Blacklists do not necessarily make people curious about invasive alien species. A case study with Bayesian structural time series and Wikipedia searches about invasive mammals in Italy

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Abstract

Blacklists of invasive alien species are a popular tool to manage and prevent biological invasions. Furthermore, by providing accessible examples of invasive alien species and by having a certain media resonance, they can in principle raise the awareness and make laypeople curious towards this topic. However, no study ever tested for this side-effect of blacklists. We tested if the implementation of the first blacklist of invasive alien species of the European concern, by the European Union in August 2016, increased visits to Wikipedia pages about invasive alien mammals in Italy. We adopted Bayesian Structural Time Series, using native mammals as a synthetic control, and we considered both invasive alien mammals that appeared on the list and those which were not included.

Following the publication of the first European blacklist of invasive alien species, there was no increase in the amount of weekly visits to the Wikipedia pages about invasive mammals. This was true both for species that were included in the list and those which were not. Rather increased search volumes were syncronous to other events that had media resonance. Our results indicate that important policymaking initiatives, do not necessarily raise public awareness about biological invasions, even when these policies, such as blacklists, are easy to understand and have a certain media coverage. We emphasize the importance of coupling them with adequate communication campaigns and also to develop communication guidelines for the media.

Introduction

Over the last few years, black and white lists became standard policy tools for tackling biological invasions [1]. Blacklists, also known as "negative lists", identify invasive alien species (IAS) for which introduction is forbidden and trade bans, management initiatives and eradication should be enforced. On the other hand, white lists (or "positive lists") identify species classified as low risk and which can enter a country for trade or other reasons and whose presence in nature and captivity is tolerated, and they automatically exclude all the remaining ones [2][3]. Both legislations are based on risk-assessments: in the first case with the aim to ban a species from a country or a geographic area, in the latter to demonstrate that the species likely will not adapt to the new environment or it will produce negligible impacts.

While the two approaches have different benefits, limitations and costs, blacklists became far more common worldwide, with white lists being limited to a few countries [4]. For example, the European Regulation on invasive alien species (n. 1143/2014), addressing biological invasions in all the member states of the European Union since January 2015, produced a first list of 37 IAS of European concern (hereinafter European blacklist) in August 2016, which was then updated in 2017 (49 species) and 2019 (66 species). Following the European Regulation, 25 member states of the EU implemented at least one type of national blacklists, with 4 states (Austria, Croatia, Germany and Spain) implementing also regional blacklists. On the other hand, 6 member states only developed positive lists, mostly for specific taxa [5].

To date, blacklists have been evaluated in terms of their potential to prevent introductions [6] and as blueprints for prioritizing control and eradication initiatives [7][8]. However, we still do not know whether blacklists contribute to outreach biological invasions, making the general public more curious towards IAS. As blacklists often create media echo and provide accessible examples of IAS, they seem suitable for this task. This was recognized by the International Union for the Conservation of Nature (IUCN), which in 1999 set up a list of 100 high-profile invasive species (the list of 100 of the world's worst invasive alien species [9] as a communication tool to address this issue. A similar list with one hundred of the most invasive alien species was draw up in Europe [10]. If blacklists had this power, this would make them a valuable conservation tools: for environmental topics, generating a public debate is often a powerful way to enter the political agenda (e.g. climate change)[11] and people discuss a certain topic only when they find it interesting and deserving their attention, developing attitudes about it [12]. Considering that most policies for biological invasions nowadays include blacklists, measuring whether they make laypeople curious towards IAS is fundamental to see if the same policies will be supported in the long term.

In this study, we aim to fill this gap by estimating the causal effect of the first European blacklist of IAS, in August 2016, over the number of Wikipedia searches about those invasive mammal species that appeared on the list, in Italy. Today, people regularly look for information about topic they care about on search engines and on-line encyclopedias, such as Wikipedia [13]. This behavior also involves controversial topics that people want to deepen [14] and it often follows news exposure from traditional media [15]. This behavior includes environmental issues [16][17][18][19]. Mammals are often iconic species, salient even to laypeople, and the publication of the blacklist could have stimulated information searching about those specie which were included in it. This because, the publication of the blacklist was announced by the EU (https://ec.europa.eu/environment/efe/news/first-eu-list-invasive-alien-species-2016-08-04$_i t$), and by national (e.g. La Repubblica) and regional newspapers (e.g. L'Eco di Bergamo).

Therefore, we predicted that: (i) H_1: the implementation of European blacklist increased the number of Wikipedia searches for invasive mammals that were included in the list, compared to

native species, (*ii*) H_2: this effect declined rapidly in time, as there was no dedicated budget for permanent outreaching initiatives [20], (*iii*) H_3: Wikipedia views also increased in August 2017 and 2019, due to European blacklist updates, (*iv*) H_4: the implementation of the European blacklist also increased the number of searches for invasive mammals that were not included, due to an increased interest towards IAS in general. Notably, while search engines data requires some cautions [21][22], the analysis of Wikipedia searches often includes people who voluntarily read up on a certain plant or animal species, and therefore Wikipedia searches can reflect increased interest towards a certain topic.

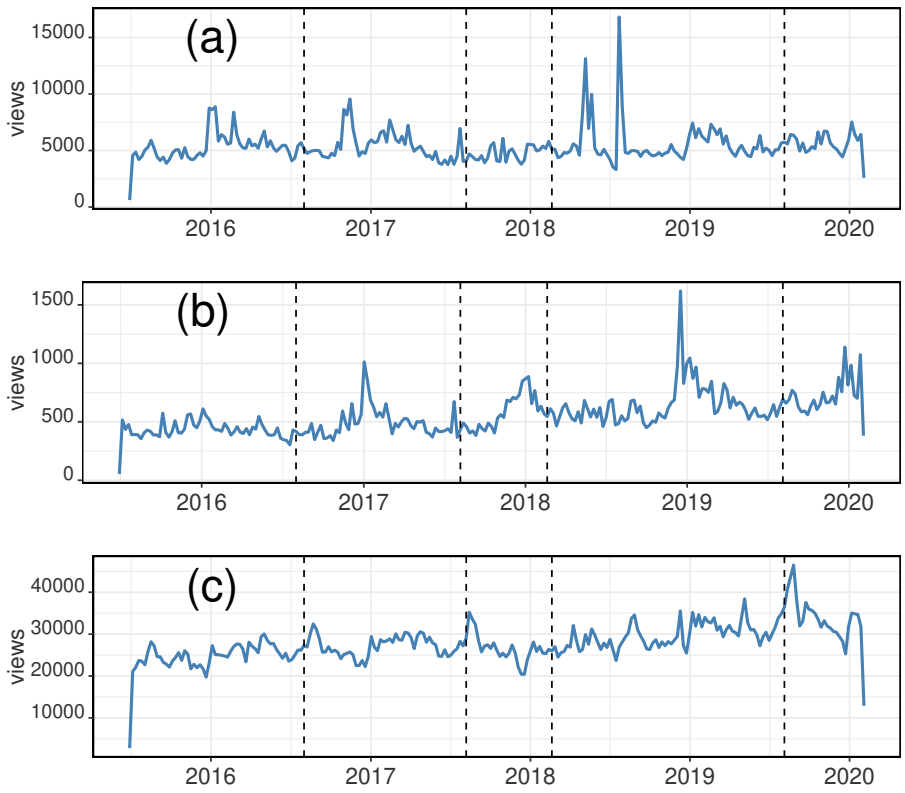

Figure 1 | Number of visits to Wikipedia pages about: (a) invasive alien mammals included in the European blacklist, (b) invasive alien mammals not included in the European blacklist and (c) native mammals. Dashed lines, from left to right represent the publication of the first blacklist (August 2016), its first update (August 2017), the implementation of the first Italian law about invasive species (February 2018) and the second update of the blacklist (August 2019).

Methods

We deemed our case study suitable for the application of Bayesian structural time series (BSTS)[23]. BSTS can estimate the causal effect of an intervention over a single target time-series, by comparing its post-treatment values with a counterfactual constructed from a synthetic control, constituted by untreated time series that were predictive of the target time series in the pre-treatment period.

In this study, to assess the causal effect of the European blacklist over Wikipedia searches about invasive mammals, we compared the volume of searches about this group with the volume of searches about native mammals. Native mammals were a suitable synthetic control because before the establishment of the European blacklist their volume of Wikipedia searches correlated

well with species later blacklisted (Pearson's correlation coefficient = 0.63), and they did not obviously appear on the blacklist, being unaffected by its publication.

The first target time series (adopted for H_1, H_2 and H_3) included the aggregated monthly number of visits to Wikipedia pages about IAS that appeared on the EU blacklist, and that were present in Italy in August 2016: the coypu (*Myocastor coypus*), the raccoon (*Procyon lotor*), the Eastern gray squirrel (*Sciurus carolinensis*) and the Siberian chipmunk (*Tamias sibiricus*).

The second time series (adopted for H_4) included the aggregated monthly number of visits to Wikipedia pages about IAS that were not included on the European blacklist, and that were present in Italy in August 2016: the Eastern cottontail (*Syvlilagus floridanus*), the American mink (*Neovison vison*), the Barbary sheep (*Ammotragus lervia*) and the Finlayson's squirrel (*Callosciurus finlaysonii*) [24].

The control time series included the aggregated monthly number of Wikipedia searches for native Italian mammals: *Erinaceus europaeus*, *Crocidura leucodon*, *Crocidura pachyura*, *Crocidura sicula*, *Crocidura suaveolens*, *Neomys fodiens*, *Sorex alpinus*, *Sorex minutus*, *Sorex samniticus*, *Suncus etruscus*, *Talpa caeca*, *Talpa romana*, *Miniopterus schreibersii*, *Tadarida teniotis*, *Rhinolophus euryale*, *Rhinolophus ferrumequinum*, *Rhinolophus hipposideros*, *Rhinolophus mehelyi*, *Barbastella barbastellus*, *Eptesicus nilssonii*, *Eptesicus serotinus*, *Hypsugo savii*, *Myotis alcathoe*, *Myotis bechsteini*, *Myotis blythii*, *Myotis brandtii*, *Myotis capaccinii*, *Myotis daubentonii*, *Myotis emarginatus*, *Myotis myotis*, *Myotis mystacinus*, *Myotis punicus*, *Nyctalus lasiopterus*, *Nyctalus leisleri*, *Nyctalus noctula*, *Pipistrellus kuhlii*, *Pipistrellus nathusii*, *Pipistrellus pipistrellus*, *Plecotus auritus*, *Plecotus austriacus*, *Plecotus sardus*, *Vespertilio murinus*, *Canis aureus*, *Vulpes vulpes*, *Felis silvestris*, *Lynx lynx*, *Lutra lutra*, *Martes foina*, *Martes martes*, *Meles meles*, *Mustela erminea*, *Mustela nivalis*, *Mustela putorius*, *Capra ibex*, *Rupicapra pyrenaica*, *Rupicapra rupicapra*, *Capreolus capreolus*, *Cervus elaphus*, *Dama dama*, *Sus scrofa*, *Arvicola amphibius*, *Chionomys nivalis*, *Microtus arvalis*, *Microtus multiplex*, *Microtus savii*, *Microtus subterraneus*, *Myodes glareolus*, *Dryomys nitedula*, *Eliomys quercinus*, *Glis glis*, *Muscardinus avellanarius*, *Hystrix cristata*, *Apodemus agrarius*, *Apodemus alpicola*, *Apodemus flavicollis*, *Apodemus sylvaticus*, *Micromys minutus*, *Mus musculus*, *Marmota marmota*, *Sciurus vulgaris*, *Lepus capensis*, *Lepus corsicanus*, *Lepus europaeus*, *Lepus timidus*, *Oryctolagus cuniculus*.

We did not consider the Pallas' squirrel (*Callosciurus erythraeus*), which does not have any page on the Italian Wikipedia, as well as the raccoon dog (*Nyctereutes procyonoides*) and the muskrat (*Ondatra zibethicus*), which appeared on the second update of the blacklist. Between species non included in the European list, we did not consider the brown rat (*Rattus norvegicus*) and the black rat (*Rattus rattus*), as the two species attained a certain news coverage due to some eradication initiatives on some Italian islands [25][26], as well as the moufflon (*Ovis aries*), which is a semi-domestic species, and the common genet (*Genetta genetta*) for which some records between France and Italy exist. We also excluded the red squirrel (*Sciurus vulgaris*) from the list of native species, because its news coverage was related to the management of S. carolinensis [27][28], and two large carnivores, the gray wolf (*Canis lupus*) and the brown bear (*Urus arctos*), whose news coverage was complex and volatile, due to their interaction with humans and the political debate around their management. We also excluded marine mammals, as they could have stronger seasonal patterns than other mammal species, caused by the fact that people visit marine environments mostly during summer, spotting whales and dolphins, and by the fact that marine mammals are prone to media echo caused by mortality events.

Wikipedia views were aggregated on a monthly basis, to increase the signal-to-noise ratio, diminishing months without searches and weekly fluctuations. To further highlight overall trends and to eliminate species-specific seasonal fluctuations, species-specific time series in each group were aggregated, obtaining three time series (Fig. 1). As the three groups of interest

have a different number of species, and different searching volumes, our time-series were standardized, as suggested by Brodersen *et al.* [23].

Results

Our findings did not highlight any effect of the implementation of the first European blacklist over the volume of visits to Wikipedia pages about mammals which were included in the list (Fig. 2). Visits did not increase after August 2016, compared to what would have been expected from our control groups containing native species. There were more visits than expected only in October/November 2016, as well as in May and August 2018.

Our findings also did not highlight any clear effect of the European blacklist on invasive mammals that were not included on it. Visits did not increase, if not until early 2017 and there were more visits than expected at irregular times, from 2017 to mid 2018, which peaked between December 2018 and February 2019 (Fig. 3).

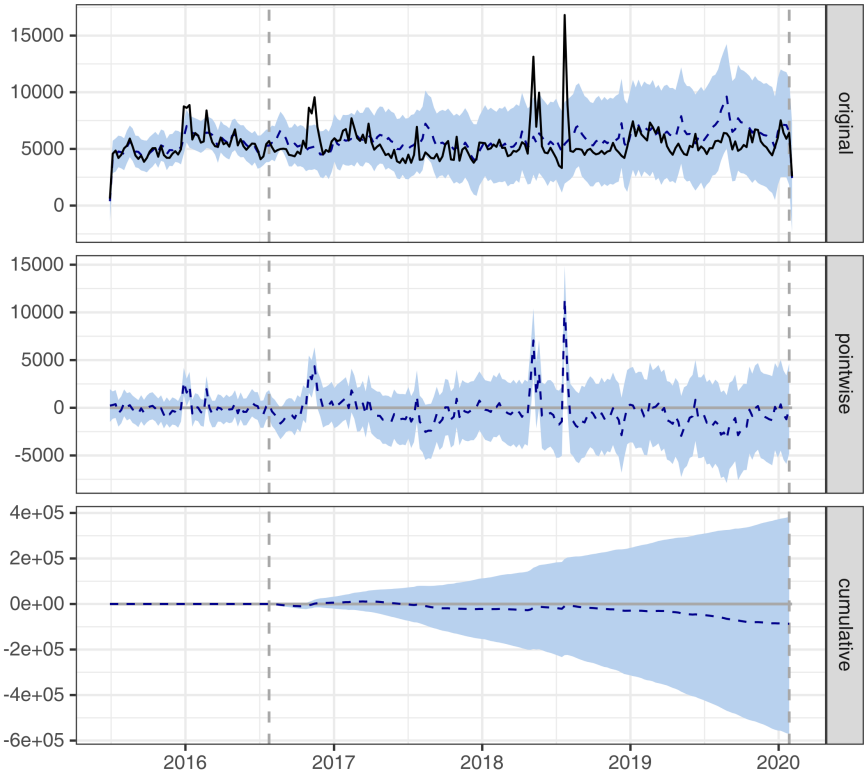

Figure 2 | Causal impact of the first EU blacklist over visits to Wikipedia pages about invasive alien mammals that appeared on the list, compared to native mammals.

Discussion and conclusion

To the best of our knowledge, this study constitutes a first attempt to quantify the potential of management tools for biological invasions, such as blacklists, to outreach the topic of invasive alien species and biological invasions to the general public. Notably, we adopted online visits to Wikipedia as a way to capture people's interest towards this topic.

Despite the first European blacklist could have had a considerable potential to raise laypeople's interest towards invasive alien species and biological invasions, because it benefited from media

coverage and it offered concrete examples, our findings indicate that this was not the case, at least for Italy. The number of visits to Wikipedia pages about invasive mammals contained in the blacklist did not increase after its publication, compared to native mammal species. There was no long-term change, and also single weeks with significantly more views did not coincide with blacklist updates, but with single events limited in time, such as the publication of the final version of the national management plan for coypu (May 2018)[29], the publication of an official note of the Lombardy region, among the most affected ones by coypu, about the intention to approve a management plan (July 2018, Regione Lombardia), and the publication of a viral video of a coypu in a city center in Northern Italy (November 2016, Cremona Oggi) (Fig. 4). Therefore, our first three hypotheses (H_1, H_2 and H_3) were rejected.

Our results about invasive mammals not included in the list were also lead us to reject H_4 as well. Although we detected an increase in Wikipedia visits in early 2017, this is unlikely to have depended upon a lagged effect of the blacklist. Usually, news exposure boosts people's interest towards a certain topic in the short term, and the number of on-line searches progressively declines through time [30][31]. Therefore, we would have expected an increase in Wikipedia views soon after the publication of the blacklist, in August 2016, and not 6 months later. Considered that we did not observe a progressive increase in the overall number of searches, but a series of single months with a peak in Wikipedia visits, these findings indicate that on-line information search could have been affected by other factors. For example, the peak observed between late 2018 and February 2019 could have resulted from the liberation of thousands american minks (*Neovison vison*) from a fur factory in Northern Italy in December 2018, which had wide media resonance for a few weeks (see for example La Repubblica; Fig. 4).

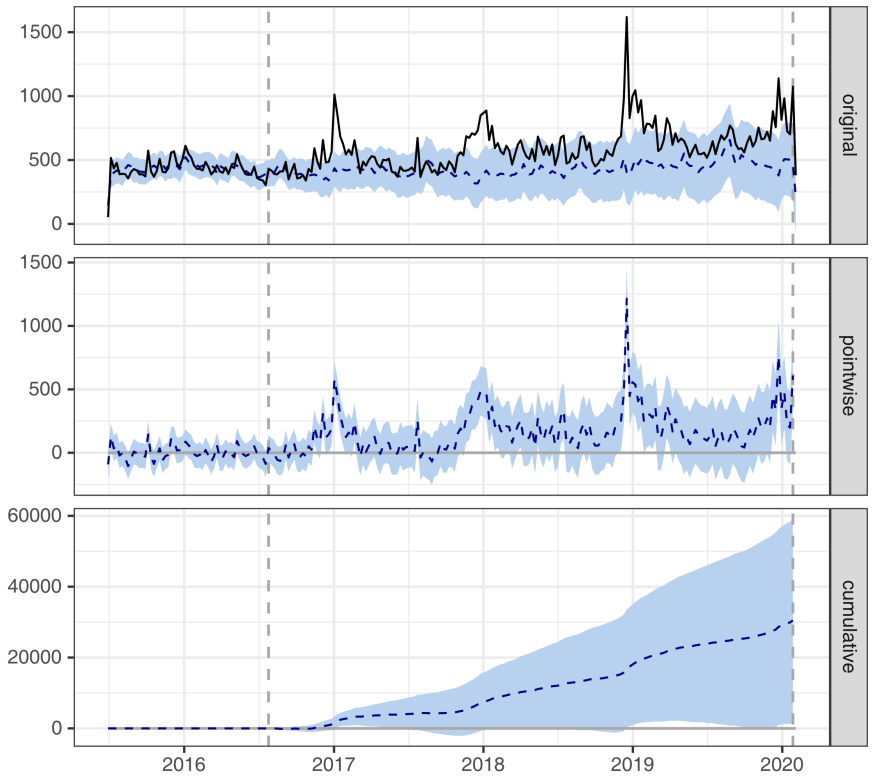

Figure 3 | Causal impact of the first EU blacklist over visits to Wikipedia pages about invasive alien mammals which were not included in the list, compared to native mammals.

As the number of Wikipedia searches also increased at irregular times, we believe this to have occurred as a consequence of outreach initiatives from single conservation projects about invasive alien species, such as the LIFE ASAP project (https://lifeasap.eu/index.php/it/). If this was the case, however, it is unclear why similar short-term increases did not occur for mammals that were included in the blacklist, as these species are usually communicated to the public. A potential explanation could be that people are attracted by novel topics and could therefore be more prone to search about invasive species that they do not know, rather than about well-known invasive species such as the coypu (*Myocastor coypus*) or the raccoon (*Procyon lotor*). Future experimental studies, possibly where participants are exposed to information about different invasive species in a controlled environment, and then monitored in their subsequent on-line searching behavior could help addressing this gap, revealing how previous knowledge of invasive species and their impacts, or their framing by media, affect searches on the Internet.

Overall, macroscopic policy initiatives seem to scarcely affect on-line information search about invasive mammals on Wikipedia. This was the case for the first blacklist but also for its two updates in August 2017 and 2019 and the publication of the a national legislative decree (230/2017) which adapt national law to the EU Regulation 1143/14: following these dates, there was no strong change neither in aggregated trends (Fig. 1), nor in species-specific trends (Fig. 4). Interestingly, a similar study [32] showed that indeed Google and Wikipedia searches for general terms about biological invasions, such as "invasive species" or "alien species" increased through time and also after the enter into force of the EU Regulation 1143/14 in January 2015. While policy tools are fundamental to prevent and manage biological invasions, future studies should disentangle how policymaking initiatives affect both species-specific and more general on-line searches on the Internet. Moreover, Italy is among the European states with the lowest level of Internet penetration and in 2016 it lied behind other member states [33]: it would be interesting to replicate our approach to other countries with a higher penetration of the Internet, to see if any difference in Wikipedia searches will emerge. Finally, this study emphasizes the influence that media have on public interest about IAS. On-line searches were not affected by news about the EU blacklist, but they aligned with sensational news about major invasive alien species. For example, viral videos of invasive alien mammals in urbanized areas, news about large-scale control initiatives and news about mass releases of IAS in nature were associated to peaks in species-specific searches. We believe that these findings show the need for reshaping media coverage about biological invasions. Although it is unlikely that traditional media will change their exploitation of sensational events, shifting to a regular coverage of biological invasions, scientists should exploit sensational news to introduce laypeople to biological invasions. The adoption of communication guidelines for traditional media [34] and a tight collaboration between journalists and researchers will be fundamental for this task.

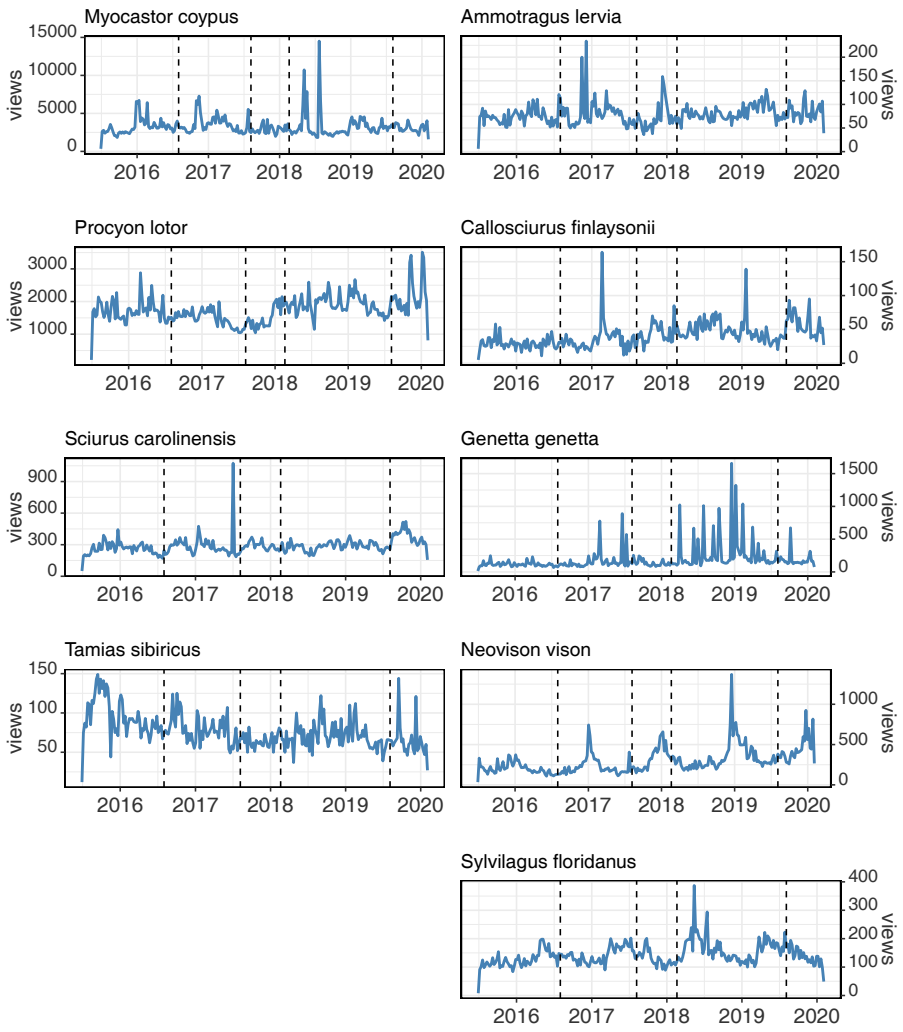

Figure 4 | Number of visits to Wikipedia pages about invasive alien mammals included in the EU blacklist (left column) and invasive alien mammals not included in the blacklist (right column). Dashed lines, from left to right represent the publication of the first blacklist (August 2016), its first update (August 2017), the implementation of the first Italian law about invasive species (February 2018) and the second update of the blacklist (August 2019).

References

1. Genovesi P, Shine C (2004) European strategy on invasive alien species: Convention on the Conservation of European Wildlife and Habitats (Bern Convention) (No. 18-137). Council of Europe Publishing. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.422.6827rep=rep1type=pdf.
2. Kaiser J (1999) Stemming the Tide of Invading Species. Science 285: 1836-1836. https://doi.org/10.1126/science.285.5435.1836
3. Perrings C, Dehnen-Schmutz K, Touza J, Williamson M (2005) How to manage biological invasions under globalization. Trends Ecol Evol 20: 212-215. https://doi.org/10.1016/j.tree.2005.02.011
4. Brenton-Rule E, Frankel S, Lester P (2016) Improving management of invasive species: New Zealand's approach to pre-and post-border pests. Pol Quart 12. https://doi.org/10.26686/pq.v12i1.4582
5. Eurogroup for Animals (2020) Analysis of national legislation related to the keeping and sale of exotic pets in Europe.
6. Maceda-Veiga A, Escribano-Alacid J, Martínez-Silvestre A, Verdaguer I, MacNally R (2019) What's next? The release of exotic pets continues virtually unabated 7 years after enforcement of new legislation for managing invasive species. Biol Invasions 21: 2933-2947. https://doi.org/10.1007/s10530-019-02023-8
7. Carboneras C, Genovesi P, Vilà M, Blackburn TM, Carrete M, Clavero M, D'hondt B, Orueta JF, Gallardo B, Geraldes P, González-Moreno P, Gregory RD, Nentwig W, Paquet JY, Pyšek P, Rabitsch W, Ramírez I, Scalera R, Tella JL, Walton P, Wynde R (2018) A prioritised list of invasive alien species to assist the effective implementation of EU legislation. J Appl Ecol 55: 539-547. https://doi.org/10.1111/1365-2664.12997
8. Tollington S, Turbé A, Rabitsch W, Groombridge JJ, Scalera R, Essl F, Shwartz A (2017) Making the EU legislation on invasive species a conservation success. Conserv Lett 10: 112-120. https://doi.org/10.1111/conl.12214
9. Lowe S, Browne M, Boudjelas S, De Poorter M (2000) 100 of the World's Worst Invasive Alien Species A selection from the Global Invasive Species Database. http://www.issg.org/pdf/publications/worst_100/english_100_worst.pdf.
10. Vilà M, Basnou C, Gollasch S, Josefsson M, Pergl J, Scalera R (2009) One hundred of the most invasive alien species in Europe. In: Hulme P (ed) Handbook of alien species in Europe, 1st edn. Springer, Dordrecht, pp 265-268
11. Dunlap RE, McCright AM (2010) Climate change denial: sources, actors and strategies. In: Lever-Tracy C (ed) Routledge handbook of climate change and society, 1st edn. Routledge, London, UK, pp 270-290
12. Heberlein TA (2012) Navigating environmental attitudes. Oxford University Press, Oxford, UK.
13. Okoli C, Mehdi M, Mesgari M, Nielsen FÅ, Lanamäki A (2014) Wikipedia in the eyes of its beholders: A systematic review of scholarly research on Wikipedia readers and readership. J Assoc Inf Sci Tech 65: 2381-2403. https://doi.org/10.1002/asi.23162
14. Yenikent S, Holtz P, Kimmerle J (2017) The impact of topic characteristics and threat on willingness to engage with wikipedia articles: Insights from laboratory experiments. Front Psychology 8: 1960. https://doi.org/10.3389/fpsyg.2017.01960
15. Tizzoni M, Panisson A, Paolotti D, Cattuto C (2020) The impact of news exposure on collective attention in the United States during the 2016 Zika epidemic. PLoS Comput Biol 16: e1007633. https://doi.org/10.1371/journal.pcbi.1007633
16. Mccallum ML, Bury GW (2013) Google search patterns suggest declining interest in the environment. Biodivers Conserv 22: 1355-1367. https://doi.org/10.1007/s10531-013-0476-6
17. Burivalova Z, Butler RA, Wilcove DS (2018) Analyzing Google search data to debunk myths about the public's interest in conservation. Front Ecol Environ 16: 509-514. https://doi.org/10.1002/fee.1962
18. Anderegg WR, Goldsmith GR (2014) Public interest in climate change over the past decade and the effects of the 'climategate'media event. Env Res Lett 9: 054005. https://doi.org/10.1088/1748-9326/9/5/054005
19. Mittermeier JC, Roll U, Matthews TJ, Grenyer R (2019) A season for all things: Phenological imprints in Wikipedia usage and their relevance to conservation. PLoS biol 17. https://doi.org/10.1371/journal.pbio.3000146
20. Turbelin AJ, Malamud BD, Francis RA (2017) Mapping the global state of invasive alien species: patterns of invasion and policy responses. Global Ecol Biogeogr 26: 78-92. https://doi.org/10.1111/geb.12517
21. Correia RA, Di Minin E, Jarić I, Jepson P, Ladle R, Mittermeier J, Roll U, Soriano-Redondo A, Veríssimo D (2019) Inferring public interest from search engine data requires caution. Front Ecol Environ 17. https://doi.org/10.1002/fee.2048

22. Jun SP, Yoo HS, Choi S (2018) Ten years of research change using Google Trends: From the perspective of big data utilizations and applications. Tech Forecast Soc 130: 69-87. https://doi.org/10.1016/j.techfore.2017.11.009

23. Brodersen KH, Gallusser F, Koehler J, Remy N, Scott SL (2015) Inferring causal impact using Bayesian structural time-series models. Ann Appl Stat 9: 247-274. https://doi.org/10.1214/14-AOAS788

24. Loy A, Aloise G, Ancillotto L, Angelici F M, Bertolino S, Capizzi D, Castiglia R, Colangelo P, Contoli L, Cozzi B, Fontaneto D, Lapini L, Maio N, Monaco A, Mori E, Nappi A, Podestà M A, Sarà M, Scandura M, Russo D, Amori G (2019). Mammals of Italy: an annotated checklist. Hystrix 30: 87–106. https://doi.org/10.4404/hystrix-00196-2019

25. Celesti-Grapow L, Abbate G, Baccetti N, Capizzi D, Carli E, Copiz R, Frondoni R, Giunti M, Gotti C, Iberite M, Monaco A, Petrassi F, Raganella Pelliccioni E, Romano A, Sozio G, Sposimo P, Tilia A, Blasi C (2017) Control of invasive species for the conservation of biodiversity in Mediterranean islands. The LIFE PonDerat project in the Pontine Archipelago, Italy. Plant Biosyst 151: 795-799. https://doi.org/10.1080/11263504.2017.1353553

26. Canale DE, Di Dio V, Massa B, Mori E (2019) First successful eradication of invasive Norway rats Rattus norvegicus from a small Mediterranean island (Isola delle Femmine, Italy). J Vert Biol 68: 29-34. https://doi.org/10.25225/fozo.060.2019

27. Bertolino S, Di Montezemolo NC, Preatoni DG, Wauters LA, Martinoli A (2014) A grey future for Europe: Sciurus carolinensis is replacing native red squirrels in Italy. Biol Invasions 16: 53-62. https://doi.org/10.1007/s10530-013-0502-3

28. Lioy S, Marsan A, Balduzzi A, Wauters LA, Martinoli A, Bertolino S (2019) The management of the introduced grey squirrel seen through the eyes of the media. Biol Invasions 21: 3723-3733. https://doi.org/10.1007/s10530-019-02084-9

29. Bertolino S, Cocchi R (2018) Piano di gestione nazionale della Nutria Myocastor coypus. Roma: Istituto Superiore per la Protezione e la Ricerca Ambientale.
https://www.minambiente.it/sites/default/files/archivio/allegati/biodiversita/piano_gestione_nutria_maggio2020.pdf

30. Bento AI, Nguyen T, Wing C, Lozano-Rojas F, Ahn YY, Simon K (2020) Evidence from internet search data shows information-seeking responses to news of local COVID-19 cases. PNAS 117: 11220-11222. https://doi.org/10.1073/pnas.2005335117

31. Fernández-Bellon D, Kane A (2020) Natural history films raise species awareness—A big data approach. Conserv Lett 13: e12678. https://doi.org/10.1111/conl.12678

32. Cerri J, Carnevali L, Piazzi A, Genovesi P, Monaco A, Bertolino S (2020) A nation-wide analysis of Wikipedia and Google Searches in Italy reveals a growing interest towards biological invasions. Archived on EcoEvoRxiv, doi not available yet.

33. Bologna E, Fornari R, Zannella L, Matarazzo G, Dolente C (2018) Internet@ Italia 2018: Domanda e offerta di servizi online e scenari di digitalizzazione. https://www.istat. it/it/files/2018/06/Internet@Italia-2018.Pdf

34. MacFarlane D, Rocha R (2020) Guidelines for communicating about bats to prevent persecution in the time of COVID-19. Biol Conserv 248: 108650. https://doi.org/10.1016/j.biocon.2020.108650