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The biosphere reserves of southern China:

Critical perspectives on linking conservation of biological diversity and genetic resources as part of sustainable development

Summary

The six biosphere reserves of subtropical China extend across the transitions from the warm temperate to the tropical zones. While there are hundreds of smaller protected areas, in this region of over a half billion people, these relatively large biosphere reserves hold particularly key roles in the conservation of biological diversity and procurement of the germplasm of wild species with genetic resources. Linkages between biological inventorying, monitoring, management, tourism, utilization of biological resources, and economic benefits have been poorly explored. A typology of strategies for managing the biosphere reserves for southern China linking research, conservation, and "sustainable development" is outlined.

Introduction

The subtropical and tropical regions of China support some of the most densely populated parts of the planet. The toll from the rapid increases of human populations, in recent centuries, on the biological resources of this relatively rich area has been staggering, however poorly documented except for the status of the larger vertebrates. It is, however, dangerously simplistic to correlate the loss of local "biological diversity" (Wilson 1988, Ingram 1989, IUCN et al. 1990, pages 58 to 67, World Resources Institute et al. 1992, Vogel and Ingram 1993) to human population levels. There have been a number of other factors including huge losses of primary tropical and subtropical forest due to national campaigns particularly in the period of 1950 to 1975, and continued declines in natural forests with the continued expansion of agriculture (Han 1989, Smil 1992); excessive hunting and collecting of particular species, especially those with medicinal properties; and poor regional and site planning decisions as part of modernization programmes and expansion of tourism.

What is the significance of biological diversity to a nation of over 1 billion people, with many regions suffering from chronic poverty (Biodiversity Committee of the Chinese Academy of Sciences 1992)? How can biological diversity from the remaining natural areas be used to contribute to economic development? How can conservation be made part of integrated programmes of "sustainable development" (Redclift 1987) in a time of growing demands for

consumer goods? How can genetic resources from protected wild populations, as part of broader conservation programmes, be used for the development of new domesticated species and improved varieties? This essay examines these questions in terms of the best protected natural areas in southern China: the six biosphere reserves (Batisse 1982, UNESCO 1984) which are part of the global network of internationally recognized sites and administered through national committees of UNESCO. We explore some possibilities of how these few biosphere reserves be effectively used as "tactics" (Soulé 1991) in broader Chinese effects for the conservation of biological diversity as part of sustainable development.

This paper is part of a collaborative review to ascertain the viability of a long-term expansion of monitoring (Heal et al. 1993) and the use of geographic information systems in China. The function of data bases would be to support monitoring and management, in biosphere reserve core, buffer, and adjacent transition areas for the conservation of biological diversity. A number of activities are particularly crucial for this decade: monitoring of fragmentation and the status of endangered species, improved site planning, enhanced capabilities for setting criteria for sustainable development in areas adjacent to protected zones, ecosystem restoration, and inventorying and procurement of species with genetic resources.

The 1992 *Convention on Biological Diversity*, (UNEP 1992) of which China is a signatory, provides some fundamentally superior approaches to the exchange of data on biological resources as part of conservation efforts. However, these possibilities remain largely unexplored as of the present. There are still few examples of biosphere reserves which have comprehensive inventorying and monitoring frameworks, let alone linkages to land management decision-making, for genetic resources.

Conservation of biological diversity and the utilization of respective germplasm, on an indefinite basis from *in situ* populations, requires a level of inventorying and monitoring of which few developing countries are capable. This paper reviews the status of the research in these biosphere reserves in order to choose priorities for biodiversity research. While Chinese ecologists and conservation biologists have made great strides in recent years in the use of geographic information systems, it will be another 5 to 10 years before databases with current, precise and high quality information can be organized in order to inform spatially oriented and prescription-oriented decision-making. Organization of data from each biosphere reserve for capabilities of "biodiversity visualization" (Hamilton and Flaxman 1992) and for compilation into geographic information systems provide potentials for more precise spatial planning and impact simulation. Such techniques could be used in management of biosphere reserves for the problematic but crucial balancing of needs for some expansion of economic activities with habitat conservation.

The subtropical and tropical zones of China and threats to regional biological diversity

The forests of southern China (Hou et al. 1979, Hou 1983) supported the most biological rich transitions between the *Indomalayan Realm* and the *Palaearctic Realm* (Udvardy 1978, 1984). However, there are very few large areas of natural habitat left in southern China and much of the tropical (Collins et al. 1991, pages 116 to 125) and subtropical forest (Hou et al. 1982, Hou 1983) has been highly "fragmented" (Merriam and Wegner 1992).

Loss of nearly all of the unlogged and "natural" forests of southern China has resulted from 5,000 years of cutting and clearing that was greatly accelerated by the seventeenth century with its burst in colonization, settlement, and human numbers (Murphey 1983). In much of southern China, consumptive land use in the original broadleaf evergreen forest, even where tree canopy is

maintained, leads to secondary forests dominated by local pine species, such as *Pinus yunnanensis* (Young and Wang 1989). The more disturbed secondary forests do not tend to support the biological richness and many of the more vulnerable species associated with the original forests which were more stable and complex. The relatively small remaining areas of tropical rain forest (Zhu et al. 1980) in far southern China amounts to less than 0.26 per cent of the total area of China (Collins et al., page 117). Subtropical China, formerly dominated by forest, is home to approximately one half billion people: nearly ten per cent of the total human population. Most of the remaining forests are protected under the 1979 *Forestry Act*, though there still is considerable poaching (Wang 1990).

As well as clearing and expansion of agriculture, the loss of forest, south of the Yangtze River over the last century, has been due to the cutting of fuelwood for the factories of World War II. The period of most rapid loss of primary subtropical forest was between 1959 and 1961, where forest was cut for the iron smelters of The Great Leap Forward, resulting in an "economic and ecological failure" (Collins et al. 1991). The political turbulence and related land management crises of the Cultural Revolution (Orleans and Suttmeier 1970) of 1967 to 1976 brought further violation such protected areas such as Xishuangbanna Nature Reserve, and disrupted the traditional patterns of tenure and culturally based conservation. In southern China, older conservation legacies were dominated by Buddhism, which for several decades was discouraged. Compounding the increase in human impacts from tourism, the surge of entrepreneurialism of the last decade has negated whatever remained of locally based conservation ethics.

Much of modern nature conservation in China has been dominated by U.S.-based efforts for the conservation of the giant panda. This powerful media symbol has highlighted the need to conserve large areas of forest, with dynamic successional mosaics and sufficient area to allow for a range of conditions, and has allowed China to increase the total number of protected areas from 120 in 1983 (Li and Zhao 1984, page 216) to 600 in 1988. However, little of the total area in protection has been fully implemented, actively supported, and effectively managed by local authorities. The most successfully managed protected forests, in terms of conservation of biological diversity, are still in Taiwan and Hong Kong.

The Chinese MAB Programme

Launched by Unesco in 1971, the Man and the Biosphere Programme (MAB) is an interdisciplinary research programme aimed at providing a scientifically sound foundation for the rational use and conservation of natural resources. The 14 major project areas identified by the International MAB Programme are also areas needing research and attention in China. The guiding ideologies of the International MAB Programme have made a significant contribution to the development of research work in China. In order to strengthen its working relationship with the international MAB Programme, China established its own national committee for MAB in 1978. The Committee is attached to the Chinese Academy of Sciences and is responsible for carrying out the MAB programme in China. The China's National Committee of the MAB consists of members representing ten state ministries including resources, environment, science and education; leading scientists in the fields of resource and environmental sciences; and 8 National Academic Associations.

To further develop the MAB Programme, the Committee, based on the existing projects, selected five key field, i.e. forest ecosystems, urban ecosystems, ecological agriculture, ecosystems of arid and semi-arid zones and nature conservation, and set up specialized groups for each to

promote and advise research, to undertake training and publication, and other activities. The Chinese National Committee for MAB endeavours to make full of the MAB framework for international exchange and cooperation with international organizations and governments to benefit China's research in the field of natural resources and environment. For example, the Cooperative Ecological Research Project (CERP) is jointly sponsored by China, Germany and UNESCO. The Main Phase of CERP has been carried out successfully and the continuous phase is still under the way. Another important task of the Chinese MAB is to establish materials for the benefit of scientists, decision makers, administrators, educators and the general public. As a "channel" and "window", the Chinese MAB Committee lays particular emphasis in publication on serving as a link between China and other countries.

The Chinese MAB programme is one of the most extensive national efforts to conserve and monitor the biological diversity of sub-tropical forest anywhere on Earth (Li and Zhao 1989, Man and Biosphere Programme of UNESCO 1991, Zhou 1989); however, the first meeting of the managers of the 8 biosphere reserves, 6 of which are tropical or subtropical (Figure 1) was only held in June of 1991. The meeting emphasized increased cooperation with local communities and the better integration of biosphere reserves into regional development. The biosphere reserve programme of China poses the most promising possibilities for the conservation of biological diversity, but the network is oriented toward larger areas. There are chronic difficulties in maintaining better protected natural portions of reserves (Batisse 1982, Verhnes 1989) and conditions least disturbed by humans. The biosphere reserve concept has evolved over the last quarter century to include:

1. the reserve core, with relatively undisturbed ecosystems;
2. the buffer zone, with some exploitation or experimentation within the context of monitoring and management; and
3. the transition zone, with extensive land use along with monitoring and special planning and management measures.

The problem with applying this trinity in China is that few cores are sufficiently large and undisturbed to afford much human disturbance in buffer zones. In addition, it has rarely been possible to influence regional planning to develop monitoring frameworks or regulatory constraints in transitional zones.

Biosphere Reserves for the *in situ* conservation of genetic resources

There is a growing body of discussion on monitoring (Ingram 1990a, Dallmeier et al. 1992) and protection of genetic diversity (Ingram 1990b) in the core, buffer and transition areas of biosphere reserves. There is growing interest and a pool of data on the wild, weedy, and traditionally cultivated plant species (Altieri 1988, Brush 1988, Brush 1991, Wilkes 1991, Gregg 1991, Hoyt 1988) which are in the genepools of crops and which can therefore be considered "genetic resources" (Harlan 1976, Williams 1988, Prescott-Allen and Prescott-Allen 1990).

The MAB Action Plan (UNESCO 1984) mentioned the conservation of the genetic diversity of crop relatives in biosphere reserves (Ingram and Williams 1984, Ingram 1990b); however, there has been little elaboration on the nature of the prescriptions for populations with potential genetic resources within the core and buffer areas of biosphere reserves (Ingram 1990a), nor consideration for traditional varieties of crops in buffer and transition areas. Multi-gene pool "ecogeographical surveys" (Ingram 1990a) are needed for each region associated with a biosphere reserve. Areas with high species richness and environmental heterogeneity, which have indications of early crop

domestication, such in the vicinity of Shennongjia Biosphere Reserve, are particularly worthy of intensive research. Higher levels of conservation, aimed at particular species and populations, are necessary (Wang and Chen 1990, World Conservation Monitoring Centre 1992, pages 546 to 549). Southern China is remarkable in its diversity of tree species, with numerous sites for *in situ* conservation (Riggs 1990) and uniquely available for seed collection.

With the initial internationalist vision of the 1992 *Convention on Biological Diversity*, there are now new possibilities for funding the inventorying, monitoring and management of "genetic reserves" (Jain 1975, World Conservation Monitoring Centre 1992) and related infrastructure. Even with the relatively advanced level of inventorying and monitoring in some of the south China biosphere reserves such as Dinghushan (Kong et al. 1993), new methodologies, practices, and cooperative relationships reflecting a more international character must be formed.

The following are outlines of the six biosphere reserves of southern China. For each, a biophysical and cultural description is followed by a discussion of directions for monitoring, management and the sustainable and equitable utilization of genetic resources (Ingram 1987, Juma 1989, Keystone International Dialogue 1991).

Opportunities for more secure levels of conservation

While there has been a considerable increase in ecological awareness over the last decades, a large portion of respective populations of species are still at risk. There is an extremely low ratio of wildland to as compared to human population in China, with some similarity to the situation in India. By overcoming the obstacles to better inventory, monitor, and manage protected areas, more secure levels of conservation can be attained.

General upgrading of the levels of conservation in the reserves could involve the following phases in conjunction with a geographic information system (Estes et al. 1992):

1. review of existing inventory data;
2. compilation of layers of spatial data in relation to particular elements of local biological diversity data;
3. construction of models for tasks related to reserve management and planning;
4. integration of remote sensing data, and, in some cases, procurement of fresh data;
5. ground visits and related field work on selected sites and communities;
6. conversion of some maps into digital form; and
7. computation and simulation as related to specific needs for reserve planning and management.

These computations can lead to more site-specific conservation, management, and regulatory interventions. This is in the context of increasing relaxations and loss of species as fragmentation progresses and protected area cores have forms of ecosystem disintegration.

Unfortunately, this process will only identify species with small populations and problematic management requirements. There are still the conundrum of the recent decades: by the time conservation prescriptions for species and habitats are developed, it may be too late to avoid, at the very least, in-breeding depressions and genetic bottlenecks. Development of new solutions to this persistent problem is becoming the core of new conservation strategies which are inevitably more quantitative both in terms of populations and space.

Conclusions: Increasing the relevance of biosphere reserves and other conservation programmes to Chinese society.

The term "sustainable development" (Redclift 1987) has many possible meanings depending

on context and priorities for economic and social development. This is even the case with more scientifically based ideals such as "conservation of biological diversity." The realities vary with socially based obstacles and opportunities. Most of the immediate social values for the biosphere reserves of subtropical China are related to the gathering and hunting of wild species, often at unsustainable levels and sometimes illegally. In addition, the revival in Buddhism has contributed to increasingly massive religious festivals that increasingly cause inadvertent damage to adjacent forest fragments.

Biosphere reserves for procurement of germplasm for biotechnology development will probably not have broad-based social support until the benefits of the genetic variation of rapidly dwindling populations are effectively demonstrated and where the benefits of genetic resources are partially channelled back to those social groups who have lost development options through preservation - but such economic restructuring requires more capital than is usually available in most World Bank projects or "joint ventures." Joe Vogel's (1994) concept of "genesteading," involving local ownership under the rubric of "community forestry" (Changjin 1992), is particularly relevant to discussions about effective conservation in China's "socialist market economy." Long-term investment in conservation infrastructure is necessary and it is still unclear if the Convention on Biological Diversity will provide the vehicle for such funds, on a protracted basis, as well as for credit. The six biosphere reserves in southern China have been relatively well-funded, by Chinese government norms, but additional technologies such as geographic information systems could fill crucial gaps in fostering benefits to both local communities and respective regions.

The central contradiction in this situation is that there are thousands, of species, that occur in few places outside of the forest fragments in these biosphere reserves, which could be used as genetic resources, both in the Chinese economy and elsewhere. But much of the populations and their genetic variability, which would provide so many options for biotechnology and agriculture, are rapidly dwindling. Even if the loss of habitat in these complexes of forest fragments is arrested in this decade, this will probably be the period of the most dramatic losses in alleles and other genetic resources. This situation, in turn, has a direct relationship to the amount of genetic material available for development of new varieties and breeds and for introductions into cultivation.

These biosphere reserves also have the potential of becoming centres for more coordinated national programmes of conservation of biological diversity at a time when few effective examples of such efforts currently exist (Blockstein 1989). And these tiny fragments of formerly vast forests have already become centres for the exploration of ecological land ethics and "bioregionalism" (Cheney 1989) for southern China, often harkening back to past times of Buddhism and Taoism. The reverence of nature and natural ecosystems has been a major theme in Chinese culture for millennia. Most of these areas had been identified as important points for spiritual renewal well before 1500 A.D. While renewed Buddhist festivals, often involving hundreds of thousands of people as in the case of Dinghusan, pose ecological threats, the education roles of these festivals can contribute to the linking scientific and economic concerns for more prescriptive and fine-scaled management of natural habitats.

Due to their extremely high religious, tourist, and biological values, these reserves will be more carefully monitored and managed in the coming decades. But continued degradation, particularly from tourism and largely illegal plant and animal harvesting, is inevitable. Geographic information systems provide various tools for information compilation and making better spatial decisions and prescriptions for landscape management if the quality of field data, indicated on maps with scales from 1:1,000 to 1:50,000, continues to improve. But if management is to be more

effective, new decision-making frameworks, which link a range of local, national and international researchers, are needed to evolve with the richer supply and ecogeographic data.

As China successfully stabilizes its population and improves its standard of living, the social importance of these biosphere reserves will quickly increase. But if biological diversity is to be successfully conserved, with at present time thousands of species are seriously at risk, these relatively small fragments must become part of broader regional networks for conservation, local management, economic development, cultural renewal, and ecosystem restoration. The management of these "sacred mountain" areas is shifting back to the (bio)regionalism of earlier times while enriching the knowledge base for ecological processes and global development of biotechnologies.

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February 28, 1995

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Quito

**RE:staying in touch / news from nowhere /
spring and all that**

Dear Joe,

Thanks for sending me that card about that position at Canterbury. I oddly missed that issue of *The Economist* so it was very kind of you to think of me. I will apply for it but frankly would not want to live in that part of the UK and hope that they offer the position to you...

Things here have been good. I have just enough grants and little jobs to get by and my case against UBC is gradually going forward. The spring has hit with a vengeance so the hormones are flowing and life is in deed amusing when not enlightening. We started a little cell / saloon of radical architects and planners called "Queers in Space Vancouver" and are organizing some fun events...We are toying with doing a symposium as a parody on the human potential movement and postmodernism called "Healing the inner slut: Place, promiscuity, and the postmodern city."...In a few weeks I will be organizing two panels at a conference in LA called *Queer frontiers* and then heading to New York and then Rome for a few months ('got a pittance of a grant from the Canadian NEA and given that they were just cut horribly must take what I can get). I will be here all summer and then may have a post-doc in France on conservation of biodiversity on islands (light some candles for me because I don't know if I actually have it given their budget cuts). In all of this, baby grows and makes me happy and her papa is adapting to taking little trips to Seattle...

One of my greatest pleasures these days is finishing off these hellish papers for IDRC (for which they did not really pay me) on China.

Since the project fell through (the Chinese got too greedy and did not want a UBC component of the project as they wanted all of the money themselves) I am mostly finishing this work to get my name around and to jump-start some critical policy discussions. Hence, the enclosed reworking of one of those papers.

Would you be interested in going through this paper and revising, adding a section or two, adding economic and policy references and then being second author? It has enough science, now it needs the policy and economics. The typologies of strategies for conservation (mentioned at the end of the abstract) have yet to be outlined and the paper needs a few new sections at the end (up to another 3,000 words). Are you interested? No rush, the stuff has been sitting around for two years. And would you be interested in choosing a policy oriented journal and then reworking the manuscript for their format? Anyway, if you get inspired, please play with it and send it back when ready...

Keep me posted. If we loose touch, just count on me getting my mail by June. I would still like to arrange a meeting or two to discuss collaboration but truth is I am already pretty booked for 1995. Perhaps we should be thinking of 1996...Take good care of your self and don't get involved in any border wars - they have disastrous implications for the whole notion of genesteading. Perhaps it is better to focus on larger more powerful nation states (that don't respect intellectual property). Regards to Camillo. ciao