WP 6

Agenda Item: CEP 8a

Presented by: SCAR, Australia

Original: English

Current knowledge for reducing risks posed by terrestrial non-native species: towards an evidence-based approach

Attachments: atcm33_att005_e.doc – Appendices 1 and 2.

Current knowledge for reducing risks posed by terrestrial non-native species: towards an evidence-based approach

Introduction

Non-indigenous species (NIS) are considered one of the most significant conservation challenges for the Antarctic, and have been discussed in a wide variety of papers to the Treaty[(1-4)].

Three major classes of challenge posed by NIS for the region may be recognized[(5,6)].

a) The introduction (by humans) and establishment of species not indigenous to the area south of 60°S – **extraregional introductions**.

b) The movement (by humans) and subsequent establishment of species indigenous to the Treaty Area among biogeographic zones or biologically distinct areas, from areas where they naturally occur to those where they do not – **extralimital introductions**.

c) The introgression of populations, constituting the movement of individuals (by humans) among populations that are genetically distinct – **genetic homogenization**.

The vectors and pathways for the entry of extraregional introductions to the Antarctic, and the higher taxa most likely to be transported are being increasingly well documented[(3, 7-19)]. Thus, risk assessments for extraregional introductions to the Antarctic based on vectors, pathways and propagule pressure can now readily be undertaken, and methods to do so exist[(1,13-18)]. Clear goals for eradication have also been discussed[(16)]. Although knowledge of vectors, pathways and taxa is not well developed for microorganisms and micro-invertebrates (tardigrades, nematodes)[(16,17,20,21)], this situation is not unique to the Antarctic.

Less attention has been given to the requirements for reducing the risks of extralimital introductions and genetic homogenization, even though these risks have been recognized explicitly for the region[(18,20)]. The risks associated with these two processes may be higher than those for extraregional introductions because the physiological barriers to establishment[(22)] for individuals of Antarctic species in another Antarctic site are likely to be much lower than those for individuals of most species from outside the region.

In this paper, the prospects for and complexities of risk assessments are reviewed. Information on vectors and pathways will be provided by IPY Aliens in Antarctica project[(19)] and are available elsewhere[(10,14,15,17,20)]. The primary objective is to provide an overview of how further to consider the risks associated with NIS, in keeping with global conservation best practise and the developing framework for such management in the region[(4)].

Extraregional introductions

Risk assessments for vascular plants and the majority of macroinvertebrates can be readily designed. General weed risk assessment (WRA) systems for plants are available[(23-25)], and a proposal has been made for introducing these sorts of systems for the region[(4)]. An example of such a system for the Antarctic region is available[(26)] (Appendix 1). Research outside the Antarctic shows how economically beneficially such assessments are[(27)].

Weedy species or species indigenous to areas adjacent to the Treaty area and those typical of logistic areas at ports of departure could be assessed this way. Good data for the identities and distributions of vascular plants, insects and several other groups are already available[(28)].

The above procedures apply to the most visible of the species likely to be introduced from outside the region. For more poorly known groups, such as micro-invertebrates and microorganisms, which may pose the most substantial risks of successful introduction, risk assessments are unlikely to be useful because of lack of information on them[(17,18,20,21)]. For these groups, assessment of pathways of introduction and restriction of these pathways[(10-20)] represent the only practicable means of reducing introduction likelihood.

For early detection and rapid response, methods exist to detect species at low abundances[29-31]. Surveys of this kind could be implemented for high visitor areas in the Antarctic. Methods to ensure detection for eradication are also developing rapidly[32], and those typically applied to decision-making for assessing extinction probabilities of rare species can also be used[33].

The lack of taxonomic information on many taxa and on the distribution of indigenous diversity[17,20,21,34] means that the probability of detection will be low for some of the groups most likely to be introduced.

Extralimital introductions

Much of the risk associated with extralimital introductions can be reduced by applying the same kinds of preventative measures typically used for extraregional introductions, and some initial proposals for risk reduction have already been made[35]. However, little attention has been given to risk assessments for the likelihood of cross-regional establishment. Because such assessments incorporate information on climates and life-histories of the species involved, the availability of the Environmental Domains Analysis (EDA)[36] will aid initial assessments, but detailed assessments will be constrained by the lack of information about many Antarctic taxa[21,37,38].

Early detection and rapid response will be further constrained by the lack of information on the taxonomy and spatial distribution of much of Antarctica's biodiversity. Of the 142 ice-free grid cells included by SCAR in the biodiversity assessment of the EDA, 45 have no species records in the SCAR database and only a few are thought to be comprehensively surveyed for the groups included in the assessment. Whilst information is improving rapidly for many taxa, the spatial coverage remains inadequate[39]. Thus, identifying an extralimital introduction will be exceptionally challenging[16,34].

Because of the challenges, quarantine arrangements for movement among environmental domains and biogeographic regions[36,40], across major biogeographic discontinuities (e.g. the Gressitt Line[21]), and to sites with unique characteristics (e.g. Charcot Island[41]) would benefit from additional consideration. Much would be gained from a concerted effort to survey biodiversity in areas that are subject to high numbers of visitors and to rapid climate change. Distinguishing the responses of local species to climate change from those of anthropogenic influences, and distinguishing natural colonisations from those assisted by human visitors will be especially challenging, as they are elsewhere[42].

If a major conservation aim is to reduce the risks posed by NIS, more rigorous approaches to managing NIS risk and quarantine for both ASPAs and the ice-free areas surrounding them[16] will be required. One way to provide the information required to do so would be to assemble comprehensive and accurate species lists for all their major taxa through surveying and the application of modern genetic approaches[43].

Genetic homogenization

Genetic differentiation among populations in the region is now appreciated in the context of the risks associated with the human-assisted movement of biota in the region[18]. However, it may be less widely known that substantial evolutionary diversification at the population level exists over surprisingly small spatial scales, sometimes <1 km[44,45]. At larger spatial scales the extent of evolutionary diversification is also high for a range of taxa once thought to be the same species[46-48].

Whilst setting limits to genetic homogenization might seem a difficult task, and may be impossible for many organisms, it should be realized that the 'everything is everywhere' idea for small organisms is likely not applicable to Antarctica. Thus understanding evolutionary diversification and reducing the risk of homogenization is necessary.

Such risk assessments are probably most suitable initially for areas with high visitor numbers. If diversification is high among populations, restriction of visitor numbers and numbers of independent visits could be considered, or improvement of quarantine measures specifically for equipment and samples. Designation of an area as an ASPA will be insufficient if the management strategy for the specific site does not explicitly take these risks into consideration both for the site and for surrounding ice free areas.

Key Conclusions

Risk assessments for extraregional introductions, and notably to the Antarctic Peninsula and Scotia Arc islands, will prove useful for reducing the likelihood of NIS establishment.

Development of eradication measures and implementation thereof where establishment of NIS has been demonstrated would be in line with international best practise in early detection and rapid response. However, identification of anthropogenic introductions may be problematic for microorganisms, in areas with rapidly changing climates, and in both cases appropriate molecular genetic approaches would inform decisions.

For many taxa, risk assessments are impracticable and may remain so owing to an absence of appropriate taxonomic knowledge and spatially explicit information for the region. A focus on pathways and their restriction would be most appropriate for these groups.

Protocols for limiting propagule transfer among biogeographic and unique biological regions should be investigated especially where air networks and rapid field transfers are involved.

Baseline diversity surveys and survey protocols for detection and response would be useful in highly visited areas, especially those that are showing rapid change.

A concerted effort to improve knowledge of the spatial distribution of diversity in Antarctic is required. A first start may be to survey comprehensively ASPAs and their surrounding ice-free areas.

Protocols to limit genetic homogenization should be considered based on risk assessments for the specific sites. The latter could be informed by targeted molecular surveys.

A review of best practise in risk assessment, survey design, detection and rapid response should be undertaken. SCAR intends to include such a review as part of its joint meeting on Conservation Best Practice for the Region.

References are in Appendix 2.