Developing response-ability in human-wasp encounters

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ABSTRACT

Learning to live with unloved others is crucial in the ecological crisis. Unloved wasps are feared and disliked for their sting. Understanding of their ecological importance is increasing, however. Human-wasp encounters are changing with environmental changes, and strategies for multispecies cohabitation are needed. This multispecies study highlights features of wasp biology affecting human-wasp encounters and analyzes how conflicted human-wasp relations could be mitigated. The geographical focus is Finland, in the Northern boreal region. Biological analysis specified spatiotemporal aspects affecting human-wasp encounters: human and wasp habitats and preferences overlap ubiquitously. From a media analysis, we identified contextual strategies for living with wasps: exterminating, repelling, relocating, and giving space. Wasps do not receive only bad press – human-wasp relations are diverse and contextual. Knowledge of wasp ecology may allow for cultivating response-ability in multispecies encounters. Media provides information and narratives that allow reinterpreting wasp "aggression" as a vulnerable multispecies condition. Human-wasp encounters are corporeal and often preferably avoided. Therefore, methods that allow developing intimacy without proximity may be used for reflecting on human-wasp relations. One such method is crocheting decoy wasp nests. Human-wasp encounters could be mitigated by species-specific strategies that assess the risk involved. However, developing such strategies is difficult because wasps are often confused with other black-and-yellow insects.

KEYWORDS: cohabitance; media analysis; multispecies study; unloved others; vulnerability; wasps

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1 Introduction

Human-animal relations are complicated and multiple. Some animals are considered more "other" than others. Often the category of "animals" does not seem to include insects – insects are seen as "the ultimate other." And yet, even among insects, there are "those we love, those we hate, and those we eat" (Herzog 2010). Traditionally, charismatic species such as large mammals, hard-working bees, or beautiful butterflies have captured human attention and are more likely to be considered in conservation policies (Lorimer 2007). But as even charismatic species are on the verge of extinction, Rose and van Dooren (2011) have asked, what chance do unloved others have then. Learning to live with unloved others is crucial in the current ecological crises. Not all biodiversity is pleasant from the human point of view, but it may be ecologically vital, nevertheless. It is necessary to develop such multispecies ethics and practices of cohabitation – in Donna Haraway's (2016) terms, *response-ability* – that allow the flourishing of humans and nonhuman others. Our focus here is on examining strategies for living with wasps.

Wasps, more precisely yellowjackets and hornets, are commonly unloved insects. Consequently, they have also been less studied than other insect taxa (Sumner et al. 2018). The negative cultural stigma wasps carry goes a long way back, at least to Aristotle. For example, we came across a fable from 1861 titled "The bee and the wasp" (Frankum and Cruikshank 1861). In the story, the wasp is portrayed as an evil creature that eats the friendly bee's family. Still, there were also the "Wasp Whisperers," or *aficionados*, already in the turn of the 19th and 20th centuries (Sumner 2022). Wasps are commonly juxtaposed with bees, for instance, in social media memes: whereas bees are portrayed as cute and important pollinators, wasps are seen as nasty and useless. Nevertheless, we share living environments with wasps, and the lives of humans and wasps are, in many ways, intertwined. Numerous wasp species perform many vital ecosystem functions, such as pest control and pollination (e.g., Brock et al. 2021; Sumner 2022). An increased understanding of wasps' ecological importance could work towards cultivating response-ability in the multispecies entanglements.

Sumner et al. (2018) wrote how the exclusively negative media profile of wasps and the lack of information on their roles in ecosystems might drive negative attitudes towards wasps. In this paper, we draw together findings from an interdisciplinary project that aimed to increase understanding of the dynamics of human-wasp cohabitance. The geographical focus of our study is Finland, in northern Europe. We studied wasps from the perspectives of ecology and biology (JT and AK), as well as environmental social science and humanities (MS). We aimed to understand i) what features of wasp

biology affect human-wasp encounters and ii) what kind of strategies may be developed for mitigating human-wasp encounters and increasing appreciation of wasps. The biological analysis allowed us to specify the spatiotemporal aspects affecting human-wasp encounters. Here we present an analysis of Finnish media that allowed us to identify contextual strategies for living with wasps. Wasps do not receive only bad press: we identified a diversity of wasp perceptions that allow developing responsible ways of responding in human-wasp encounters.

Next, we will briefly discuss why wasps are disliked (1.1) and the environmental changes affecting human-wasp encounters (1.2). Section 2 introduces our interdisciplinary multispecies approach and research material. Section 3 summarizes the features of wasp biology that increase human-wasp encounters. Section 4 characterizes the wasp narratives found in the media material, and in Section 5, we discuss four territorial strategies for human-wasp cohabitance based on the media analysis. Finally, in Section 6, we draw conclusions on response-able human-wasp relations.

1.1 The unloved wasp

The fear and dislike of wasps is a complex phenomenon constituted by evolutionary, psychological, social, and cultural factors (Lockwood 2013). Wasps, along with spiders, score high in anxiety ratings (Davey 1994). The possibility of a sting is a principal factor behind the dislike of wasps. A wasp sting is painful and even life-threatening for people allergic to wasps (Golden et al. 2006; Smallheer 2013). Therefore, avoiding wasps is rational. However, the potential harmfulness of the insects alone cannot explain the fears, as people are afraid of, e.g., spiders that are generally not harmful to humans (Gerdes et al. 2009). Fear may be related to the size of an insect (Leibovich et al. 2016); for instance, humans are often more afraid of larger hornets, even though they do not pose more danger than smaller wasps. Sumner et al. (2018) suggest that the more interest a person has in nature, the more positively they view insects. Thus, fear and disgust toward wasps could be remedied by increased nature contact and engaging with the ecology of wasps. The trouble is the 'extinction of experience' (Soga and Gaston 2016), as humans spend less time in natural environments, and nature contact is increasingly mediated for many.

Wasps are commonly perceived as more aggressive than bees, as they may, at least in theory, sting more than once. The "aggressive" behavior of worker wasps may also result from their hunting behavior, as wasps hunt animal protein for the meat-eating larvae, whereas bees are vegetarians (Sumner 2022; on variation in colony-level

aggression, Jandt et al. 2020). Interestingly, bee and wasp venom are used widely to relieve pain and treat inflammatory diseases such as rheumatoid arthritis (e.g., Pemberton 1999; Sumner 2022), so venom also has positive connotations. Besides cultural differences, humans are differently exposed to wasps depending on their occupation and living environment. People living in rural areas and working in agriculture are more exposed than people who spend most of their time indoors. Exposure may increase understanding of the other, but it also increases the likelihood of a sting. For people earning a livelihood from berry farming, wasps have been reported to cause economic losses by spoiling the crop.

Human death by wasp sting is rare. In Finland (~5,5 million habitants), there is fewer than one death per year caused by wasp sting (Hirvonen and Jäntti 1995), whereas in neighboring Sweden (over 10 million habitants), there have been two deaths annually (Johansson et al. 1991). The situation may change, however, with increasing human-wasp encounters due to wasp distribution shifts with climate change (Sumner 2022; Turillazzi and Turillazzi 2017). According to Smallheer (2013), 0.05 to 5% of the human population has hypersensitivity to *Hymenoptera* venom (bees, wasps, and hornets). Without a history of severe allergic reaction to wasp venom, the likelihood of a systemic anaphylactic reaction is small (Smallheer 2013). However, an allergy does not develop before exposure to the allergen, so even having been stung before, a person does not necessarily know whether they are currently allergic. Studies suggest that allergy may be species-specific (Smallheer 2013). However, developing species-specific strategies for human-wasp encounters would require keen species identification skills. Today, autoimmunotherapy is an effective treatment when a wasp venom allergy has been diagnosed, and adrenaline injectors are prescribed to severely allergic persons as an emergency treatment in case of a wasp sting. With precautionary measures, the fear of wasps may be alleviated even for allergic people, but fear and justified health concerns must be considered in mitigating the conflicted human-wasp relations.

1.2 Environmental changes and increasing human-wasp encounters

Globally, there are over 100,000 species of wasps, which participate crucially in many ecosystem functions, particularly in regulating the populations of other arthropods (Brock et al. 2021). Most (70%) are solitary, and humans rarely conflict with them. From the 33,000 aculeate, i.e., stinging, wasp species, approximately one thousand are social, forming colonies. Sumner et al. (2018) claim wasps to be among the world's ecologically most important taxa, along with bees. According to them, the reputation

of wasps is tarnished by the sixty-seven species of social *Vespinae* wasps (i.e., yellowjackets and hornets; from here on 'wasps'). In Finland, there are twelve species of social vespine wasps (Pekkarinen and Huldén 1995).

Global environmental changes, including climate change, affect the behavior, range, and abundance of wasps. For instance, the German wasp, *Vespula germanica*, native to central and southern Europe, has expanded its range north to Finland (Sorvari 2018; Komonen et al. 2020). In Finland, several exceptionally hot and long summers in the 2010s facilitated wasp communities to grow large. This was reflected in news headlines such as "Aggressive wasps are pestering people on holidays." In parts of the world, wasp species, especially the common wasp *Vespula vulgaris* and the German wasp *V. germanica,* have become widely spread and abundant invasive species with harmful impacts on native biodiversity and ecosystem functions (Beggs et al. 2011). As generalist insect predators, they become pests and compete for food with native species. In such a situation, the question of human-wasp cohabitance is ecologically and socially quite different from the northern boreal context with only native wasp species.

Urbanization affects wasp populations in several ways: urbanization destroys and fragments habitats but also provides novel biotopes with the potential to provide shelter, nest sites, and food (McDonald et al. 2013; Turillazzi and Turillazzi 2017). The changing environment may increase human-wasp encounters, further highlighting the need to develop strategies for living well together.

The last decade saw an awakening to the ecological importance of insects. Studies and news have highlighted the loss of insects worldwide (Hallmann et al. 2017) and the vital ecological functions that insects perform, such as pollination, pest and disease control, and decomposition (Sumner et al. 2018). An IPBES report (2016) stated that over three-quarters of main global food crops rely on insect pollination. Concern for pollinators has resulted in many campaigns aiming to help bees. Wasps are also known to contribute to pollination, and some plant species even specialize in wasp pollination (Fateryga 2010; Sumner 2022), but the extent and importance of wasp pollination are poorly known. The IPBES (2016) report stated that "the vast majority of pollinator species are wild, including more than 20,000 species of bees, some species of flies, butterflies, moths, wasps, beetles, thrips, birds, bats, and other vertebrates." The report, for its part, has increased awareness of pollinators other than bees, including wasps. The growing concern over insect decline may "trickle down" to wasps, and attitudes towards them could change with an increased understanding of wasps' ecological importance.

2 An interdisciplinary multispecies study

As sketched in our introduction above, wasps are awkward creatures – they are despised but, at the same time, increasingly acknowledged as important. Multispecies entanglements are often like that: uncomfortable and including vulnerabilities, violence, and death (Ginn et al. 2014; Valtonen et al. 2020). Multispecies studies is an interdisciplinary field that has emerged in social sciences and humanities within the last decade (van Dooren et al. 2016). Multispecies studies highlight the multiple ways human lives are intertwined with the lives of other species and the contextually specific assemblages in which we live with others (van Dooren and Rose 2012). In line with Donna Haraway's (2016) relational ontology, multispecies studies aim to create modes of paying attention to others, practice arts of inclusion (Tsing 2015), and craft meaningful and benevolent responses for multispecies flourishing (Rose and van Dooren 2011). As a multispecies research practice, multispecies writing aims for research narratives that contribute to creating ways of living and crafting ethical responses (Kirksey and Helmreich 2010).

Multispecies studies draw from diverse disciplinary approaches and build on forming collaborative teams to combine complementary skills and expertise (van Dooren et al. 2016): biologists, social scientists, and humanists become "critical friends" to one another. This is still not always straightforward despite existing traditions and practices in interdisciplinary research. From the perspective of natural sciences, the research tradition in human and social sciences has been human-centered and is, as such, considered to be partly behind current eco-social crises. From the perspective of human sciences, natural sciences may lack an in-depth understanding of science-policy interfaces, the complexities of social and cultural systems, and the means for achieving cultural and behavioral changes. In natural sciences, fields such as community ecology have a long history. From that perspective, approaches such as multispecies studies may seem like rediscovery and re-labeling of existing traditions, whereas in human sciences, they may be seen as a radical step away from anthropocentrism. Openness to diverse methodologies, epistemologies, and ontologies and a shared concern for human and nonhuman life facilitates multispecies research.

We have addressed human-wasp cohabitance as a multispecies study, taking the perspectives of both the wasp and the human. While we aimed for a genuinely interdisciplinary research narrative, the different sub-studies and datasets are in different roles in the paper. Results from the ecological research have already been published in Komonen et al. (2020), Komonen and Torniainen (2022), and Torniainen and Komonen

(2021), and here they are referred to as secondary material. We also refer anecdotally to unpublished work, including questionnaires for high-school and university students, material obtained from a citizen science survey, and observations from collaboration with a pest management company[1]. The collaboration provided us with samples of wasp nests that would have been otherwise destroyed. Even though our research aims at responsible and peaceful human-wasp cohabitance, we acknowledge our research methods were not entirely nonviolent: wasps were captured and consequently killed in our study of wasp distribution. We do not discuss the topic of killing insects for science here; it has been discussed, e.g., in Torniainen and Komonen (2021) and Sumner and Hart (2019). Nevertheless, the question of killing is central in human-wasp relations, and it highlights multispecies entanglements' uncomfortable and contextual character, often involving violence and death (Ginn et al. 2014).

Media is in a key role in mediating human-nature relations and reproducing and creating attitudes towards nonhuman others. Furthermore, social media, for instance various thematic Facebook groups, have the potential for peer learning (Santaoja 2022). To tap into different perceptions of wasps and various means of human-wasp cohabitance, we analyzed Finnish news and social media content concerning wasps. We collected news articles on wasps from *Helsingin Sanomat*, the largest Finnish daily newspaper, for the period 2016–2019 (n = 46), and *Ilta-Sanomat*, a tabloid media and the most-read Finnish digital news media, for the period 2015–2019 (n = 56). The articles were collected from the digital archives using the keyword "wasp" (in Finnish, "ampiainen") and its derivatives. Wasps were featured in many sections of the media: domestic news, living, health, science, city, children's science questions, well-being, entertainment, history, and opinions. Part of the media analysis has been published in a Finnish-language article discussing the phenomenon of crocheted fake wasp nests to repel wasps (Santaoja 2021). Besides that, this paper reports previously unpublished observations from the media analysis.

To further analyze public attitudes towards wasps, we examined the contents of two social media groups: The bugs of Finland Facebook group (20,400 members in March 2022) and a Finnish Facebook group for people with anaphylactic allergies (620

1 We aimed to collect experiences from human-wasp encounters via a Webropol survey, but the outcomes of this citizen science part of our study were modest. There were simultaneously several ongoing citizen science projects in Finland regarding different insect species, which may have limited participation. We collaborated with a local pest management company so that they gave us a call when they were called for wasps, and we were able to observe their work on site, and collect samples of wasps and nests.

members). Both groups are private, and in striving for ethical research, we discuss the contents on a general level, avoiding any identification of the group members. The first author has been a member of both groups for several years. Although wasps are often discussed in gardening-related social media groups, these two groups were selected to examine the assumptions that people who are broadly interested in nature and "bugs" would have positive attitudes toward wasps (as suggested by Sumner et al. 2018). In contrast, people with severe allergies could be expected to express fear and hate toward wasps. Search for content on wasps for the period 2015–2019 resulted in 24 posts in the bugs group and 19 posts in the allergy group, with a varying number of comments. The groups are of very different sizes, and therefore, findings from the groups are neither comparable between one another nor representative of the views of amateur entomologists or people with allergies in general. Still, the content analysis revealed interesting characteristics in the group discussions on wasps.

The news and social media material were analyzed utilizing qualitative content analysis and thematic analysis (e.g., Smith 2000). Reading the material, we asked questions such as: How are wasps spoken of? In what kind of situations do humans and wasps meet? What kind of means have people developed to live with wasps? Our interest was not in quantifying, for instance, how much media content was negative or positive towards wasps. We aim at understanding and showing the diversity of responses and based on that, discuss means for developing response-ability in entangled human-wasp worlds. Based on the qualitative analysis, we organized the different responses toward wasps into four strategies for cohabitance: exterminating, repelling, inviting or relocating, and giving space. We provide examples of each from the rich media material. Our categorization is not exhaustive, but it highlights the multiplicity and messiness of human-wasp relations.

3 Wasp ecology affecting human-wasp encounters

In ecological terms, human-wasp encounters are primarily determined by the behavior, distribution, and abundance of humans and wasps. From the wasp's perspective, these factors are influenced by the distribution and abundance of resources (food and nest sites), environmental conditions (weather), and to a minor extent, interactions with other species, such as predators and parasitoids.

Wasp distribution determines which wasp species potentially come into contact with humans in a given area. In Finland, most wasp species have a nationwide distribution, but there are two important exceptions: the German wasp, *V. germanica,* and the

hornet, *Vespa crabro*. Both species have been expanding their range northwards over the past few decades, presumably due to global warming (Jantunen and Saarinen 2007; Sorvari 2018). Our study recorded the German wasp from central Finland for the first time (Komonen et al. 2020). The availability of nest sites largely determines the small-scale distribution of wasps in an area. For example, the German wasp seems particularly common in urban areas (Sorvari 2018), which increases the likelihood of human-wasp encounters, especially as the species' range expansion continues. Furthermore, flexibility in wasps' choice of nesting sites is manifested in the fact that diverse wasp communities occur in urban areas (Moller et al. 1991; Nadolski 2012; Komonen et al. 2020).

Wasp abundance is determined both by the number and size of colonies. The same factors that affect wasp distribution also affect their abundance. In urban areas, social wasp colonies may grow large due to favorable microclimate, abundant food, and spacious nesting sites in buildings, safe from predators or parasitoids (Nadolski 2012). Particularly, warm spring temperatures, often associated with global warming in the northern latitudes, have favored the German wasp (Sorvari 2018). Warming spring temperatures can advance wasp phenology (Tryjanowski et al. 2010), i.e., the overwintering queens may start a colony earlier, allowing the colonies to grow large and thus further increase the likelihood of human-wasp encounters. It should be noted that only the mated wasp queens overwinter, whereas the males and workers face death in the autumn. Moreover, the winter mortality of wasp queens is high (> 90%; Archer 2012), and the number of successfully overwintering queens largely determines the number of wasp colonies in the spring. Therefore, winter conditions can be equally important for wasp population size as summer conditions.

Our studies showed that wasp abundance varies significantly between urban gardens and woods (Komonen et al. 2020). The proximity of urban forests may increase the number of wasps in nearby gardens, as, depending on the species, their foraging distance from the nest is a few hundred meters (Archer 2012). Also, our studies showed great within-region variation in the colony size of the Saxon wasp, *Dolichovespula saxonica,* in bird nest boxes (Komonen and Torniainen 2022) and a broader variation in the colony sizes of the common wasp, *V. vulgaris,* and the median wasp, *Dolichovespula media* over Finland (Komonen unpublished). There was also evidence of year-to-year variation in the local abundance of wasps (ibid., see also Pawlikowski and Pawlikowski 2006; Lester et al. 2017). Our studies on the daily activity of *D. saxonica* and *V. vulgaris* revealed that the colonies are active already before sunrise and still after sunset, which in central Finland, in July, equals ca. 18 hours (Komonen and Torniainen 2022). We observed high among-colony variability in wasp activity linked with the colony size

(ibid.). In addition, because wasps are quite robust creatures and fly even in temperatures below 10C and under moderate rain, human-wasp encounters are likely to occur in various conditions. As a result of the high but spatiotemporally variable abundance of wasps, human-wasp encounters are hard to predict.

Wasp activity is linked to their foraging behavior. Wasps are commonly considered opportunistic generalist predators (Raveret Richter 2000). Especially *Vespula* species generally feed on carcasses and human-processed protein sources (Archer 2012). Wasps are also known to change their diet easily, allowing them to forage on humans' plates. However, our study offered novel insights into the varying food web positions and dietary segregation in the social wasp community and suggested specialization in diet resource utilization, especially between *Dolichovespula* and *Vespula* species (Torniainen and Komonen 2021). *Dolichovespula* species rarely use human-processed protein sources, and they seem to be more specialized in one or a few invertebrate taxa, which lessens their encounters with humans. Therefore, when encountering wasps in urban environments, accurate species identification could help to assess the likelihood of wasps interfering with humans. Wasps' colonial lifestyle and wasp foragers' ability to learn odors and landmarks means that the foragers return to the same foraging sites (Raveret Richter 2000). This behavior can increase human-wasp encounters if humans provide food sources, but it may also be used to relocate the wasps by providing them with food elsewhere.

It is difficult to design species-specific strategies for human-wasp encounters because the species identification skills of humans are generally relatively poor. People often mix wasps with other insects with similar black and yellow coloring. For example, the Hymenoptera *Urocerus gigas* (greater horntail, a sawfly), the Lepidoptera *Sesia apiformis* (the hornet moth), and the Diptera *Laphria flava* (the yellow robber fly) are often mixed with hornets. This was confirmed by citizen observations sent to us, and the same phenomenon was observed in the images posted in the Bugs of Finland Facebook group. We tested the identification skills of science-oriented high school students (n = 33) and first-year university biology students (n = 79) by showing them pictures of four species: *V. vulgaris* (the common wasp), *Sesia apiformis* (a moth), *Syrphus ribesii* (a hoverfly), and *Tenthredo scrophulariae* (a sawfly). 64% of the high school students and 92% of the university students were able to identify the vespine wasp correctly. While the students did reasonably well in the classroom test, wasps are more easily confused with other species out in nature. The misidentifications complicate human-wasp cohabitance as people mistake many species for wasps. However, as Sumner and Hart (2019) have observed in the context of the Big Wasp Survey in the UK, the public may become good at identifying wasps after a training session.

4 Wasp narratives in news and social media

Finnish media coverage on wasps followed wasp phenology, i.e., the yearly cycle of wasps. In May or June, there were forecast-type articles predicting insect numbers later in the summer, especially concerning mosquitoes, ticks, and wasps – all unloved species. These articles rehearse how to protect oneself against bothersome insects and what to do if you are bitten or stung, especially if being allergic. The next clear cluster of media coverage on wasps was in late July or August. That is when the nests of social wasps have reached their peak size, and human-wasp encounters are most common. For instance, in 2018, the warm spring and summer were especially favorable to wasps in Finland. This was reflected in abundant media coverage. The tone of news titles was negative overall: "aggressive" was repeated often. There are differences in the reporting style between the leading Finnish daily paper *Helsingin Sanomat* and the tabloid *Ilta-Sanomat*. The latter has more scandalous content, such as a story of a man who burned his garage attempting to destroy a wasps' nest or an incident where wasps attacked daycare children as they accidentally stumbled upon an underground nest. The tabloid has more "human interest" content, such as stories of famous people (singers, members of the parliament, etc.) who have been stung by wasps and taken into hospital. But upon closer reading, the media image of wasps is more diverse than the headlines suggest.

Engagement with fictional, personal, and cultural narratives has the potential to encourage environmental awareness that may help craft more equitable and considerate means for multispecies living (James 2015). An interesting counternarrative to "aggressive wasps" was "wasps in an existential crisis," introduced by an interviewed entomologist in *Helsingin Sanomat* in July 2016. The article provided information on wasp ecology in explaining "aggressive" wasp behavior. In the late summer, there are fewer insects to feed the wasp larvae and fewer flowers, meaning less nectar for the workers. It was explained how wasps might experience stress and seek food more eagerly from human sources. When the new queens and drones leave the nest to mate, the worker wasps feeding them lose the meaning of their lives. That is why they may wander around aimlessly – or, as often interpreted, "aggressively." The narrative of wasps in an existential crisis was picked up and repeated in the media in the following years. In later iterations, wasps were described as desperate or unemployed[2]. The narrative allows finding parallels between wasps and humans, recognizing shared precariousness

2 Sumner (2020) has named the same phenomenon as wasps being furloughed.

and vulnerability in the face of environmental crisis. It may allow reacting to the "aggressive" wasp behavior with compassion.

Our data-driven analysis of Finnish media on wasps does not fully support Sumner et al. (2018) claim that wasps are portrayed solely negatively in the media. On a closer look, the representations and perceptions of wasps were diverse. There may be cultural differences in the perceptions and media reporting styles between UK and Finland. In the Finnish press, wasps were not represented as annoying and useless creatures or as important and fascinating parts of the web of life, but both-and: wasps are often portrayed as annoying *and* important – as awkward creatures. The media articles convey messy and contextual multispecies ethics (Ginn et al. 2014). Wasps were mentioned several times in the context of the "insect apocalypse," alongside bees and other, generally more loved insects, but the human-wasp relations are ambiguous. Along with tips for homemade traps to kill wasps, media reports attitudes such as "we have understood that the plants and the world need wasps" or "wasps are actually quite sympathetic creatures and nice to observe."

Similarly, diverse attitudes toward wasps were found in the social media groups. Peer learning in social media may facilitate changing perceptions on wasps, but it may also reinforce existing biases. The Bugs of Finland group aims to share knowledge on insects, help in species identification, and learn about insect ecology. The group rules specify that the group is not for sharing information on how to exterminate insects or to be used as group therapy for insect phobia. Furthermore, the rules state that there are no "good and bad" bugs, and all insects have their place in nature. Despite the rules, some group members expressed opinions such as "I love all bugs except wasps." The European hornet was often discussed as it catches attention because of its size. The question was often whether the species is more aggressive or poisonous than "regular" wasps. People asked for advice on removing wasp nests against the group rules, leading to disagreements between the group members.

Much of the wasp-related discussion in the Bugs of Finland group concerned stinging. Some members thought getting stung by a wasp was the human's fault – one should behave calmly in the presence of wasps. Others contemplated that wasps have personalities, too, and can be in a bad mood. The members speculated that a person afraid of wasps might secrete adrenaline when encountering a wasp. The wasp could interpret it as aggression, leading to self-defense. To our knowledge, there is no research on the subject, but wasps have a keen sense of smell. The interpretation was, however, countered in the group by experiences of a wasp stinging before the person had even noticed its presence. Clinically justified instructions on how to treat a wasp

sting in case of allergy were shared, but also a diversity of traditional remedies for less severe symptoms, such as rubbing a sugar cube, vinegar, or garlic on the sting. The human-wasp encounters are very corporeal. Even without knowing the exact chemistry involved, it is safe to say they are intra-active (Barad 2007): movements, odors, and other bodily cues influence the wasp-human encounters, constructing situated multispecies agency.

In the Facebook group for severely allergic people, we expected to find expressions of hate towards wasps. Surprisingly, there were only a couple of such mentions. One group member said they had made a hobby of killing wasps with an electric racket. More than hate, there were expressions of fear and frustration, especially during busy wasp summers. Some group members had had several anaphylactic reactions from wasp stings the same summer and felt exhausted and depressed. A wasp sting is always unexpected, regardless of how well the person is prepared, which causes alertness in the presence of wasps. At the same time, the group members allergic to wasps considered themselves fortunate for knowing the cause of anaphylaxis and, thus, being able to be prepared, which is not always the case with severe allergies. In the group, the life-threatening topic was also dealt with humor and lightness. For instance, the group members joked about buying new sports shoes to be able to run faster from wasps. It was emphasized that one should not let the allergy limit life too much. The members exchanged experiences of immunotherapy and treatment received in healthcare in case of anaphylaxis. Like in the Bugs of Finland group, the members speculated how wasps might smell fear and sting allergic persons more often than others. This was also turned humorously upside down: "we are so sweet that they go after us."

It was surprising that in the bug enthusiasts' group, more negative attitudes towards wasps were expressed than in the allergy group. The group size may explain the difference: among the 20,000 members, there is diversity in opinions. The seemingly more positive tone in the allergic persons' group could also be because people severely allergic to wasp venom have had to process their relationship with wasps further, arriving at a conclusion to "live and let live." Allergy is not in human control, which may increase understanding that nature, more broadly, is not under human control. Severe allergy is a precarious and vulnerable condition, and the increase in allergies is connected to environmental changes and loss of biodiversity in multiple ways not completely understood yet (Hanski et al. 2012). Coming to terms with shared multispecies vulnerability may allow contextual strategies for cohabitance that are messy and caring and sometimes include violence.

5 Territorial strategies for living with wasps

The media and social media material we analyzed showed human innovativeness in developing different strategies for living with wasps. Valtonen et al. (2020) studied living with another unloved species, the mosquito, in the Finnish Lapland. Following Puig de la Bellacasa (2017), they describe multispecies care as negotiating an appropriate distance to the other. Human-wasp cohabitance involves negotiating the boundaries of human and wasp territories. The four territorial strategies we identified form a continuum regarding the distance considered appropriate between the species, and they suggest different response-abilities in human-wasp encounters.

5.1 Exterminating

Figure 1. Wasp nests can be removed from camping sites in National Parks if they pose a threat to visitors. Image: JT.

In the media, citizens and interviewed experts offered tips on getting rid of wasps permanently. These strategies included destroying the wasp nest or, if the nest is not located, killing individuals in places where wasps are not wanted. Professional pest controllers are called when the nest is especially big or not easily accessible (Fig. 1). In 2018, when wasps were especially abundant in Finland, pest controllers removed multiple times more wasp nests than in an average summer and could not even respond to all requests. In 2019 and 2020, when we observed the work at a pest control company, wasp populations were at their lows. There were twenty-three calls for intervention during the observation period - much fewer than in a typical summer. Six of the calls for exterminating a wasp nest came from schools. Regarding the species, in twelve cases, it was the common wasp *V. vulgaris*. In one case, the species was the red wasp *Vespula rufa*, in eight cases, the Saxon wasp *D. saxonica*, and in two cases, the median wasp *Dolichovespula media*. There were also several cases when the insects were misidentified as wasps and turned out to be tree bumblebees (*Bombus hypnorum*). These were exterminated nevertheless per the customer's request; this way, the desire to get rid of wasps may also harm other species. On the exterminator companies' web pages, there are misidentified images of species, which raises questions about their skills to identify the species correctly.

Usually, the desire to get rid of wasps rises late in the summer when the colony has grown large and is perceived to cause disturbance to humans. In the media, experts emphasized it would be better to exterminate the nests when they are small or, better yet, to kill the queen in the spring before it has produced any offspring. Killing one individual may sound easier, more efficient, and more ethical than exterminating a whole colony. From a biological perspective, however, destroying the queen or destroying a whole nest before it has produced any offspring is equally disastrous, as it prevents the queen from producing the next generation. Also, it should be noticed that removing a nest rarely destroys all or even most wasp workers, which are then left swarming around the destroyed nest and might become even more bothersome to humans than if left alone.

Indicating the popularity of the extermination strategy, record sales of household insecticides were reported in Finland in 2018. Insecticides are not used only against wasps, but during the busy wasp summer, they were employed in attempts to destroy wasps' nests. Media also offered various do-it-yourself instructions on wasp traps built from plastic bottles, rags, water buckets, etc. Some were reported to be highly efficient in getting rid of wasps. These news articles often sparked hundreds of readers' comments, the majority questioning the extermination of wasps in large numbers. The

extermination strategy does not tolerate the overlap of human and wasp territories. Killing may be a contextually justified response if the wasps pose a danger to children or allergic people or if they nest in a place frequently occupied by humans, thus posing an elevated risk of confrontation. However, the critical comments on the extermination tips allow questioning the normalized practices of violence, and the debate provides opportunities for learning and developing new response-abilities.

5.2 Repelling

Figure 2. Crocheted decoy wasp nest to prevent wasps from building a nest. Image: MS.

Another way to negotiate an appropriate human-wasp distance is to repel the wasps or prevent them from entering human dwellings. This may mean installing nets in windows and doors and sealing cracks and seams where the wasps might enter. While these methods are likely to work in drawing a territorial boundary, there was a range of other methods people have experimented with. Many wasp repelling methods mentioned in the news or social media relied on wasps' sense of smell. Odors that wasps do not like, in people's experience, include coriander, vinegar, peppermint, turpentine, and pine soap. Frying onions supposedly repels wasps, and one person mentioned placing copper coins close to wasps' passage with a successful repelling effect. Repelling methods supposedly based on wasps' other senses included water bags and fake nests. Transparent plastic bags were filled with water and hung in places where wasps were not wanted, such as on a terrace. The reflection of light in the water was claimed to disorient wasps and keep them away. Another method was hanging fake (decoy) wasp nests in spring before the queens choose their nest site (Fig. 2). The method assumes that wasps are territorial and do not build a nest where there already is one. Fake nests imitating a ball-shaped grey wasp nest, made of paper or clay, can be bought in gardening stores. In the Finnish media, instructions on how to easily make a fake nest from a coffee filter were shared, but in 2016, crocheted fake wasp nests became popular (Santaoja 2021).

In the media, entomologists were asked to comment on these repelling methods, and they debunked the water bags and fake wasp nests as urban legends. The experts said artificial decoy nests would not fool wasps; if anything, the repelling effect could be based on the smell of wool or newspaper or the movement of a fake nest if it was not steadily attached. Furthermore, the entomologists stated that wasps are not territorial as the method assumes. While the fake nests convinced many people, others posted images where wasps had constructed their nest next to or even directly on an old or fake nest. However, from the perspective of multispecies ethics and cohabitance, people's willingness to try these methods instead of lethal ones is more interesting than whether the repelling methods actually work. It signifies a willingness to stay with the trouble (Haraway 2016) instead of looking for clear-cut, simple solutions for an appropriate distance. Despite experts debunking the fake wasp nests, they remain popular. Making a crocheted fake nest requires some time and effort. It may allow for cultivating multispecies imagination and developing intimacy without proximity (ibid.), and as such, it could be used to alleviate wasp fear. The fake wasp nests – sometimes fake wasps attached – were called "a cute summer handcraft" and "a nice present to give." This implies a notable change in wasp representations, although wasps and bees are often mixed also in this context.

5.3 Inviting/Relocating

Figure 3. A "wasp bar" containing beer, sugar, and yeast is used to attract wasps away from human dwellings and in research for trapping wasps. Image: AK.

Territorial human-wasp negotiations do not always involve drawing a strict boundary between *our* and *their* territories. Interviewed entomologists promoted the strategy of inviting or relocating wasps in the media. The aim is not to repel wasps from human territory but to accept space–sharing at an appropriate distance. With growing concern over pollinators, various means to help them, such as insect hotels, have become popular. While such solutions are more of a gesture than a strategy for conserving pollinators,

they acknowledge the intertwining of human and insect lives. Interviewed entomologists reminded that a wasp nest in a garden equals a pair of birds preying on pest insects. Social wasps do not benefit from insect hotels, but solitary wasps might, which could provide opportunities for humans to observe them. For social wasps, similar nest boxes as for birds may be provided. As our studies showed, bird nest boxes are readily used by the Saxon wasp *D. saxonica*.

An invitation that benefits insects, including social wasps, is to plant fragrant flowers in the garden, providing nectar for wasps to eat. If wasps invade human tables, a proven strategy is to provide them an "insect bar" to relocate them somewhere where human-wasp encounters are less inconvenient. (Fig. 3) When wasps are still feeding their larvae, scraps of animal protein food may be offered for certain wasp species. In the late summer, adult wasps prefer sweet fruits or honey. Thus, as with the other strategies, relocation works best when some knowledge of wasp biology is available.

A strict territorial line is usually drawn between indoor and outdoor spaces: indoor spaces are human territory, whereas outdoor spaces may be shared with wasps. Under the relocation strategy, different means of capturing and carrying the wasps away were mentioned in the media. A common method is to place a glass on top of the wasp, slip a postcard under it, and carry it out. The most fearless humans carry wasps out with their bare hands. This is also facilitated by ecological knowledge: if the wasp is identified as male, there is no danger of sting.

5.4 Giving space

The previous territorial strategies were anthropocentric, prioritizing human uses of space. However, many such strategies were mentioned in the media that involve humans adapting their behavior and giving space to wasps. Suggestions included not wearing perfume as it might attract wasps, wearing dull-colored clothing with long sleeves, and avoiding walking barefoot on the grass. Food and drinks should be covered outdoors not to attract wasps. For instance, during the busiest wasp season, berries may be picked before sunrise or after sunset to avoid wasp encounters; however, stumbling on a wasp nest initiates a defensive reaction even in the dark hours. While picking apples, a suggested strategy was to work slowly and respectfully and not wave hands – although waving was recommended if there was a danger a wasp might sting in the face, as in hand, the sting would be less dangerous. An interviewed entomologist commented that wasps might be interested in the smell of food in human breath, so a good strategy would be to close the mouth, hold the breath, and take a few steps back. The

wasp might go away as the smell disappears. Some people had learned to recognize wasp buzz – especially the larger hornet's buzz was recognizable to many – so they knew when a wasp was flying nearby and could take evasive measures. The examples highlight the intra-active corporeality of human-wasp encounters. While there might be no time for reflecting on different strategies in the instantaneous encounters, reflecting on human-wasp relations without immediate proximity may strengthen response-ability – reacting in the encounters in a way that supports multispecies flourishing.

In giving space to wasps, humans have avoided using spaces where a wasp colony has built its nest. People have also placed warning signs next to wasp nests encountered in the ground in recreational areas, so others would know to keep away. (Fig. 4) Putting up warning signs is aimed at not only protecting humans from harm but also the wasps.

Figure 4. A sign saying "Warning! A wasp nest underground" placed to avoid wasp-human encounters. Image: AK.

6 Conclusions

We set out to explore what features of wasp biology affect human-wasp encounters and how the conflicted human-wasp relations could be mitigated by developing response-ability to unloved others. Insects are often perceived as the ultimate other among the animal kingdom, and unloved species such as wasps are placed at the bottom of the hierarchy. However, as our studies on wasp biology showed, wasps are in many ways like us. Human and wasp habitats overlap ubiquitously. Wasps are highly flexible regarding their nest sites, active from dawn to dusk like us, and even the preferred wasp food – sugars and meat – overlap with human food. These features, combined with changing wasp distribution and abundance due to anthropogenic environmental changes, increase the likelihood of human-wasp encounters. Knowledge of wasp ecology may allow understanding wasp behavior better, develop tolerant strategies for cohabitance, and adjust human behavior in the presence of wasps. Knowledge alone is probably not enough to develop responsible practices for human-wasp flourishing. The value-action gap in pro-environmental behavior is well-established – humans do not always act on their best knowledge. One way of bridging the gap might be involving people in citizen science (Sumner and Hart 2019).

Recently, the widespread concern for insects, especially pollinators, has been rising, and the ecological importance of wasps is also becoming better understood due to research. We are somewhat reluctant to emphasize the ecosystem services provided by wasps, as we think wasps have a right to life regardless of their utility to humans. Still, emphasizing the ecological functions of wasps, e.g., pest control and pollination, may be necessary for reformulating human-wasp relations and increasing the appreciation of wasps. However, the ecological importance of wasps does not remove the justified concerns involved in human-wasp encounters. Wasps are feared and disliked because of their painful sting, which may be dangerous for allergic persons. The possibility of a severe allergic reaction reveals human vulnerability. Not being in control over nature and one's life may induce fear, manifesting in aggression and violent practices towards wasps. But wasps are like us also in their vulnerability, and understanding this shared precarious condition may strengthen our response-ability towards wasps.

In human-animal relations, shared experiences with the other are expected to increase understanding and develop empathy toward the other. Human-wasp encounters are profoundly corporeal, intra-active tuning into the other's movements, sounds, and odors. Strategies of cohabitance may be based on this corporeality, such as learning to distinguish the wasp buzz. With unloved species such as wasps, when direct

contact is preferably avoided, developing multispecies ethics on first-hand experience is difficult. However, there are means for cultivating intimacy without proximity (Haraway 2016), maintaining an appropriate distance. Media, literature, and other arts are important in creating representations of the other. A powerful example in our media material was the narrative of wasps in an existential crisis. Being able to interpret wasp "aggression" through the lens of them losing the meaning of their lives allows drawing parallels to our human condition without excessive anthropomorphism. Another means of intimacy without proximity can be crocheting a fake wasp nest. While the decoy nest might not stop the wasp queen from building a nest, making it offers an opportunity for reflecting on the lifeworld of wasps. At best, it signifies a playful manifestation for peaceful human-wasp cohabitance.

While we focused here on human-wasp relations, our initial thought was that wasps could also serve as a proxy for developing response-ability to other unloved species. Some general methods and guidelines may be surely developed, but one key conclusion of our study is the contextuality and situatedness of human-wasp encounters. Parallels between living with different species should not be drawn too quickly. Media articles often bundle unloved species such as wasps, ticks, and mosquitoes, but there are significant differences between living with wasps and living with mosquitoes. Mosquitoes use human blood as food and are actively attracted to humans, but mosquito bite is not interpreted as aggression. Mosquitoes may cause an anaphylactic reaction in some rare cases, but in general, in the boreal region, a mosquito bite is unpleasant rather than dangerous. However, living with mosquitoes is entirely different in places where mosquitoes regularly spread malaria and other contagious diseases (e.g., Richter 2003). In the same way, the question of living with wasps is very different from Finland in places where wasps are invasive species causing significant harm. Human-wasp encounters are also species-specific as wasp species differ in, e.g., their preferred food or nesting site. However, developing species-specific strategies for cohabitance is difficult, as people commonly confuse wasps with other similarly colored insects.

We believe our interdisciplinary analysis has provided tools for developing response-ability toward wasps. We have shown the diversity in human-wasp relations and the potential of different narratives for reconfiguring human-wasp relations. Although we believe scientific knowledge and media have the power to change the cultural narratives on wasps, our study was not able to show whether the new narratives can change human behavior. For this, a different setup would be required.

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