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## Horizon-scanning for invasive alien species with the potential to threaten biodiversity and ecosystems, human health and economies in Britain

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## Introduction

Invasive non-native species are a major and growing threat to biodiversity and ecosystems but also, in some cases, nature's contributions to people and good quality of life (IPBES 2023). Prevention is the most effective approach to mitigating the adverse effects of invasive non-native species. If prevention fails, deploying measures for early detection and rapid response are recommended. Predicting the invasive non-native species that are most likely to arrive, establish and negatively impact biodiversity and ecosystems through horizon scanning can inform prevention and early detection and rapid response.

In 2013, the yellow-legged hornet, *Vespa velutina*, was predicted to arrive in Britain and pose a threat to pollinating insects. This species was added to the list of alert species for Britain. Monitoring and surveillance systems were implemented and communication campaigns were used to raise awareness about *V. velutina* and encourage people to submit potential sightings. This invasive non-native species was first recorded in Britain in 2016 and there have been subsequent sightings every year since, however early detection and rapid response has been successful in preventing the establishment of *V. velutina* in Britain (Hassall, Purse et al. 2024).

Here, we present the outcomes of a consensus approach which repeated the process undertaken for Britain in 2013 (Roy, Peyton et al. 2014) and 2019<sup>1</sup> to derive ranked lists of INNS likely to arrive and establish over the next ten years.

## Methods

We used a combination of rapid species assessment coupled with expert-elicitation as previously described (Roy, Peyton et al. 2014, Dawson, Peyton et al. 2023) summarised in the following steps:

1. Five thematic groups were convened:
  - i. Plants (lead: Wayne Dawson, University of Liverpool; Katharina Dehnen-Schmutz, University of Coventry)
  - ii. Terrestrial invertebrates (lead: Alan Stewart, University of Sussex)
  - iii. Freshwater invertebrates (lead: Lori Lawson Handley, UKCEH; David Aldridge, University of Cambridge)
  - iv. Vertebrates (lead: Aileen Mill, University of Newcastle; Colin Harrower, UKCEH)
  - v. Marine species (lead: Christine Wood, Marine Biological Association)
2. Long-lists of invasive non-native species were compiled including the following lists: previous GB horizon scanning long lists and the 2024 EU horizon scanning list
3. Long-lists were reviewed by thematic groups leading to deletion and addition of invasive non-native species
4. Detailed instructions on scoring the invasive non-native species were circulated to all experts and an on-line meeting was held in advance of the scoring to brief thematic leads and address questions.
5. Scores (scale 1 to 5) were assigned to invasive non-native species for the likelihood of arrival, establishment and impact to biodiversity and ecosystems. Additional information was also collated including likely introduction pathways, mechanisms of impact and scores for economic and human health impacts. Confidence levels were given to the total score (product of arrival, establishment and impact scores which with a 3-criterion, 5-point scoring system, this produces a maximum score of 125).
6. In person 2-day workshop at APHA, Sand Hutton, York from 12 to 13 March 2025 to:
  - i. Review lists compiled within each thematic group and agree on scores
  - ii. Compile lists across all thematic groups
  - iii. Agree, through expert-elicitation and consensus building, a final ranked list of invasive non-native species

It is important to note the following:

Geographic scope: Britain. The geographic scope of the search for potential INNS was global but with the following restrictions:

- (i) Are absent or not considered established in GB
- (ii) Have documented histories of invasion and causing undesirable impacts in other regions worldwide with similar climatic conditions
- (iii) Traded within GB or are present in areas that have strong trade or travel connections with GB and where there is a recognised potential pathway for arrival.
- (iv) Are present in captivity including gardens, zoological parks, aquaculture facilities and glasshouses but not present in the wider environment.

Temporal scope: Invasive non-native species likely to arrive and establish in the next 10 years. This temporal limit informs the relevance of, for instance, long-term climate change projections.

## **Results**

Annex 1. Table of invasive non-native species considered to be high-risk of arriving, establishing and posing a threat to biodiversity and ecosystems in Britain

## Discussion

The final list of 145 comprises a diverse range of invasive non-native species spanning taxonomic groups and environments. Through the discussions at the workshop the success of the approach previously deployed in 2013 and 2019 was noted by the participants with examples given of the responses to *V. velutina* and *Procyon lotor* (raccoon).

There were extensive discussions on current establishment status of some of the invasive non-native species with uncertainty for some species across all groups but particularly plants and marine species. As an example, there were extensive discussions about the white river crayfish, *Procambarus acutus*, and whether it is still within captivity in a fishery but it was agreed that there have been confirmed sightings near waterbodies that are not fisheries and the Environment Agency is actively managing these populations. Therefore, it was confirmed that currently there is a self-sustaining population in the wild and the species was removed from the 2025 horizon scanning list. In contrast, there are varying accounts of the establishment status of Prussian carp, *Carassius gibelio*, and veined rapa whelk, *Rapana venosa*, but the experts agreed there was no evidence of self-sustaining populations for either species.

For many species the scarcity of information compounds the issues of assigning scores with confidence. The spaghetti bryozoan, *Amathia verticillata*) is one such species. Additionally, for some species there was uncertainty about the potential for establishment with climate change. As an example, the sea temperatures around Britain may be too low for the brown seaweed, *Rugulopteryx okamurae*, even with climate warming. However, there was sufficient doubt for this species that it was decided to include it within the list of high-risk species and specifically within the top 20.

While management measures were not accounted for in the scoring process, it was agreed that for some species the introduction pathways were no longer in place and arrival for these species should be assigned a suitably low score. As an example, in 2019 the arrival score for American bullfrog, *Lithobates catesbeianus* was 5 but this was decreased to 4 following the EU-wide ban in sale of this species and concurrent removal of the pet trade pathway for this species. Consequently, *L. catesbeianus* still remains within the long-list of high-risk invasive non-native species but not within the top 20.

There are a number of invasive non-native species that have arrived in Britain but that were not included in previous horizon scanning lists. The group considered that these should be reviewed and potential reasons for their omission should be critically reviewed. The blood cockle, *Tegillarca granosa*, was given as an example.

In conclusion, the final list of 145 invasive non-native species, ranked in groups of 1-20, 21-50, and 51-145 was agreed unanimously by all participants. The need for additional information on establishment status of invasive non-native species was considered a priority going forward. Additionally, information on impacts was also considered to be lacking for some species and increasing the evidence-base for impacts would benefit the horizon scanning process, and indeed other reporting needs. There is an urgent need to raise awareness about the importance of enhancing flow of information, by capturing information from people making observations in the field or from reports on-line and other sources.

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<sup>i</sup> [https://www.nonnativespecies.org/assets/Document-repository/Horizon\\_scanning\\_short\\_report\\_2019-2.pdf](https://www.nonnativespecies.org/assets/Document-repository/Horizon_scanning_short_report_2019-2.pdf)