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Absent action or crippling conflict? Moving from latency to a manifest problem: trajectories across scientific and public salience

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ABSTRACT

When people know and care about an environmental problem, does that result in action or conflict? This chapter looks at thirteen invasive alien species in the Netherlands, and reconstructs the development of their public and scientific salience, assessed from the amount of publications in newspaper database LexisNexis and scientific database Scopus respectively. Three trajectories are derived for a latent problem to evolve towards a manifest status. The trajectory where first scientific salience increases, followed by public salience, is the most common. For three species with different degrees of public and scientific salience, we coded the content of newspaper and governmental documents on action and conflict. We found that high public salience coincides with much action, both on the part of the community and the government. Surprisingly, conflict was also higher for problems with high public salience, and it often pertained to the type of action undertaken. An additional factor that appears to mediate the dynamics surrounding action and conflict, is the type of impacts occurring: health impacts resulted in much action and conflict. Ambiguous or uncertain impacts did not appear linked to conflict, which poses questions regarding the need for stakeholder agreement. Based on this research, a species with many stakes involved and knowledge available, results in much action, but also accrues conflict.

5.1 INTRODUCTION

Getting people involved with management of environmental problems is one of the major challenges of environmental governance. To deal successfully with environmental issues, the involvement of communities in the management of the environment is widely accepted as crucial (Folke et al. 2005, Papadopoulos and Warin 2007, Armitage 2009, Turnhout et al. 2010, Lührs et al. 2018). Despite the limited empirical proof for local actors' involvement resulting in better outcomes of decisions (Newig and Fritsch 2009), higher acceptance and implementation of environmental decisions is consistently claimed to follow from participatory processes (Newig et al. 2018). Involvement of stakeholders can be hampered in two general ways: by people not knowing, or not caring. Not knowing could mean that people are ignorant regarding a problem and the risk it entails (e.g., Esteve et al. 2018, Fizer et al. 2018); not caring could follow from people's value system not affording the problem sufficient attention (Tauro et al. 2018), or them being less oriented towards the environment in general (Newig et al. 2018). But when people do fully understand the problem, and there are clear interests at stake, does action ensue?

We explore this question by looking at action undertaken regarding invasive alien species in the Netherlands. Ecologists list invasive alien species (IAS) as one of the major threats to biodiversity, with cost estimates ranging from €12 billion a year for the EU to €120 billion a year for the USA (Pimentel et al. 2005, Shine et al. 2010). To deal with IAS successfully, involvement of local communities is increasingly recognized as crucial (Stokes et al. 2006, Verbrugge et al. 2013, Niemiec et al. 2016). It was shown earlier how for an IAS that poses little threat to a community and on which scant scientific knowledge is available, inertia can arise (Vaas et al. 2019). Acting is refrained from by a community regarding such a latent problem, as there are few stakes involved and scant insights into impacts. Yet, looking at invasion literature, the opposite situation with many stakes involved and plenty of scientific knowledge available, can suffer from inertia as well. For example, cacti in South-Africa cause major harm to biodiversity and human health, but also serve an agricultural and ornamental purpose. These discrepancies hamper collaboration and cohesion between stakeholders, which in turn limits the development and implementation of management strategies (Caplat and Coutts 2011, Novoa et al. 2016). Thus, a manifest problem with high public salience can also result in inertia, and even give rise to conflict. Likewise, high scientific salience, i.e., the availability of ample knowledge, might have adverse effects as well (Cortner 2000, Van Enst 2018). Byers et al. (2002) provide an example of the Zebra mussel, to show how knowledge availability itself is not enough: nature managers were not prepared for dealing with the invasive species, despite the large body of literature available. Alternatively, knowledge can be used strategically by policy makers and scientists alike. Policy makers can ignore insights that are not in concert with their preferences, or use uncertainty and contradictions

within knowledge available to postpone decision-making. Also, knowledge produced by scientists can leave out topics or stakeholder positions that were not considered relevant (Turnhout et al. 2007, Van Enst et al. 2014).

This chapter seeks to explore how different degrees of public and scientific salience coincide with inertia and conflict. To that end, we first reconstruct the development of scientific and public salience for thirteen IAS in the Netherlands. From these reconstructions, we learn how a latent problem can evolve towards a manifest status. Secondly, we explore whether that is desirable, i.e., how different degrees of public and scientific salience coincide with inertia and conflict. We search newspaper and governmental documents on three species representative of different trajectories across public and scientific salience, for mentions of action and conflict. Based on this, we get an idea of whether making people know and care more, is indeed conducive to management of invasive alien species.

5.2 THEORETICAL FRAMEWORK

In this section we outline three analytical elements of this chapter. Firstly, the salience of an issue to the public and science, and secondly the development thereof. Thirdly, action undertaken and conflict risen regarding an invasive species. In the methods section we link these to three research steps.

5.2.1 Scientific and public salience

The first analytical element is the problem status of an invasive species, depending on public and scientific salience. The distinction between these two types of salience follows from a typology for environmental problems, presented as a grid consisting of two axes creating four problem statuses. The vertical axis looks at the predictability of impacts, and the horizontal axis at the threats posed to livelihoods. This is an adaptation of distinctions made earlier by e.g., De Boer et al. (2010), Hurlbert and Gupta (2015), Van Enst et al. (2014) and Gromley (1986), between certainty of science and certainty of values. For this article, we zoom out from the community level to a more abstract national level, and adjust the axes of the grid accordingly. The vertical axis represents the *scientific salience* of an invasive alien species, meaning the amount of scientific attention it has received in for example scientific journals. This is mostly a quantitative measure, and does not say much about the quality of the knowledge available. Likewise, *public salience* on the horizontal axis is a measure for the amount of attention a species gets from society in general; it does not say anything about whether that attention is warranted or not. These two variables result in four problem statuses, that are depicted in Figure 10.

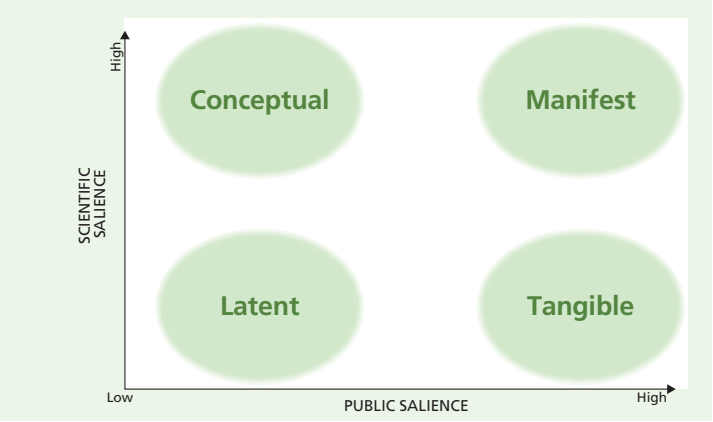

Figure 10. Problem statuses defined by two dimensions: salience to the public on the horizontal axis, and scientific salience on the vertical axis.

A *conceptual problem* is one for which elaborate scientific knowledge is available to predict which impacts will occur where, allowing for a technocratic type of management. Support from a community or government for such measures may however be lacking, since conceptual problems are characterized by bearing little relevance to the public. This is the inverse of a *tangible problem*, which is very salient to the public. However, low scientific salience makes informed management difficult to achieve, and therefore tangible problems can be expected to spur perception-based management. When both scientific knowledge is absent and the problem holds low public salience, we are dealing with a *latent problem*. Since there is no public nor scientific concern to act on, latent problems typically do not encourage any management. *Manifest problems* are the complete opposite, characterized by a good understanding of which impacts will occur when, like for conceptual problems, and compounded by a large concern from the public. These are the four statuses we discern, but the problem status of a species is subject to change as both scientific and public salience can change. The next section presents three theoretical trajectories along which the problem statuses can change, which is this article's second analytical element.

5.2.2 Problem status trajectories

Changes in how IAS are regarded, occur frequently. For example, *Rhododendron ponticum* progressed from being an exclusive garden plant to a costly invader, and prickly pear (*Opuntia ficus-indica*) started as an important fodder crop in South Africa, but is now hampering livestock productivity (Dehnen-Schmutz and Williamson 2006, Shackleton et al. 2019). Such shifts in framing can be due to changes in scale: a species starting out in gardens providing an ornamental service, can incur great agricultural damages once it invades pastures (Vaz et al. 2017). But people's perceptions may also change

over time due to changes in what they value, or insights they gained (Shackleton et al. 2019). Many alien species were considered beneficial when they were introduced, such as the rainbow trout in South Africa for fishing, or intended to combat another pest like with the giant toad in Australia (Caplat and Coutts 2011). If, with time, they also turn out to have major negative impacts, their management may become an urgent matter. Other species are initially perceived as a major pest that is zealously managed, only to turn out not to be all that bad after all. This was the case with tamarisk shrubs in the USA, which were heavily suppressed from the 1930s onwards for their alleged water depleting character, costing US$80 million between 2005 and 2009 alone. Yet, their water consumption turns out to be comparable to that of native counterparts, and they are the preferred nesting habitat of the endangered native willow flycatcher (Davis et al. 2011). In sum, changes occur in perceptions of the problem a species poses, both from a scientific and a societal perspective.

Looking back at our grid and translating this to the problem status typology, a species with a latent status could first progress towards a conceptual status as additional knowledge becomes available, which is then picked up by society and pushes the species towards a manifest status. Alternatively, the public could become concerned first, awarding a species a tangible status, followed by scientific efforts at understanding the species, resulting in a manifest status. Alternatively, we discern a trajectory in which scientific and public salience increase simultaneously. Figure 11 depicts these three theoretical itineraries, referred to as route A, B, and C respectively.

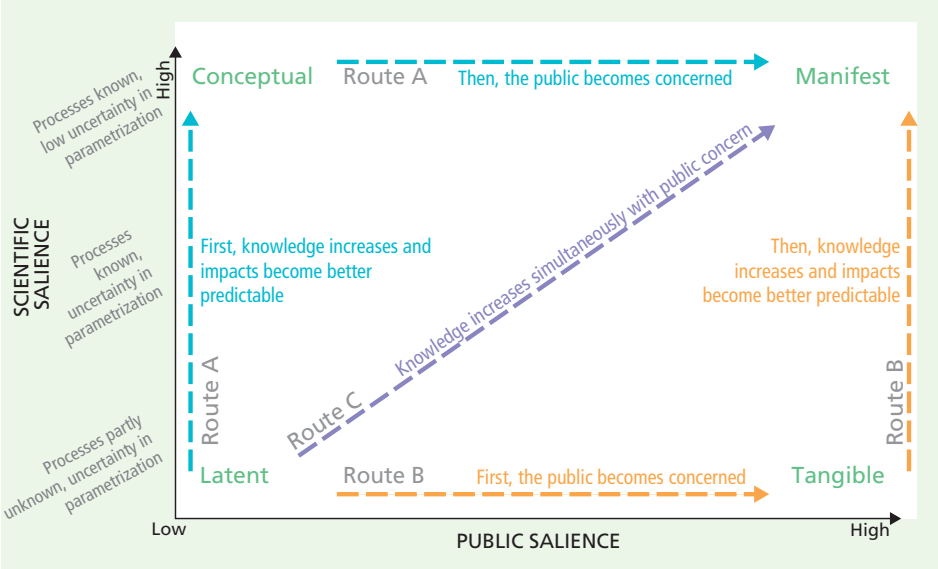

Figure 11. Three theoretical problem status trajectories: route A, B and C.

In this chapter we will reconstruct the trajectories across problem statuses for thirteen invasive alien species in the Netherlands, for two reasons. One, to see if the theoretical trajectories of Figure 11 exist in practice as well. Does the public only become interested once there is ample scientific insight into an invasive species, or does scientific attention follow on public concern? And second, to explore the tension mentioned earlier, of having people care for an issue to avoid inertia, and conflict arising instead.

5.2.3 Inertia or conflict?

It was shown earlier how latency results in difficulties with identifying stakeholders, because there is not enough information regarding impacts for people to articulate positions towards (Vaas et al. 2019). When the impacts are better predictable, people can articulate opinions regarding them, and stakeholder groups will appear. Following this reasoning, a conceptual, manifest or tangible problem status should be conducive to action: there are clear stakes involved, and these stakes affect a community.

But, in invasive species literature, the existence of multiple stakes is generally linked to conflict. Novoa et al. (2018) define a "conflict species" as one for which there are medium to high costs and benefits involved, which are distributed across multiple actors. Dealing with conflict species requires dealing with multiple stakes and stakeholders, and Woodford et al. (2016) contend that this is when invasive species management becomes particularly tricky. They even suggest that the aim of eradication in such cases becomes unattainable. For example, pine trees (*Pinus* species) that were planted in the 1930s in South Africa to provide timber, are now invading the native fynbos shrubland. Foresters and conservationists have opposing stakes, and as the trees continue to spread, the conflict becomes increasingly intractable. Another classic conflict species is the earlier mentioned rainbow trout *(Oncorhynchus mykiss)*, which was introduced all over the world for sport fishing purposes, but threatens local fish species (Woodford et al. 2016). Thus, higher public and scientific salience might result in clear stakes and entice action, but could also sprout inertia inducing conflict.

In this article we aim to explore this tension by looking at conflict arising and action undertaken regarding invasive alien species with different problem statuses, which is the article's third analytical element. Both will be operationalized in the methods section, but here we briefly point out the distinction between governmental and community action. Responsibilities for IAS management are divided across multiple levels, from the European Union all the way down to that of water authorities and municipalities (European Parliament and Council of the European Union 2014, Provincie Gelderland 2018). Next to these *de jure* institutions, Sullivan et al. (2017) show how oftentimes *de facto* institutions emerge to complement the governmental policies. When community actors feel governmental policy is not sufficient, they can develop their own initiatives, which was done for example by Landcare groups regarding the invasive weed serrated

tussock *(Nassella trichotoma)* in south eastern Australia (Marshall et al. 2016). We thus distinguish two kinds of action undertaken regarding an invasive alien species: governmental action and community action.

In the foregoing, three analytical elements were presented to explore how different degrees of public and scientific salience, i.e., different problem statuses, coincide with inertia and conflict. Namely, a typology of problem statuses a species can have, the trajectories along which these could theoretically develop and the concepts of action and conflict. The next section links these analytical elements to three methodological steps, applied on thirteen IAS in the Netherlands.

5.3 METHODOLOGY

In this chapter we will reconstruct the problem status trajectories of a carefully selected set of invasive alien species, and assess the action and conflict pertaining to them. The three research steps for doing so are explained here, as well as the selection of species focused on.

5.3.1 Thirteen invasive alien species in the Netherlands

We look at invasive alien species present in the Netherlands, which is a spatial scale at which a comprehensive impression of action on the part of the community and government can be obtained, without having to account for differences in jurisdiction. The Dutch species database lists 148 invasive alien species in The Netherlands (Nederlands Soortenregister, accessed 19 February 2019), from which we selected thirteen species. These are the species that were mentioned by more than one of the four sources representative of four different types of actors: scientific, civil society, nature management organizations, and a governmental source. By selecting species from such diverse sources, we prevent a bias towards scientific or public salience. As a *scientific source* we used the article by Verbrugge et al. (2013), in which a group of invasive species that have different levels of appeal and impact on biodiversity is presented. As a *governmental source*, we used the species listed by the EU directive on invasive alien species as to be managed by the member states (European Parliament and Council of the European Union 2014). As a *civil society source*, we asked the chairman of the main civil society organization in the Netherlands regarding invasive species "Platform Stop Invasieve Exoten" (Reinhold p.c. 2019) for the most important IAS. As representative for *nature management organizations* we used a list of species mentioned in Boomblad, a magazine published by Alterra (Holtjer 2009). This magazine published a list of most prominent species in the Netherlands based on input from several nature management organizations, at the occasion of the national government establishing its first Team Invasive Aliens. We list the species

mentioned by these different sources in Table 44 in the Appendix. Newspaper articles often conflate Coypu and Muskrat, so we excluded Muskrat. We added Japanese knotweed *(Fallopia japonica)* and Quagga mussel *(Dreissena bugensis)*. Japanese knotweed because it has been raising a lot of attention recently (LexisNexis shows multiple hits per day), and Quagga mussel since the chairman of the NGO we spoke with, mentioned this as a species for which scientific salience changed, which rarely happens. The result is a list of thirteen species (Table 15), for which we will reconstruct the problem status trajectories, as explained in section.

Taxonomic group	Common name	Common Dutch name	Latin name
Invertebrate	Asian tiger mosquito	Aziatische tijgermug	*Aedes albopictus*
Mammal	Coypu	Beverrat	*Myocastor coypus*
Bird	Egyptian goose	Nijlgans	*Alopochen aegyptiacus*
Aquatic plant	Floating pennywort	Grote waternavel	*Hydrocotyle ranunculoides*
Mammal	Grey squirrel	Grijze eekhoorn	*Sciurus carolinensis*
Bird	Japanese housecrow	Huiskraai	*Corvus splendens*
Terrestrial plant	Japanese knotweed	Japanse duizendknoop	*Fallopia japonica*
Mammal	Pallas' squirrel	Pallas' eekhoorn	*Callosciurus erythraeus*
Vertebrate	Pumpkinseed sunfish	Zonnebaars	*Lepomis gibbosus*
Invertebrate	Quagga mussel	Quaggamossel	*Dreissena bugensis*
Mammal	Raccoon	Wasbeer	*Procyon lotor*
Freshwater invertebrate	Red swamp crayfish	Rode Amerikaanse rivierkreeft	*Procambarus clarkii*
Bird	Ringnecked parakeet	Halsbandparkiet	*Psittacula krameri*

Table 15. The thirteen species for which the problem status trajectories will be reconstructed

5.3.2 constructing trajectories

During the first research step for exploring the link of different problem statuses with action and conflict, we establish the current problem status of the thirteen species. The second step is to reconstruct the trajectories towards these statuses. This serves to verify whether the trajectories depicted in Figure 11 indeed occur in practice, and to select species representative of different trajectories for which to assess the occurrence of conflict and action.

The problem status of a species is defined by its public and scientific salience. For *public salience*, the amount of publications in Dutch newspapers and magazines is taken as a proxy. When a problem raises concern among a community – because it poses a threat to their livelihoods or is perceived as doing so – it can be expected to receive attention from journalists. Therefore, we look at the records in the LexisNexis database regarding the scientific name and common Dutch name, as listed in Table 15. LexisNexis has publications starting from 1990, but the earliest record on any of our thirteen spe-

cies stems from 1997. For *scientific salience* we look at the amount of records in Elsevier's Scopus database, which has records on these species starting from 1980. This can be considered a proxy for the amount of scientific attention that has been awarded to a given species. We assume that a higher amount of scientific publications results in a better predictability of impacts, due to increased understanding of processes and higher parametrization. In the Scopus database, we searched only for Latin names, as adding the common names made little difference in amount of hits, but does raise debates about what the common name is. For each of the thirteen species, we downloaded an overview of the amount of publications from the Scopus and LexisNexis databases. For the Scopus publications of the Tiger mosquito, the amount of publications was too large to process, and we added "alien OR nonnative OR invasive" to the query.

To *establish the problem status* per species, we compare the amount of records in Scopus and LexisNexis across the species. The four species with the highest amount of LexisNexis records compared to the other species, are ranked highest for public salience. The four species with the highest amount of Scopus records compared to the other species, are ranked highest for scientific salience. And the inverse: the four species with the lowest amount of LexisNexis and Scopus records compared to the other species, are ranked lowest on public and scientific salience respectively. If the amount of records is not explicitly low or high, they are ranked intermediate. Combining the rankings on these two indicators determines a species' location on the salience grid.

To *reconstruct the trajectories* of the species, we look at the sequence in which both indicators developed. If the amount of Scopus records increased before the amount of LexisNexis records increased, this is perceived as route A from Figure 11. For route C the LexisNexis records increase first, and when both sources increase simultaneously it is interpreted as route B. These reconstructions will show how a species can arrive at a manifest problem status – whether that is indeed worthwhile is explored by looking at the conflict and action occurring, as described next.

5.3.3 Assessing action and conflict

The two steps described above will show how an invasive alien species can evolve from a latent problem towards a more manifest problem status. Earlier we discussed how the higher public and scientific salience can be expected to accrue more management action, since there are more stakes involved and knowledge available. However, we also relayed contradicting insights on conflict species and misuse or abuse of knowledge. So the question remains whether progressing towards a manifest problem status is beneficial, which is the third research step outlined here. From the reconstructions of the trajectories, we will derive a few archetypical trajectories. For each of these archetypical trajectories we select one representative species, for which we assess the occurrence of

action and conflict. The indicators for doing so are listed in Table 16, varying between the content and the amount of publications.

Source and search query	Assessment indicators	Indicator of:
LexisNexis *www.academic.lexisnexis.nl* LexisNexis > Power search > search terms [Latin name & common name] & select source by type: Dutch news	Number of records NVivo analysis of content	Public salience Conflict; community action
Official announcements of national government *zoek.officielebekendmakingen.nl* > P*arlementaire documenten* [latin name & Dutch common name]	Number of records Scanning of content	Governmental action Conflict; governmental action
Open Staten archive for provinces *Openstateninformatie.nl* [abbreviated common name + latin]	Number of records Scanning of content	Governmental action Conflict; governmental action
Water authority Rivierenland archive *https://rivierenland.notubiz.nl/* [common name + latin]	Number of records Scanning of content	Governmental action Conflict; governmental action
Scopus *www.scopus.com* ABS-TIT-KEY: [Latin name]	Number of records	Scientific salience

Table 16. The databases searched (left column) to establish problem statuses, conflict and action (right column) for different species, based on either amount or content of the records (middle column).

As discussed in section 5.2.3, we distinguish between two types of action regarding an invasive alien species: governmental action and community action. To establish *governmental action*, we look at the records of several Dutch governmental bodies, across which responsibilities have been divided. The Ministry of LNV is responsible for those listed in the Visserijwet, and the water authorities for the species that are listed in the Waterwet. The Ministry is also responsible for complying with the European Directive on IAS (European Parliament and Council of the European Union 2014), but has devolved the execution to the provinces. Thus, IAS not explicitly assigned to other governmental bodies by Dutch law, are responsibility of the provinces. However, in the program presented by province of Utrecht, tasks are in turn devolved to other bodies among which the water authorities. Also, doubts regarding the Ministry's aptness for dealing with the species within their mandate are expressed, and the province appears inclined to take measures itself (Provincie Utrecht 2019). Given these overlaps, for each species we will look at policy development by all three bodies. For the national government, documentation of policy attention within a ministry is not easily acquired for the public, which is why we combine records of regulations implemented and questions posed by the Second Chamber to Cabinet. The archives of the provinces and water authorities are all separate and differ in types of documents made accessible, which poses significant limitations to the analysis. Some provinces and water authorities do not publish any of

their meeting documents, and when they do, the documents are often scans that are not amenable to text searches. Thus, for the provinces we worked with the archive offered by the NGO "Open Staten", that made documents of five provinces searchable (Limburg, Flevoland, Utrecht, Zuid-Holland and Noord-Holland). By researching the records of these five provinces, we can assume that each species will be invasive in at least one of the provinces, guaranteeing the availability of documents. For the water authorities, we use the archives of the water authority Rivierenland for two reasons. One, since it was mentioned by an IAS expert from the Water Authority Research Association (STOWA) as a proactive water authority regarding invasive species (p.c. Van der Wal 2019). And two, since the archive is easily searchable. For the species chosen as representing archetypical trajectories, we search these archives to assess the *governmental action* undertaken regarding them.

To assess what *community action* has been undertaken, and whether conflict exists regarding these species, we analyzed the 100 most recent LexisNexis publications per species. Using NVivo v.12 software, we coded for *conflict* (both agreement and disagreement) and *action* (both by government and the community). We conducted axial coding, setting the categories in advanced and adjusting them during the process if found expedient (Wald et al. 2019). *Community action* ranges from NGOs, individual citizens, or civil society organizations undertaking any kind of activity regarding an IAS. Activities can vary from organizing hikes, to lectures, to individual citizens undertaking management actions. For *conflict*, we coded everything from opposing opinions, to disavowals of other actors' actions, to unwillingness to work with other actors. An overview of the databases searched per indicator can be found in Table 16.

5.4 RESULTS

5.4.1 Problem status trajectories

5.4.1.1 Problem statuses per species

For the thirteen selected species, problem statuses were assessed based on the amount of scientific and Dutch news articles, as explained in section 5.3.2. The results are shown in Table 17.

There are two manifest species: the Tiger mosquito and Raccoon both have relatively the highest amount of scientific and newspaper articles. There are also two latent species, namely the Pallas' squirrel and Japanese housecrow, for which both scientific and newspaper articles are relatively low. The Coypu falls in the middle of all four quadrants, ranking medium on both scientific and newspaper publications. There is one species with a tangible problem status, the Egyptian goose, which ranks explicitly low on sci-

Species	All species		A.tiger mosquito		Coypu		Egyptian goose		Fl. pennywort	
Source	SC	LN	SC	LN	SC	LN	Sc	LN	SC	LN
TOT	6382	7591	418	689	357	548	55	1011	50	562
PERC	100%	100%	> 28%	9%	6%	7%	1%	13%	1%	7%
Species	Grey squirrel		Jap. housecrow		Jap. knotweed		Pallas' squirrel		Pumpk. sunfish	
Source	Sc	LN	Sc	LN	Sc	LN	SC	LN	Sc	LN
TOT	500	236	110	53	228	1308	77	184	514	266
PERC	8%	3%	2%	1%	4%	17%	1%	2%	8%	4%
Species	Quaggamussel		Raccoon		Red sw. crayfish		Ringn. parakeet			
Source	SC	LN	SC	LN	Sc	LN	SC	LN		
TOT	373	78	1394	1857	1774	549	178	39		
PERC	6%	1%	22%	24%	28%	7%	3%	1%		

Table 17. Relative amount of Scopus (SC) and LexisNexis (LN) publications for thirteen IAS in the Netherlands. The colors are used to indicate the four lowest (red) and four highest (green) relative number of publications. For example: for the Grey squirrel, the amount of Scopus publications since 1980 is 8% of the amount of Scopus publications for all 13 species, which is why it is colored green. For Tiger mosquito the amount of records was much higher, as explained in section 5.3.2 (28% refers to the adjusted more selective query).

entific and explicitly high on amount of newspaper publications. Somewhere between a tangible and manifest problem status, there is Japanese knotweed, ranking high on LexisNexis and mediocre on Scopus. In between a latent and conceptual status are the Ringnecked parakeet and Quagga mussel. Three species, the Pumpkinseed sunfish, Red swamp crayfish and Grey squirrel, have a problem status between conceptual and manifest. A graphical visualization of this is given in Figure 12.

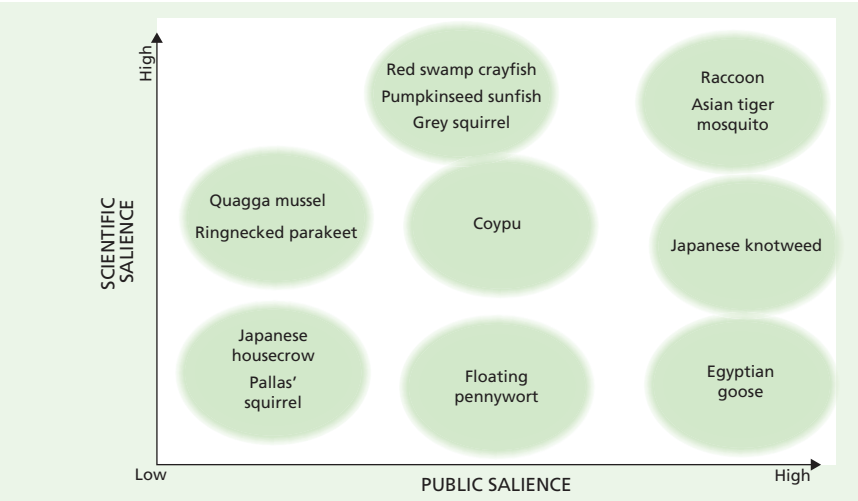

Figure 12. Problem statuses of thirteen IAS in the Netherlands, as defined by their relative amount of Scopus publications (vertical axis) and LexisNexis (horizontal) publications.

5.4.1.2 Problem status trajectory per species

Graphs of the publications through time for all thirteen species can be found in the Appendix. Looking at the sequence in which scientific and public attention for an IAS develop, three general trajectories can be discerned, which we will refer to as Sophos, Pathos and Ambos. Sophos is the trajectory where first mainly scientific knowledge is produced, and the public attention follows markedly later. Pathos is the opposite trajectory, where public attention dominates first, and scientific information follows later. When both types of attention increase at the same time, the trajectory will be referred to as Ambos. The respective trajectories will be illustrated by discussing an invasive species for which attention developed according to that trajectory. They are depicted in Figure 13, with the different colors coinciding with the three different trajectories discerned.

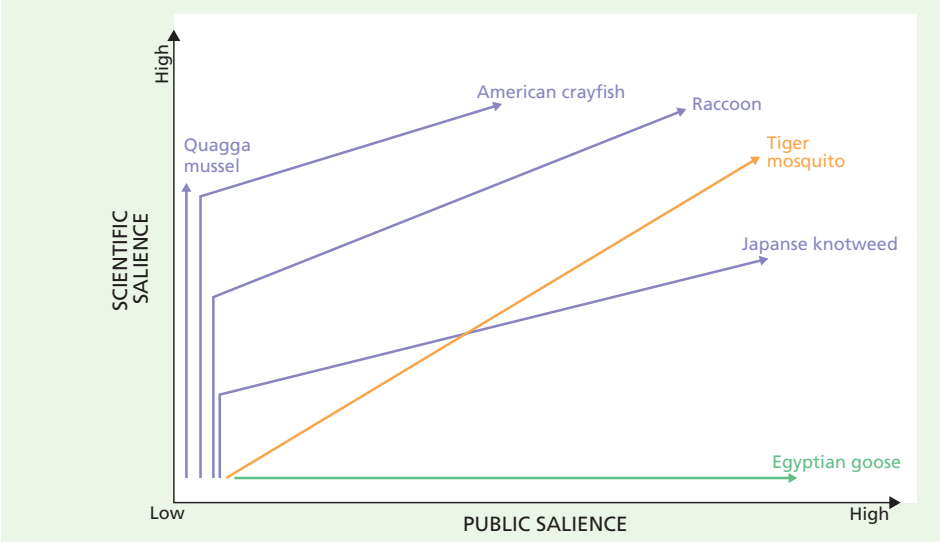

Figure 13. The different trajectories found in practice, indicated by different colours: purple for *Sophos*, orange for *Ambos*, green for *Pathos*. A trajectory is a representation of the order in which public and scientific salience increased through time.

Regarding the *Pathos trajectory*, it is important to note that the species following that trajectory (Egyptian goose) receives conspicuously little scientific attention. The Egyptian goose has a tangible problem status, meaning that scientific attention is very low. The graphs below (Figure 14) do show some clear peaks for Scopus publications, but these should be understood as representing only a very low absolute number of publications. Hence its tangible problem status. From 2008 onwards, the accelerating increase in public attention was followed by some increase in scientific attention as well.

Japanese knotweed, which also ranks explicitly high on public attention, ranks higher on scientific attention than the Egyptian goose. However, when looking at the sequence

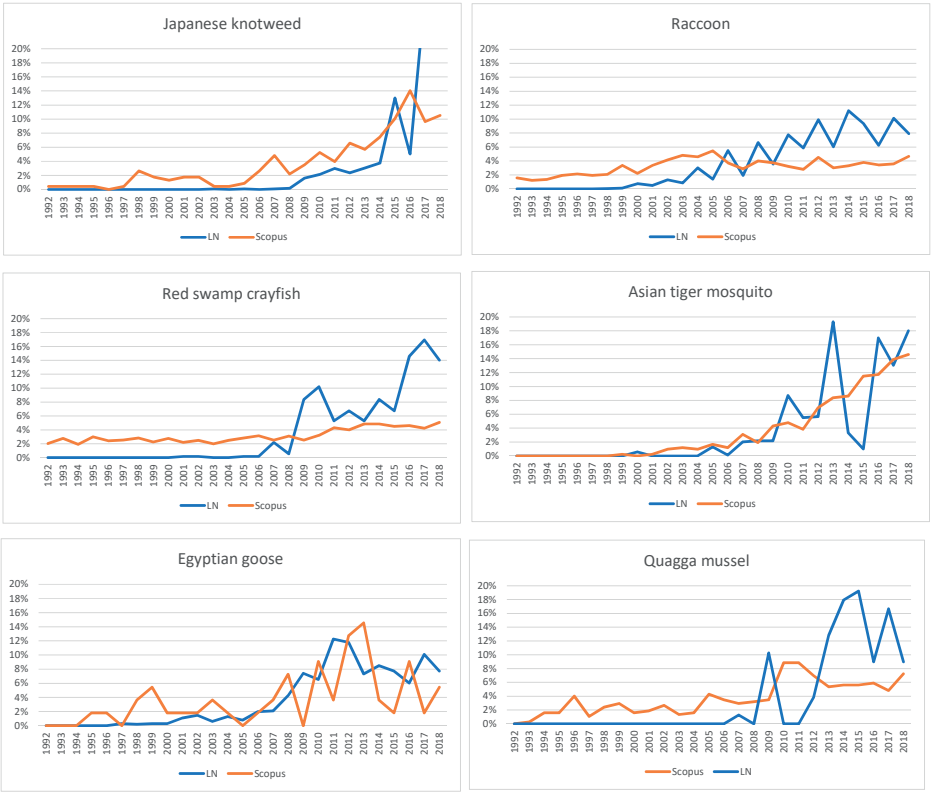

Figure 14. The percentage of publications per source (Scopus and LexisNexis), throughout the years, for the six invasive alien species shown in Figure 13.

of the scientific and public publications, the former's rate increased first, and was followed by public publications only later. Therefore, Japanese knotweed follows the *Sophos trajectory*, be it that overall it ranks higher on public attention than scientific attention. Which differs from another species that followed the *Sophos trajectory*, namely the Raccoon. For the Raccoon, scientific attention grew first and public attention followed, but it ranks highest on both types of attention, rendering it a manifest problem. The public attention also picked up much later regarding this species (around 2004), when there had already been a strong increase in scientific publications. For Japanese knotweed, around 2007 public salience followed quite closely on the increase in scientific publications. For a third species following the *Sophos trajectory*, Red swamp crayfish, public salience lagged even further behind scientific salience (around 2006). The differences in lags between scientific and public salience increasing, are represented in Figure 13 by the different bending points in the lines. A fourth species that follows the *Sophos trajectory*, is the Quagga mussel. The scientific publications clearly increased before the newspaper articles, and so far the overall amount of newspaper articles is still very low,

which is why this species ranks between a latent and conceptual species. For now it cannot be said with certainty whether the public attention will catch up, moving it towards a more manifest status, or whether it will continue to attract mainly scientific attention.

The third trajectory, *Ambos*, is what the other manifest species followed, the Tiger mosquito. Since for this species, scientific and public salience started to increase at the same time (around 2006), this line runs diagonal across the grid. Now that we have elicited three archetypical problem status trajectories, we will look at representative species for each of them, to explore the action and conflict occurring per status.

5.4.2 Action and conflict for three conspicuous species

We zoom in on three species that are representative of the different trajectories found: the Asian tiger mosquito as representative of the *Ambos trajectory*; the Quagga mussel representing the *Sophos trajectory* and the Egyptian goose as representative of the *Pathos trajectory*. For each of these species we briefly discuss the governmental action undertaken as retrieved from three databases representing the national government, provinces and the water authorities. In addition, we discuss the action and conflict pertaining to that species as mentioned in the newspaper articles. After that, we compare the three species to see if a link between problem status, and conflict or action can be discerned.

5.4.2.1 Asian tiger mosquito, Aedes albopictus

In 2005, the first occurrence of an Asian tiger mosquito (ATM) was recorded in the Netherlands, which presumably made it from Asia to Europe through the transport of car tires and bamboo plants. In 2017 a total of 194 mosquitos were found distributed over 12 municipalities; for 2018 the Netherlands Food and Consumer Product Safety Authority (NVWA) reports 39 instances at which the mosquito was found in the Netherlands (NVWA 2019). In June 2018, the European Center for Disease Prevention and Control (ECDC) deemed the mosquito "established" in the province of Limburg in The Netherlands (ECDC 2018), but in January 2019 its status was back to "introduced" (ECDC 2019). The mosquito is mainly feared for its potential to transmit the virus for diseases such as chikungunya, dengue, yellow fever and zika, and its bite is allegedly exceptionally painful. However, given the virtual absence of these viruses in Holland, the national health institute RIVM assesses the health risks to be very low (van der Werff 2018, Meershoek 2018, Dagblad de Limburger 2018). Still, whenever an ATM is encountered somewhere, the NVWA puts out traps and checks water sources in the environmental, striving for complete eradication of the mosquito (Teunissen 2018).

Results from governmental databases

In the governmental documents, a focus on ATM as a disease vector is very clear. The documents reflect how the species started out as an occupational health hazard in 2006 for employees in green houses where the bamboo was grown, and evolved into a public health hazard upon the first sighting in nature in 2010. The health risks are the reason for control, and when the mosquito's alien status is mentioned, it is to reinforce the need to eradicate the species. A dispute on how to prevent introduction of the species was visible throughout multiple years, where the Ministry prefers covenants, and parliament has more faith in import restrictions. In 2007 a covenant with bamboo importing companies was signed, which in 2009 was made binding by converting it into a ministerial regulation. In 2011 this raises criticism from parliament, arguing the import of the plant should be prohibited entirely. Regarding car tires the same dispute exists, for which in 2013 a covenant is signed, again raising criticism from parliament for not being binding.

Year of publication	**Asian tiger mosquito**																			Total amount of publications
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	
Parliamentary						3	7	1	4	5		5	6	3	4	2	2	2		44
Provincial													1				1	2		4
Water authority																			1	1
All																				49

Table 18. The amount of governmental publications for Asian tiger mosquito, broken down per source and year.

Results from newspaper articles

Asian tiger mosquito was most densely coded compared to the other species on almost every variable, except ambiguity regarding impacts: for this, it ties with the Quagga mussel. Both action and inertia are highest regarding this species, which itself is the source of conflict: some public actors argue that the government is not doing enough. The impacts do not spur conflict, as there are only negative impacts reported. This might explain the high amount of action, and the persistence of conflict in spite of it.

Code	**Reference frequency**	**Content of references**
Governmental action	76 ref. 54 art.	- mostly eradication campaigns by NVWA: placing traps, administering larvae-killing substances to standing water, and checking for breeding spots - municipalities are sometimes involved, to inform inhabitants about the NVWA activities - requires cooperation from the community, as the NVWA needs to enter gardens to check for mosquitos and potential breeding spots

Governmental inertia	23 ref. 22 art.	- municipalities refer to the NVWA for management - lack of regulation regarding companies importing tires and bamboo plants - pausing eradication of Asian mosquitos (Ae. albopictus and Ae. Japonicus) in the province of Flevoland while the NVWA and RIVM reassess strategies
Community action	34 ref. 24 art.	- granting NVWA access to garden for eradication campaign - NGO "Platform stop invasive aliens" sues the national government, aiming for regulation regarding car tire importing companies - companies importing tires from countries where the mosquito has established, store these in a dry area and have mosquito traps installed around the area
Conflict	28 ref. 19 art.	- is the national government doing enough, or should the army be involved in eradication? NGO "Platform stop invasive aliens" and scientist Bart Knols argue the latter. - are the health risks posed by the species significant? NGO "Platform stop invasive aliens" and scientist Bart Knols versus RIVM - how will the distribution of the mosquito change through time as a result of climate change?
Agreement	4 ref. 4 art.	- ECDC, NVWA and RIVM agree that the mosquito will establish in the Netherlands - the NVWA and tire companies agree on their cooperation being effective *Note that both these elements are also a source of disagreement*
Negative impacts	66 ref 56 art	- potential to spread diseases - painful bite
Positive impacts	0	none
Ambiguous impacts	12 ref. 10 art.	- uncertainties regarding future spread and where mosquitos that were exterminated came from

Table 19. Amount of references (ref) per coding theme across newspaper articles (art) on Asian tiger mosquito.

5.4.2.2 Egyptian goose, Alopochen aegyptiacus

The Egyptian goose has been in the Netherlands much longer than the Asian tiger mosquito, with the first breeding instance in 1967, after having been introduced to Europe in the 18th century as a decorative bird (Sanders-Kroeze 2018). According to the latest assessments, in 2013-2015 there were between 6900 and 11400 Egyptian geese (which is in fact a duck) in the Netherlands, but their number seems to be stabilizing (RAVON 2019). Their harm lies in their aggressive behavior, taking over territory and nests of even buzzards and goshawks. They can breed multiple times a year and even mid-winter, but there are no indications so far that they have restricted populations of other water birds (SOVON n.d.). The species features in the EU directive regarding invasive species under article 19, meaning member states can decide whether to aim for eradication or control. National policy is to contain the Egyptian goose, for which provinces develop policy and then typically grant a mandate to the Fauna Control Unit (FBE), as done by Utrecht and Gelderland (Provincie Gelderland 2018, Provincie Utrecht 2019).

Results from governmental databases

This species has the highest number of governmental records. It mainly features in provincial documents, rather than national documents as the Asian tiger mosquito did. Also for this species, the alien status is used to emphasize the need for management, but is not the main reason why it should be managed. The danger geese pose to air traffic around Schiphol is the main reason, which resulted in multiple covenants on how to limit their presence. Thus, while the impacts of a native and an alien goose on air traffic are the same, the target number of aliens is much lower than of native species in these covenants. This distinction gives rise to part of the conflict concerning this species, with several NGOs and one party in Second Chamber arguing against targeting alien species specifically. The methods of eradication also give rise to protest, and a court case revolved around the use of carbon dioxide to cull geese.

Year of publication	**Egyptian goose**																			Total amount of publications
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	
Parliamentary	1			3	1	1	1		2	3	10	3	3	6	7	1	1	1		44
Provincial								3	5		5	7	3	22	15	15	12	21		108
Water authority																1				1
All																				153

Table 20. The amount of governmental publications for Egyptian goose, broken down per source and year.

Results from newspaper articles

The newspaper articles on this species are least densely coded, with a large share of the articles mentioning the goose as an example of an invasive species or as a sight to be seen when hiking. This demonstrates the species' public salience, being part of common vocabulary and therefore surfacing in articles not solely devoted to them. Only few mentions are made of impacts of the geese, so whereas for the tiger mosquito its impacts could explain the salience, for the goose they do not. Nor can it be readily derived from the articles why the salience is so high.

	Reference frequency	**Content of references**
Governmental action	24 ref 22 art	- research on the distribution of the species - the design of invasive species policies on the provincial level - shaking eggs or treating them with corn oil, typically on municipal level - lifting of hunting restrictions, for example in the province of North-Holland
Governmental inertia	1 ref 1 art	- city of Leeuwarden will not be undertaking action regarding the Egyptian goose, despite European regulation

Community action	6 ref 6 art	- hikes in which the species features as a sight - public lecture on invasive species - processing geese meat into food - citizens reporting sightings of the species - cooperation initiative on the provincial level between governmental and non-governmental actors
Conflict	8 ref 8 art	- is shooting the geese protecting or damaging nature? The NGO "Natuur- en milieufederatie Zuid-Holland" challenges the decision of that same province to allow the geese to be shot - is damaging the eggs inhumane? - The NGO IVN that organizes "city safaris" is in favour of keeping the species in Rotterdam
Agreement	1 ref 1 art	The province, Natuur & Landschap and Fauna Control Unit of Zeeland agree that current management measures regarding the geese are not sufficient, and suggest among others to broaden the management area
Negative impacts	19 ref 19 art	- threat to native species by breeding at a high rate, taking over nesting sites of other birds and killing chicks of other species - can be aggressive towards humans - posing a traffic hazard, since they are attracted by the grass between tram tracks - like other geese: damage to crops and grasslands, and noise production
Positive impacts	3 ref 3 art	- aesthetical value - serving as food for the European pine marten - foxes prefer eating the Egyptian goose over other pasture birds
Ambiguous impacts	2 ref 2 art	- since geese look for cover to breed while pasture birds prefer an open area, they may not pose a real threat - having a new bird settle in the Netherlands is interesting, but might in the long term do damage

Table 21. Amount of references (ref) per coding theme across newspaper articles (art) on Egyptian goose.

5.4.2.3 Quagga mussel, Dreissena bugensis

The Quagga mussel originates from the Dnieper delta and Black Sea, and made its way to the Netherlands upon the construction of the Rhine-Main-Danube canal or via the ballast water of a ship. At the beginning of the 2000s, the first Quagga mussels were found in Hollandsch diep and the Westeinderplassen, of which the bottom is covered by about 3000 Quagga mussels per square meter. They are also found in the canals in Amsterdam, and often praised for cleaning the water and reducing occurrence of the cyanobacteria, commonly referred to as an algae hampering swimming (Tielemans 2015, Dorrestijn 2015). As will be discussed below, these two impacts both raise some ambiguity.

Results from governmental databases

The Quagga mussel reaps the lowest amount of records in governmental databases, and the majority of the documents express uncertainty or refer to ongoing research. The predominantly positive impacts, as we will get to below, are reflected in these documents: the mussel is referred to as improving the quality of swimming water, solving a

recurring issue with cyanobacteria during summer. The alien status is only mentioned on the side, as compounding the uncertainty of long term impacts. It is not a reason for eradicating the species; rather, governmental actors appear in favor of promoting the mussel's presence, given its supposedly positive impacts.

Year of publication	Quagga mussel																			Total amount of publications
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	
Parliamentary									1		1	1	1	10	9			1		24
Provincial															3		5			8
Water authority															5					5
All																				37

Table 22. The amount of governmental publications for Quagga mussel, broken down per source and year.

Results from newspaper articles

Despite this species having twice the total amount of references the Egyptian goose does, it has fewer references on action and conflict. Instead, most references pertain to impacts; positive, negative and ambiguous. The filtering capacity of this mussel is presented most often as a positive impact, but also frequently as a negative impact. The low amount of conflict surrounding this species is therefore surprising, as the many repercussions it has throughout the ecosystem can each be valued differently. As with the ATM, human health appears again to be the main point of focus: most attention is on the quality of swimming water, rather than other repercussions on the ecosystem. A large share of the articles refers to pilots in which the species is put to use. It being an alien is only mentioned sporadically, when the uncertainties regarding this species are mentioned.

	Reference frequency	**Content of references**
Governmental action	18 ref 15 art	- experiments with the mussel filtering water bodies. E.g., water authority Brabantse delta doing tests in a pond in Breda, and water authority Amstel, Gooi and Vecht constructing a "quagga filter" in the Sloterplas. - Ministry of Economic Affairs stimulating such experiments - EU regulation regarding IAS - 2017 regulation from the International Maritime Organization imposing the treatment of ballast water of ships
Governmental inertia	2 ref 2 art	- water authority Rijnland does not see grounds yet for acting and prefers monitoring
Community action	3 ref 3 art	- a dive center sinks Christmas trees to the bottom of the Reeuwijkse Plassen, in order for Quagga mussels to attach to them and improve visibility
Conflict	1 ref 1 art	- disagreement between divers and boat owners, the former against the mussel and the latter in favor of them

Agreement	2 ref 1 art	- embargo on fishing in the Ijsselmeer, with the mussel referenced as one of the reasons for lower fish stocks
Negative impacts	31 ref 27 art	- filtering activity lowers presence of plankton, negatively affecting other species - reduction of fish means fewer sights for divers - clearer water increases plant growth because of more light infiltration - sticking to surfaces such as drainage pipes of electricity plants, boats and docks - outcompeting native mussel species, which has repercussions for native fish
Positive impacts	54 ref 47 art	- filtering results in clearer water, which increases the light availability - higher light availability spurs the growth of water plants and algae, which attracts birds and fish - filtering is generally assumed to reduce the instance of the cyanobacteria, benefiting swimming conditions for humans
Ambiguous impacts	13 ref 9 art	- the filtering capacity results in clear water, but also decreases the presence of plankton, which benefits some species and damages others - does the mussel indeed decrease the presence of the Cyanobacteria? - what will effects on the long term be?

Table 23. Amount of references (ref) per coding theme across newspaper articles (art) on Quagga mussel.

5.4.3 Comparing the three species

Here, we compare the three species regarding the two elements of our research question: action and conflict.

5.4.3.1 How do problem status and action undertaken correlate?

The species with a manifest problem status, the Asian tiger mosquito, is also the species for which we found most activity undertaken by the government and the community: more than half of the articles contained a reference to such action undertaken. Regarding action on the part of the community, only for this species we found many references of that happening: 34, versus 3 and 4 for the other two species. These are partly references to people cooperating with the NVWA by granting access to their garden or reporting sightings, and covenants with tire and bamboo importing companies, but for the majority pertain to the NGO Platform stop invasive aliens and scientist Bart Knols undertaking action. The low community action regarding the Quagga mussel is in line with our expectations, but for the Egyptian goose we would expect the public salience to coincide with action on the part of the community. However, while the citations are low in number, they reflect structural community involvement. The bird collision covenants, as well as the Fauna management programs of the FBEs are both examples of long-term collaboration between government, nature management organizations and private actors. Looking at this, public salience seems to positively correlate with community action.

As for governmental action, the largest amount of references pertains to ATM. Interestingly enough, it is also the species with the highest amount of references on

governmental inertia, which are predominantly assertions of two non-governmental actors, spurring conflict which we will get to later. When looking at the impacts of the ATM, the high degree of action is somewhat surprising, as this species' damage is confined to the realm of hypotheticals: it could spread a certain virus, were the virus to be present in the Netherlands. Yet for the Quagga mussel, which has already changed the composition of entire lakes, much less action is undertaken. This could be attributed to its lower score on public salience, or it could have to do with the type of impact involved: for the ATM we are dealing with a health hazard, whereas the Quagga mussel is mostly perceived as a health benefactor. Which might also contribute to the ATM's high public salience. For the Egyptian goose with a tangible problem status, a much lower share of the newspaper articles refers to action undertaken by the government, but it does have the highest amount of records in the governmental databases. This difference could indicate that journalists are less interested in these activities than the extermination campaigns regarding the ATM, or it could be reflective of the relatively high amount of articles in which the Egyptian goose is merely mentioned and does not play a central role. Based on this, it appears that high public salience coincides with both community and governmental action undertaken.

5.4.3.2 How do problem status and conflict correlate?

Conflict is also highest for the manifest species, and lowest for the Quagga mussel with its limited salience. Despite the amount of action undertaken regarding the Asian tiger mosquito, a large share of conflict sprouts from accusations of inertia. Also, the action undertaken is criticized: parliament deems the voluntary agreements insufficient. For the Egyptian goose, which has high public salience but low scientific salience, conflict is present to the same degree as for the ATM, when comparing it to the amount of references on governmental action. Moreover, in the governmental records more mention is made of conflict regarding the goose than the mosquito. Similar as for the mosquito, conflict pertains for a large share to the type of management measures taken. For the Quagga mussel almost no conflict is reported, neither in newspaper articles nor governmental records. While we cannot be certain whether it is the salience that spurs conflict or the action that comes with salience, it appears that high public salience coincides with conflict.

Looking at the impacts of the species, we would have expected more conflict regarding the Egyptian goose, given the ambiguity of its impacts compared to that of the ATM. For the mosquito there are no positive impacts mentioned, whereas for the goose there is no unanimity concerning its impacts. This is even more surprising for the Quagga mussel, for which only one reference was found concerning conflict, despite the complex repercussions within the ecosystem. Apparently, ambiguity about impacts does not necessarily give rise to conflict. The type of impact involved might play a role, and the

large amount of conflict regarding the ATM could be attributed to the health hazards involved. We cannot derive the cause of conflict with certainty from this assessment, but it does appear that high public salience comes with conflict, whether the impacts are certain or not.

5.5 CONCLUSION AND DISCUSSION

In this chapter we sought to explore whether knowing more and caring more about an invasive alien species results in more action. Having established in an earlier chapter that a lack of understanding and stakes involved resulted in an absence of action, the opposite situation was researched here. To that end, we reconstructed the development of public and scientific salience for thirteen IAS in the Netherlands, and found three typical trajectories. The *Sophos trajectory* was followed by most species, and consists of first an increase in scientific salience, followed by public salience sooner or later. The *Pathos trajectory* starts out with public salience, whereas for the *Ambos trajectory* both increase at the same time. Notably, the two species with a manifest problem status followed a S*ophos* and *Ambos trajectory*. This raises questions on whether a problem ever becomes manifest by starting out as mainly salient to the public. Next, we explored whether a manifest problem status indeed results in action, or incites conflict. Based on our results, it would be both: action is higher for species with higher public salience, but conflict as well. Moreover, the conflict pertained often to the type of action undertaken.

A caveat to these findings is that the proxy of newspaper articles to assess a species' public salience, may have resulted in a selection bias towards species with conflict and action. Either since these are interesting phenomena to report on, or inversely, press cover might encourage action to be undertaken and conflict to arise. When research would aim to make causal claims, public salience should be measured differently. But for the purpose of our research we do not need to disentangle the underlying dynamics of public salience.

Our finding that action and conflict do not preclude each other calls into question efforts within environmental governance aimed at creating agreement among stakeholders in order to promote action. Although the exact relation between problem status, action and conflict cannot be derived from this research, it might be that conflict does not hamper action, or that action always generates conflict. It might even be that conflict is conducive to action, for example because governmental actors feel pressure from their constituency to act. Likewise, literature on so-called constructive conflict (Cuppen 2012), argues that conflicting perspectives are required for social learning and reaching the best outcome. It also shows how conflict can be used in order to further a specific stakeholder's goal (Maclean et al. 2015). However, in other cases the need for consensus

building among conflicting views exists (Newig et al. 2018, Tauro et al. 2018). Further research is needed to elicit the precise dynamics at play, but a distinction between conducive and detrimental conflict seems in order.

Regarding invasive alien species, the results have two main implications. One, that a species' impacts appear to affect action more than whether it is alien. And two, that low likelihood of impacts does not preempt action, and unambiguous impacts raise more conflict than ambiguous ones. Regarding the former, in our findings the label "invasive alien" served mainly to corroborate or enhance actions already decided on: for the Asian tiger mosquito it adds to the reasons for wanting to exterminate it; for the Egyptian goose it is a legitimization for stricter management compared to other geese; and for the Quagga mussel it is no reason not to experiment with it. This confirms the usefulness of conceiving an invasive species in terms of the public and scientific salience, rather than ecological perspectives such as the barrier model (Richardson et al. 2000). Both perspectives are valid, but when wanting to understand and promote action, pushing for a manifest problem status might be more useful than stressing the invasion stage of the species.

A manifest problem status may however to a large extent be dependent on the type of impacts of the species. This has been pointed out earlier (e.g., Verbrugge et al. 2013, Shackleton et al. 2019) and for the three species researched here, human health impacts appeared decisive: potential positive impacts resulted in enthusiastic employment of the Quagga mussel, while potential negative impacts resulted in extermination efforts for the Asian tiger mosquito and criticism of the action undertaken. Diverting from generally held beliefs in invasion literature (e.g., Woodford et al. 2016, Novoa et al. 2018) we found that a species with ambiguous impacts or a disparity in perceptions among stakeholders, did not incite much conflict. The Quagga mussel can be perceived very differently by fisher people, boaters, divers, swimmers and ecologists, and yet it spurred less conflict than the straightforward impacts of the Asian tiger mosquito. The low public salience of the mussel may imply that too few people know of it for real conflict to arise, but this dynamic requires further research. How risks are perceived could be helpful there (e.g., Estévez et al. 2015, Robinson et al. 2017). Either way, the tension between having people care and avoiding conflict, showed to be more of a challenging combination. When prepared for that, a manifest problem status is worth striving for.