

# Science for Environment Policy

## Under- and over-managing invasive species: what are the acceptable risks and costs?

**Monitoring of at-risk sites is important for preventing the arrival and spread of invasive species.** However, resources are often insufficient to achieve the level of risk reduction desired by authorities. This study presents a novel framework, based on the 'acceptable level of risk' construct, to align needs to reduce risk with available resources.

**When animals and plants are introduced into a natural environment where they are not usually found, it can have serious consequences.** As well as representing a threat to [biodiversity](#), invasive alien species are economically destructive — causing damage that costs Europe billions of Euros each year<sup>1</sup>. To avoid these negative impacts, a range of management schemes have been developed: prevention (limiting the arrival of new populations), early detection and rapid response (detecting and eradicating new populations), and control (monitoring and reducing the impacts of existing populations).

In order to be effective, monitoring efforts require sufficient financial resources. Decision making on investment for such efforts usually involves cost-benefit analysis, which compares the costs of an action to the costs of inaction. An alternative approach is 'acceptable level of risk' or ALOR, which represents the highest level of risk an organisation is willing to accept, and is often relative to the costs of implementing a risk-reduction policy. An informal example of ALOR could be home insurance. Somebody with a higher ALOR might be willing to accept a less expensive policy, which provides less protection in the event of a disaster but saves money under ordinary circumstances.

Although the ALOR concept is already used in policy, applying it to management programmes presents many difficulties, such as how to measure risk. Hence, according to the researchers, previous invasive species management programmes have focused on available resources, which prioritises affordability over need to reduce risk.

This study attempted to create a management framework that has outcomes in line with ALOR. The framework is based on 'Type II error' — the quantitative equivalent of ALOR. Type II error represents the acceptable 'miss rate' of failing to intercept a species of concern, and therefore the costs of under-management of invasive species (e.g. incorrectly assessing a new species as no impact). As under-management can lead to potentially irreversible environmental damage, considering Type II errors is critical to effective management. Type I errors refer to over-management (e.g. incorrectly assessing a new species as high impact).

To demonstrate its use for biosecurity decision making, the framework was applied to monitoring of lakes in Michigan, USA, which are at risk of invasive species due to recreational boating activity. Monitoring was of the 'early detection and rapid response' type, used in the context of a large aquatic plant survey programme.

The decision-support framework was applied to two different scenarios. The first (*current budget*) determined the ratio of acceptable error rates in a standard early detection and rapid response programme. In the second scenario (*ALOR budget*), the ALOR indicated by a policy document (the 2012 Great Lake Restoration Initiative Action Plan) was used to determine the budget. Here, the acceptable Type I error rate represents the acceptable rate of assigning a lake as high risk when it is in fact moderate or low risk (*over-management*) and the acceptable Type II error rate represents the acceptable rate of assigning a lake as low or moderate risk when it is in fact high risk, and missing a species introduction (*under-management*).

Continued on next page.



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1. [http://ec.europa.eu/environment/nature/invasivealien/index\\_en.htm](http://ec.europa.eu/environment/nature/invasivealien/index_en.htm)

# Science for Environment Policy

## Under- and over-managing invasive species: what are the acceptable risks and costs? (continued)

Of the 391 locations captured by the survey, 42% were categorised as 'low', 'moderate', 'high' or 'very high' risk, and therefore had some risk of species introduction. Applying this proportion to the 1157 Michigan lakes subject to invasion risk, 491 lakes are at risk of invasion.

The Type I (over-management) costs were the costs of monitoring, which, under the current budget scenario, were US \$64 137 (€59 053) per year. The costs of under-management were more complex, and based on the costs of controlling introductions and property value decline (due to reductions in environmental amenities, such as recreational use of the water). Combined, the costs were estimated at \$131 600 (€121 229) per water body. This was multiplied by the number of lakes with unacceptable risk levels (greater than 'very low'). The total Type II costs were estimated to be \$64 615 600 (or \$131 600 x 491; €59 174 500).

Under the current budget, the ratio of acceptable Type II to Type I (under-management: over-management) error rates was 1007:1. This suggests a willingness to under-manage over 1000 times more often than to over-manage, and means the ALOR is very high.

Under the ALOR budget scenario, the costs of monitoring to achieve the mandated 'very low' ALOR was \$323 078 000 (€297 466 166). There was a large gap between the resources needed to achieve the desired level of protection and actually available resources (\$64137, or €58736).

As the authors acknowledge that a budget of \$323 (€297) million is unrealistic, they suggest ways to reduce the cost. Raising the ALOR to 'moderate' would reduce the optimal budget to \$6.46 (€5.95) million, while reducing the acceptable rate of over-management would reduce it to \$32.3 (€29.7) million. The final suggestion was to reduce overall risk, for instance by establishing quarantines or installing boat wash stations.

The researchers say existing approaches to minimise species introductions — which rely on cost-benefit analyses — focus on reducing management costs rather than addressing policy mandates like ALOR. By contrast, the framework presented in this study makes risk a driving factor, increasing the political and management relevance of analysis, they suggest. The researchers say their framework could be used for other aspects of invasive species management (e.g. prevention or control) and for other environmental applications, such as species conservation or habitat restoration.



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