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Botanical aspects of eco-civilisation construction

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ABSTRACT

The concept of eco-civilisation refers to the need for human affairs to be contained within the limits set by nature. Plants play such fundamental roles in the functioning of ecosystems and economies that due attention must be given to them for eco-civilisation to be achieved. Species are the basic functional units of the plant world and, taking a long term perspective, their conservation with their genetic diversity should be a primary objective in eco-civilisation construction. However, standard procedures used for plant conservation have met with only limited success. Therefore, plant conservationists need social allies to boost their efforts – referring to elements of society whose primary interests in eco-civilisation construction are different, but whose efforts, if successful, will bring benefits to plant conservation too. Potential allies can be identified using an ecosystem system services framework showing how benefits received from the delivery of ecosystem services overlap with those that favour conservation of plant diversity. The concept of eco-civilisation was adopted officially in China in 2014 as a principle guiding its future development. A project at Ludian, Yunnan Province, is used to show the relationships between an ecosystem services framework and a conservation initiative.

1. Eco-civilisation

The world considered as an ecosystem is becoming destabilised by human activities, as demonstrated by climate change and ocean acidification (Stocker et al., 2014). A sixth great mass extinction event may have begun (McCallum, 2015). Tropical forests are being reduced (Baccini et al., 2012), deserts are spreading, large quantities of soil are being eroded, oceanic ecosystems are being polluted by industrially-generated iron fertilisation (Lin et al., 2015) and the lives of many people are being blighted by problematic access to food, water or fuel. Armed conflicts and cases of unsolicited or forced migration can often be interpreted as due, at least in part, to conflicts over scarce resources or triggered by environmental degradation (Kelley et al., 2015; Wendle, 2016). The scale of human impact on biogeochemical systems has become so great that some geologists propose recognition of a new geological period to cover this modern time of great human influence, the Anthropocene (Smith and Zeder, 2013).

The concept of eco-civilisation provides a vision of a future state of harmony between people and nature – a target for attainment. It was incorporated into the Charter of the Communist Party of China (CPC) at its 18th National Congress in 2012, moving it to the forefront of China's national development strategy. Hu Jintao, then leader of China, explained: "*… the essence of the construction of ecological civilisation is building a resource-saving and environmentally friendly society based on the environmental carrying capacity of resources, the laws of nature and sustainable development …*" (The Climate Group, 2014). For the environmentalist, the concept of eco-civilisation is one relevant to everywhere, not just China.[1] Its adoption by China is especially welcome, given the country's large size and global influence, and because China has an exceptional record of turning radical policies into practice (for example the One

[1] The word 'civilisation' is derived from Latin *civis*, originally referring to an inhabitant of a town, but nowadays it has modified meanings. One, according to Wikipedia, is: "*any complex society characterized by urban development, social stratification, symbolic communication forms (typically, writing systems), and a perceived separation from and domination over the natural environment by a cultural elite.*" It is possible to regard virtually all humanity today as belonging to a single global civilization, given the large number of urban dwellers (more than 50% of the global population since 2008), the high degree of connectedness of town and country, the large scale movements of people within and between countries, and the increasing globalisation of economies and cultures. This means that no one country, especially one as internationally influential as China, will be able to achieve the end point of eco-civilisation, unless other countries do so too.

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Child Policy launched in 1978–1980). China with its eco-civilisation policy has the potential to become a model for the rest of the world.

2. Plants in eco-civilisation construction

Plants play such fundamental roles in the functioning of ecosystems and economies that due attention must be given to them for eco-civilisation to be achieved.[2] As photosynthetic organisms, plants provide the organic molecules on which animals feed and produce the oxygen required by most life. As living things attached to place, plants provide the main structural elements of terrestrial ecosystems, hold the soil together and, on decay, replenish soil fertility. Numerous products are obtained from plants, including food, construction materials, fuel, fibre and medicines. Also, plants form a major part of the sentient environments in which people enact the dramas of their lives. Aspects of the plant world – for instance, perhaps particular specimens of trees, or types of flowers, vegetation or landscapes – can come to hold special significance for people through their lifetime experiences, as mediated through the prisms of culture.

Taking a long term view – a relevant planning horizon to consider in this case[3], we regard the single most important botanical task in eco-civilisation construction is the conservation of plant species with their genetic diversity. Species are the basic functional units of the plant world, those existing today being the products of evolutionary processes extending back hundreds of millions of years (Table 1). They can be considered a legacy from the past to the present, essentially non-renewable if viewed as natural capital (Constanza et al., 1997; WFNP, 2016).

3. Extent of threats to plant species

Despite the great importance of plant diversity to the future of humanity, it is alarming that already about 20% of the ca. 300,000 plant species now on earth are in danger of extinction, overwhelmingly at the hand of man (Kew, 2012). Another indicator of the problem is that an estimated 75% of the genetic diversity of agricultural crops was lost during the 20th Century (FAO, 1992; FAO, 1998; Hawkes et al., 2001).

We refer to two countries to illustrate the extent of threats to plant diversity, one of its financially poorest (Uganda) and one of its richest (UK). A review has highlighted the challenges faced by plant conservationists in Uganda (Hamilton et al., 2016). Threats to plant diversity include a very high rate of loss of tropical forest, loss or degradation of numerous protected areas, and difficulties in maintaining germplasm collections of crops.

In the case of the UK, inadequate support for conservation of biological diversity (in general) is apparent in the declines in population size over the last 50 years of 60% of the 3148 species of plants and animals for which quantitative assessments of population trends exist; 31% have declined strongly (Hayhow et al., 2016; RSPB, 2013). Plant conservation is of much less interest to the general public than birds, judging by the relative sizes of the membership of Plantlife International (about 10,000 members) and the Royal Society for the Protection of Birds (about 1,000,000 members) (Avery, 2012). Even the Royal Botanic Gardens, Kew, an institution of the highest rank as a resource centre for international plant conservation, has failed to obtain adequate and consistent governmental support (Commons Select Committee, 2015; Sample and Bell, 2014; UK Plant Science, 2014). Culturally, the foundation for practical involvement in biological conservation seems set to decline. Children play much less outdoors than they used to, younger people tend not to join natural history societies and 'whole plant botany' has become a dying subject in schools and universities (Hindson and Carter, 2012; Natural England 2016; UK Plant Science, 2014).

4. An expanded agenda suggested for plant conservationists

Standard procedures adopted over the last 60 years to conserve plant species include the stepwise processes of taxonomic recognition of species, assessments of their degrees of endangerment and putting into place *in situ* and/or *ex situ* conservation measures as possible and appropriate (Given, 1994; IUCN, 2012). The main *in situ* tool has been the protected area. Places especially important for the conservation of plant species have been mapped (Anderson, 2002; Davis et al. 1994–1995), as too have centres of origin or diversity for traditional varieties of crops (Brush, 1999; Dvorak et al., 2011; Harris, 1990; Vavilov, 1926). Scientists concerned with plant genetic resources concentrated at first on conserving the landraces of a few major crops, especially using *ex situ* measures (seed banks and field collections), but subsequently have given more attention to *in situ* measures, wild crop relatives, minor agricultural crops and other uses of plants additional to food (FAO, 1992; Hawkes et al., 2001; Maxted et al., 2016).

Standard procedures for conservation of plant diversity have met with only limited success. We conclude that plant conservationists need social allies to boost their efforts – referring to elements of society whose primary interests in eco-civilisation construction are different, but whose efforts, if successful, will bring benefits to plant conservation too. Elsewhere, this expanded approach has been termed ecosystem-based plant conservation (EBPC) (Hamilton, 2007; Hamilton et al., 2012). Standard procedures still apply, but with more consideration given to *who* should be involved (not just to *what* needs to be done), taking into account the long-term sustainability of all ecological systems in which plants are significant components, and promoting conservation across the landscape. EBPC is a place-centred, not taxonomically-centred, approach.

We consider that the key people to drive this expanded agenda forward are those interested in conservation of plant diversity, given their dual interests in plants and conservation. Depending on their situations, not all need be experts on Red Listed species – if this was a universal requirement, then there would be very few plant conservationists available to catalyse the work in many parts of the world. Some of the many types of social players that can potentially contribute are indicated on Table 2 (listed in the cells after the symbol **S**). They include conservation-minded farmers, people concerned about the availability of water resources, teachers, religious leaders, and many others. Researchers have major roles to play in distributing practical information for the use of such parties appropriate to their roles. For instance, farmers and those managing water catchments could benefit from advice on how best to pursue their tasks in ways that benefit plant

[2] The dependencies of people on plants can be particularly apparent in more subsistence-based economies, for instance when people grow much of their own food, collect wood locally for fuel, and draw water from springs protected by forests. These dependencies can be less obvious or psychologically meaningful to people who are distanced economically, physically or mentally from the realities of the natural world, for instance if living in more monetarised economies, urban places or immersed in digital worlds.

[3] In principle, the structure and functioning of an eco-civilisation should be sufficiently robust to be able to continue indefinitely, at least regarding ecological constraints. For example, an eco-civilisation should be robust enough to survive the shocks that will be imposed by the major changes in climate anticipated over coming millennia, as the earth continues to traverse its present ice-age climatic phase (which began about 2.6 million years ago and is driven by three astronomical cycles with periodicities of between 23,000 and 100,000 years). A single ice–ice climatic cycle is not so long when compared with the span of time that the human species has already existed (200,000 years).