21. Amidst the flyway: co-designing accommodation fields for the barnacle goose in south-eastern Finland

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INTRODUCTION: THE PROBLEMATIC SITUATION

In the 1970s, the barnacle goose population breeding in the Russian Arctic numbered some tens of thousands of individuals wintering in only a few locations (Tucker & Heath, 1994). As such, the species was listed in Annex I of the European Union (EU) Birds Directive in 1979 (Directive 2009/147/EC) and was also protected under the Bern Convention (the Council of Europe's Convention on the Conservation of European Wildlife and Natural Habitats, 1979). The population began to recover as hunting pressure declined and the barnacle geese shifted to agricultural fields for grazing, which provided nutrition-rich food during non-breeding seasons (Fox & Madsen, 2017). In 40 years, the population has grown to over 1.4 million individuals (Agreement on the Conservation of African-Eurasian Migratory Waterbirds, European Goose Management Platform [AEWA EGMP], 2021), and its breeding range has extended to the Baltic and North Sea. The Russia–Baltic Sea–North Sea is now the largest of the three recognized populations (AEWA EGMP, 2021).

According to the experts' view presented by Jensen et al. (2018), there is no foreseeable limit for the population size (see Trinder, 2014 a, 2014b, for the Svalbard and Greenland populations), and based on the long-term trend, researchers have estimated that the population will continue to grow substantially and could reach 8 million birds in the next 20 years (Jensen et al., 2018). However, this estimate assumes density-independent population growth. In addition to possible density-related factors, there may also be other limits to the population growth. For example, although the productivity of Arctic geese varies substantially between years (Madsen et al., 2007), rapid climate change is known to cause a mismatch in food availability and hatching dates (Lameris et al., 2018).

Arctic barnacle geese staging in south-eastern Finland during the spring and autumn migration is a relatively new phenomenon. Until about 2010, the staging sites of the migrating barnacle geese breeding in the Russian Arctic were mainly located in the Baltic outside Finland (Eichhorn et al., 2006). Since then, the numbers of staging geese have gradually increased in Finland. Currently it is estimated that, depending on the weather conditions in spring and autumn, roughly about 50 per cent of the Russian breeding population stage in Finland every year. The damage they inflict on farmers has grown at the same rate as their numbers, and today they cause important economic losses and practical difficulties for farmers

in south-eastern Finland. This particularly concerns the sub-region of Central Karelia within the region of North Karelia (Figure 21.1). The grazing of barnacle geese causes particularly serious damage in spring, when they consume the shoots of the cereals sown in the autumn and the first nutrition-rich fodder crop shoots, which are important for dairy farms. Barnacle geese grazing has ceased cultivation of autumn-sown cereals in large areas in south-eastern Finland. In autumn, the total scale of damage is smaller than in spring but can still be significant. The economic impact caused by the geese can be substantial; in 2020, farmers suffered more than €3 million worth of compensated damages (Ministry of Environment, Report VN/13432/2020).

Source: Photo by Mikko Jokinen.

Figure 21.1 A flock of barnacle geese in Central Karelia, Finland, in 2021

Addressing the conservation and sustainable use as well as human–wildlife conflicts caused by increasing goose numbers in Europe on a flyway scale was behind the establishment of the AEWA European Goose Management Platform in 2016. Understanding and resolving human–wildlife conflicts in all their forms is currently also high on the agenda of the ongoing Global Biodiversity Framework negotiations under the Convention on Biological Diversity. Such conflicts may pose a risk not only to communities and species, but also to wider support for biodiversity conservation in general. The global, regional, and national discussions therefore all highlight the need to develop and implement a multitude of approaches to tackle these conflicts with a wide involvement of all key stakeholders as well as collaboration amongst countries, where appropriate, as in the case of migratory species.

While extensive goose damage to agricultural areas has long been an issue in many other European countries, it has only more recently evolved into such a large-scale problem in Finland, as highlighted by the record compensations paid in 2020. The ensuing human–wildlife conflict has also received wide-ranging attention, both politically and in the media, following the pattern of other European countries where increasing geese numbers have long been a part of the national discourse. As for the institutional setup in Finland, the barnacle goose is strictly protected under the Nature Conservation Act; therefore, large-scale derogation shooting of the species has not been possible so far. However, in Denmark, Estonia, and Sweden, the species is covered by the respective hunting legislation, whereby deviating from its strict protection – whether by damage-based or managerial derogation (see Habitats Directive Article 16 [b, e]) – has in practice proved to be more flexible. Unlike in these other countries, in Finland large-scale preventive hunting of the barnacle goose, which would consist of derogations issued, for example, for entire municipalities, is currently not possible. The new Nature Conservation Act was passed in the Finnish Parliament in December 2023. It will enter into force on the 1st of June 2023. The Act (9/2023) allows the issuance of derogation to prevent agricultural damage on a broader geographical scale instead of a property of an individual landowner. The prerequisite for this is that adequate available resting and feeding areas are identified. Another option to change the current regulatory system would be to transfer the barnacle goose as a protected species from the Nature Conservation Act (1096/1996) to the Hunting Act (615/1993). As a result, the process of applying for derogation licences might become easier. In addition, the utilization of geese shot under derogation as human food would become appropriate to the context if the goose was protected by the Hunting Act. This would alleviate a major point of contention amongst stakeholder groups and potentially motivate more hunters to participate. However, derogation shooting might still not be the solution, as there is no scientific evidence that it is workable on this scale (e.g. Heldbjerg et al., 2022). The EU regulation requirement of strict protection would remain in place, and mitigating the damage caused by the barnacle goose by hunting would still require an exemption permit for derogation shooting.

The reimbursement for agricultural damage caused by barnacle geese is currently routine in Finland, but there is no consensus about the adequate level of compensation. The compensation level is estimated using the local average yield estimate of all fields within the production type, for example, hay fields. This results in sub-compensation of the real costs for farms that invest in production and aim to maximize the yield of fields. The total level of funds available for compensation payments depends on the political priorities of future governments. Governmental actions or aid to prevent damage in advance have thus far also been limited. Compensation exceeding direct economic damage is easily interpreted as additional state aid for agriculture which, under the EU's competition legislation, is seen as distorting the European internal market (Laakso, 2017). However, recent efforts spearheaded by the Finnish Ministry of the Environment are also bringing about change. A new legislative package on the compensation of damage caused by protected species (Government 15/2022) entered into force in February in 2022. The new Act provides for possible for stakeholders to apply for financial support for measures implemented to prevent damage. In addition the Finnish Common Agricultural Policy (CAP) programme also includes the possibility for farmers to set aside bird accommodation fields (which could also cater to common cranes, Grus grus *Branta leucopsis*) and to receive compensation for lost agricultural yield through the CAP. It remains to be seen how well these different schemes will function and interlink in practice. The goose

accommodation field (GAF) project is providing vital information that will feed directly into the implementation of these measures.

In response to the growing conflict, a 'goose fist' composed of representatives of the Ministry of Agriculture and Forestry and the Ministry of the Environment as well as other key actors proposed the establishment of GAFs as one solution in 2020 (Governmental Working Group on the Barnacle Goose, 2020). The GAF is not a new concept: fields where geese are allowed to rest and feed have already been established for barnacle geese in Scotland (McKenzie & Shaw, 2017) and the Netherlands (Koffijberg et al., 2017), and accommodation fields have been established for common cranes and whooper swans (*Cygnus cygnus*) in Finland (Niemi et al., 2009).

GOOSE ACCOMMODATION FIELDS AS A TRANSDISCIPLINARY POLICY CHALLENGE

Brute and Institutional Facts in Nature Conservation Policy

Policies can be characterized according to how they are intended to affect the possibility space of actors. Policies may regulate or provide incentives or information. Here our theoretical perspective is that of institutional economics. Institutions are defined as collective decisions that constrain, expand, liberate, and induce individual and social action (Commons, 1990; Bromley, 2006). In this perspective, institutional design can be considered as public policy formulation, potentially covering all three aspects (Pierson, 2006).

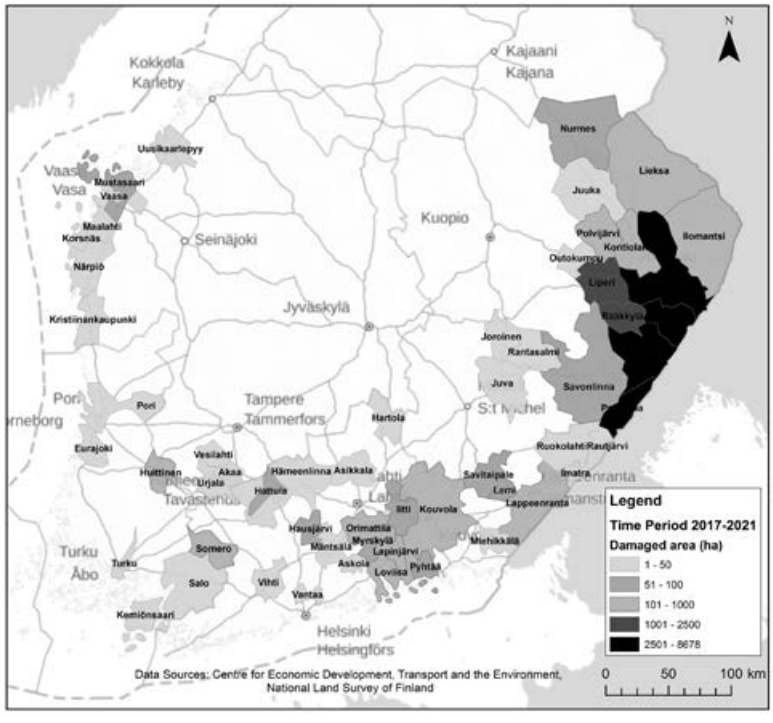
The GAF is a so-called institutional fact: it is a societal arrangement, an institution with a status function. Philosopher John Searle (2005) launched the concept of status function. He formulated it in the following rather simple way: X counts as Y in situation C. A certain field lot (X) counts as a GAF (Y) because it meets certain conditions given to the goose field (C). In other words, farmers and the environmental administration agree that a particular field section will serve as a GAF when it meets certain conditions given to the goose field. The status function fulfils its purpose on the basis of promises and commitment, not physical features. Institutional facts differ from so-called brute facts (Searle, 2010, p. 10). For example, the fence and the bullet do their deed and fulfil their purpose through their physical features. Marriage and money do not.

For Searle (2005), 'An institution is any system of constitutive rules of the form *X counts as Y in C*' (p. 10). Constitutive rules differ from regulative rules. Regulative rules describe or guide the behaviour of individuals in certain social interactions, while constitutive rules are necessary to define or create new social entities, roles, or facts (Guala, 2016, p. 58). A GAF is an arrangement that does not arise by its physical characteristics alone, but requires human promise, commitment, and cooperation to function. However, human promise and commitment are not enough. The GAF must also satisfy geese preferences. A GAF is a policy instrument that reconciles the short-term and long-term needs and interests of both farmers and geese. The GAF having a status function means that institutional and brute facts must come together by some key constitutive rules.

To explicate how institutional facts and brute facts are integrated to become a workable policy instrument – the GAF – is our objective in this chapter. We design and test the GAF to suggest how to modify institutional and ecological structures for co-beneficial outcomes

for humans and geese. Our focus is on the practical effects of these socio-ecological modifications, not in any way in the transcendental conditions of justness of those arrangements (on realization orientation, see Hiedanpää & Bromley, 2016; Sen, 2010). Our task is pragmatist.

As the goose-damage situation, itself, and the possible mitigating measures build on a complex set of institutional and brute facts, decision-makers simply cannot declare goose fields into existence, regulate how the benefits and costs ratios should be distributed, or inform farmers and citizens to tolerate the effects of geese. The situational meanings and the significance of brute and institutional facts set up the criteria and conditions of the GAF. These conditions do not unfold and fit together automatically. If this were the case, North Karelia and Finland (Figure 21.2) would not be in such a problematic barnacle goose situation.



Source: Image by Mika Pirinen.

Figure 21.2 Goose damage concentration areas and accommodation field areas in Central Karelia

Understanding and altering this kind of problematic goose situation calls for research based on both natural and human sciences (Fox & Madsen, 2017). As typically understood, in multidisciplinary projects the research problem is examined from many scientific perspectives (Schoot Uiterkamp & Vlek, 2007). Here, a multidisciplinary approach is not enough since the social and natural sciences and their findings need to be integrated to deliver functioning working rules for the GAF. Interdisciplinary research goes one step further as it seeks to integrate the scientific practice of various research experts, but this must be pushed even further, when the

implementation of research and the expected scientific outcome require ongoing collaboration with local actors or stakeholders. This is then called interactive research (Nielsen & Svensson, 2006).

Our GAF project attempts to collaboratively modify the institutional and ecological structures and their function for the co-benefit of humans and geese. Our work can be characterized as transdisciplinary (Leavy, 2011). Transdisciplinary GAF research is not just about co-producing knowledge, it is about creating an epistemic architecture and a community of inquiry of human and nonhuman entities to solve a multifaceted research problem at hand. We align with Rorty (1999), who asserts that '[t]he purpose of inquiry is to achieve agreement among human beings about what to do, to bring about consensus on the ends to be achieved and the means to be used to achieve those ends. Inquiry that does not achieve coordination of behaviour is not inquiry but simply wordplay' (p. xxv). However, while it is true that typically the process of inquiry (i.e. establishing warranted assertibility; Dewey, 1941) and coordinating behaviour happen between humans, our ambition is wider. It expands towards integrating the goose as a goal-oriented actor with its own behavioural features (e.g. field selection) and collective intentionality (e.g. migration) into human-induced instrument design processes (on animal minds, see Godfrey-Smith, 2020, and on animal collective intentionality, see Searle, 2010, pp. 6–7). In this light, our core research question is practical: What are the conditions of a workable GAF?

MATERIALS AND METHODS

Action Research

The most important feature of our transdisciplinary research practice is the active and continuous collaboration between researchers, farmers, local administration (Centre for Economic Development, Transport and the Environment, ELY), and the Ministry of the Environment. Especially important, the Ministry of the Environment has funded a position called the Species Damage Coordinator, whose work covers all of Finland, while the special focus is in Northern Karelia. The coordinator, with an environmental policy research background, is very much responsible for networking, cooperation, and collaboration with the farmers in the GAF design process. During the barnacle goose migration period, the Species Damage Coordinator has had daily conversations with farmers. Through continuous collaboration, ties are expected to become stronger, suspicion dispelled, and a critical level of trust established between farmers, rural authorities, and interest groups, such as the Central Union of Agricultural Producers and Forest Owners (MTK).

Farmer Preferences

Crucial elements in establishing GAFs are the farmers' preferences, habits, and preparedness to live with the geese. Information about this needs to be collected with wide geographical spread. The same grass is good for geese and livestock, and therefore the grass used by the geese has to be replaced somewhere else. The questions are: Does the farmer accept the idea of the GAF and settle for compensation paid for damage? Are farmers willing to coordinate with their peers to take coordinated anticipatory action where the damage may occur? What

do farmers value and prefer, and what are they ready to do in the face of migrating geese? The answers to these questions provide key grounding information for the establishment of the GAF.

We studied the farmers' views on how to find solutions to the barnacle goose problem by interviewing 26 farmers. Based on early findings, we conducted an online survey with a full sample of Central Karelian farmers; 871 surveys were distributed, and 209 responses were received during the period 2020–21. Along with the data from the interviews and survey, we base our understanding of farmer opinions and local culture on ethnographic fieldwork and participatory observation (Bernard, 2018). Social scientific project work has been based on close collaboration with farmers when planning and implementing fieldwork, arranging meetings, and having informal discussions. This has provided multifaceted material for understanding the social and cultural context the Karelian farmers live in.

In Central Karelia, the area worst affected, about 30 per cent of the farms include fields that use organic farming methods, adding up to about one-third of all fields in the area. In the spring of 2020, which was the top season in terms of goose damage, damage was sizeable, and almost 40 per cent of it took place on organic fields, which is proportionally more than their relative cover in the area. This could be due to some combination of at least the following factors: the geese may prefer organically farmed fields, these fields may be in areas preferred by geese, or the organic farmers might have a stronger motivation to report damage.

When making decisions about the locations of potential GAFs, the most important issue is to choose fields that are preferred by the geese. Thus, a sensible starting point is to locate the accommodation fields in areas where most of the goose damage has occurred in the past. To ensure objective and equal information about the worst areas when it comes to goose damage, we also statistically analysed the occurrences of verified damage in 2017–20. Our aim was to find out if the goose damage in our case study area was evenly or randomly distributed in space, and whether it was possible to recognize statistically significant concentration areas of goose damage.

As primary data for the goose damage concentration analyses, we used damage information maintained by the ELY Centre. The material consists of the damage information reported by farmers and verified in the field by the ELY. Because the material was in tabular format, we first prepared it as a georeferenced raster to be used in GIS (Geographic Information Systems). We used ArcInfo GIS to make a grid covering the Central Karelia case study area with a grid cell size of 1000 metres. This resolution was accurate enough to enable the necessary analysis.

In the analysis phase, we first calculated the sum of damaged field areas inside a grid cell for each raster cell by using an overlay analysis in GIS. To identify possible damage concentration areas, the damage area raster was analysed in ArcInfo by using a hotspot analysis (Environmental Systems Research Institute, 2018). This analysis enables the recognition of the statistically significant spatial clusters of a phenomenon. The method utilizes Getis-Ord Gi* statistics, where the basic idea is to examine each raster cell or entity within the context of its surroundings. In statistically significant hotspots, a raster cell should have a high value and be surrounded by high-value cells.

Identification of Field Blocks for the Experiment

The above analysis was carried out to test whether the damage caused to farming by barnacle geese is evenly distributed in the study area, and if not, in which specific field areas and

field blocks therein it is concentrated. We presume that all significant damage is reported by the farmers, and while some damage remains unreported, a GIS analysis of goose damage locations gives an indication of the geographic locations and site characteristics as well as the vegetation preferred as feed by the geese.

As a result of our spatial damage analysis, we obtained spatial clustering information about the goose damage that occurred in 2017–20, and on this basis we prepared a goose damage concentration map covering our case study area. This map enabled the selection of the exact study locations, and it clearly indicated that the goose damage in our case study area was spatially clustered to certain areas; this information was utilized as one data source when locating a new GAF. The scale of the map was coarse, but to prevent the identification of separate farms or fields, we do not publish it here. Instead, we show the general distribution of compensated barnacle goose damage to agriculture in Finland at the level of municipalities (see Figure 21.2).

It is known that geese prefer large open fields in proximity to water bodies for roosting (Fox et al., 2017), and field observations have shown this to be evident also in Central Karelia. In the areas with the most significant damage concentration, the size of the largest uniform open fields ranges from 200 to over 500 hectares. The experiment blocks were selected within the identified concentration areas of damage based on the willingness of the volunteer farmers therein.

Based on the above selection process, the GAFs were established in the spring of 2021 in Central Karelia on 61 field blocks covering a total area of about 350 hectares. In addition, there were other field blocks serving as the GAF in Europe-wide Natura 2000 Reserve Network areas and also as experiments run by the farmers themselves (36 blocks; about 130 ha). In the spring of 2021, geese expulsion field blocks were established in 113 field blocks, with a total area of about 680 hectares. Here, geese were repelled continuously. In the autumn, the GAF blocks were the same as in the spring, but there were 86 expulsion blocks with an area of about 660 hectares.

The Experiment

The functioning of the GAFs and their effectiveness in preventing agricultural damage can be measured in at least two ways. The first is to observe goose flocks or to track individual geese and monitor the amount of time they spend on different field blocks. The second method is to directly measure the grazing pressure the geese exert on different blocks and consequent agricultural damage. We used both approaches. When comparing observations and measurement results between expulsion blocks and GAF blocks, one can evaluate the ability of the arrangement to reduce the overall damage and direct the remaining damage to pre-selected blocks.

To measure the grazing pressure exerted by the geese on the experiment blocks, 1 m × 1 m chicken-net cages were placed on the fields prior to the start of the migration season. This prevented the geese from accessing the crop at the measurement spots. Around 200 cages were in use in the spring and about 180 cages in the autumn. The crop height was measured on each block both inside and outside the cages, and the height difference during the migration season provided information about the grazing intensity of geese on different blocks.

When the migrating geese reached the research area, we initiated the counting, marking, and expulsion tests. Researchers and 'goose herders', members of a local hunting club hired by the ELY of North Karelia, toured the study area daily during daylight hours, counting or

estimating the numbers of geese during each round and on each block. Other significant goose concentrations outside the experiment blocks were also registered. In addition, 50 geese were captured and fitted with GPS transmitters in the spring and another 20 geese in autumn 2021. Their movements were monitored continuously in almost real time.

When geese were spotted on expulsion blocks, they were approached by humans and driven into flight, and the outcome was registered. In addition, some researchers and 'goose herders' had a signal pistol or fired blank shots from a shotgun, which were used to repel geese. The geese equipped with GPS transmitters were specifically targeted and expulsed using different methods and their movements registered after the expulsion through the GPS locations. The methods of passive expulsion used in the autumn of 2020 (hawk kites, air balloons, etc.) were no longer used in this project, as their efficacy had proved to be weak and/or short term.

Citizens' Attitudes

The increasing population of many large birds, such as geese and cranes, has led to rising tensions and even conflicts with birds and urban or rural activities and specific land uses (Smith et al., 2000; Eriksson et al., 2020). In the face of increased barnacle geese numbers, we explored the supporting and opposing reactions of Finnish citizens towards the presence of geese and the GAF concept.

Our exploration was based on a nationwide survey, where we focused on the relative role of sociodemographic characteristics, the personal level of (direct) goose experiences, the personal beliefs about goose-caused impacts, and the perceptions of (other) societal arrangements around goose management, including the level of support given to non-lethal measures to mitigate damage to agriculture.

Our survey data were collected in 2021 among Internet panellists (M3Panel, Nordstat) by the market research company Bilendi Oy. The respondents (N = 2500) were randomly chosen to represent the adult population (aged 18–79) in three strata. The first stratum covered the provinces within the barnacle goose flyway across south-eastern Finland in the spring and autumn, the second one covered the three south-western provinces with the highest number of nesting geese in the summertime, and the third stratum covered the remaining provinces of continental Finland. The collected data were weighted to represent the age and gender distributions of the populations by stratum and across strata when making summaries of nationwide opinions. Our exploration of the factors explaining the level of support for the GAF concept was based on logistic regression analysis without data weighting. We modelled the probability of responding 'agree'/'strongly agree' to the specific claim 'Agricultural damage caused by geese should be prevented primarily by scaring away birds from vulnerable areas or attracting them to goose fields, even if there are costs to society'.

CONDITIONS FOR GOOSE ACCOMMODATION FIELDS

According to the farmers' survey, we found indications that the goose problem has a negative effect on their wellbeing. Losing crops leads to increased concerns of how to cope economically, where to find supplementary food for livestock, and whether possible investments in production are worthwhile. As explained above, specific subsidies for the establishment of the GAFs have not been administratively possible, but agricultural damage caused by geese

is compensated. Farmers estimate that the compensation only covers one-third of the total damage and economic burdens. In their worst-case scenarios, farmers fear that they need to give up farming, meaning a disruption to family legacies possibly carried on through several generations and even hundreds of years.

Many farmers feel that the value of farming has plummeted in the eyes of people outside of the farming community. According to interview data, many milk and beef producers think that they have been branded negatively in the current climate debate, which calls for milk and meat production and consumption to be reduced to enable the society to meet global sustainability and climate targets. Organic farmers think that their environmental activity is not acknowledged by the urban populace and the elite of the capital city, Helsinki, who represent power. According to the survey results, 93 per cent of farmers think that city people show no signs of understanding rural livelihoods and living conditions. The identity of the farmers is built on producing food for Finnish people and the continuity of agricultural heritage in the family. Feeding the Finns is a matter of pride for many and the cross-generational way of repositioning themselves in society. The feeding of geese is a perverse issue to some farmers, and if the GAF concept is to offer a long-term solution, then the perceived meaning and the general idea of agriculture need to be transformed accordingly. The issue is not only economic but, above all, cultural.

Farmers agree that the current situation must change, and many of them think the GAF concept can be one key solution. It also requires new ways of thinking from farmers. Before we introduced the GAF experiment, 93 per cent of farmers believed that the problem can be solved only by reducing the barnacle goose population. Only one-fourth (24 per cent) believed in the GAFs at that time. For successful repelling, 80 per cent of respondents believed that shooting must be done. Furthermore, if the law were to allow killing geese, it should also allow them to be used as human food (92 per cent agreed with the statement). Culling is not considered in line with Finnish rural and hunting culture.

Regarding goose behaviour in the GAFs, first, according to a preliminary analysis of the data, the GPS-tracked geese spent most of their time on fields outside the experiment blocks. However, the experiment blocks only covered less than 3 per cent of the total fields of the study area. Conversely, the GPS-tracked geese spent much more time on the accommodation field blocks than expected based on the area of these blocks (less than 1 per cent of the total area). Likewise, the GPS-collared geese spent more time on the laser tower and active expulsion blocks than expected based on their area, but proportionally less than on the accommodation field blocks. About 74 per cent of all tracked geese visited the project's GAF at some point. Individual variation was high, with some geese spending up to 85 per cent of their feeding time on the GAF. We found no evidence that targeted repelling would cause individual geese to use a GAF more frequently (see also Heim et al. 2022). Secondly, the preliminary results from the cage experiment suggest that the expulsion of geese managed to reduce grazing pressure on these blocks, although the variance of the crop length from block to block was relatively high (Figure 21.3).

According to the nationwide survey, the majority (60 per cent, 95 per cent confidence interval: 58–62) of the adult population in Finland supported the non-lethal scaring methods as the primary mitigation methods for agricultural damages. Among the citizens that had personally encountered geese in fields (some 42 per cent), a majority of them reported that the encounter had raised sorrow (58 per cent), compassion (55 per cent), or frustration (63 per cent) in them,

Source: The photo was taken by Jukka T. Forsman in May 2020 after the migration period.

Figure 21.3 Cages preventing the access of geese to crops were used for quantifying the impacts of geese on the cultivations

at least to some extent. The feelings probably are associated with their awareness (beliefs) of the birds causing damage.

Which factors predicted moderate or high support for the GAF concept, irrespective of the other factors included in the model? Women supported the concept more often than men, and so did the respondents who resided in the regions with either no geese present or mainly geese from the breeding populations within or near urban areas. Neither age nor education level was significantly associated with public preferences.

Irrespective of the effects of other explanatory factors, support for the GAF was higher among people who believed that geese represent no risk of collisions at airports. However, the support was not associated with other beliefs regarding other potential and either positive or negative impacts of geese to people (or their interests) in urban or rural surroundings.

While citizens' support for the GAF and empathy related to the problems experienced were common regardless of one's socio-economic background and beliefs about geese impacts, support was higher among those who: (1) disagreed with the claim that goose problems are consequences of successful conservation policy that does not react to the population increase, and (2) viewed that the barnacle goose should remain a protected species with restricted removal (i.e. hunting) allowed. The supporters, more often than others, also perceived that the geese in general should have undisturbed places and expressed that the geese chicks should not have to suffer due to mitigating measures. They also viewed more often than others that total economic compensation of agricultural damage should be made.

One condition of the study is also the administrative collaboration behind the successful establishment of the GAF experiments in 2021 and 2022. The Ministry of the Environment provided financial resources for the project and the GAF itself, but also for the Damage

Species Coordinator who, with the regional ELY of Northern Karelia, acted as intermediary between farmers, stakeholders, and other administrative actors. The apparent differences in value orientations between the Ministry of the Environment and the Ministry of Agriculture and Forestry provided some tensions, or problem-solving creativity, to the design processes.

DISCUSSION

Reconfiguring the Institutional and Ecological Environment

In the spring of 2022, we continued the landscape-level goose field design in the worst-hit goose areas of Central Karelia in three rural municipalities (Tohmajärvi, Kitee, and Liperi), aiming to co-design field-block-specific plans for the next 3−5 years. The plan will suggest the separate GAF and agricultural production fields by integrating the specific requirements (i.e. the constitutive rules instigated by the geese: location, crop, openness of landscape, etc.), farming and deterrence practices (crop rotation, goose expulsion methods, etc.), and farmers (willingness to participate, best crop fields for agriculture, etc.). The purpose is two-fold: to indicate enough land (about 10–20 per cent of the arable land) for GAF, and to indicate especially valuable agricultural areas to be safeguarded from the effects of geese.

As our results indicate, the status function of the GAF is built on four principles emerging from the above constitutive rules: farmers voluntarily commit to the establishment of the GAF, the chosen fields are preferred by the geese, there is a committed task force of those who expulse geese for the protection of the other fields identified as particularly valuable for agriculture, and the wider populace of Finns shows acceptance for the GAF as a policy instrument. The reconciliation of institutional facts and brute facts has, it seems, become possible. The GAF does not introduce new formal rights or duties to farmers; instead, its functioning is based on the re-configuration of the existing legal positions of right, duty, liberty, and no-right. The task has been to voluntarily modify the human promises and commitments to fit with the biological goose requirements of the GAF.

The key to understanding the nature and significance of this as a transdisciplinary research challenge is the prefix *trans*: change happens through the environmental structures. These structures may be, as theorized here, institutional or brute. This idea that behavioural change is mediated by environmental structures and features has been made familiar by pragmatist philosophers, such as John Dewey (Dewey & Bentley, 2008), and cognitive scientists, such as Andy Clark (1997). According to them, cognition, knowledge, and opportunities are distributed in relevant socio-ecological environments. The prefix *trans* implies that the induced changes in who can, cannot, may, or must do something inflict a change in what kind of knowledge becomes useful (i.e. what affordances actualize and what actions become possible) – and, especially, what kind of consequences renewed activities and behaviours may start to produce (see Sunstein, 2019). Our transdisciplinary research expands understanding of the contingent institutional and ecological arrangements needed to make goose knowledge useful and to open novel long-term opportunities and behavioural outcomes.

Though voluntary, the GAF does not build on economic incentives, as the arrangement only compensates for actual damages and introduces minimal financial means for damage prevention. It nevertheless motivates voluntary engagement in exploring and co-designing constitutive rules in dynamic goose–human field compositions. Our careful conclusion with

one year of experience is that (1) active expulsion of the barnacle geese is rather effective when guiding them to a GAF, and (2) because individuals suffering from goose damage see that efforts are being made to relieve their problem, social tensions around the goose problem may have decreased.

There is a sufficient level of interpersonal trust between farmers, researchers, and administrators to establish the status function for the GAF. However, the same is not obvious regarding the confidence that farmers show to the government, especially to the agricultural and environmental agencies. Customarily, farmers have been confident in the Ministry of Agriculture and Forestry, but this time the relationship is more ambiguous due to the institutional complexity around it, for example, regarding killing geese, utilizing the killed geese as food, and obtaining state aid for the GAF (on trust and confidence in nature conservation in Finland, see Hiedanpää & Borgström, 2014). As the ambiguity between ministries has remained, the new EU CAP period and the updated Nature Conservation Act will most likely strengthen confidence again and speed up changes regarding public preparedness to live with the geese because legal changes provide better tools and financial aid for preventive actions to decrease goose damage (HE 154/2021).

Our transdisciplinary project has been an intermediary in the GAF co-design process. It has prepared farmers for the GAF, tested the effectiveness of the expulsion measures, and kept ministries in contact with each other, especially in the steering group of the project. As Turner et al. (2016) have shown, increased confidence in government may strengthen the perceived legitimacy of policy designs. In this respect, we have contributed to the development of collaborative instrument design and workable instrument implementation (for barriers, see Solheim et al., 2021).

Institutional Co-Design with Nonhuman Actors

Societies have always organized themselves to reap the benefits from the natural environments and to prevent costly damages. This organizing is done with institutions (Bromley, 2006). Before the era of nature conservation, if a species did not bring forth benefit but harm, the reasons for its protection were short and landowners exercised their power to kill to prevent damage (Pohja-Mykrä et al., 2012). If the life-realm or habitat of beneficial species extended beyond one's property boundaries, reasons for its protection were equally limited (Naughton-Treves & Sanderson, 1995). The barnacle goose is an example of this. However, currently, the interference with the barnacle goose – the right to take its life, for example – is very limited since it is only possible to derogate from the strict protection when specific criteria are met. Nowadays, the barnacle goose can exercise its power to the limit. Only when the limit is met may damage-based derogation (in the form of shooting) begin.

As a general social norm, people tend to take more care of nonhuman species that are of benefit rather than those that are a nuisance (Whyte & Cuomo, 2016). However, controlling the harm that nonhumans exert takes effort, and the effort taken must come to terms with the benefit gained or damage prevented. In this sense, endeavours with nonhumans, especially with the problematic ones, are exercises of a rational cost–benefit calculus (on cost–benefit thinking, see Sunstein, 2018). But living together with the geese is not only a matter of such calculus. The GAF is a spatially coordinated cost–benefit exercise on how the geese's and the farmers' activities should fit together in a landscape during the migration period. Both sides cannot exercise power to the limit. We could say that the GAF is institutionally induced for-

bearance for dynamic co-existence. Unlike the avoidance or the performance with full power, in forbearance, the exercise of power is limited, critical responsiveness is practised, and the nonhuman actors and their sensitivities are taken into consideration. Under the institutional umbrella of the GAF, neither birds nor humans can one-sidedly assert and claim their territories by brute force. Territories are co-constructed, the boundaries between the territories of two species become stricter and better defined, and their rights become better articulated and explicitly relational.

In Central Karelia, there is a negotiation situation between farmers, geese, and the administration. The geese cannot simply be killed to prevent the damage, nor can the farmers be compensated excessively to let the geese forage. From this, two moral stances are created. First, in the spring, according to the interpretation of the law and decision practices of the Finnish environmental administration, the lethal derogation is not allowed during the breeding season. The barnacle goose has the inherent right to a life well lived (Nussbaum, 2006, p. 130). Second, the barnacle geese indicate a need and interest for resting, foraging, and the companionship of species-mates that cross the threshold level of moral importance; consequently, they have a right to access the pasture, for example, and this logically leads to some form of ownership regarding that particular resource (Hadley, 2015) or habitat (Cooke, 2017).

Regarding our contribution to the formation of transdisciplinary theory, the concept of the GAF has opened a space for a novel kind of animal rights discussion. The flocks of 50 000 geese can possess physically appropriate fields of their preference in Central Karelia. Quite naturally, this possession is not sufficient for claiming full legal rights. However, as the barnacle goose is strictly protected, it has been acknowledged with some type of property rights; it has a right to take control of a benefit stream of their liking on the field they have chosen. Following Bromley (2006) recall that 'property is not an object, but is instead, a value … control over a benefit stream arising from settings and circumstances that runs into the future' (p. 63). The GAF is one tested, feasible, and workable policy solution of organizing human–goose co-existence under the current conditions of institutional and brute facts. There is a growing literature on wildlife as property owners. Also relevant to our goose concern, Bradshaw (2020, pp. 65–78) introduces the legal trust as an organizing arrangement for the ecosystem-level wildlife property regime. Herrmann-Pillath (2023) expands on this and develops the idea of trust towards the non-anthropocentric conception of 'the universal commons'. Our case points to a humbler future research question: How to restructure and organize socio-ecological environments, sets of integrated institutional facts, and brute facts when both the geese and farmers have equally safeguarded rights, especially property rights to the benefit streams these lands provide.

CONCLUSION

The barnacle goose remains strictly protected under Finnish national and EU legislation and is currently in a favourable conservation status. Goose population growth and their changed migration habits have led to a human–wildlife conflict, including sizeable economic damage, and the reimbursement for Central Karelian farmers has dramatically increased in the last ten years, reaching €3 million in 2020. We experimented, tested, and co-designed a GAF through transdisciplinary research. Recall that in multidisciplinary research, various disciplines scrutinize the research problem from their respective perspectives and help fill in the specific

knowledge needs (e.g. nutritional needs of geese and the best soil type for trifolium). In interdisciplinary research, scientists integrate some research findings (e.g. the behavioural habits of the goose) and help policy planners see the problematic situation as a thematic whole. As transdisciplinary research practitioners, we have engaged authorities and affected parties, not only in knowledge production or knowledge integration but also in identifying and articulating the problematic situation, collecting research materials, and, especially, testing the real-life goose field conditions and functioning.

The purpose was to understand brute facts regarding goose behaviour and to describe and prescribe some constitutive rules in order to establish GAF status functions (i.e. to alter how farmers and geese convivially interact with their living environments). The results indicate reasons for optimism. The farmers showed willingness to join the collaboration with environmental and agricultural administrators and scientists in a collective effort to find practical solutions to the pressing problem. In addition, citizens in general felt empathy for the farmers struggling with the effects of species conservation. Not only humans but also the geese seemed to prefer the provided institutional arrangement of the GAF. Our study was a first transdisciplinary construct towards the practice of convivial relationships between humans and geese.

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