

Invasive non-native species risk assessment in Great Britain

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Summary

Invasive non-native species risk assessment in Great Britain is coordinated by the Non-native Species Secretariat for the GB Programme Board for non-native species under a Great Britain strategy that follows the principles of the Convention on Biological Diversity. Risk assessments are commissioned from independent expert assessors and overseen by the Non-native Species Risk Analysis Panel, a panel of risk assessment experts that ensures consistent and technically valid assessments and interpretation. The process uses a risk assessment template to follow closely the scheme used by the European and Mediterranean Plant Protection Organisation (EPPO) for agricultural quarantine pests, modified for all non-native organisms in the natural environment. Each response is documented by the assessor and checked by a peer reviewer and by the Panel. Directly elicited estimates of entry, establishment, spread and impact, with measures of assessor confidence, give an overall semi-quantitative summary of risk, in terms of likelihood and magnitude.

Key words: Risk assessment, invasive species, non-native species, risk management, uncertainty

Introduction

Risk assessment for non-native species in Great Britain is coordinated by the Non-native Species Secretariat (NNSS) for the three national administrations and covers all mainland and islands of Great Britain. The NNSS coordinates much of the work prescribed in the Invasive Non-Native Species Framework Strategy for Great Britain (Department for Environment, Food and Rural Affairs, 2008). Technically validated scientific evidence is an essential part of this strategy, in identifying potentially invasive organisms, assessing the associated risks, communicating those risks, and evaluating appropriate management options, including the development of government

policy. The process is carried out as part of commitments to the Convention on Biological Diversity. A process has been developed in Great Britain that closely follows international guidelines set out by the International Plant Protection Convention (IPPC, 2004) and uses a common software template with the European and Mediterranean Plant Protection Organisation (EPPO) pest risk assessment scheme (EPPO, 2009). The general structure of the risk analysis scheme used in Great Britain is based on elements of what has become the ISO 31000:2009 risk management standard (Baker *et al.*, 2008).

Non-native organisms pose a particular problem for risk assessment because the hazards are by their nature novel and it is impractical to gather experimental evidence. In addition, the difficulties in managing invasive non-native organisms once established means it is imperative to assess risk in advance of their arrival and well before any impacts become evident. We face threats from a wide range of terrestrial, freshwater and marine species, so many risk assessments need to be done in a relatively short period. Because the risks are so diverse, different experts must be called upon to make the assessments, yet the risks must be managed by a relatively focused group of authorities, with limited resources. The management of invasive species can be a process that raises considerable public interest, both in favour and in opposition, depending on the organism. A robust, reliable, science-based system is required to ensure that risks are assessed in a consistent manner at a reasonable cost, to guide relevant, effective and efficient management.

Materials & Methods

To obtain consistent, well-documented assessments the Department for Environment, Food and Rural Affairs (DEFRA) commissioned the development of a risk assessment template in 2004 (Baker *et al.*, 2008). This was first built as a spreadsheet, with standard questions on entry, establishment, spread and impact. These key risk components are specified in the IPPC standard (IPPC, 2004) and are used in the agricultural risk assessment scheme developed by the EPPO (2009). While the IPPC and the EPPO set standards and provide examples, the demands of assessing non-native species in Great Britain are different and required a modification of the process used elsewhere to give a scheme where risk assessments could be made relatively quickly and comparably for a large number of species. For example, the EPPO may conduct five agricultural pest risk assessments in a year, drawing on panels of 5–6 experts familiar with the species, whereas the NNSC coordinates 15–20 non-native organism risk assessments per year, and it can be difficult to find even a single expert for some non-native species with experience relevant to Great Britain.

The development of the Great Britain Non-native Risk Assessment Scheme has also benefited from the EC Framework 7 PRATIQUÉ project (Baker *et al.*, 2009), which has been developing enhanced pest risk analysis techniques and considering ways to get greater harmonization in pest risk assessment across Europe. This has created an opportunity for close cooperation between the Great Britain non-native species risk assessment and PRATIQUÉ and resulted in some joint developments. The relatively high throughput of risk assessments under the Great Britain scheme, and the greater diversity of species, has allowed experience of testing new template questions. There is also more latitude within the Great Britain scheme for modification than in the EPPO, which has 50 member countries. When the EPPO decided to produce a purpose-built computerized pest risk assessment program for its assessment panels it was agreed that the Great Britain Non-native Scheme would use the same software, but with some modifications to the wording of questions to reflect the nature of the species and the more limited area. The Great Britain Non-native Species Risk Assessment (GBNNRA) template for assessors, also called NAPRA in parallel to the EPPO CAPRA software, can be downloaded at the EPPO website (<http://napra.eppo.org>).

The essence of the GBNNRA is that clearly defined scores are elicited from assessors for the likelihood of entry and establishment (the latter being contingent on the former), for the marginal

proportion of spread within the potentially affected resource over the next five years (either from zero or the present distribution if already established), and the expected level of annual impact on the resource at a point five years into the future. For each of these components a five-point scale is used. For scores describing the likelihood of entry and establishment the scale is based on the probability of the event occurring over a five year period as: 0–10%; 11–33%; 34–66%; 67–90%; 91–100%. The scale is narrower at the extremes to allow more positive discrimination of very rare and highly likely events. Spread is expressed as a proportion on a similar scale. Impact covers a wider range and follows an order of magnitude (log₁₀) scale, with parallel definitions in monetary, environmental and social terms as described by Baker *et al.* (2008). The most significant change over the original scheme has been in redefining spread as a proportional change in the resource affected, to allow for the different patterns of spread possible in heterogeneous environments, in linear resources like rivers or hedgerows, and in isolated situations, like ponds. This has made the multiplicative product of the four risk components more meaningful in terms of risk interpretation.

Associated with each score, the assessors also give a confidence rating on a four point scale, based on the definitions of the Intergovernmental Panel on Climate Change (IPCC, 2005). This is based on the expected chance of the score being correct (about 35%; 50%; 80%; 90%). The lower end of this scale is modified from the IPCC scale to allow for there being only five choices of score on which to express confidence. The Eppo scheme uses only three scale points, and asks for the level of uncertainty rather than its inverse (confidence), whereas the GBNNRA scheme uses four levels to allow even higher degrees of confidence to be expressed, particularly when dealing with cases where organisms have already successfully entered and/or established in Great Britain. The expression of uncertainty or confidence is very important to allow assessors to make judgments with reservations in many cases. However, this poses a challenge to risk communication and interpretation, which we have attempted to address in the GBNNRA scheme by Monte Carlo simulation of risk using specific score distributions for entry, establishment, spread and impact.

No attempt is made to sum the scores of the individual questions in the templates to produce quantified overall scores. No appropriate weighting mechanism has been found that would allow this, reflecting the diverse nature of the organisms and issues in question. In addition to a response to each question the assessor is asked to provide a summary score for each of the four components as well as an overall risk and confidence score. The individual question scores from the template are used, with their confidence rating and assessor documentation, as part of the peer review process to validate the four key components. Individual question scores can be visualized against a background bar showing the integrated estimate provided by the assessor for each of the four key component scores (Fig. 1), with shading to indicate the degree of confidence (narrower, sharper bars represent greater confidence in the integrated score, and smaller bubbles represent a greater confidence for individual questions). The NNRAP, as part of its peer review, considers how well the documented evidence justifies individual and overall scores and confidence, and takes note of the implied weighting of different elements by the assessor in reaching their integrated score. Where the evidence is not consistent or insufficient, assessments are returned to the assessor for further explanation or revision, with further iteration of the process until consensus is achieved. By contrast, the Eppo uses its template as a focal point to record consensus as it is agreed by a risk assessment panel assembled as a group, with the Eppo secretariat providing the continuity between assessments for different species.

Results

There are over 100 risk assessments of organisms that have or may enter Great Britain in progress using the GBNNRA scheme (risk assessments accepted as “fit for purpose” can be viewed at <http://www.nonnativespecies.org>). These include mammals, birds, crustaceans, fish, molluscs,

NNRAP - Risk Assessment Visualiser

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Visualisation types to show on subsequent sheets:

- Histograms
- Box with Error
- Error Bars only
- Robbers

Example Mammal - Cross channel by vehicle

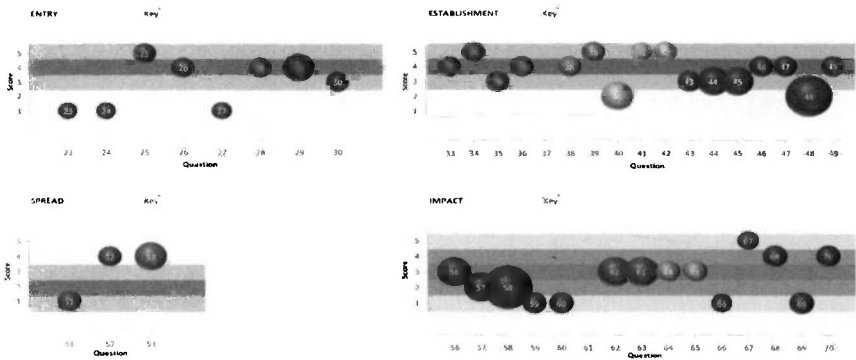


Fig. 1. A visualization of the responses to individual questions and four key risk components in the Great Britain Non-native Species Risk Assessment Scheme.

and plants. A risk profile can be produced (Fig. 2) for each organism, showing the cumulative probability of a magnitude of impact being reached five years into the future. This cumulative risk profile is generated by sampling the component scores according to the confidence distribution for each component in a simulation comprising 5000 realizations of score values. A steep curve denotes higher levels of confidence by the assessor. This simulation helps in the interpretation of the assessment by showing the distribution of possible expected outcomes, so that managers can consider the level of uncertainty across the full range of possibilities, rather than focusing only on the worst case, or the median. The cumulative risk profiles also allow a common comparative measure for risks between organisms when considering priorities and consistency of response.

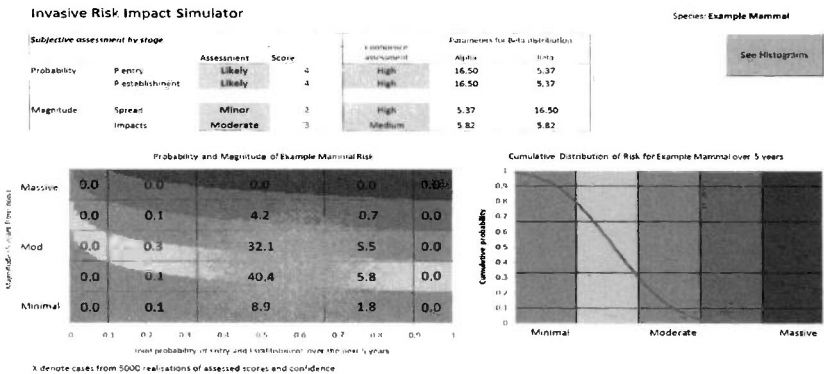


Fig. 2. A representation of the cumulative risk simulated for a species from the combined assessments of likelihood and magnitude, taking into account assessor confidence.

Another use of the profiles is to test the impact of greater confidence on the interpretation of the risk. We may all wish for greater certainty, but this may come at a significant cost. The NNRAP can look at how much the risk profile would change with more or less confidence in particular

scores and makes a judgment on how valuable extra information may be. The NNRAP must also consider whether, say, seeking a third opinion (beyond the assessor and the independent reviewer) would result in convergence on a confident consensus, or simply create even greater disagreement.

Discussion

The use of a consistent template of questions across the range of species ensures that the outputs of risk assessments can be compared to set priorities on risks. The four main components of risk for a non-native organism are estimated explicitly in a way that allows risk to be estimated as a product of likelihood and magnitude, based on the component definitions as a probability, a proportion and a monetary value. Uncertainty is explicitly identified in each question, and all ratings and confidence scores are documented by the assessor, reviewed, and validated by a peer review panel. The aim is to produce a robust and pragmatic assessment of relatively unknown risks in a manner that allows management decisions and priorities to be informed by sound evidence.

The NNRAP has used a time horizon of 5 years in the future in making impact assessments. This was chosen because of the difficulty of making shorter term assessments because of seasonal variation from year to year, and the difficulty of getting high confidence in assessments over longer terms. Impacts 5 years in the future give some implied priority to invasive organisms with more immediate impacts. A revision of the template is being implemented that will seek information from assessors on longer term impacts that may be relevant to management decisions, but it is expected that there will continue to be a common reference period to allow species comparisons.

In the evolution of the scheme, questions judged not to contribute to the overall value have been removed, and questions and scores have been reviewed to ensure they are presented in clear language and without potentially confusing multiple concepts embedded within them. It has been difficult to remove questions; however, because of the diversity of species involved. While some issues are not important for many species, they may be critical for others. The gradual change in the detailed questions does not affect the overall meaning of risk assessments made over the course of the scheme, since only the four integrated components (directly elicited from the assessor) contribute to the overall risk measure. The more detailed questions are used as an important guide to the peer review of these estimates and to inform the risk management process. This approach to risk estimation has also avoided the difficult issue of variable weighting that occurs with many assessment schemes which use summation of scores. The use of simulation to sample the distributions of the four key components ensures that the uncertainty elicited from the assessors is captured in the final risk assessment.

It has been important to build this Great Britain Non-native Species Risk Assessment Scheme in close harmony with similar schemes with wider geographical coverage in Europe and with those that focus on agricultural pests in plant health. The current review by the European Commission DG SANCO of the Community Plant Health Regime (Food Chain Evaluation Consortium, 2010) recommends that the regime be extended to include invasive alien species alongside agricultural quarantine pests, that natural spread be included without the distinctions that currently apply, and that there is better risk targeting through prioritisation mechanisms. The Great Britain scheme already addresses these issues in a way that will hopefully make it a robust model as the greater inclusiveness, harmonisation and modernisation of the wider European scheme takes place.

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