

REPLY TO BRIDGEWATER AND BABIN:

Need for a new protected area category for ecosystem services

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We thank Bridgewater and Babin (1) for their perspective. We are aware of, and appreciate, the consideration of ecosystem services in the management of Biosphere Reserves. However, we see a strong imperative for establishing a protected area (PA) category focused specifically on protecting ecosystem services, for several key reasons articulated in our paper (2) and below.

First, although China has indeed 33 Biosphere Reserves, all of them were established for biodiversity conservation, excepting one for geological heritage (Table 1). Ecosystem services were not considered in the delineation or establishment of any of China's Biosphere Reserves, as indicated in the protection targets shown here and in more extensive descriptions available elsewhere.

Second, according to the criteria for Biosphere Reserve nomination, there are three key considerations, including conservation, development, and logistic support (Table 2)—and none of these prioritizes ecosystem services. Conservation refers to “the conservation of landscapes, ecosystems, species and genetic variation.” It stresses “the importance of the site for conservation of biological and cultural diversity at regional or global scales.” Although there is mention of “protecting cultural diversity and biodiversity, including genetic variation, species, ecosystems and landscapes and securing services provided by such diversity,” ecosystem services do not constitute key criteria in nomination of Biosphere Reserves. Development refers to fostering “economic and human development which is socio-culturally and ecologically sustainable.” It is required to “indicate current activities and the potential of the proposed biosphere reserve in fulfilling the objective of fostering sustainable economic and socio-cultural development, including by securing flows of ecosystem services from the

biosphere reserve.” Thus, although securing ecosystem services is one of the objectives for biosphere management, it is not a criterion for establishing a Biosphere Reserve.

Third, our suggestion to establish PAs explicitly for sustaining the provision of ecosystem services is based on three considerations vital in China and across much of the world today. The first consideration is that, currently, China's nature reserves do not secure key regulating ecosystem services (2), including water retention (e.g., for flood control, irrigation and drinking water security, and hydropower production efficiency); soil retention (for landscape stability and sustainability, underpinning food and livelihood security); sandstorm prevention (for air quality downwind and livelihood security in source regions); and carbon sequestration (for global climate security). Because key areas for biodiversity conservation do not always match well with those for ecosystem services, the current nature reserves systems cannot meet the requirements for sustainable development in China. The second consideration is that, although there are six categories in the International Union for Conservation of Nature PA system, none is oriented around securing ecosystem services. The third consideration is that, to our knowledge, there are no PA types oriented around securing ecosystem services in the PA system of many countries, including for example Austria, Canada, Germany, Russia, South Africa, and the United Kingdom.

Thus, we see an urgent need to establish a PA category for ecosystem services, for the purpose of securing ecosystem services in China and across the world. Given the ever-intensifying human pressures on land, this approach is vital for realizing the necessary local and national support for, effectiveness of, and durability of investments in conservation (2).

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Table 1. Biosphere Reserves in China

ID	Name	Protection targets	Level of nature reserve	Established year	Year listed in BRs
1	Tianchi Bogda Peak	Forest ecosystem and mountain lakes	Provincial	1980	1990
2	Huanglong Temple	Giant panda and forest ecosystem	Provincial	1983	2001
3	Baishuijiang	Giant panda and forest ecosystem	National	1978	2000
4	Baotianman	Forest ecosystem	National	1980	2001
5	Chebaling	Subtropical forest ecosystem	National	1981	2007
6	Dalai Lake	Inland wetland and wildlife	National	1986	2002
7	Daxing'anling Hanma	Cold temperate conifer forest	National	1995	2015
8	Dinghu Mountain	Subtropical forest ecosystem	National	1956	1979
9	Fanjing Mountain	Forest ecosystem and golden monkey	National	1978	1986
10	Fenglin	Korean pine forest	National	1958	1997
11	Foping	Giant panda and forest ecosystem	National	1978	2004
12	Fujian Wuyi Mountain	Subtropical forest ecosystem	National	1979	1987
13	Gaoligong Mountain	Forest ecosystem and wildlife	National	1983	1997
14	Changbai Mountain	Forest ecosystem and volcano relics	National	1960	1980
15	Jinggang Mountain	Subtropical forest ecosystem	National	1981	2012
16	Jiuzhaigou	Giant panda and forest ecosystem	National	1978	1997
17	Mao'er Mountain	Even-green forest ecosystem	National	1976	2012
18	Maolan	Karst forest ecosystem	National	1984	1996
19	Nanji Islands	Marine ecosystem and birds	National	1989	1998
20	Niubeiliang	Takin and its habitat	National	1988	2015
21	Saihan Wula	Forest ecosystem and red deer	National	1997	2001
22	Shankou Mangrove	Mangrove forest ecosystem	National	1990	1993
23	Laoticshan Snake Island	Snakes, migratory birds, and their habitat	National	1980	2014
24	Shennongjia	Golden monkey and forest ecosystem	National	1982	1990
25	Wolong	Giant panda and forest ecosystem	National	1963	1980
26	Wuda Lianchi	Volcano relics	National	1980	2003
27	Xishuang Banna	Elephant and tropical forest	National	1958	1993
28	Xilingole Grassland	Meadow and sparse forest	National	1985	1987
29	Xingkai Lake	Wetland ecosystem, red-crowned crane	National	1986	2007
30	Yading	Forest ecosystem and glacier	National	1996	2010
31	Yancheng Wetland	Red-crowned crane and coastal ecosystem	National	1983	1992
32	Tianmu Mountain	Ginkgo, katsura tree, and forest ecosystem	National	1975	1996
33	Qomolangma Mountain	Montane forest, desert, and snow leopard	National	1988	2004

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Table 2. Criteria for nominating Biosphere Reserves

Criterion	Elaboration
Conservation	Protecting cultural diversity and biodiversity, including genetic variation, species, ecosystems, and landscapes and securing services provided by such diversity
Development	Fostering economic and human development that is environmentally and socially sustainable and culturally appropriate
Logistic support	Facilitating demonstration projects, environmental education, and sustainable development education and training, research, and monitoring. Although education, research, monitoring, and capacity enhancement are seen as components of the logistic or knowledge-generation function of biosphere reserves, they are also integral to the conservation and development functions

Table 2 data from United Nations Educational, Scientific and Cultural Organization, available at www.unesco.org/new/fileadmin/MULTIMEDIA/HQ/SC/pdf/biosphere_reserve_nomination_form_2013_en.pdf and www.unesco.org/new/en/natural-sciences/environment/ecological-sciences/biosphere-reserves/main-characteristics/functions/.

1 Bridgewater P, Babin D (2017) UNESCO–MAB Biosphere Reserves already deal with ecosystem services and sustainable development. *Proc Natl Acad Sci USA* 114:E4318.

2 Xu W, et al. (2017) Strengthening protected areas for biodiversity and ecosystem services in China. *Proc Natl Acad Sci USA* 114:1601–1606.