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Why and How to Make Plant Conservation Ecosystem-Based

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Received: September 12, 2011

Accepted: October 9, 2011

Published: February 1, 2012

doi:10.5539/sar.v1n1p48

URL: <http://dx.doi.org/10.5539/sar.v1n1p48>

The research has been financed by grants to Plantlife International from the Allachy Trust, the Rufford Maurice Laing Foundation, the Gurney Charitable Trust, the Tanner Trust and Dr William Hamilton. Susan Hamilton provided guidance on parallels with medicine, including on evidence-based approaches. Patrick Hamilton assisted with literature research.

Abstract

Compared to other groups of organisms, plants require distinctive approaches in their conservation because of their keystone roles in ecosystems and economies. The state of the whole plant cover of the Earth should be of concern to conservationists – for its capacity to ensure the survival of plant species, deliver ecosystem services (locally to globally) and provide produce from plants in ecologically sustainable ways. The primary targets of attention in ecosystem-based plant conservation are the relationships between people and plants, as relevant to every locality, rather than the species-centric approach of conventional plant conservation. Moving plant conservation to an ecosystem-based approach will require the development of training programmes for field practitioners and of information systems for their use.

Keywords: Plant conservation, Ecosystem-based, Evidence-based conservation

1. What is Ecosystem-based Plant Conservation?

We believe that the ecosystem-based approach is appropriate for plants and that plant conservation should be a consideration in all places where the land has, or potentially could have, a covering of plants. It is an approach requiring urgent development, given that many species of plants are under threat, large areas of vegetation are

ecologically degrading and there are severe declines in those many ecological services whose quality is closely linked to the plant cover on the land. According to a 2010 estimate, twenty-two per cent of plant species are threatened with extinction (www.kew.org/plants-at-risk).

Ecosystem-based conservation has been stipulated as the primary framework to be used for implementation of the Convention on Biological Diversity (CBD) (www.biodiv.org). The precise meaning of the ecosystem approach *sensu* CBD is debateable, but broadly it encourages conservationists to think in terms of systems and to keep in mind that people are major elements of ecosystems in nearly every case. A set of twelve guiding principles has been provided (www.biodiv.org/programmes/cross-cutting/ecosystem). Nevertheless, none of the sixteen targets of the Global Strategy for Plant Conservation, developed under the CBD, refers specifically to the delivery of ecosystem services, a fundamental part of the ecosystem approach.

We consider the ecosystem-based approach to have three purposes - conservation of plant species, delivery of ecosystem services and the ecologically sustainable supply of produce from plants (A.C. Hamilton & Hamilton, 2006; Pei, Huai, Hamilton & Hamilton, 2009). The conservation of plant species and their genetic diversity is the principal purpose of conventional plant conservation, targeted species by species. The methodology used includes the identification of species under threat (Red Lists) and the localities where they are found, and then trying to secure the continuing existence of the species, especially through the use of protected areas and *ex situ* facilities (Given, 1994; Heywood & Iriondo, 2003; Krupnick & Kress, 2005; Schemske *et al.*, 1994).

The nature of the land's plant cover has a strong influence on the functioning of ecosystems, acting on various scales (e.g. (Haslett *et al.*, 2010; IPCC, 2007; Nicholson *et al.*, 2009; Cao, Chen & Yu, 2009; Zheng *et al.*, 2002). One of the reasons why the conservation of tropical forest is important is because its existence contributes substantially to carbon sequestration, moderating global climate change. More locally, the plant cover can have a major influence on the local climate, the provision of water supplies, control over soil erosion and flooding, and the availability of habitats for animals, including insects that pollinate crops. These are provisioning and regulating ecosystem services. There are two other types (Millennium Ecosystem Assessment, 2005): cultural services, such as aesthetic appeal and spiritual value, which are important in the implementation of plant conservation (see next section), and supporting services, such as nutrient cycling, which are concerned with the internal functioning of ecosystems.

All types of production systems involving plants should be targets in ecosystem-based plant conservation. They include agriculture, livestock grazing in more natural habitats and resource harvesting from wild plants (timber, fodder, medicines, etc). Much progress must be made. Intensive, chemical-based, agriculture is a major cause of loss of biological diversity (Mabey, 2010). Extensive areas of savannah and other rangelands are over-grazed (He, 2009; Perrings, 2000). Livelihoods in developing countries have commonly been made more precarious by the overharvesting of resources gathered from wild plants, such as firewood (Dounias, Rodrigues & Petit, 2000). Even with protected areas, the inclusion of sustainable use as a major management objective is often unavoidable. Many protected areas, supposedly under strict protection, suffer from unregulated harvesting of their plants (Nagendra, 2008).

2. The Frontline: the Locality

The locality is the critical place for the pursuit of ecosystem-based plant conservation. This is where plants live and where conservationists can interact directly with those people who have the most immediate influence on their fate. In rural settings, such people may include farmers, herders, collectors of wild plant produce and the managers of protected areas, according to the site. Urban settings too are relevant to ecosystem-based plant conservation, for instance for the contributions that their plants can make to ecosystem services. Grass-covered, rather than hardtop, driveways permit the recharge of aquifers and reduce flooding (White, 2008), while plants in gardens can provide habitats for threatened wildlife (Osborne *et al.*, 2007).

The locality is where the integration of all three aspects of ecosystem-based plant conservation must be practically achieved. An initial step is the evaluation of the special conservation features of the place with respect to plants (Fig. 1). Analyses should be forward-looking, taking account of anticipated environmental change, for instance in the climate. Questions to ask include: how does (or could) the locality contribute especially to conservation of plant species?; how does (or could) the cover of plants at the locality contribute to the provision of ecosystem services?; what types of ecologically sustainable produce from plants does (or could) the locality provide?

Of course, actions taken away from the locality are often needed to achieve much conservation advance. They may include new laws and regulations, awareness-raising campaigns on plant conservation and steps taken to encourage environmentally responsible purchasing of plant-based products. However, any actions taken in

favour of conservation away from where the plants grow must result in better conditions for the plants on the ground to be of real use. The relationship between field projects and policy development can be synergistic. Progress at field level can be highly dependent on advance in policy. In turn, field examples can provide case studies useful for ensuring that policies are realistic.

Cultural services, the third type of ecosystem services, are of great importance for the delivery of plant conservation. It is normal in human societies for people to hold religious or other cultural beliefs that help protect certain features of the natural world from destructive exploitation (A.C. Hamilton, 2001). Examples include the beliefs and related practices that protect the Sacred Landscapes of the Tibetans, the Holy Forests of the Dai and numerous sacred groves in Africa and India (e.g. Xu *et al.*, 2005). Similarly protective beliefs are found in western societies. Americans are attracted to 'wilderness', the British to 'old fashioned countryside' and Germans to 'forest' (Schama, 1995).

3. Developing Plant Conservation as a Service

Plant conservation requires development as a service to deliver its full potential. We see a parallel with medicine, which similarly is an art applied to practical problems and which likewise is strongly influenced by science. The same form of social organisation seems appropriate for both, that is with a frontline of general practitioners delivering services to the public, backed up by information systems and other specialist support. However, there is a major difference between conservation and medicine. Medicine (dealing with human health) is much better supported financially than conservation (dealing with environmental health), even though the latter is just as essential in the longer term for human welfare.

There are many hurdles to overcome in building capacity for ecosystem-based plant conservation: gaining acceptance by government agencies and conservation groups of the validity of the approach, developing training programmes for field practitioners, developing information systems targeted at field practitioners and, most fundamentally, winning more public support. Plant-based sciences, such as botany and forestry, have been in decline as university subjects in many countries over recent years (Disney, 1998; A.C. Hamilton *et al.*, 2003). Plants tend to be poor relations to animals in the public's conservation consciousness, despite their key roles in ecosystems and economies. With the possible exception of the 'medicinal plant', no-one has yet come up with an image of plant conservations as iconic as the panda.

The key competencies required of field practitioners must be established. They will certainly include knowledge relating to all three purposes of the ecosystem approach, the social skills necessary to work constructively with partners, especially communities, and the acumen to know when to ask for help. These are demanding requirements, though in principle not much different from the cross-disciplinary understandings and inter-personal skills required of any practical conservationist. Previous educational experiences should be helpful for devising training programmes, for instance those of the People and Plants Initiative (PPI, 1992-2005), an international programme to build global capacity in applied ethnobotany (A. C. Hamilton, 2004). This experience is relevant, because applied ethnobotany, like ecosystem-based plant conservation, straddles the boundary between the social and botanical sciences and centrally involves working with communities. One lesson learnt from PPI is the value of extensive period of mentored field research by trainee professionals. As with the acquisition of other practical skills, there is much to be gained from an apprenticeship approach.

Knowing how conservation can best be pursued can be problematic, given its multidimensional nature with many influencing variables. An 'evidence-based approach' and 'participatory action research' (which is rather similar) have been proposed as useful for its development, the former inspired by its success in medicine (A.C. Hamilton & Hamilton, 2006; Song & Vernooy, 2010; Sutherland, Pullin, Dolman & Knight, 2004). There have already been some attempts at an evidence-based approach, for example a programme of WWF to identify best practice in integrated conservation and development projects (ICDPs) (McShane, 1999) and another of Plantlife International to identify how communities can best conserve their medicinal plants (A.C. Hamilton, 2008; Pei *et al.*, 2010).

An evidence-based approach involves periodic reviews of the evidence relating to the success or failure of practical efforts to deal with particular issues, followed by the formulation of recommendations on best practice. These recommendations can then be disseminated for wider practical adoption or treated as hypotheses for further testing. If properly applied, the evidence-based approach should not lead to 'cookbook' solutions, but rather to the integration of the expertise of the individual practitioner with the best external evidence (Sackett, Rosenberg, Gray, Haynes & Richardson, 1996).

4. Ecosystem Thinking Can Boost Species Conservation

The ecosystem approach is not a threat to conventional plant conservation, which is mainly concerned with saving species. Rather, by providing a wider conceptual framework - through broadening the purposes seen for plant conservation and rooting the discipline in people-plant relationships - it should increase the effectiveness of many activities associated with the conventional approach.

Success at achieving delivery of ecosystem services or sustainable use can result in relatively immediate and tangible benefits appreciated at local level. Therefore, emphasising these aspects of plant conservation can be helpful for gaining public support. Habitats that are good providers of ecosystem services are often good for species' conservation too (Dobson *et al.*, 2006; Duffy, 2009; Hector, Joshi, Lawler, Spehn & Wilby, 2001; Hooper *et al.*, 2005).

An example of how attention given to a prized ecosystem service can help deliver species' conservation is provided by the history of forest conservation on the Eastern Arc Mountains of Tanzania. These forests are of great global significance for the conservation of plant species (Lovett & Wasser, 1993). Here, the delivery of water supplies from the mountains is closely linked to the presence of forest. It was threats to water supplies, in particular, that led to the government strengthening its control over these forests during the 1970s (A.C. Hamilton & Smith, 1989). Later, it was the hydrological, more than the biodiversity, case that was critical in the decision to create Amani Nature Reserve on the East Usambara Mountains, a prime Eastern Arc site (AH, pers. involvement).

An example demonstrating the value of focusing on sustainable use is provided by the history of conservation of Bwindi Impenetrable National Park in Uganda (A.C. Hamilton, Cunningham, Byarugaba & Kayanja, 2000). The small forest contained within this park is of prime national and international value for the conservation of plant species (Davis, Heywood, Herrera-MacBryde, Villa-Lobos & Hamilton, 1994, 1995; Howard, 1991). It is home to half the world's mountain gorillas. The creation of the park in 1991 was accompanied by the imposition of strict rules prohibiting all access to its plant resources. This, in turn, generated local hostility and fires were set within the forest and threats made against the gorillas. A major contribution to avoiding disaster was a field evaluation of the values of the plant resources of the park to the local people (Cunningham, 1996). The results of this survey were instrumental in the drawing up of agreements between the park and local communities, allowing defined rights of access to plant resources (Wild & Mutebi, 1996). Tensions were reduced.

Placing more emphasis on ecosystem services and sustainable use should be useful for saving plant species away from protected areas, the desirability of which is widely acknowledged today. Many endangered species of plants are not confined to protected areas (e.g. about 40% of Chinese species – CSPC, 2008), certain aspects of plant diversity, such as traditional crop varieties, are closely associated with people and not readily amenable to a protected area approach (Pei *et al.*, 2009) and protected areas will lose much of their effectiveness for conservation with predicted climate change unless attention is given to conservation elsewhere (Ackerly *et al.*, 2010; Manning, Gibbons, & Lindenmayer, 2009).

It has become recognised that the *ex situ* conservation of threatened plants should not be conceived as an end in itself (Schulman & Lehvävirta, 2011), a view endorsed by the ecosystem approach with its *in situ* focus. Recognising this, it follows that the usefulness of *ex situ* plant collections for conservation purposes should be gauged by their effects on the *in situ* world. *Ex situ* plant collections are not *a priori* necessarily beneficial to conservation. Many serious plant invaders have spread out from collections in botanic gardens (Mabey, 2010) and the introduction of modern crop varieties (bred from the germplasm of crop landraces in seedbanks) is ironically one of the principal reasons why such landraces have been disappearing (Song & Vernooy, 2010; Veteläinen, Negri & Maxted, 2009).

The ecosystem approach has some democratic advantages. It is inclusive in seeing roles in plant conservation for people everywhere. It inherently acknowledges the value of geographically-based cultural diversity, since every locality requires the presence of people with an interest in its particular plants. The ecosystem approach incorporates a social model that offers the potential to develop greater equality in distributing the costs and benefits associated with conservation. A fair distribution of costs and benefits is likely to be instrumental for achieving long-term success in conservation – another parallel with medicine (Wilkinson, Pickett & De Vogli, 2010).

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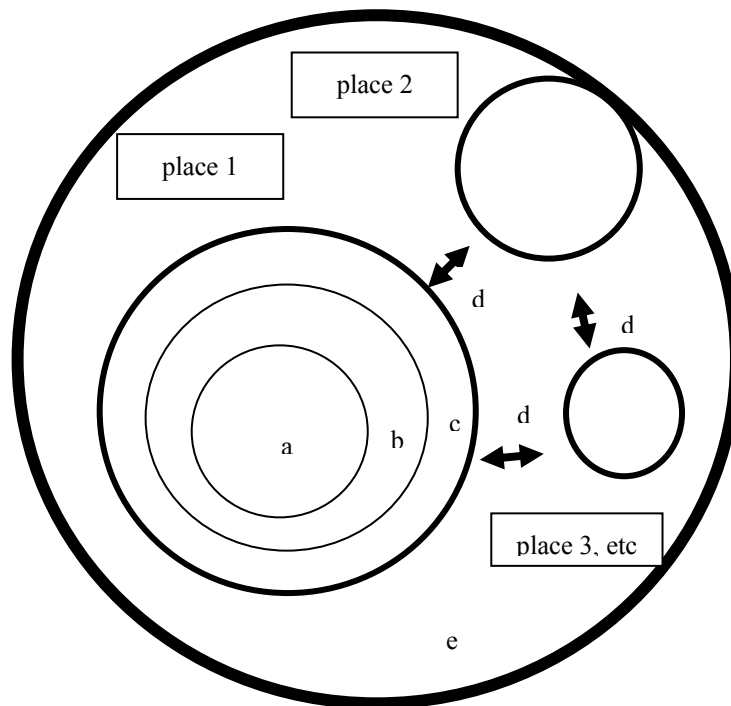


Figure 1. Representation of Ecosystem-based Plant Conservation

- a. The inner circle represents the plants of any place. These plants may contribute to one or more of the three purposes of plant conservation (species conservation, ecosystem services, sustainable use). Alternatively, the plants may deliver few or no conservation benefits (e.g. with much intensive agriculture) or be replaced by a plant-free surface (e.g. where the land is covered by buildings).
- b. The inner ring represents those people who do (or could) influence the plants directly, such as farmers, gardeners, collectors of wild plant resources and reserve managers.
- c. The outer ring represents those people who do (or could) influence the plants, though only indirectly, such as lawmakers, consumers, contributors to climate change and conservation biologists.
- d. Places vary in their relative (actual or potential) contributions to plant conservation. Therefore, the optimal delivery of conservation benefits from plants entails trade-offs between places (indicated by the two-way arrows).
- e. The outer circle represents the Earth's limit of ecological sustainability, setting a minimum long-term requirement for conservation achievement. The current level of exploitation of Earth's ecosystems already exceed the limits of global sustainability (Hails, Humphrey, Loh, & Goldfinger, 2008).