a species has already established itself, all stakeholders provided the same answer: The importance of the ecosystem takes precedence over the well-being of the individual animal. Which means that an individual animal can/should be eliminated if an ecosystem is saved. However, when it comes to

animals with neotenic features, a lot of negative feedback from society can be expected. This often results in a more “acceptance” strategy. Also, when IAS are already widespread, they problem tackling the IAS might be perceived as too big, or the IAS is seen as a species that belongs to the landscape, also resulting in the acceptance strategy.

The effect also influences the perception of an stakeholders. Effects can be ecological, economic and/or social. the data-analysis shows that the negative ecological effect an IAS can bring is most apparent among all the stakeholders. When discussing other possible characteristics and effects of an IAS, economic damage and social damage are also mentioned. The negative economic effect of IAS damaging assets is most apart among mentioned by the Department of WPM and the water authorities, while the Ministry ANFC, the municipalities, State Forestry also emphasize the costs of removing IAS, also indicated by the water authorities as well. We can see a difference where the Ministry ANFC, the NFCPS Authority and the Province of North-Brabant in practice focus more on the ecological effects of an IAS. However, the analysis has shown that IAS that address social harm in the form of public health or IAS that cause economic harm take precedence over IAS that only have an ecological effect with the other stakeholder. This mainly takes place locally where stakeholders do not have the resources to tackle all species, and then mainly focus on the species that cause more direct effects that have an effect on humans rather than on an ecosystem.

The traits of a species influence how species are being perceived, which subsequently has consequences for the management that are carried out. An important trait that emerged during the data-analysis was to what extend a species has neotenic features. The Ministry ANFC, Province of North-Brabant, Municipality of Tilburg and Breda and Water Autority Rivierenland all indicated that when animals have neotenic features leads to a more positive view on the species as they are perceived cute of cuddly. This might provide implications with control measures as cute and cuddly features also have a significant impact on the public opinion on the species. When species with neotenic features are tackled, a stakeholder might a lot of negative feedback from the population. Various stakeholders such as the Municipality of Breda and Tilburg and Water Authority Aa and Maas pointed out that the visibility of a species also influences the perception, as people tend to be more concerned and involved with objects, events or concern they encounter in their daily life, which also indicate resources are provided to tackle IAS which are perceived negative by society.

5.2. Policies

After the perception of the key stakeholders has been established, the policies of the different stakeholders will be described. Stakeholders can have different policies that support or contradict each other. It is important to gain insight into this in order to ultimately be able to make statement about why and how they support or affect invasive alien management. This section will therefor answer sub-question 2: *What are the main policies of the stakeholders and how do they relate to the implementation of the IAS management?* These policies can be public, private and hybrid policies. First the main policy goals towards IAS and IAS management will be discussed. Secondly, the policy instruments used by the key stakeholders that emerged from the data-analysis will be further explained. A policy instrument is a means that an organization deploys to implement a policy plan. So, not only the policy goals will be addressed, but also which instruments are used to implement it. Together they draw up the policy of a stakeholder. As stated in chapter 3, semi-structured interviews were conducted discussing stakeholders' current policies, however, this section is also supplemented with information from the stakeholder's policy documents. The following policy instruments emerged from the data and will be discussed: 1) legal policy instruments, 2) communication instruments and 3) financial/economic instruments.

5.2.1. Policy Goals

First of all, what are the main goals and targets regarding IAS described by the key stakeholders? Starting again with the Ministry ANFC and the NFCPS Authority. The Ministry ANFC is responsible for the national policy and the NFCPS Authority has a supporting role. What does this entail? For the Ministry ANFC and the NFCPS Authority the European Regulation for Invasive Alien Species is leading and their policies are a direct reflection of this regulation. The regulation speaks of prevention, control and elimination. Control and elimination is delegated to the province of North-Brabant. So, for example, if a raccoon (an IAS species that is common in North-Brabant) has been spotted, the Province of North-Brabant must decide whether to shoot or catch this raccoon. This choice is theirs and with it the costs that are involved, according to the interviews. However, a very large part of the regulation concerns itself with the part of prevention. As shown in the policy documents and resulting from the interviews, a main goal for the Ministry ANFC is the prevention of IAS listed in the Union List of entering the Netherlands. This means customs supervision for the import of species via the port of Rotterdam and Schiphol. Much of the regulation also deals with monitoring species in the wild. Distribution maps are made to get insight into where IAS are located. According to the data, it is the responsibility of the Ministry ANFC to have a signaling system, so when people see a species, they don't recognize, they can report it so species that are on the union list can be eliminated immediately and as early as possible. The NFCPS Authority indicates during the interview that there is no such thing as "invasive alien species policy" in the Netherlands, and that they follow the European Invasive Alien Species Regulation. The NFCPS Authority conducts and provides risk-assessments of IAS, as also discussed in paragraph 5.1, risk assessments provide information on IAS to make well-informed decisions about measures to prevent introduction or spread.

Within the province of North-Brabant, policy regarding IAS is relatively new. Recently (2020) an action plan for IAS has been established. The three policy goals that distinguish the province are:

1) Focus on the complete and permanent elimination of invasive alien species early on from the natural environment in North Brabant where this is still possible.
2) Where elimination is no longer possible: focus on control at the local level – area-oriented approach. Control can also mean that efforts are made at local level for elimination if this is possible and desirable.
3) The primary goal of the elimination or control of invasive alien species is to prevent biodiversity loss and damage to native plant and animal species.

Considering the most recent policy document and the interview, it can be stated that there are no clear goals formulated. For example, no specific timeframe is provided in which the goals must be achieved, the policy document does not specify about approaches to tackle IAS and it is not clear who is responsible for the approach. According to the interview the Province of North-Brabant takes on a more facilitating role by, for example, releasing subsidies for combating IAS. The following quote illustrates the issue of no specific policy goals:

For example, we do not have a target of 'in 5 years the invasive alien species will no longer increase', for example. We have no such goals.

The Department of WPM has no formulated policy goals with regards to IAS at this time. A reason for the lack of policy that arose from the data might be because IAS are not given priority within the organization and there are not enough people on the subject:

“Our efforts towards alien species are a bit fragmented, was fragmented. Someone was working on it, but he went to another department within Rijkswaterstaat.”

Another reason which became apparent from the data analysis is a lack of urgency and unfamiliarity. When an IAS causes major nuisance, it is tackled on a project basis when the resources and knowledge are available. But there is also a lot of uncertainty about IAS. The lack of clarity can lead to a lack of action, because once an IAS has been identified, the first questions are according to the interviewee: "if it is a problem what should we do?" and "what would it cost?".

The same problem appears at State Forestry and within the municipalities. Policy goals and targets concerning IAS remain absent. An important reason that appears from the data analysis is the fact that employees are given ecology in combination with IAS on top of the work they already had. Not only do the employees not have the specialist knowledge to tackle the IAS, but other nature and management tasks are given priority:

Invasive alien species, well, to be honest, if I'd known it was going to take so much time, I wouldn't have jumped in so hard.

Another reason for the lack of policy indicated by all the municipality is a perceived lack of knowledge to develop those policies. There is also a need for practical knowledge. So how

should a particular species be addressed? How can this be done as efficiently as possible? This knowledge is lacking even though it is highly sought after at the same time. However, according to all municipalities, there are not enough resources to develop sufficient policy. For the time being, IAS are only being addressed project-based when current targets set for nature aren't met.

The regional water authorities, on the other hand, have a very clear policy on paper. A Brabant-wide pest species document (2021) has been drawn up for all regional water authorities. The policy goal is as follows:

Providing an unambiguous assessment framework for dealing with pest species in the management area. This should lead to the timely prevention or, as much as possible, limitation of the damage, nuisance and spread of pest species at the best possible cost efficiency.

This policy distinguishes between different management strategies, which can be followed when IAS are present. The choice of strategy depends on the characteristics of the species, the risks and damage that is caused, the size of the local population, the effectiveness of the control and the costs associated with this.

According to the document there are four management strategies:

1.Prevention: Preventing the problem

2.Eliminate: remove the problem - fight until the pest is completely gone

3.Accept: Accept the problem - don't fight it

4.Control: Control the problem, control the extent of the contamination

Control and elimination include aftercare. Monitoring and research are essential according to the policy plan. However, the data analysis has shown that although this looks like effective policy on paper, there are perceived gaps between policy and practice. This is indicated by the interviewees, who explained that the people in the field do not share this knowledge, and it is actually already impossible to recognize an IAS in the first place. It is stated that "*many policy plans are written, but many end up on the shelf because the translation is not made into practice."* This indicates implications for effective IAS-management as policies are not carried out in the field.

5.2.2. Legal policy instruments

Firstly, the legal policy instruments affecting IAS-management in North-Brabant will be discussed. Legal policy instrument relates, among other things, to granting rights, rules and laws, pointing out obligations, and concluding contracts.

The European Invasive Alien Species Regulation is the biggest driver of policy in the Netherlands. The European regulation on IAS has been in effect since January the 1st, 2015. The regulation uses the three-step approach to limit the negative impact of IAS within Europe. This three-step approach involves: 1) Prevention. There is a European ban on the

possession, trade, breeding, transport and import of exotic animals and plants that are on the Union list. The Union list contains species which cause harm to biodiversity and/or ecosystem services in parts of the EU. 2) Detect and intervene. All Member States are obliged to identify Union List species and remove populations if it concerns an IAS that is new to the country. 3) Control and reduce. If removal is not possible, Member States must take proportionate control measures to prevent the spread and/or damage by the IAS as much as possible (EU, 2015).

All stakeholders are aware of the regulations and recognize it must be followed and implemented. However, looking at various stakeholders, the Ministry ANFC, The NFCPS and the Province of North-Brabant, the European Invasive Alien Regulation serves as a clearer starting point than for other stakeholders such as the regional water authorities, State Forestry and the Municipalities. This means that within the Ministry ANFC, The NFCPS and the Province of North-Brabant a clear distinction is made between species that fall under the European Regulation and species that do not. This results in practical implications, as is seen for example within the Municipality of Tilburg and Breda, who could not be provided with subsidy to tackle the Triturus carnifes, a type of salamander which originates from South-East Europe. This IAS is common in North-Brabant and displaces the native population of salamanders and disrupts many ecosystems. The Municipality of Tilburg and Breda try to combat the IAS, but due to the fact it is not included in the Union list they are not entitled to financial resources provided by the Province of North-Brabant.

The data-analysis showed that at the municipalities and State Forestry there is less clarity about the European Invasive Species in general. There is a vague understanding of a regulation. However, according to the data-analysis, within all municipalities, water authorities and State Forestry, most resources are distributed to species that cause social and economic damage, as also stated in paragraph 5.1.2.

“There is a European directive that obliges a few things, but what makes it mandates and who is ultimately responsible for tackling it. I dare say that hardly anyone knows”

This quote provided by a municipality indicates the lack of clarity about the European Regulation that is perceived among many stakeholders on the lower policy levels. This quote also reflects a general degree of ambiguity. A feeling that, according to the municipalities, water authorities, the department of WDP and State Forest, they are all struggling with. This ambiguity is perceived as it is not clear who is responsible for which tasks in which region regarding IAS, and the European Invasive Alien Species Regulation does not clarify that. However, this clarity that is needed to carry out sufficient IAS-management according to all these stakeholders, as it is sometimes unknown who should tackle a particular species. For example, when a species has taken residence in one concentrated area on someone's land it is clear, and the stakeholder who owns the land should take measures. However, a lot of times this is not the case as IAS spread further and spread across boarder. It is also unclear to those stakeholders when, for example, an invasive plant is located in and around water in a certain municipality, whether it is then the responsibility of the municipality or the relevant Water Authority. This can result in management implications when both stakeholders adopt a wait-and-see attitude.

Another problem emerged from the data-analysis concerning the European Invasive Alien Regulation. One of the Water Authorities stated:

"Those are species that are all already a problem, aren't we all too late for that. Because they are already a problem and they are already untreatable. They have proven that they multiply explosively and are difficult to combat. In fact, you would like to have a similar list for the potential problem children."

This statement sums up the feelings of various stakeholders including the Municipality of Breda and Tilburg, Water Autority Aa and Maas and Water Autority Rivierenland. The species that are on the Union List already established themselves and as a result they are often more widely spread which means more resources are needed for taking management interventions.

Other laws (e.g. the fisheries law, phytosanitary legislation,) are legal policy instruments that have to be taken into account as they have an effect on IAS management. A certain legislation might be in force for a certain species. For example, the fisheries law:

"And, if you're talking about exotic crayfish and mitten crabs, we have arranged that through the fisheries law that professional fishermen are allowed to fish for them and the provinces are therefore designated for all other plants and animals."

This might result in more affective management interventions when it results in controlling a specific IAS population. However, no data or examples have been found of North-Brabant to support this standpoint.

5.2.3. Communication

The second policy instrument utilized by several stakeholders (the Ministry ANFC, The NFCPS. the Province of North-Brabant, the Water Authorities and State Forestry) in IAS-management is communication. As stated in paragraph 4.1.1., a common cause of IAS entering nature in North-Brabant is the release of animals held as pets by citizens. Communication as a policy instrument aims at achieving external effects in society, for example, the prevention of releasing animals into nature.

According to the data analysis, a distinction can be made between passive communication and active communication. Currently, passive communication is the only form of communication common among these stakeholders. Passive communication in this sense means that information is provided through the stakeholders' own channels such as social media of websites. Active communication indicates communication through, for example, national campaigns. The following quote provided by one of the Water Authorities is an example on passive communication:

"We have a website and you would click on a block. There could you download our policy, pest species: what can you do about it as a citizen? It is a short story about alien species and pest species. That is it, that's what we do, so That's basically passive communication, but if you happen to run into that, you can read what we do. It is not the same as actively communicating to the outside, that is limited."

However, according to all stakeholders, a greater degree of active communication is desirable. Two reasons emerged from the data analysis:

1) All stakeholders agreed, when people are better informed, they might not release their pets into nature. 2) the Department of WPM, te Province of North-Brabant, the municipality of Eindhoven, Tilburg, Breda and State Forestry indicated that when there is more active communication concerning IAS, the support for measures for tackling IAS among citizens becomes greater. An example provided by both the Municipality of Tilburg and the Municipality of Breda is the raccoon. The municipalities indicate that they experience a lot of nuisances from this IAS. However, they experience backlash from the public when they try to remove this species. This is mainly because the raccoon had neotenic features and is experienced as "cute" by the public. Both stakeholders indicated that if there was more knowledge among citizens about IAS, there would be more support for measures against them. Most stakeholders such as the State Forestry, the municipalities of Breda, and the Water Authorities Rivierenland indicate that active communication should be the responsibility of the Ministry ANFC. However, the Ministry ANFC on its turn indicated that there is not enough attention for the problem of IAS within politics for IAS.

A third form of communication that emerged from the data-analyses would be involving citizens in IAS discussions, for example, conversations or sounding boards groups. The stakeholder can be divided into three groups when it comes to whether citizens should be involved in the discussion on IAS.

First, there is the Ministry ANFC, the municipality of Eindhoven and Water Authority Rivierenland, who indicated that entering into a dialogue with citizens has no added value. They indicate that they do not know what knowledge they should obtain from the public. The municipality of Eindhoven also states that conversations with citizens might lead to liability on the part of the municipality when an IAS cause damage to a citizens' property. This also holds them back from engaging in conversations about IAS with citizens.

Second, we see stakeholders with a divided opinion on this matter, for instance the Municipality of Tilburg, the Municipality of Breda and the Department of WPM. These stakeholders indicate that conversations with citizens can be useful, but that it depends with whom this conversation is. For example, when a citizen has some knowledge on IAS, conversations can be useful. The municipality of Tilburg does indicate that ultimately, they have the obligation to tackle IAS, and that citizens cannot participate in decision-making. The Province of North-Brabant and the NFCPS Authority indicated they do not facilitate discussions, but do not actively oppose it either.

Third, there is State Forestry, who is a full supporter of engaging in conversations about IAS with citizens, according to the interview. An argument the stakeholder provided, is that while performing tasks related to IAS, for example, setting out fish traps, noticed that citizens want to talk about the subject of IAS. Conversations with citizens will therefore only increase support, according to State Forestry.

5.2.4. Financial and economic instruments in place

The financial and economic policy instruments are the final policy instruments that emerged from the data-analysis and will be discussed. Financial policy instruments are the financial structures in place to achieve IAS policy goals, for example, subsidies.

The ministry ANFC stated during the interview that the eradication and control of IAS and its costs has been allocated to the Province of North-Brabant. The Province of North-Brabant issues subsidy for species that are listed on the Union List. However, this is not a guarantee and each case is assessed individually. During the interview, the Province of North-Brabant indicated that they want to take on a more facilitating role:

"I then got to work, initially with subsidy schemes. They opened on June 1. One for control projects in Natura2000 areas and one for control projects, actually collaborative projects of land owners and managers, to combat invasive alien species outside Natura2000 areas. And I'm very curious what the result will be. As a province, we really want to take that responsibility to facilitate this".

This is in line with the invasive alien species action plan provided by the Province of North-Brabant (2020), which states the new subsidy options:

Subsidy options for specific situations: After the adoption of this action plan, a number of subsidy schemes will be worked out:

1. A subsidy scheme to stimulate the approach in areas where invasive alien species are a threat to biodiversity and for which the province bears responsibility, such as the Natura 2000 areas and the Brabant Nature Network.

2. A subsidy scheme for plans that promote cooperation between landowners; the goal is to establish area-level collaborative projects to effectively combat widespread species.

Those two options indicate subsidy will be provided when it: concerns Natura 2000 area's or when it is for promoting cooperation between landowners. The goal is to enhance cooperation projects at regional level to promote effective control. This collaboration can take place at any desired level (municipality, catchment area, water board, etc.).

According to the data-analysis, the Municipalities, Water Authorities and State Forestry do not feel supported by the national government and the Province of North-Brabant, as they often bear the costs of tackling an IAS themselves. This highlighted by the following quote provided by one of the municipalities:

"R*esearch was so expensive that I also asked for a contribution from the province. And yes, the province just lets you know that it's not their job. Or yes, at least saw no possibilities. So yes, in the end it just came to nothing and the animal is still there. And yes, I think that's just not right*"

Within the municipalities, stakeholders indicate IAS management receives very little financial support by the organization itself. According to the data analysis, an important reason is the unfamiliarity with IAS:

“Well, look, because it's also relatively unknown. Even with municipalities and therefore the responsibilities are not clear, there is absolutely no budget, so these are all extra costs that put money on your management. And that cost item, in my view, is only increasing.”

Especially within the municipalities, IAS management is financed from other funds. This also means that attention is only paid to IAS when it is really considered necessary. And in practice, these are mainly the species that have negative social or economic consequences.

Sub-conclusion
The Ministry ANFC is responsible for the national policy and the NFCPS Authority has a supporting role. The main policy goal for the Ministry ANFC is the prevention of IAS listed in the Union List of entering the Netherlands and to provide a monitoring system. The NFCPS Authority indicates during the interview that there is no such thing as invasive alien species policy in the Netherlands, and that they follow the European regulation. The policy of the Province of North-Brabant is relatively new, and focus on elimination or control when elimination is no longer possible. The primary goal is to prevent biodiversity loss and damage to native plant and animal species. However, the goals that are formulated are not very specific as it sets no timeframe nor does it provide a clear understanding of who is responsible for what, which can bring implications for IAS-management as stakeholders such as the Water Authorities, State Forestry and the municipality indicated that there is a need for this information.

Policy remains absent at the Department of WPM, State Forestry and the municipalities. An important reason is because of the fact that IAS is not giving priority within the organization, shown in the fact that employees are made responsible for IAS on top of their other work. Especially within the municipalities, IAS are only being addressed project-based when current targets set for nature are not met. Reason for those policies lacking is: 1) a perceived lack of knowledge to develop those policies and 2) a lack of resources such as people and finance to develop them. This results in in-effective IAS management as many IAS are not addressed. Water Authorities on the other hand have a very clear policy, aiming to the timely prevention or as much as possible limitation of the damage, nuisance and spread of pest species at the best possible cost efficiency. However, a gap between policy and practice has been perceived as people in the field are not aware of the policy.

The European Invasive Alien Species Regulation is the biggest driver of policy in North-Brabant and the foremost legal policy instrument. However, looking at the Ministry ANFC, The NFCPS and the Province of North-Brabant, the European Invasive Alien serves as a clearer starting point than for the other stakeholders, such as the Water Authorities, State Forestry and the Municipalities. This means, for example, that the Province of North-Brabant only provides resources for species on the Union List, while stakeholders like the municipalities, Water Authorities and State Forestry try to tackle the species that are perceived to cause the most damage, even if they are not included in the Union List. Moreover, the species that are on the Union List already established themselves, as a result, they are often more widely spread which means more resources are needed for taking management interventions.

There is a strong desire in increasing active communication as well, as it could contribute to more support from the public for certain management interventions. This could improve

IAS-management in North-Brabant. The stakeholders were less united about the question if citizens should be participating in conversations about IAS. On the one hand we see the Ministry ANFC, the municipality of Eindhoven and Water Authority Rivierenland who indicated that entering into a dialogue with citizens has no added value. On the other hand, there are the Municipality of Tilburg, the Municipality of Breda, the Department of WPM. Who indicate that conversations with citizens can be useful, but that it depends on the topic that is up for discussion. Finally, there is State Forestry, who is a full supporter of engaging in conversations about IAS with citizens.

5.3. Relationship between stakeholders

This chapter will provide an answer to sub-question 3: What is the relationship between the perceptions and policies held by the different stakeholders? First, the relationship between the stakeholders will be explained, followed by instruments aimed at improving this relationship.

5.3.1. Relationship

According to the interviewees, the Invasive Alien Species Policy in the Netherlands is relatively new. Around 1990, a start was made with global biodiversity treaties. Member States of the European Union slowly started to work on the goals which were agreed in the treaties. This formed the basis for an early invasive alien policy in The Netherlands. Policies were created for species that had to be looked out for, species that were no longer allowed to be sold and species that were banned. However, as a result of the decentralization of nature policy in the Netherlands, this fledgling policy that was first created has been discontinued. Since 2015 the European Invasive Alien Species Regulation came into force while other policies regarding IAS, for example, covenants on aquatic plants have been stopped. Because of the little national policy on tackling IAS, most IAS policy has been developed by every stakeholder themselves. As a result, some stakeholders such as the Ministry ANFC, the NFCPS authority and the Regional Water Authorities having strong policies in place with clear goals and aims, while other stakeholders such as the Municipalities are lacking policy on regard of IAS.

The national government (Ministry ANFC) has policies in place aimed at prevention and monitoring. However, they transfer the responsibility of control and elimination to the provinces (the province of North-Brabant). They, on their own terms, transfer the same responsibility to tackle the problem of IAS to stakeholders as following: the Water Authorities and the municipalities.

However, the policy of the Ministry ANFC and the Province of North-Brabant is still mainly driven by the European Invasive Alien Species Regulation, leading to implications such as: 1) The Province of North-Brabant has financial policy instruments in place such as subsidies to tackle species found on the Union List. However, stakeholders such as the municipalities and Water Authorities are aware of the Union list, but choose to tackle IAS that are perceived to cause the most damage, even if they are not included in the list. Yet, when a certain species is not listed on the Union List, stakeholders will not be able to receive financial resources, leaving the IAS in the ecosystem. 2) The NFCPS Autochories carries out and provides risk-assessments and obtaining knowledge on the different risks certain species obtain. However, looking at stakeholders who are responsible for tackling IAS, there is a perceived lack of knowledge on how to tackle a certain species. Also, stakeholders are also not enabled by their organization to obtain knowledge as IAS are not given priority. This results in stakeholders being responsible for carrying out IAS measures to not having the information on how to carry out efficient management interventions. There are organizations who could provide this information, but especially the municipalities do not have the financial resources to obtain this knowledge through these organizations. 3) Species listed on the Union List have already established themselves into the landscape, resulting in the perceived

feeling of “the problem is too big”. Many stakeholders become despondent and decide not to take any action as it might feel as “emptying the ocean with a thimble”.

Moreover, due to the transfer of responsibility, stakeholders are looking for a party to take on a leadership role. This is highlighted by the following quote:

“In such a complicated subject as this, there is actually no great director? It is quickly shifted downwards, that's how I see it, a bit, a bit of a transfer system in the Netherlands to lower governments. Going further down, and then it becomes more and more difficult to organize, because if you are all the way down and you want to organize it, you have a lot of neighbors that you have to talk to.”

This quote indicates a perceived problem around IAS-management within North-Brabant. Stakeholders who are directly responsible for taking management interventions (municipalities and Water Authorities) indicated they are looking for someone to take the lead, as the problem now is perceived as too big and comprehensive. Two other problems that stakeholders who are directly responsible for carrying out IAS measures have encountered that contribute to this feeling are: 1) there is not a single way of measuring. There are no systems that indicates from which point an IAS can become a problem that must be addressed, leaving stakeholders guessing. 2) There are no targets which stakeholders such as the Water Authorities, State Forestry and the Municipalities have to comply with. There is a commitment through the European Invasive Alien Species Regulation. However, especially for stakeholders who are directly responsible for tackling IAS, perceive a lack of practical commitments. The data-analysis show that this can bring implications for IAS-management, as stakeholders feel “left in the dark”.

Improving the collaboration between the stakeholders can improve IAS-management. The Ministry of ANFC, the Department of WPM and the Province of North-Brabant look to local parties to organize cooperation, highlighted by the following quote:

“Well, as a ministry we are often addressed about this, aren't we? You must promote cooperation or take control. We do that to a certain extent, but of course it is also up to the provinces to work together and to municipalities to work together, and they have to shape that themselves and they do that too.”

So far, there is no cooperation between the municipalities, and there is little cooperation between different stakeholder groups in North-Brabant, such as between the municipalities, the Water Authorities and State Forestry. This collaboration is challenging for several reasons according to the data analysis. First of all, the financial resources for many stakeholders are limited, as indicated before. For example, Aa and Maas indicates that it often happens that they want to work together with other parties, but these parties indicate that they no longer have a budget or a lack of people. Second, it is also indicated by stakeholders such as Water Authorities and State Forestry that the problem of IAS is not always an issue with their neighbors:

“And we also said that as a water manager we also want to work as a good neighbor as a good neighbor. So, when we write down something that pests need to be controlled, we

want to do that too. And that is very difficult to convince your own neighbor that he should do the same."

Moreover, those different perceptions on IAS lead to different management interventions in a stakeholder's own region. For example, some stakeholders are more optimistic in regard to "nature eventually finding its balance" and those stakeholders are quicker to adopt the "acceptance" strategy of IAS, while other stakeholders might perceive those species as IAS which need to be tackled in order to preserve the ecosystem. We also see stakeholders not implementing IAS measures due to the fact that certain IAS hold neotenic features, again leaving the problem this IAS is causing unattended. Other stakeholders such as the municipality of Tilburg might consider adopting an acceptance strategy when IAS that are already widespread are being perceived as part of the landscape. According to the data-analysis, this results to stakeholders indicating that they want to invest in tackling the problem of IAS, yet choose not do so, as they believe this will not have any effect in the long term when neighbors do not invest as well. This can result in management implications as stakeholders take a passive stand and start waiting for the other party to take action. However, stakeholders are aware of these problems as the data-analysis indicated that various stakeholders including the Department of WPM, the regional water authorities, the municipalities and State Forestry indicated that there is a greater need for cooperation among different stakeholder groups to overcome this problem.

All stakeholders indicated that the public also has a big influence on IAS-management. Therefor policy instrument such as communication with citizens might create more support for certain management actions, even for species with neotenic features. Stakeholders including the State Forestry, the municipalities of Breda, and the Regional Water Authorities Rivierenland indicate that this should be the responsibility of the Ministry ANFC. Who, in their turn, indicated that there is not enough attention within politics for such national campaigns, leaving it to the Province of North-Brabant.

5.3.2. Instruments aiming at improving the relationship

There are some instruments available to enhance the relationship between stakeholders. First of all, within the Water Authorities, cooperation is an important instrument in regard to IAS-management, as emerged in the policy documents as well as in the interviews. Cooperation between different Water Authorities is stimulated by different consultation structures to improve the mutual relationship.

One example of a policy instrument used by the Province of North-Brabant is to stimulate this cooperation by providing subsidies to parties that want to stimulate cooperation. This is, however, put in place very recently and it remains to be seen whether or not this will have a positive effect.

The Province of Noord-Brabant also established in their action plan (2020) that a Platform Invasive Alien Species will be put into operation with the representatives of various stakeholders (land management organizations, land owners, municipalities, regional water authorities, agriculture and horticulture, Fauna Management Unit as well as the province). Agreements are made within this platform as to who is able to or must combat which species and in which way this should be handled. This platform has been delayed due to the

Covid-19 crisis. It is not yet known which effect this platform will have on the relationship between the stakeholders

Sub-conclusion

As the result of the decentralization of nature policy in the Netherlands, this fledgling policy that was created has been discontinued. And since the European Invasive Alien Species Regulation went into force in 2015, other policies regarding IAS, for example, covenants on aquatic plants have been stopped. Because of the little national policy on tackling IAS, most IAS policies have been developed by every stakeholder themselves. Most policies and structures put in place with the higher policy levels such as the Ministry ANFC, the NFCS Authority and the Province of North-Brabant are driven by the European Invasive Alien Species Regulation, resulting in implications as for example stakeholders who want to tackle IAS yet who are not facilitated with the knowledge on how to, and financial resources. Moreover, Stakeholders are waiting for a party to take on the leadership role. There is a perceived problem around IAS-management within North-Brabant. Stakeholders who are direct responsible for taking management interventions indicated they are looking for someone to take the lead. Other problems including not sharing one singular way of measuring whether or not a species becomes a problem, and no practical targets stand in the way of effective management as well. Furthermore, we see a difference in perceptions on IAS leads to different management interventions in stakeholder's own region. For example, some stakeholders are more optimistic in regard to "nature eventually finding its balance" and those stakeholders are quicker to adopt the "accept" strategy of IAS, while other stakeholders might perceive those species as IAS which need to be tackled. We also see stakeholders not implementing IAS measures due to the fact that certain IAS hold neotenic features, again leaving the problem this IAS is causing unattended. This leads to stakeholders indicating that they want to invest in tackling the problem of IAS, but decide not to as this will not have any effect in the long term when neighbors do not invest as well. This can result in management implications as stakeholders take a passive stand and start waiting for the other party to take action. Collaboration between the stakeholders can improve IAS-management and some instruments are put in place to enhance the relationship, for example a subsidy for collaborations and the Platform Invasive Alien Species that will be put into operation with representatives of various stakeholders or consultation structure. However, cooperation is still lacking between stakeholder groups, resulting in a wait-and-see attitude, standing in the way of effective IAS management.

6. Conclusion and Discussion

6.1. Conclusion

IAS established themselves into the landscape of North-Brabant, causing ecological, economic and social damage. Management interventions of different stakeholders are needed to tackle the problem. This research aimed at answering the following main question: *To what extent do North-Brabant stakeholders' perceptions and policies on invasive alien species in reinforce or contradict each other and how does this influence invasive alien species management?*

IAS-management is still in its early stages in North-Brabant. The European Invasive Alien Regulation proved an important turning point in invasive alien management and over the past 5 years, the problem of IAS has attracted more attention of the different stakeholders. The responsibility of control and eradication was transferred from the Ministry ANFC to the Province of North-Brabant, who on its term transferred the responsibility of taking appropriate actions to stakeholders such as the municipalities, State Forestry and Water Authorities. However, from the data-analysis several problems became apparent resulting in management implications for IAS-management in North-Brabant.

First of all, stakeholders who are responsible for tackling IAS indicated there are little to no resources available to tackle the problem. This is mainly due to the fact that IAS-management is relatively new to many organizations, which results in a lack of urgency, prioritizing and unfamiliarity within the different organizations. This is reflected in the following issues: 1) there is a lack of available people, as seen within the Department of WPM and the municipalities. As a result, people are given "IAS-management" on top of their other responsibilities. 2) Little to no financial resources are being made available within organizations for IAS-management and 3) there is a perceived lack of knowledge as stakeholders such as the municipalities and State forestry are not supported by their organizations to obtain knowledge, in contrast to the other stakeholders. However, these stakeholders indicated there is a need for practical knowledge to successfully carry out management interventions.

Secondly, we can see a difference in the way policies are developed and priority is given to certain IAS. There are the stakeholders such as the Ministry ANFC, the NFCPS Authority and the Province of North-Brabant who's policies are a direct reflection of the European Invasive Alien Species Regulation and the Union List, and focus on species dominantly causing ecological damage. This is in contrast to stakeholders such as the municipalities, Water Authorities and State Forestry who, mostly due to the lack of resources, mainly concern themselves with IAS that cause social harm in the form of public health or IAS that cause economic harm. These are given priority over, for example, IAS that only have an ecological effect. This is also due to the fact that the control of IAS causing social or health issues is expected by the public. This results in further management implications as policy instruments such as subsidiarity systems and knowledge presented by the NFCPS Authority focus on species listed on the Union List.

Also due to the lack of resources, IAS are mostly tackled in a project-based manner. Moreover, different perceptions lead to implications in IAS-management. All stakeholders perceive nature as dynamic, however we can see a difference where the municipality of Tilburg, Ministry ANFC, and The Department of WPM are more 'optimistic' than the other stakeholders as they rely more on the premise that in some cases nature will eventually finds it balance. This might result in the acceptance of a species. The other stakeholders such as the NFCPS Authority, Province of North-Brabant, the municipalities Breda and Eindhoven, State Forestry and the Water Authorities also view nature as dynamic, but the risk that people accelerate this dynamic is emphasized, making them less likely to adopt an "acceptance strategy".

An important trait of an IAS affecting the perception of the stakeholders that showed during the data-analysis was the question to what extend a species may hold neotenic features. The Ministry ANFC, Province of North-Brabant, Municipality of Tilburg and Breda and Water Autority Rivierenland all indicated that when animals have neotenic features, they have a significant impact on the public opinion of the species. When species with neotenic features are tackled, a stakeholder might receive negative feedback from the population. This phenomenon is recognized by the Ministry ANFC, Province of North-Brabant, Municipality of Tilburg and Breda and Water Authority Rivierenland. This might have implications on the used control measures, as animals with neotenic features will be accepted sooner by society and are more likely to be left in order to avoid backlash from society.

In addition, we see that the longer a species is established, the further the species has spread. This can evoke two feelings: on the one hand IAS are seen as a part of the landscape of North-Brabant, it may become as if the species "belongs" there. This feeling is mostly described by the Ministry ANFC and the municipality of Tilburg. On the other hand, the species can be seen as a problem that has become too big, as it evokes a feeling of "this makes no sense anymore, we can no longer eliminate the species". Solving the problem may not be deemed feasible anymore. This feeling is mostly described by the municipalities of Eindhoven and Breda, State forestry, Water Authorities Rivierenland and Aa and Maas. Both perceptions might result in adopting the acceptance strategy of a certain species instead of taking the needed measures to eradicate or control the species.

Thus, those different perceptions lead to different management interventions in the stakeholder's own region. Where, depending on the species, stakeholders might not take any measures due to the fact that the ecosystem will finds its balance, hold neotenic features or is too widespread, while other stakeholders might hold a different perception on whether or not to tackle a certain species to preserve the ecosystem. This may lead to stakeholders indicating that even though they want to invest in tackling the problem of IAS, they will not take any measures as this will not have any effect in the long term when neighbors do not invest as well. This can result in management implications as stakeholders take a passive stand and start waiting for the other party to take action.

Collaboration between the stakeholders can improve IAS-management. The Ministry of ANFC, the Department of WPM and the Province of North-Brabant look to local parties to organize this cooperation. So far, there is no cooperation between the municipalities, and there is little cooperation between different stakeholder groups in North Brabant such as

Water Authorities and State Forestry as well. This collaboration is difficult for several reasons according to the data analysis. First of all, the financial resources for many stakeholders are limited, as indicated before. For example, Aa and Maas indicates that it frequently occurs that they want to cooperate with different parties, but these parties may no longer have a budget or experience a shortage of people. This leads to stakeholders who want to take measures to tackle a certain IAS, but will not, as neighbors do not invest as well, resulting in the species coming back.

This passive stand is being magnified due to the perceived lack of uniformity between stakeholders by the municipalities and Water Authorities. Stakeholders who are directly responsible for taking management interventions indicated that they are looking for someone to take the lead as the problem is perceived as too big and requires too much comprehensive skills. Other problems such as the fact that there is not one singular way of measuring when a species becomes a problem and the absence of practical targets stand in the way of effective management as well. This, in combination with a feeling of "the problem is too big", results in management implications as stakeholders become despondent.

However, stakeholders are aware of these issues as the data-analysis indicated that various stakeholders such as the Department of WPM, the regional water authorities, the municipalities and State Forestry stated there is a greater need for cooperation among different stakeholder groups.

One policy instrument of the Province of North-Brabant to stimulate this cooperation is through providing subsidies to parties that want to stimulate cooperation and want to establish a platform with different stakeholders and parties. This has however only been put in place very recently, and it remains to be seen whether this will have a positive effect.

6.2. Discussion

The following section will dive further into the results and what they may imply. First an interpretation of the results will be provided and through these results the knowledge gap will be addressed, followed by my recommendations. Lastly, the limitations of the research will be discussed as well as the suggestions for future research.

6.2.1. Interpretations of the results

Over the past five decades, the European Union (EU) has developed into a legally and politically authoritative regional organization in the world, wielding significant influence across a wide range of problem areas such as the protection of biodiversity (Vandeveer, 2015). Member States are required to implement regulations and policies in order to preserve and restore Biodiversity. As of 2015, Member States of the European Union are required to take effective management measures for IAS. Measures must aim at the prevention, eradication, or population control of the IAS listed on the Union List.
This research shows different management implications as a result of the relatively new IAS policy and the decentralization of this policy to the local stakeholders. First of all,

stakeholders experience a lack of resources to take sufficient management interactions due to the lack of urgency and unfamiliarity with regards to IAS. Moreover, stakeholders perceive nature and IAS differently which results in different types of management interventions. This makes IAS management inefficient which results in a passive attitude towards taking management interventions.

This research will provide empirical contributions to research as it describes details of the phenomena of beginning IAS-management in North-Brabant. Discussion points will be provided on IAS-management implications and stakeholder engagement, integrative governance and participation in governance and animal rights.

Management implications

The understanding of the human dimension of IAS management is critical for tackling the problems which are associated with IAS. Over the years, there has been an increase in efforts to study the social side of IAS -research. A better understanding of IAS and perceptions toward them remains a vital and urgent issue which needs to be addressed as soon as possible. This research attempts to fill this gap of stakeholder engagement research. The analysis in this thesis supports the argument that a lack of cohesion between policy makers is at the root of the failure to develop and implement sustainable management practices for invasive alien species (Stokes et all, 2005; Shackleton et all, 2019; Dana et al., 2019). This research argues that it should be encouraged to have a more integrative and collaborative engagement which will improve management actions and the discussion on practical policy suggestions for improving stakeholder involvement in IAS management (Shackleton et all, 2014). This argument is supported by the data, which shows that stakeholders are not engaged from the off-set, resulting in an overall feeling of unfamiliarity and lack of urgency within different organizations. There is little to no collaboration and engagement between the different stakeholders, especially between the stakeholder groups who are responsible for the direct implementation and management interventions. Due to this lack of engagement and cooperation, the different perceptions and policies held by the key stakeholders are not addressed from the offset of IAS-management, causing stakeholders to adopt a passive stance towards implementing management interventions. This is mainly due to the fact that stakeholders do not want to action when neighboring land-owners do not implement sufficient management interventions as well.

Thus, when different stakeholder groups identify the problems associated with invasive species and confront invasive species management under different perceptions and policies, management implications occur. This supports the argument for a better collaborative engagement.

Governance

This thesis also places itself within the debate about integrative governance and how it effects IAS management. As stated in the introduction, governance often has a gap between theory and practice. For example, there is a tendency to be optimistic about the possibility

of developing common understandings and collaborations between different interest groups/stakeholders (Schultz et al., 2015; Cleaver and Whaley 2018).

Taking the landscape of North-Brabant into consideration where cities, nature and agricultural landscapes alternate quickly. The results highlighted the challenges of integrating a governance instrument such as the European Invasive Alien Specie Regulation. Data-analysis shows that stakeholders responsible for carrying out the management interventions, such as the municipalities and State Forestry manage to integrate sufficient policy goals and targets related to IAS-management. The European Invasive Alien Species in designed to ensure prevention, control and eradication of IAS in the Member States. The national government delegates control and eradication to the local levels of government. However, looking at the region of North-Brabant, city, agricultural landscape and nature alternate quickly there is a need for extensive collaboration between different landowners. This is also due to the fact that IAS spread quickly and they not stay within the boundaries of one area.

Results shows that the European Invasive Alien Species Regulation does not provide enough support for the key stakeholders at the local level to develop sufficient, practical and coherent policies. As it solely provides a list of species which are already widespread in the region. The practical knowledge on how to develop those policies is also not provided by the national government or the Province of North-Brabant. Results showed that a stakeholder might want to invest in tackling the problem of IAS, however, due to the lack of collaboration and the different policies, stakeholders state taking measures will not have any effect in the long term as the IAS will most likely return. Moreover, stakeholders do not know where to start, perceiving the problem of IAS as too big to tackle. This results in stakeholders waiting for other parties to take action. This shows a gap between policy and practice within the region of North-Brabant.

The case of North-Brabant also underlines the importance of participatory governance. In the case of North-Brabant we see that stakeholders were not engaged from the off-set but were only provided with a list of IAS that needed to be addressed following the European Invasive Alien Species Regulation. However, stakeholders did have a voice in regulation that affects them, resulting in:

- Stakeholders take a passive stand as the problem is perceived as too big and too incomprehensive when provided with a list of species which need to be tackled.
- A perceived lack of knowledge and confusion about the European Invasive Alien Species and what is entails.
- A lack of urgency and unfamiliarity within organizations, which results in a lack of resources to carry out management interventions.

<u>Animal Rights</u>

There is a discussion in the academic community regarding the “invasive” narrative towards non-native species. On the one hand it states that the invasive species narrative, and with it

the demonization of “invasive”, is morally wrong as it usually results in the unjust killing of the animal (Inglis, 2020; Warren, 2007; Larson, 2007). On the other hand, researchers emphasize the nature and severity of threats that arise from "invasive", stating that IAS should be treated as such. This research will place itself into the discussion whether the invasive species narrative can be flawed and if the systematic devaluing of animal life is a practice that is not morally justified.

The data-analysis showed that when a species established itself in the landscape of North-Brabant, the importance of the ecosystem is preferred over the well-being of the individual animal among all the key stakeholders. Meaning that an individual animal, an IAS, should be eliminated if an ecosystem can be saved. Furthermore, the review of the policy documents showed that policies in place for IAS often recommended complete eradication of the invasive species. Only when eradication is not feasible, control measures are utilized. Exceptions are made for animals with neotenic features, due to the perceived backlash of society. Those policies set in place support the argumentation that the invasive species narrative is flawed as it systematically devalues an animal life due to the term “invasive”.

6.2.2. Recommendations

Recommendations for Ravon and other organizations

The findings of this research yielded insights for Ravon and other organizations concerned with IAS- management. Based on the results, the following recommendations are being made:

- Stakeholders should be involved from the off-set of the development of IAS management or management interventions. This research shows that stakeholders involved might perceive IAS differently, resulting in different management interventions. Facilitating ways different stakeholders can discuss IAS management with their neighbors can improve cooperation between different stakeholders. In this way trade-offs and commitments are made from the start.
- Shift more attention to the translation of policies into the actual workfield. There is a need for more practical information which makes IAS management more tangible for stakeholders directly involved with IAS in the field. Not only information on a species should be provided, but also the best and cost-efficient way to tackle it. This also includes implementing more specific policy goals stakeholders and commitments between stakeholders so they can work towards something.
- There should be an internal common understanding within the organization what negative effects IAS might hold when left unaddressed. Organizations might not feel a sense of urgency towards IAS, especially for IAS they do not encounter in their daily life or only have negative ecological effect. It is important to create this sense of urgency by not only including people who are responsible for carrying out the IAS-management, so sufficient resources are located to IAS management.

Recommendations for further research

As stated in paragraph 2.2.1. this research only implements the first step of the IG framework as this study focusses on the mapping of the perceptions and policies of the involved stakeholders and determining their relationship. It is therefore recommended to carry out step 2: Analyzing the performance of governance systems and step 3: Explaining the performance of a governance system in further research. In this way, it will be possible to get a more thorough understanding of the performance of the whole system.

6.2.3. Limitations

Although this research contributed to the limited body of stakeholder involvement in IAS management, this research also holds it limitations.

This research used In-depth, semi structured interviews to collect data on the different stakeholders. Those interviewees had a background in policy-making but also worked in the field directly with IAS. During this research it became clear policy-makers and people who carry out this policy in the field hold different perceptions even within the same organization. This should be borne in mind when reading this research. It is recommended in further research to make a clearer distinction.

Moreover, this research utilizes the IG framework to determine the relationship between the different policies of the stakeholders. However, some stakeholders did not formulate any goals or targets and did not have any policy instruments in place yet in regards to IAS-management, providing implications for the analysis. It is recommended to apply the IG governance framework again in a later stage when IAS-management in North-Brabant has developed.

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Appendix 1: Interview guide stakeholders

Introduction

First I want to thank you for joining me for this conversation. My name is Lieke and I'm a student from the Radboad University, currently doing the master Environment and Society Studies. For my thesis I'm researching the current perceptions and policy's concerning invasive alien species. I would really like to use your knowledge and experience as input for my research. Your input will be crucial to my research, that's why I'm really glad you are willing to help me. It's important for me to hear your vision and that of your organisation, so there are no wrong answers.

During the conversation we'll be discussing the following subjects:

- Vision on nature management
- Vision on invasive alien species
- Policy and measures concerning invasive alien species
- Roll of your constituency

The interview will take approximately an hour. Before we start I would like to thank you again for your participation, do you have any questions before we start?

Before we dive into the subject of invasive alien species I first have some general questions about your job within the organisation and your vision on nature.

Personal

-Can you give a short description of your position within organisation	- How long have you been working for this organisation? - What are your most important tasks?	Context for the interview

1: Nature management

Vragen	Further questions	Notes
	-	
The following is a personal question, it is nog about your postion in the organisation Do you have a strong connection to nature?	- How strong would you say this connection is, on a scale of 1 to 10. From not at all to a lot. - Where does your connection come from?	To get an insight in the persons values surrounding nature.

Invasive alien species can have a large influence on nature. I'm trying to get an insight into your vision on invasive alien species and therefore I would like to ask you a few questions about it.

2: Vision on invasive alien species

What do you define as an invasive alien species?	- Is there a differentiation made between alien species and invasive alien species within your organisation?	Getting insight in what constitutes as 'invasive' with an alien species within the organisation and if there even is a difference.
According to you, what are most significant features of an invasive alien species	- Which characteristics set an invasive alien species apart from an alien species? -	
Do you think alien species can have a place in the ecosystem of the Netherlands?	If so, in what way? If so, do you think alien species can be valuable and in what way? If not, why? Do you feel that alien species could be seen as native in the future? Why yes or no? Do you think native species have more right to exist than alien species in the Netherlands? Can you explain your answer?	
How do you see the relationship between the wellbeing of the individual animal against the wellbeing of the ecosystem?		
What role do invasive alien species play in your activities at your organisations	- What percentage of your time do you allocate to IAS? - What activities do you do?	Involvement and interest in the subject Getting a picture of the experience with the subject.
What are examples of IAS that your organisation has prior experience with?		
How do you personally collect information about a IAS?	- In what way? - Does the organisation play a role in collecting information? If so, how?	According to the literature, a persons perception comes about through his/her "knowledge system". With

	- Do you read scientific articles or papers? Or do you have a contact within the scientific community?	this question I am trying to get an insight on that.
	-	
When are there concerns about an IAS?	- What are those concerns? - What are de characteristics of an IAS? - How do these characteristics compare against each other? Which ones are seen as harmful? - If any of the following concerns are not mentioned prior to this, they can be mentioned now: Are there any concerns of an economical/ecological/social nature talking about the IAS?	The characteristics of an alien species have an effect on the perception, with this question I am trying to get an insight on those characteristics and how they have an effect on the attitude towards this IAS.
Do the problems this IAS brings have priority above other (management) activities you handle within your position?	- If they have no priority, Why not?	Collecting insight into how much the problem is recognized within the organisation.

Then we can go onto the next theme. We have previously discussed when an invasive alien species can be a problem but now, I want to discuss the moment you would intervene.

3: Measures and policy

When do you intervene?	- In what way do you intervene?	Perception is, among other things determined by the "residence time" of an alien species. With this question I am trying to get insight on that.
Can you take me through the process from discovering to when you intervene? Which steps do you take?		Which steps does an organisation take?
What laws/rules do you have to adhere to when dealing with an IAS?	- By whom are the rules imposed? By the organisation itself or from higher up?	Where does the policy come from? How is the implementation of those policy's handled? Getting insight into how public policy and measures work.

	- Which laws and regulations have effect there?	
Has your organisation produced policies in handling IAS?	If so, what does this policy look like? What is the propose of these policies? Is the effectiveness of these policies measured? If so, how is this done and how effective has the policy been? How did these policies come into effect? Is this policy specific for certain species, if so how does your policy surrounding fish look like? Are these policies adjusted based on the policies of other parties involved with IAS? Do you work together with other organisations in the development of these policies? If so, which organisations and what does this cooperation look like in practice? Does your organisation have an interest in more or less of a cooperation? Why and in what form? How are these policies financed?	Seeing how the structure for policies works in the organisation.
Do you work together on the issue of invasive alien species?	- What does this collaboration look like? - Are you satisfied with that? - Is your organisation encouraged by other parties to work together and develop policy?	Cooperation improves IAS management. With this question I am gaining insight to their view on the value of cooperation.
There are different possibilities to tackle an IAS	- If a short answer is given like “positive” or “negative”, why?	Seeing what the organisations thinks about different

Whats your organisations stance on: - Mechanical removal (Example: fishing) - Biological removal (Example: releasing pike) - Chemical removal (Example: Biocides)	- Which measures are preferred by your organisation? - Biocides are currently not widely used but can provide opportunities, what's your view on this? - Is it dependent of the species/location and stage?	approaches of tackling the problem .
What are the bottlenecks in the current policy?	- Is there an ethical dilemma? Or a financial?	What are most difficult issues within IAS management and which of them does Ravon have to take into account?

4. Opinion constituency

De following questions relate to the constituency of [organisation]. The constituency can take on different roles within organisations. In this segment we try to find out the role that the constituency plays in the organisation and their involvement in IAS management and some measures.

Can you give a description of your constituency?	What role does your constituency play in your organisation?	If there is no specific constituency, ask for the parties/stakeholders that are involved. Purpose: Getting information about the constituency of the organisation and what role they play (Knowledge, financing and support)
Do you provide communication about IAS with your constituency?	If so, in what way? If so, what is the reason? If not, why not? And for other cases? If not, is there willingness to do so?	*Mapping if the organisation informs its constituency or lets it participate. Hereby getting an idea of the possibilities of engaging the constituency with the measures.*

	Do you think communication about IAS with your constituency is important?	
Does your organisation give its constituency the possibility to engage in a conversation about IAS and potential measures?	If so, in what way? If so, what is the reason? If not, why not? And for other cases? If not, is there willingness to do so? Do you think participation on IAS with your constituency is important?	Possible explanation about potential ways of informing the constituency.
Does your organisation ask its constituency for advice on potential measures?	If so, in what way? If so, what is the reason? If not, why not? And for other cases? If not, is there willingness to do so? Do you think asking your constituency for advice is important?	For example, is the constituency brought along in developing policy?
How do you think your constituency feels about using biocides to take on IAS?	Why positive or negative? Dependent on the type of biocide? Dependent on the implementation? Dependent on the species it concerns? Dependent on location?	*Getting information about the support base of the constituency about the use of Rotenon to remove the Zonnebaars, Blauwband and American Dogfish.* *Doel: direct inzicht krijgen in het draagvlak van achterban voor het gebruik van Rotenon ter bestrijding van Zonnebaars, Blauwband, Amerikaanse Hondsvis*

Closing statement

We have come to the end of our interview, do you have any other addition you'd like to share? Something that you think is important to note? Then I would like to thank you once again. Would it be all right if I contact you via e-mail if any more questions come to mind during the writing of my thesis?