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Item 22 of the provisional agenda*

ALIEN SPECIES THAT THREATEN ECOSYSTEMS, HABITATS OR SPECIES

Progress report on matters relating to the implementation of paragraph 14 of decision V/8 of the Conference of the Parties and section B in recommendation VI/4 of the Subsidiary Body on Scientific, Technical and Technological Advice

Note by the Executive Secretary

I. INTRODUCTION

1. In paragraph 14 of its decision V/14, on alien species that threaten ecosystems, habitats and species, the Conference of the Parties requested the Executive Secretary to collaborate with the Global Invasive Species Programme, the Food and Agriculture Organization of the United Nations, the International Maritime Organization, the World Health Organization and other relevant organizations, and other relevant internationally and regionally binding and non-binding instruments to assist the Parties to the Convention in:

(a) Developing standardized terminology on alien species;

(b) Developing criteria for assessing risks from introduction of alien species;

(c) Developing processes for assessing the socio-economic implications of alien invasive species, particularly the implications for indigenous and local communities;

(d) Furthering research on the impact of alien invasive species on biological diversity;

(e) Developing means to enhance the capacity of ecosystems to resist or recover from alien species invasions;

* UNEP/CBD/COP/6/1 and Corr.1/Rev.1.

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(f) Developing a system for reporting new invasions of alien species and the spread of alien species into new areas;

(g) Assessing priorities for taxonomic work.

2. In addition, in section B of its recommendation VI/4 on intersessional work on invasive alien species (UNEP/CBD/COP/6/3), the Subsidiary Body on Scientific, Technical and Technological Advice requested the Executive Secretary to:

(a) Explore ways and means of cooperating with the Office International des Epizooties and the international and regional organizations operating within the framework of the International Plant Protection Convention in the development and periodic review of standards recognized under the Agreement on Sanitary and Phytosanitary Measures of the World Trade Organization; and

(b) Explore, for biodiversity-related matters not covered by the above organizations, possible options for facilitating the development of standards, guidelines and recommendations for recognition under the Agreement on Sanitary and Phytosanitary Measures of the World Trade Organization.

3. In the same recommendation, SBSTTA invited Parties that have not provided their national reports in response to paragraph 8 of decision V/19 to do so as soon as possible, and all Parties, other Governments and relevant bodies to continue to provide case-studies, for dissemination through the clearing-house mechanism.

4. The Executive has prepared the present note to complement the information provided in UNEP/CBD/COP/6/18 (Alien species that threaten ecosystems, habitats or species: Review and consideration of options for the implementation of Article 8(h), on alien species that threaten ecosystems, habitats or species) and assist the Conference of the Parties at its sixth meeting in its consideration of item 22of the provisional agenda, on alien species that threaten ecosystems, habitats or species.

II. MATTERS REQUESTED BY THE CONFERENCE OF THE PARTIES

5. The Executive Secretary carried out informal consultation with experts from various organizations including in particular the Global Invasive Species Programme, the International Plant Protection Convention, the Food and Agriculture Organization of the United Nations, the International Maritime Organization, the World Health Organization, the Office International des Épizooties and various organizations working on plant conservation to find ways to identify elements and ways for assisting the Parties to the Convention on issues listed on para 14 of decision V/8.

A. Developing standardized terminology on alien species

6. The Executive Secretary received comments from the Glossary Working Group of the International Plant Protection Convention and the Office international des epizooties and has issued a revised note on use of terms to take into account the comments received (UNEP/CBD/COP/6/18/Add.1/Rev.1). This information complements the report in para. 13 of UNEP/CBD/COP/6/18.

B. Developing criteria for assessing risks from introduction of alien species

7. See paragraph 13 in document UNEP/CBD/COP/6/18.

C. Developing processes for assessing the socio-economic implications of invasive alien species, particularly the implications for indigenous and local communities

1. General considerations on the assessment of the socio-economic implications of invasive alien species

8. From the literature produced under the first phase of GISP, there is clear evidence that an understanding on how human behaviour and AIS interact is key for any appropriate prevention and control strategy. Human decisions and subsequent activities do not only constitute vectors for the introduction and the spread on alien species, but also affect the local resilience of ecosystems and the possibility for timely policy responses, thus influencing the risk of alien species to establish and spread (to become invasive) and, hence, having a crucial impact on the success of preventive measures. Humans will usually adapt their production and consumption patterns to invasive alien species; this has a crucial influence on the estimated net costs of invasive alien species. In addition human behaviour, especially at the local level, will have a significant impact on the chances for success of specific eradication and control measures.

9. Any meaningful prevention and control strategy has a cost. Given budget constraints, any decision-making on what, if any, measures to apply will inevitably involve trade-offs. In consequence, the determination of costs and benefits of invasive alien species and the related options for prevention, eradication and control becomes paramount.

10. Moreover, it is widely agreed that costs associated with invasive alien species mostly accrue at the local or regional level, either directly (e.g., through losses in agricultural productivity) as well as indirectly (e.g., through a loss of ecosystem services). While some costs may also accrue on an international level, the preponderance of local costs points to the important role of local and traditional communities in assessing the impacts of invasive alien species and designing adequate policies for prevention, eradication and control.

2. Invasive alien species and local and indigenous communities

11. In considering the socio-economic implications of invasive alien species on local and indigenous communities, experiences in Australia provide many valuable insights as such implications have been the subject of a number of studies in the arid and semi-arid lands of the more remote regions of central, northern and northwestern Australia, where local indigenous communities have had at least a century of experience with several fauna species that have been introduced to the continent by European settlers since 1788.

12. The list of invasive alien species includes camels, donkeys, horses, cats, rabbits, foxes, dogs, pigs and goats -- all of which have had significant impacts on the local ecosystems, and in some cases, causing the disappearance of native species from these ecosystem. With the exception of rabbits and foxes, all were brought in as domesticated animals; all, including rabbits and foxes, have established large populations and all are subject of management and control programmes. From the studies, a number of conclusions of relevance to policy-makers, local indigenous stakeholders and environmental managers have been drawn, namely:

(a) Local indigenous communities do not view the presence of the above-mentioned invasive alien species in the same way as policy-makers and environmental managers do. For example, the local indigenous communities generally consider that these invasive alien species have a right to live in the local environments fitting in with their cultural view of their world. They do not usually see them as posing any

threats to the environment, local habitats or to particular native species. Thus in a sense, these communities see these species as neither alien nor invasive, but often as a valuable resource;

(b) There can be considerable variation between the local indigenous communities on their views about particular invasive alien species. This has implications for the management of such species. For example while some communities bestow a quasi-sacred status on camels and donkeys via references in the Bible and are therefore reluctant to see such animals captured for sale or slaughter, other communities see these animals as an economic asset;

(c) Many invasive alien species have become economically significant to the local and indigenous communities, either as subsistence species (for example, rabbits, feral cats, pigs and goats), or as commercially valuable (particularly camels and horses). The removal or reduction in the numbers of such species may therefore have significant economic impacts for these communities, especially in regions where economic opportunities are few;

(d) To date, programmes to control populations of these invasive alien species do not generally reflect local indigenous community priorities - also bearing in mind point (b) above. Many communities feel that if the government wants to control these species, they should compensate the communities for the loss of resources that they would suffer.

13. This "snap-shot" from Australia does provide some clues to the scope and dimensions of the issues concerning socio-economic impacts that should be taken into account with regard to research questions and methodologies and in the formulation of adequate and appropriate terms of reference for any project on the assessment of the socio-economic dimensions of invasive alien species with respect to indigenous and local communities.

3. Key elements of a research agenda for assessing the socio-economic implications of invasive alien species

14. In light of the above insights and the Australian example, the following seem to be necessary elements of a future research agenda on assessing socio-economic impact of invasive alien species. Assessments may, in principle, be applied under two distinct situations or states-of-the-world: a specific alien species may have already become invasive, or this may not (yet) be the case. Both situations are now discussed in turn. Some of the elements discussed under the second situation do also apply to the first situation.

(a) Before invasion (introduction and establishment of invasive alien species): risk assessment and prev ention

15. Most measures designed to prevent the introduction of invasive alien species or their establishment and spread are taken at the national level (e.g. quarantine and other trade-related laws). It might therefore appear that local communities have only a very limited role in this regard. However, their role may be more substantial when they are associated to the planning and implementation of measures:

(a) *Intentionally introduced alien species*. In some cases, the introduction of alien species may be preferred by policy-makers because of the huge associated benefits, although, in the case of spread, their negative effects on neighboring ecosystems and the related costs will also be substantial. In these cases, the introduction of the alien species may be coupled with a regulatory regime designed to prevent the spread and establishment of the species into wild ecosystems. Enforcement of this regulatory regime will often be a public good of the weakest link-type, meaning that prevention will only be as effective as the degree of cooperation of the least enthusiastic member of the community. Community

cohesion and inter-community cooperation may be key factors in implementing such a regime, especially given the poor enforcement capacities of regulatory agencies even in developed countries. Assessments may further scrutinize the extent to which communities can play such a role in local enforcement and identify key factors that influence their capacities in this regard, as well as possible policy responses to such deficits. In this regard, it is important to note that increasing local enforcement capacity may decrease the risk of spread which, in turn, should feed into the initial risk assessment of the introduction of the alien species;

(b) *Early warning systems*. Local communities, in principle, can also play a key role in implementing effective early warning systems on the invasiveness of alien species. Again, assessments could analyze the capacity and the incentives of local communities to play such a role, as well as possible policy responses. Importantly, the overall policy on invasive alien species will have an impact on the incentives of stakeholders to take part in the early warning system. Specifically, when the overall policy favors measures that put an additional burden on local communities or that neglect the interests of important local stakeholder groups, those communities or stakeholder groups will not have an incentive to forward their information.

(c) *Risk assessment.* Within the formulation of prevention policies, governments have to analyze the risks of alien species becoming invasive. In economics, the expected costs of a harmful event or "bad state" are usually given by the costs accruing under the bad state times the probability of a bad state to occur. In regard to alien invasive species, the former (the costs accruing when the alien species becomes invasive and a pest) are usually very high, while the latter (the probability of the species becoming invasive and a pest) is usually very low. But it is well known in economics that such high-cost-low-probability situations put severe constraints on the expected-utilities-hypothesis and, hence, on usual cost-benefit analyses.* For the analysis of risks related to alien invasive species methodologies should therefore be developed that can constructively address or circumvent the related problems.

(b) After introduction and establishment of invasive alien species: eradication, control and other policy options

16. Any assessment should cover all possible benefits and costs, both of the impacts of the invasive species as well as of the possible measures for prevention and control. This is important, as traditional cost-benefit-analyses, especially for biological control, often focus on producer's surplus and the direct costs of control measures alone. Specifically,

(a) Indirect costs of invasive alien species (e.g. through the loss of ecosystem services, deteriorated local nutrition and medicine, and the loss of social or religious values) need to be taken into account;

(b) Benefits of invasive alien species should be fully taken into consideration, also including those that are merely a by-product of accidental spread.

(c) Costs of specific control measures should also include the indirect costs (e.g. health and ecological hazards from chemical eradication programmes) as well as their opportunity costs (the foregone net benefits of not taking the same measure to deal with the problem of another invasive alien species).

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* For a discussion, see: Perrings, Charles (2000*): The Economics of Biological Invasions*. Paper prepared for the workshop on Best Management Practices for Preventing and Controlling Alien Invasive Species. 22-24 February 2000, South Africa, p. 6-7.

17. Assessment of the costs and benefits of invasive alien species should fully consider the opportunities for adaptation of local communities. For instance, any assessment of productivity losses in agriculture due to imported pests will be biased when not accounting for farmers' opportunities in crop substitution. As the Australian example makes clear, traditional communities may also adapt their diet to new hunting opportunities given by invasive alien species. Here, the opportunity was turned into a benefit for the community, which, in this case, may also have lowered the pressure on local biodiversity. In other cases, adaptation measures may lead to further ecological and economic deterioration; such secondary effects should also be taken into account.

18. Assessments should be policy-oriented, striving to answer the question which, if any, (mix of) policy measure(s) is most appropriate and cost-efficient, including both the full range of instruments in eradication and control. The potential irreversibility of the costs of invasions and the uncertainty of the damages they may cause both favor a conservative approach to their management. But this has been tempered by a realistic appraisal of the costs and benefits of the options.

19. Hence, assessments should:

(a) Be undertaken *ex ante*, before the design and implementation of a specific policy measure. In biological control, many cost-benefit-analyses only deal with 'successful' control programmes. While these are usually shown to be highly cost-effective, success rates of such programmes are often rather low, 10-15 % for insects and 30-40 % for weeds. In consequence, such analyses were characterized in the literature as calculating the value of a winning lottery ticket, which tells nothing about the efficiency of the decision to buy a (specific) lottery ticket;†

(b) Not restrict from the outset the set of measures considered. Their methodology should not only be suited to fully compare a given set of eradication and control measures, but should also be open and able to identify, during the assessment process, additional policy options. Under the Australian example given above, the hunting of the invasive alien species by local traditional communities might appear as an interesting option for control policy, whose benefits and possible shortcomings should be taken fully into account in the assessment of possible policy measures;

(c) Tap economic valuation methodologies. While methodological and capacity-related challenges in regard to non-market valuation exist, these tools are of strategic importance in policy formulation. As they analyze different types of costs and benefits under the common (economic) metric of money and prices, they allow to directly compare the cost-efficiency of the different policy options at hand, and to easily communicate them to stakeholders and the general public;

(d) Actively involve all relevant stakeholders and local communities. In the light of the Australian example above, the involvement of all relevant stakeholders is not only key to identifying additional policy options, but also to success in eradication or control. Many control measures presuppose cooperation at the local level. Specifically, control will again be a public good of the weakest-link type. Hence, not taking into account the interests of an important local stakeholder group may undermine the success of eradication and control programmes. Moreover, because of the said weakest-link characteristic, community cohesion and inter-community cooperation may also be key factors for success. Assessments should therefore explore possible synergies between control programmes and community cohesion and, subsequently, the necessity of additional measures to actively explore such synergies.

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† Hill, Gary; D. Greathead (2000): "Economic evaluation in classical biological control". In: Perrings, Charles; M. Williamson; S. Dalmazzone (eds): *The Economics of Biological Invasions*. Cheltenham, UK: Edward Elgar.

D. Furthering research on the impact of alien invasive species on biological diversity

20. See paragraph 14 in document UNEP/CBD/COP/6/18.

E. Developing means to enhance the capacity of ecosystems to resist or recover from alien species invasions

21. There are a plethora of management actions for invasive alien species, but it is only now that ecosystem-based approaches are beginning to be developed and put into action. The means by which ecosystems may be enhanced to resist biological invasions remains very much still in the theoretical and laboratory based experimental stage, while the measures for helping ecosystems to recover are more developing into practical options. Even then the system-based context is only now being developed.

1. Means to enhance the capacity of ecosystems to resist invasive alien species

22. The ability to predict the most likely sites of future invasions and future invaders has great importance as a research and practical issue (Mack *et al.*, 1999). Ecosystem resistance to invasion has been defined as the inherent resistance of native ecosystems to invasions (Williamson 1996). A survey of the literature reveals that there is virtually no 'practical means' of enhancing the capacity of ecosystems to resist from biological invasions caused by invasive alien species. There is, however, a body of theoretical and experimental information (Elton, 1958; Case, 1990; Baltz and Moyle, 1993; Grosholz, 1996; Tilman, 1997; Williamson, 1996; Mack *et al.*, 1999; Smith *et al.*, 1999; Lonsdale 1999 and 2002) on factors and attributes of ecosystems/communities that may make them less susceptible (i.e. resistant) or more prone to invasions. This information can set the foundation for deriving practical measures applicable at the system levels. However, elements that may increase and decrease susceptibility to invasive alien species are not universally accepted.

23. The term "invasibility" has been put forward to describe inherent susceptibility to invasions (most often interpreted as inverse of invasion resistance). Invasion resistance is a relative characteristic (Lonsdale, 1999 and 2002; Williamson, 1996), which can be measured. Others have pointed out that propagule pressure, described by Williamson (1996) as the number of propagules arriving at a site, is being considered more important than the attributes of systems in determining the degree to which a system is invaded.

24. An analysis of global patterns of plant invasion showed that it was difficult to make conclusions on relative invasibility of regions and biomes with the existing information (Lonsdale, 1999). Ecosystems with fewer invasions may be perceived as those that are more resistant to invasions. This could be a false conclusion for reason such as lack of concrete information on such places (e.g., tropical rain forests, coral reefs). A recent review of the habitat diversity of marine and coastal invasions argues that, in part, lack of investigation may have led to the appearance that certain communities are less invaded and thus more resistant to invasive species (Carlton, 2002). Some systems (e.g., San Francisco Bay) do not seem to "resist" invasions - a rich dversity of invasions (now over 250 species) does not seem to result in a reduced number of invasive species that continue to become successfully established there (Carlton. personal communication). One conclusion that emanates from the current state of work is that a proper understanding of what constitutes invisibility is yet to be put forward. Simberloff and von Holle (1999) suggest that 'invasional meltdown' may take place in situations where the rate of invasion accelerates as the ecosystem becomes more and more invaded resulting in collapse of the system. A similar example where one invasion exacerbates another is that of introduced species which induced the collapse of vital

species interactions in New Zealand's *Nothofagus* forests where non-native mammals and wasps affect native birds including a threatened forest birds and plant reproduction (Clout1999).

25. Ruiz *et al.* (2000) pointed out that "variation among recipient regions in susceptibility or resistance to invasions" is only one out of three possible categories of hypotheses (the other two being "variation in propagule supply characteristics; or bias in the quantity or quality of existing data") to explain observed patterns of invasion. They further stated that "these hypotheses are not mutually exclusive and have been advanced in various forms and combinations to account for patterns of invasions". They considered the role of resistance in a survey looking at patterns in invasions of coastal and marine communities and recommended that more rigorous measures of invasion resistance are urgently required.

26. It has been also argued that predictions of community vulnerability to invasions and of future invaders are complex and inextricably linked issues (Crawley, 1987) as exemplified by questions such as "Did a community sustain an invasion because it is intrinsically vulnerable or because the invader possesses extraordinary attributes? Do communities with few current invaders possess intrinsic resistance or have they been reached so far by only weak immigrants?" (Mack *et al.*, 1999). It is well established that in geographically and evolutionarily isolated locations, 'undisturbed' ecosystems are at great risk from invasions. These results show that the quality and intensity of disturbance and its possible interactions with other forms of change can bring about very complex consequences. More scientifically rigorous measurements are called for in order to test predictions of ecosystem resistance to invasions.

27. The role of 'disturbance'(both natural and due to human activity) in mediating invasions is a better documented aspect (D'Antonio and Vitousek, 1992; D'Antonio, 2000; Hobbs, 1989 and 2000; Hobbs and Hunneke, 1992) and its possible linkage to ecosystem/habitat resistance to invasive species merits serious attention. Decreasing levels of 'disturbance' may decrease chances of invasions. However, there is also some evidence that lack of disturbance does not preclude invasions by exotic weeds and that 'undisturbed' ecosystems are also invaded (Marler, 2000; Stohlgren, 1999). In coastal systems, decreasing 'disturbance' in the form of decreasing water pollution may actually make them more prone to invasions (Carlton, personal communication). This again suggests that the quality and intensity of disturbance and its possible interactions with other forms of change can bring about very complex consequences.

3. Means to enhance the capacity of ecosystems to recover from invasive alien species

28. Most invasive species management attempts, including efforts targeted at recovery/restoration of native biodiversity, address one or a few species, are short-term and address only issues of immediate concern. A strategic approach as opposed to a tactical approach for dealing with invasions has been called for where system management rather than species management is conducted and addresses the problem of why invasive species are established in a site or region (Mack *et al.*, 1999). This strategic approach has begun to be applied in some countries through the development of strategies aimed at specific groups of invasive species such as weeds (e.g. in Australia), or terrestrial vertebrates (e.g., in Europe). Other examples of strategic approaches include the national plans on invasive species as a biosecurity issue in New Zealand and the Working for Water Programme in South Africa (Mack *et al.*, 1999; Genovesi, 2000; Anon. 2001a; van Wilgen and van Wyk, 1999).

29. Out of all possible management strategies of invasive alien species, eradication (removal of the entire population), when feasible and if it can be carried out early enough in an invasion, is most suited as a means for restoration of native biological diversity. A recent analysis of eradication programmes provides examples of this management technique (Myers *et al.*, 2000). Zavaleta *et al.* (2001) discussed the potential impacts of removal of invasive species within an ecosystem perspective and suggest that

managers should ideally engage in pre-eradication assessment as well as post-eradication assessment on target species and the ecosystem.

30. The most successful examples of removal of introduced species are from small islands. There are also success stories from smaller areas on the continents. The papers presented at the first international meeting on *Eradication of Island Invasives*: *Practical Action and Results Achieved* showed that a variety of taxa had been targeted; a "surprising number of introduced populations have been eradicated; some at relatively low cost and without harmful side effects; and that the technology for this approach has evolved into one of great promise "(Simberloff 2002). The abstracts of the papers of this conference, which are still in the process of being published, can be found at http://www.issg.org/Eradicat.html. Many of the reported methods can be adapted into strategies based on ecosystems and communities. Experience with re-introductions of species lost or in severe decline from a site shows that they too can fail unless introduced species present are eradicated or controlled.

31. Protocols have also been developed for the restoration of systems, such as the South African fynbos once heavily invaded (Holmes and Richardson, 1999, Holmes *et al.,* 2000), based on conceptual frameworks that take into account community and ecosystem dynamics. The toolkit developed by the Global Invasive Species Programme on prevention and management (Wittenberg and Cock, 2001) is aimed mainly at managers of environment and biodiversity conservation. It contains many examples of successful case studies and develops a ' what to do' approach to the problems of invasive alien species. Good practice approaches for restoration are among those detailed. While not explicitly set within an ecosystem context, the practical means described can be applied to multi-species systems and using the ecosystem approach.

F. Developing a system for reporting new invasions of alien species and the spread of alien species into new areas

32. See paragraph 15 in document UNEP/CBD/COP/6/18

G. Assessing priorities for taxonomic work

33. See the draft programme of work of the Global Taxonomy Initiative (SBSTTA recommendation VI/6)

III. MATTERS REQUESTED BY SBSTTA

34. The Executive Secretary has started some consultation with the Office International des Epizooties and the International Plant Protection Convention to review standards recognized under the Agreement on Sanitary and Phytosanitary Measures of the World Trade Organization and explore possible options for facilitating the development of standards, guidelines and recommendations for recognition under the WTO Agreement on Sanitary and Phytosanitary Measures.

C. Progress report on national thematic reports and case studies on invasive alien species

35. See paragraphs 5, 6 and 16 in document UNEP/CBD/COP/6/18.

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