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On the untapped potential of people passive exposure to invasive forest pests through mainstream media

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On the untapped potential of people passive exposure to invasive forest pests through mainstream media

Abstract. Invasive forest pests are often first detected in urban forests, making these environments strategic for early warning and global forest protection efforts. Although early detection is crucial to the success of eradication measures, the surveillance capacity of official authorities is limited. Citizen science can help bridge this gap — provided that citizens are aware of the stakes and prepared to play an active role. In this context, mainstream media may serve as a key channel to raise public awareness. We surveyed mainstream media coverage of 14 native, exotic, and quarantine forest pests across 15 European countries. Our findings reveal a consistent background level of media attention to forest pest issues. While quarantine species are mentioned less frequently than native pests, they are more likely to be covered in countries where they have occurred, remain present, or have been eradicated. Interestingly, we also found references to quarantine pests in countries where they are not officially reported. Altogether, our exploratory research highlights the significant potential of mainstream media to attract public attention to forest health issues—an opportunity that should be more systematically leveraged to support early detection and citizen engagement.

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Introduction

Over the last decade, an accrual of scientific articles documented the wide array of ecological services provided by trees in urban environments. Motivated by the need to alleviate the urban heat island effect, improve air quality, enhance biodiversity and provide restorative and recreational areas for city dwellers, tree planting initiatives have bloomed in cities worldwide (FAO 2018, Sousa-Silva et al. 2023). Surveys conducted in large cities found that, generally speaking, the public is aware of and values ecosystem services provided by urban trees (Ordóñez Barona et al. 2022, Moffat et al. 2024). Cities therefore have the potential to become greener, for the need and good of people living there. However, only healthy trees can sustainably provide such services, which should be a concern for green space managers, elective representatives and the general public. Whereas professionals have an appreciable knowledge of what makes the urban forest vulnerable (Raum et al. 2024), the awareness of the general public still needs to be assessed (Marzano et al. 2016).

Extreme heat or drought are common in urban environments, which can weaken trees. Equally, attacks by pest insects can result in trees that convey disservices and may even represent a direct risk, for people that can be hit by falling branches or trunks, for urban forest ecosystems as a whole, and forests in the surrounding environment (Paap et al. 2017, Roman et al. 2021, Raum et al. 2023). For instance, the detection of species regarded as union quarantine pests and priority pests according to EU Regulations (EU) 2019/2072 and (EU) 2019/1702 and in any European Union Member state triggers extreme eradication measures such as the removal of every susceptible tree in circular buffers around any tree on which the pest was observed. Successful eradication is possible, should the early detection of quarantine and pest insects be reported to the authorities, enabling quick response (Tobin et al. 2014). This requires public awareness of pest insects and associated risk, as well as acceptance of preventive and control measures (EPPO 2019).

The urban forest is particularly vulnerable to emerging and invasive pest species, for several reasons. First, the urban environment exacerbates abiotic stresses trees are exposed to, which weakens them and, in turn, makes them more prone to attacks by pest insects (Tabassum et al. 2024). Second, the species richness of trees is generally higher in cities than in surrounding forests, thus providing greater opportunities for exotic pests to find suitable hosts and get established in urban environments (Hutt-Taylor and Ziter 2022, Augustinus et al. 2024).

Finally, the concentration of the human population and transport infrastructures generates intense commercial exchanges that increase the probability of introduction of invasive pests in cities (Paap et al. 2017, Branco et al. 2019). City dwellers can therefore contribute, along with green space managers, to surveying and maintaining the health of the urban forest.

There is mounting evidence that the general public can play a great role in the early detection of emerging and invasive pest insects (de Groot et al. 2023). Invasive pests are often found by the general public before formal surveillance schemes (Epanchin-Niell et al. 2021, Epanchin-Niell and Pi 2024), in particular through biodiversity oriented citizen science initiatives (González-Moreno et al. 2025). However, sharing observations of insect herbivores on online platforms does not necessarily imply neither knowledge of the risk nor awareness of the necessary control measures the observation may trigger. Traditional media may play this role by exposing the public to information regarding pests and to what is at stake for forests. In this exploratory research, we asked a single question: *Is the general public prepared to contribute to early detection of quarantine priority pest insects in Europe*? We addressed this question by surveying public passive exposure to media content related to pest insects — including quarantine pests and non-quarantine pests as controls — in national and local media at European scale, with a particular focus on the largest cities in Europe. By doing so, we aim to unravel patterns of attention and identify gaps in communication that citizen science or public engagement projects might help fill.

Materials and methods

We focused on the pest insect species recommended for regulation as defined by Regulation (EU) 2019/1702 of 1 August 2019 as so-called priority pests to which we added non-regulated species as a control (Table S1). Control species included both invasive alien species already established within European Union boundaries and native pests having outbreaks in recent years in several European countries. We referred to regulated and non-regulated species as candidate species.

The last two weeks of October 2024 (save for Sweden which we included in the survey in early April 2025), we searched for references of candidate species (both scientific name, common name and synonyms, Table S1) in three types of media in each country: newspapers, TV, radio. For each media, we targeted the one with the largest audience (using national sources) considering the number of

printed copies as a proxy of the audience of national newspapers. Where appropriate, we also considered the most popular local newspaper edited in the region where our institution is located. We conducted the same search on the website of the five cities with the largest number of inhabitants in each country. We considered the number of outputs as a proxy of people's exposure to information to each pest insect. We filtered irrelevant outputs based on their title. We considered any mention as promoting people awareness through passive exposure to candidate species.

In April 2025, we interrogated the EPPO global database (https://gd.eppo.int/), searching for occurrence data for selected quarantine pests in each country. We defined pest status as present (P), absent (A), or eradicated (E). Eradication implies that the species has been observed and that appropriate measures were taken. Although this would result in an absence status, we subsequently merged *presence* and *eradicated* statuses into a single category (P/E). When no record was found in the EPPO database, we considered the species to be absent. We additionally searched the date of the first report of each quarantine pest in the EPPO database. Although *Ips typographus* and *Thaumetopoea processionea* are native to Europe, they are regulated pests in the British islands. We included first reports of these two species in the UK and Ireland in the analysis. We also added information on *Corythucha arcuata* for the spread of this species since its introduction to Europe has been well documented (Csóka et al. 2020).

We modeled the number of mentions of a candidate species in mainstream media as a function of pest status (present/absence) using generalized mixed-effect models (GLMM) in a two-steps approach. We first modeled the probability of a candidate species to be mentioned in the media using a GLM with binomial error distribution where the binomial data were coded as "yes" (the pest was reported at least once in a given medium and country) or "no" (no report). Then, we modeled the number of articles related to a given pest among sources that had reported information on the pest at least once in a given medium and country. In this case, we used a GLMM with a Poisson error distribution. In each GLMM, we declared candidate species, medium and country as crossed random factors. We ran models with the function *glmmTMB* in library *glmmTMB* and checked for appropriate residual distribution with functions provided on the package *DHARMa* (Hartig 2016, Brooks et al. 2017).

Results

The analysis of raw occurrences of candidate species names (whether scientific

names or common names) in media outcomes across 15 European countries reveals that European residents are exposed to information content dealing with forest pests (Figure 1).

Ips typographus was the pest that received the most attention (n = 1,4496 outpouts), followed by *Lymantria dispar* (n = 486) and *Thaumetopoea processionea* (n = 482). These three species are native to Europe. Among quarantine pests, *Anoplophora glabripennis* and *A. chinensis*, *Popillia japonica* and *Agrilus planipennis* received the most attention (Figure 2). The conifer defoliator *Dendrolimus sibiricus* was only found to be mentioned in media in Finland and Northern Ireland (Figure 1), yet, none of these two countries are bordering the current range of this pest in Europe. None of the quarantine pests included in the survey was mentioned in Romania, despite the fact that media coverage for other candidate species was comparable in Romania and other countries.

As for quarantine pests, there was no particular relationship between the year of first occurrence in the EPPO database and the year of first mention in national medias (Figure 3): in six instances media coverage occurred after the first introduction was reported to EPPO, in six instances the opposite occurred, and in four occurrences mention in the media and EPPO database occurred the same year.

In almost every country, mainstream media reported information on native and already established pest species. There were less occurrences of outcomes related to quarantine pests (Figure 1). Both the probability of reporting information on tree pests (Figure 4A, Table 1) and the number of media releases referring to a tree pest (Figure 4B, Table 1) were on average larger when the pest was present in an European country or had been present and then eradicated. In addition, the difference in media coverage between pests that are present or not in a given country was influenced by the biological status of the pest (*i.e.* significant *Status* × *Presence* interaction, Table 1). Specifically, the greater coverage of topics related to tree pests that were present in a given country was exacerbated for native emerging pests (Figure 4). Despite these differences, it is noticeable that *Dendrolimus sibiricus*, *Agrilus planipennis* and *Agrilus anxius* were mentioned in some media whereas they had never been observed with EU boundaries.

Discussion

We found that in almost every country included in our study, mainstream media

reported information on native and already established pest species and, to a lower extent, on quarantine species.

Background coverage of pest-related issues in mainstream media is encouraging in several regards. First, it is primarily indicative of a general interest for pest-related issues. Second, several studies reported that receiving information on the environment and associated threats to human and non-human organisms has the potential to trigger pro-environmental behaviours (Holbert et al. 2003, Hong et al. 2019, Awan et al. 2022, Meng et al. 2023). Finally, it is increasingly well established that the general public may play a significant role in the early detection of non-native invasive and quarantine pest, thus complementing surveillance schemes (Epanchin-Niell et al. 2021, Epanchin-Niell and Pi 2024, González-Moreno et al. 2025). These considerations and our results thus converge towards the idea that the European population is partially prepared to play an active role in monitoring forest pests. Still, this potential can be better exploited.

Despite their greater potential harm to forests, quarantine species received less attention than native expanding or invasive species. A likely explanation for such a difference would be that media attention is primarily attracted to what makes "news" and may catch the public attention. Pest outbreaks responsible for massive tree mortality and economical loss are therefore expected to attract a large audience, as well as outbreaks of species that represent a real (processionary moths) or perceived (oak lace bug) risk for people. On the contrary, quarantine species are, by definition, not expected to be found in European countries. An intuitive expectation would be that they only attract media attention when their detection triggers eradication measures. Following this idea, we would expect a greater probability of occurrence and greater number of media outcomes referring to quarantine pests in those countries where they were detected and possibly eradicated. Our data partially support this view, as the probability of mention of a pest in mainstream media was higher in countries where the pest has been officially reported as being present by EPPO (Table 1). Still, in a third of the study cases we examined, the pest was mentioned in mainstream media before it was considered as being present in the country.

We refrained from commenting on potential differences in media coverage among countries, for these differences could have arisen from methodological aspects of the study (e.g., uneven accessibility to primary data). However, differences among pests are insightful. The three species that received the most attention (*I. typographus*, *L. dispar* and *T. processionea*) are all native to Europe. Together, they represented 92% of media outputs. These three species are major outbreaking

forest pests, but only outbreaks of *Ips typographus* triggers extreme management measures such as salvage logging. *Thaumetopea processionea* is mostly cited in reference to its urticating character and the harm it causes to humans, pets and cattle. The conifer defoliator *Dendrolimus sibiricus* was only found to be mentioned in media in Finland and Northern Ireland (Figure 1), yet, none of these two countries are bordering the current range of this pest in Europe. None of the quarantine pests included in the survey was mentioned in Romania, despite the fact that media coverage for other candidate species was comparable in Romania and other countries.

Our exploratory study highlights the potential role of mainstream media in raising awareness about pest-related issues, which can potentially foster pro-environmental behaviors and enhance the probability of detection and report of quarantine pests by the public. However, future research should explore strategies to increase media coverage of quarantine species, ensuring that the public is well-informed and prepared to contribute effectively to pest management efforts.

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CrediTs

Conceptualization: BC, MdG; Investigation: All; Analyses: BC; Funding acquisition: MdG, JW; Original draft preparation: BC; Writing: All.

Data availability

Raw data along with R codes used to analyse them are provided as supplementary material.

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Figures and tables

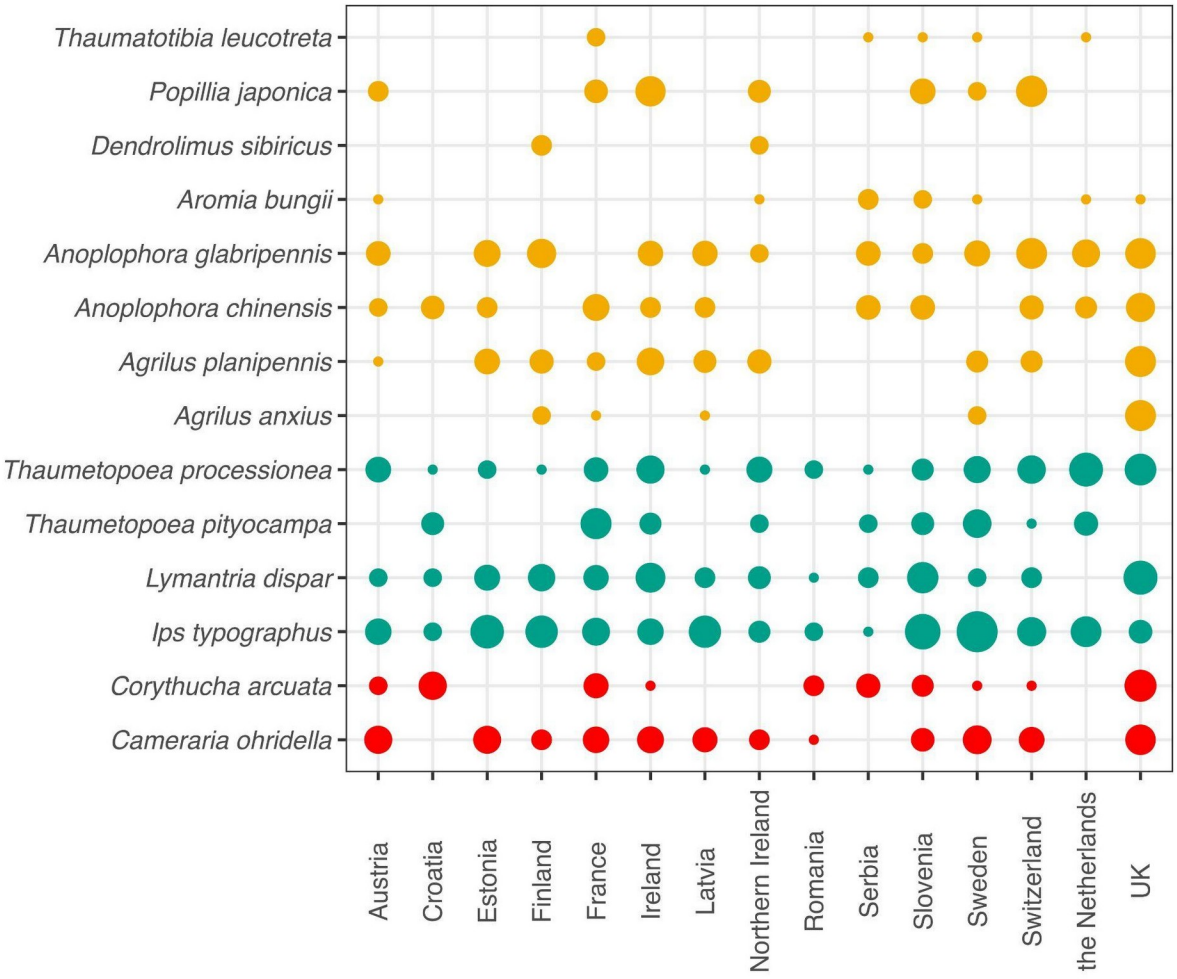


Figure 1: Total number of mentions of pest species in mainstream media. Dots represent the number of media outputs mentioning each pest species in each country. We used a log-scale to compensate for the disproportionate number of media outputs referring to *Ips typographus* in Swedish media. Because the sampling effort differed among countries, differences in dot size are only meaningful when compared within countries. Orange, green and red dots represent quarantine, native expanding and invasive pests, respectively.

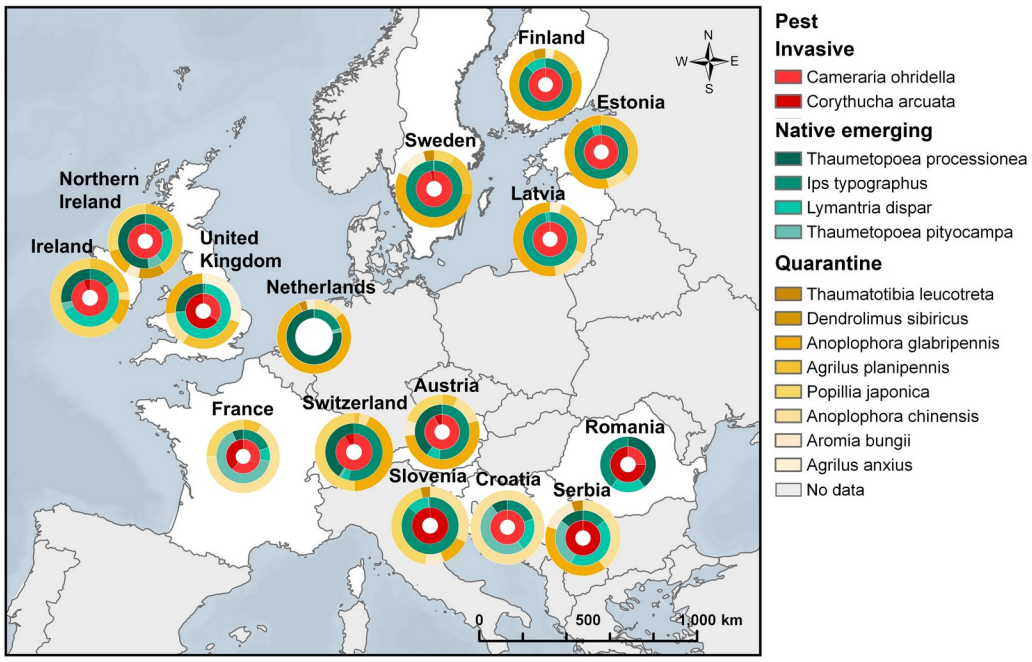
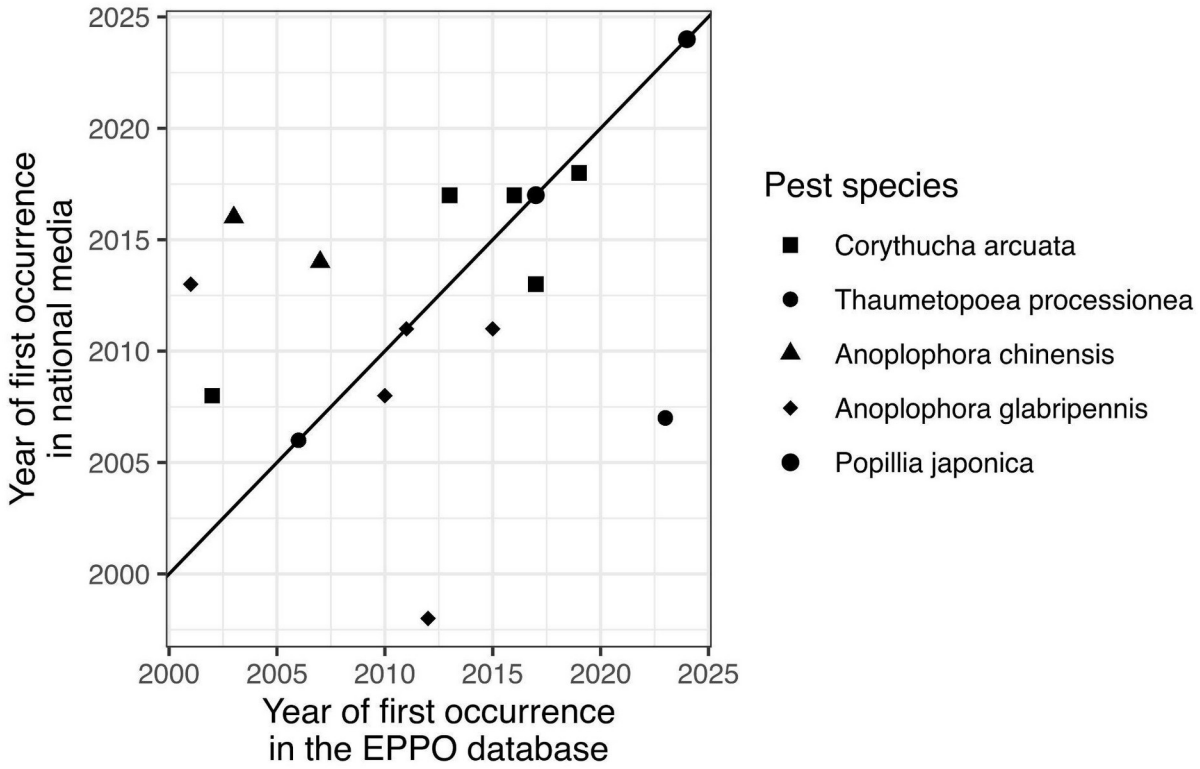


Figure 2. Relative media coverage per pest and country (%). Each concentric ring represent pests of a given status (quarantine, invasive or native emerging). Bar areas are proportional to the the percentage of media release with mention of a particular pest in each country, relative to pest status.

399



400

401 **Figure 3.** Relationship between the year of first occurrence of a quarantine pest in a country
402 according to the EPPO database and the year of first mention in national media. Source:
403 https://gd.eppo.int/, search on April 22nd, 2025.

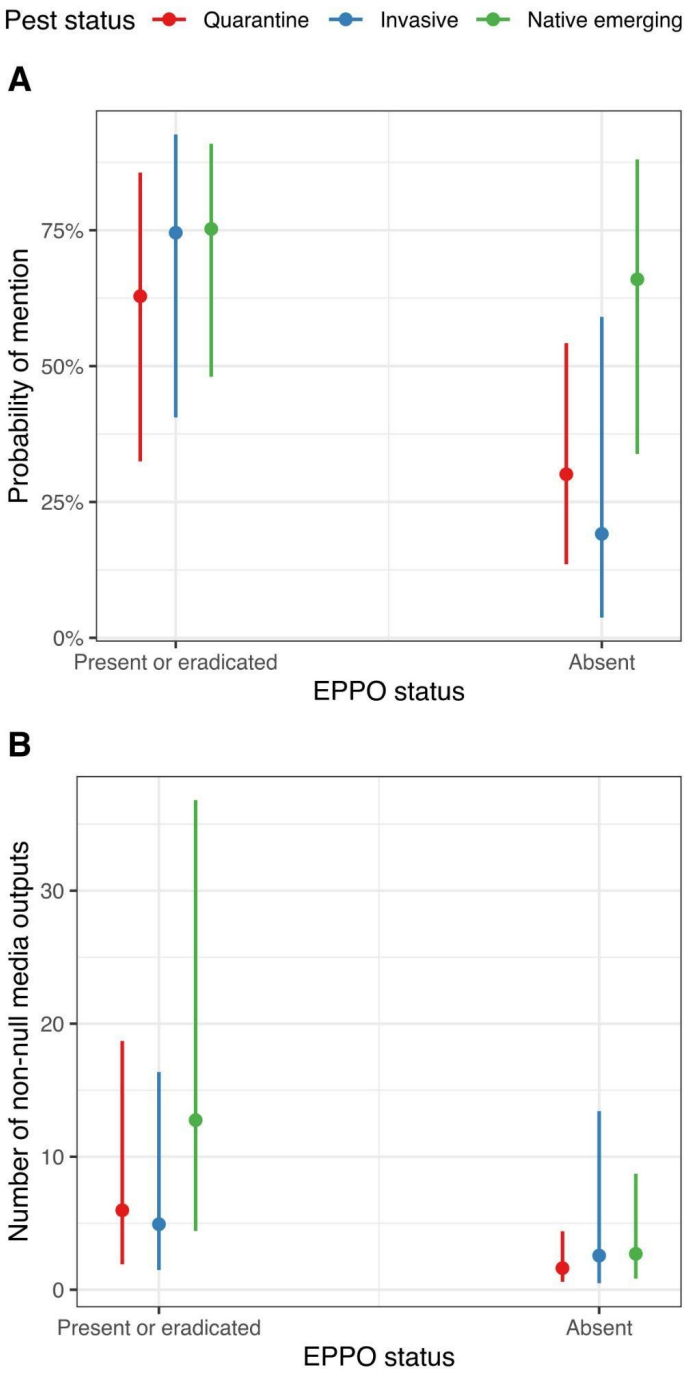


Figure 4. Probability of occurrence of information on tree pests (a) and number of media outcomes (b) in mainstream media according to pest status and present and past occurrence in surveyed countries. Colours of dots and lines refer to the pest status in the EPPO database. Dots and error bars represent model predictions and confidence intervals, respectively.

Table S1. List of candidate species included in the survey. Scientific names as well as common names in local languages are given. Pest status is indicated following the scientific name (q: quarantine pest, ne: native or emerging pest, i: invasive pest). Click to access to the table.

Species	Group	English	French	German	Dutch	Slovene	Finnish	Serbian	Croatian	Romanian	Latvian	Estonian
Agrilus anxius (q)	Coleoptera	bronze birch borer	Agrile du bouleau, Perceur doré du bouleau	Bronzefarbener Birkenprachtkäfer	amerikaanse berkenprachtkever	brezov krasnik	pronssijalosoukko	Bronzani brezin krasac	brezov krasnik	no romanian name	no latvian name	no estonian name
Agrilus planipennis (q)	Coleoptera	Emerald ash borer	Agrile du frêne	Asiatischer Eschenprachtkäfer	aziatische essenprachtkever	jesenov krasnik	saarnenjalosoukko	Smaragdni jasenov krasac	jasenov krasnik	sfredelitorul frasinului	Ošu smaragzaļā krāšņvabole	saare-salehundlane
Anoplophora chinensis (q)	Coleoptera	Citrus long-horned beetle, Citrus longhorn	Capricorne asiatique (des agrumes)	Zitrusbockkäfer (Citrusbockkäfer) (CLB)	oost-aziatische boktor	kitajski kozliček	kiinanrunkojäärä	Kineska strižibuba	azijska strizibuba	croitorul citricelor	Citrusu ūsainis	hiina sikk
Anoplophora glabripennis (q)	Coleoptera	Asian long-horned beetle, Asian longhorn	Longicorne asiatique, Capricorne asiatique	Asiatischer Laubholzbockkäfer (ALB)	aziatische boktor	azijski kozliček	aasianrunkojäärä	Azijska strižibuba	zvjezdano nebo	gândacul asiatic cu coarne lungi	Āzijas ūsainis	aasia puidusikk
Aromia bungii (q)	Coleoptera	Red-necked longhorn beetle	Longicorne à col rouge	Asiatischer Moschusbockkäfer		Rdečevratni kozliček	punakaulusjäärä	Crvenovratna strižibuba	no croatian name	gândacul cu gât roșu	no latvian name	no estonian name

Species	Group	English	French	German	Dutch	Slovene	Finnish	Serbian	Croatian	Romanian	Latvian	Estonian
Dendrolimus sibiricus (q)	Lepidoptera	larch caterpillar, Siberian conifer silk moth, Siberian moth, Siberian silk moth	Scientific name is used	(Sibirischer) Lärchenspinner, (Sibirischer) Arvenspinner, (Sibirischer) Seidenspinner		Sibirska svilena kokljica	siperianmäntykehrääjä	Sibirska svilena kokonoprelja	sibirski prelac	molia siberiană a coniferelor	Sibīrijas priežu vērpējs	no estonian name
Popillia japonica (q)	Coleoptera	Japanese beetle	Scarabée japonais	Japankäfer	japanse kever	japonski hrošč	japaninturilas	Japanski gundelj	japanski pivac	gândacul japonez	Japānas vabole	jaapani mardikas
Thaumatotibia leucotreta (q)	Lepidoptera	False codling moth	Teigne de l'oranger, Faux carpocapse	(Zitruswicker)	afrikaanse fruitmot	Afriški plodov zavijač	säärystinkääriäinen		no croatian name	molia citricelor	no latvian name	no estonian name
Thaumetopoea processionea (ne)	Lepidoptera	Oak processionary moth	Chenille processionnaire du chêne	Eichenprozessionsspinner	eikenprocessierups	hrastov sprevodni prelec	tammikulkurinirkko	Hrastov četnik	hrastov četnjak	omida procesionară a stejarului	Ozolu zobspārnis	no estonian name
Thaumetopoea pityocampa (ne)	Lepidoptera	Pine processionary moth	Chenille processionnaire du pin	Kiefernprozessionsspinner	dennenprocessierups	pinijev sprevodni prelec	isokulkurinirkko	Borov četnik	borov četnjak	omida procesionară a pinului	Priežu zobspārnis	no estonian name

Species	Group	English	French	German	Dutch	Slovene	Finnish	Serbian	Croatian	Romanian	Latvian	Estonian
Ips typographus (ne)	Coleoptera	European spruce bark beetle, eight-toothed spruce bark beetle	Bostryche typographe, Scolyte typographe	Buchdrucker	letterzetter	osmerozobi smrekov lubadar, lubadar, podlubnik	kirjanpainaja	Osmozubi smrčin potkornjak	smrekov pisar,osmerozubi smrekov potkornjak	gândacul mare de scoarță al molidului	Egļu astoņzobu mizgrauzis	kuuse-kooreürask
Lymantria dispar (ne)	Lepidoptera	Gypsy moth, spongy moth	Bombyx disparate	Schwammspinner	plakker	gobar	lehtinunna	Gubar	gubar	omida păroasă a stejarului	Ozolu mūķene	käsnalainelane
Cameraria ohridella (i)	Lepidoptera	Horse chestnut leaf miner	Mineuse du marronnier	Roßkastanienminiermotte	paardenkastanjemineermot	listni zavrtač divjega kostanja	kastanjamiinaajakoi, kastanjamiinakoi	Lisni miner kestena	kestenov moljac miner	molia minieră a castanului	Zirgkastaņu raibkode	hobukastani-keerukoi
Corythucha arcuata (i)	Hemiptera	oak lace bug	Punaise réticulée (du chêne), tigre du chêne	Amerikanische Eiche Netzwanze		hrastova čipkarka	no Finnish name	Hrastova mrežasta stenica	hrastova mrežasta stjenica	ploșnița dantelată a stejarului	Ozolu tīklblakts	tamme-võrklutikas

Table 2. Summary of GLMM testing the effect of pest status (quarantine, invasive, native emerging) and presence / absence according to EPPO database on (a) the probability of mention in mainstream media and (b) the number of articles referring to a particular pest when media coverage is detected.

Response variable	**Predictor**	**Chisq**	**DF**	**P**
Pest presence/absence	Presence (EPPO)	13.14	1	<0.001
	Status	2.91	2	0.233
	Presence × Status	6.42	2	0.040
Number of articles	Presence (EPPO)	25.31	1	<0.001
	Status	3.80	2	0.233
	Presence × Status	1.47	2	0.040