Conservation of Indian Forests

Since 2500 B.C., forests in India have been viewed as sources of limitless products that require few special regulatory and management measures. Planning for population growth and resource availability has been ignored or dismissed, even with the effects of wars on resource depletions (Lal 1989; Hawkins 1986). Recent changes in forest conservation in India acknowledge that forests cannot recover from endless and intense exploitation and that current and future demands cannot be ignored. Under a new forest management policy, India is readying itself to implement resource management practices to restore and maintain the diversity of its native biota to provide for both ecological and human communities. This article reviews some of India's current dilemmas in forest management and some promises for the future under the new programs.

Expanding Human Populations and Shrinking Forests

With a land base of more than three million square kilometers and 850 million people (est. 1990), India has a population density nine times that of the U.S. Some 70 to 80% of all Indians depend directly on productivity of the land. Agricultural, grazing, and forest product needs are heavily taxing the country's resource sustainability. Only 19% of India's land base is currently forested and just 3.9% of the total land base is in protected status. (For comparison, in the U.S. about 32% of the land base is forested and 7.5% of the total land base is protected [Salwasser 1991].) Of the officially recognized "forest lands" in India, some 22% are actually forested and the rest are agricultural lands.

The skikaris, the hunters and explorers from the 19th and early 20th centuries, once wrote of deep jungles with great densities and diversity of wildlife. India's population is growing at 2% per year with a doubling time of just 35 years. In a decade, the human population will top one billion. Under such intensive land use, the native forests, grasslands, wildlife, and fish of India have suffered great declines in abundance, distribution, and long-term security. In a single generation, presently arable and productive lands will be taxed as never before in four millennia of development.

In northern India, forests are dominated by dipterocarp trees, predominantly sal (*Shoria robusta*). Forests of teak (*Tectona grandis*) occur throughout the central and southern states. Old world bamboo (e.g., *Bambusa arundinacea*), an economically and ecologically important component of the natural forests, is present in the understory and in forest openings. Other Indian forests include evergreen forests of chir pine (*Pinus roxburghii*) and deodar (*Cedrus deodara*) in the middle to upper elevations of the Himalayas. There, resins from the chir and blue pine or kail (*Pinus wallichiana*) are collected and used for a remarkable variety of products, including fungicides, plasticizers, lacquers, varnishes, emulsifiers for rubber, bactericides, surfactants, and corrosion inhibitors. Large specimens of the strangler fig, *Ficus benghalensis,* are scattered throughout the sal forests. *Ficus* is revered in the Hindu religion and small rural temples are often found erected in old-growth sholas or riparian gallery forests with large specimens of the species. Large *Ficus* specimens are thus indicators of stand diversity and forest age, as well as of the religious value of a forest.

Most existing forests in India result from sal and teak plantations begun 50 to 180 years ago (Troup 1975; Champion & Seth 1968). These forests constitute the major timber sources for the country, but they bear little resemblance to the truly aboriginal forests of the past. Plantation-derived forests are markedly more uniform structurally and contain a less diverse mix of plant and animal species. India has protected a few outstanding examples of older forest stands in "preservation plots." Such stands provide benchmarks for measuring changes in tree size, stand composition and structure, species diversity, and ecological succession in younger forests. However, even these forests are not truly aboriginal, as they have been influenced by decades or centuries of human occupation and resource use.

Categories of Managed Forests in India

In India, forests are conserved in national parks, reserved forests, wild-

life sanctuaries, and other protected areas. As mandated under the reauthorized 1988 National Forest Policy of India, forests are managed for a wide spectrum of values and interests.

Management categories of Indian forests are often based on those of biosphere reserves. Core areas, or *sanctum sanctora,* are explicitly managed to exclude human habitation, development, or direct resource exploitation, and many are guarded day and night by Forest Service personnel. Bordering core areas are buffer areas in which human use of resources is limited, allowed only through concessions and rights. Concessions are legal permits for use of the forest lands for a variety of purposes including fruit harvest and livestock grazing. Rights are guaranteed allotments given to some tribes that ensure their access to traditionally used forest resources, especially those necessary for continued subsistence. Scheduled tribes and castes, constituting one quarter of India's population, have special traditional rights in some forests, but through heavy use for grazing, lopping, and other activities, those rights can impede successful resource conservation.

National parks, wildlife sanctuaries, and general reserved forests are designated by the Indian Forest Service and administered by the state forestry agencies. Some areas are designated as biosphere reserves or as the nation's 18 reserves designated to provide habitat for tigers (*Panthera tigris*). All areas are administered by the states. Management jurisdictions for the various designations of forests often overlap and sometimes compete.

Forests administered by the states are also classified according to predominant land use: reserved, protected, and unclassed forests. Some 85% of India's forests are classified as reserved forests, which have the most constraints on resource use. Only specially permitted activities are allowed within reserved forests. Reserved forests are free of all rights, but the designation allows numerous concessions. Limited timber removal is allowed, but the Indian Forest Service does all timber marking and oversees all harvest and hauling operations. In many cases, however, concessions in reserved forests effectively (but not nominally) become rights through tradition, local politics, legislation, and, in some cases, bribes.

Protected forests constitute 10% of India's forested lands, and provide some rights and concessions of resource use. Villages within a protected forest may be listed as concessionaires to that forest for grazing, timber collection, fuelwood gathering, collection of resins and gums, lopping of trees for fodder, and harvest of a vast host of forest products for food, medicine, religious rites, and other purposes. Many of these harvesting activities have drastically changed the structure and composition of the protected forests and have disturbed native faunal communities.

Unclassed forests constitute the remaining 5% of India's forested land, and include small areas awaiting classification as either reserved or protected.

About 78% of classified forest lands were once, but are not currently, forested and such areas might require massive reforestation programs. These categories include land outside the legal forest lands overseen by the state forestry agencies, are typically bereft of natural forest cover, and have little or no native wildlife. Although there is a national recovery program for "Greening the Wastelands," there is neither an agency nor a budget officially allocated for implementing the program. Villages are sometimes left to police their own rates of resource exploitation—a situation that often leads to degraded forest conditions.

Forest conservation under the new Forest Policy is intended to account for all of these land use allocations and local needs. In India, as in North America, multiple-use public lands contribute to an overall conservation strategy, along with more strictly protected national parks and wildernesses and forests that are allocated to production of commercial timber and other forest products. Reserved lands complement national parks, wildlife sanctuaries, and more heavily used buffer areas and revenue lands to provide critical wildlife habitats and linkages between habitats in parks and sanctuaries (Rodgers & Panwar 1988; Salwasser 1991).

Threatened Species and Opportunities for Forest Management

India's move toward a national network of protected areas was prompted by the establishment of tiger reserves in 1973 (Panwar 1978). The focus on a single charismatic species helped fix public interest and stir political awareness, just as today's interest in conserving ancient forest ecosystems in the northwest U.S. has been spurred by focus on the northern spotted owl (*Strix occidentalis caurina*). In both cases, networks of reserved forests also serve to conserve habitat for other wildlife species. Management of some tiger reserves includes environmental education as a major theme (Gogate 1988).

Still, fragmentation and loss of native forests in India are threatening a wide variety of fish and wildlife species (Saharia 1982). For example, in the south, many of the moist and wet evergreen forests of the Western Ghats mountains have been converted to teak plantations. Many threatened species are found in these forest remnants, including black eagle (*Ictinaetus malayensis*), Nilgiri langur (*Presbytis johni*), lion-tailed macaque (*Macaca silenus*), and Indian elephant (*Elaphas maximus*) (Prasad et al. 1978).

Decades of European scientific

forestry have created large plantations with few snags, little down wood, and low floral and structural diversity. Legal and illegal grazing of the forests by tended livestock and free-ranging cattle have devastated riparian and aquatic systems and reduced once lush native grass cover. The combination of plantation forestry and intensive grazing, burning, and other practices has caused declines in many wildlife species, including many cavity-nesting birds and mammals, frugivores, and nectivores. Wildlife associated with dense cover and less disturbed forests, including tiger, gaur (*Bos gaurus*), sambar (*Cervus unicolor*), and game animals, such as gray (*Gallus sonneratii*) and red (*G. gallus*) junglefowl, have also suffered declines in population sizes and ranges and are now nearly restricted to *sanctum sanctora*.

The effects of fragmentation are even more acute when coupled with intense needs of local peoples for fuelwood and fodder. Lal (1989) found that rural peoples rely on fuelwood for over 68% of their energy needs. Fuelwood depletion has been accelerating since the middle of the twentieth century, when it was first tracked, and now greatly exceeds annual forest production. For example, in 1975–76, the total consumption of fuelwood from all Indian forests was estimated at 133.1 million metric tons, whereas that year's forest production was a paltry 19.0 million tons. And that gap is widening. The total quantity of wood cut in excess of the silviculturally permissible limit totaled a staggering 3,244.5 million cubic meters during the period 1953 to 1987 (Lal 1989). The conservation challenge is to produce adequate fuelwood to meet local needs, to shift reliance on fuelwood to other fuel sources, and to maintain adequate forest structure and down wood for associated wildlife species (Lal 1989; Agarwala 1990).

Another aspect of forest resource overuse is dependence of villagers on forest products as sources of income. The government has long classed resources taken from forest lands as either timber or "minor forest products." The list of so-called minor forest products, however, is astonishing, literally filling a six-volume catalog. Such products include gums, resins, fibers for rope, wood for ceremonial bowls, arrows, bows, chairs, walking canes, musical instruments, medicines for all types of ailments, dyes for cloth and paper, dyes for the skin for traditional and religious ceremonies, bamboo and pole timber for houses, and hundreds of other products. These forest products are hardly minor and very well could be the key to sustainable forestry, alternative economies, and diverse and conservatory land use. Training villagers to develop these and other resources as sources of sustainable income might be the key to reducing fuelwood depletion.

Conserving India's Forests: A New Policy

The government of India recognizes that the future health of India's forest ecosystems depends on maintaining and restoring the diversity of wild ecological communities and in moderating rates of exploitation. Several policies have been developed to meet these objectives. The Ecodevelopment Program focuses on developing standards and directives for managing human habitation in forest buffer areas. The goal of the program is to find ways to raise the rural standard of living to self-sustaining levels. In 1972, the Wildlife Protection Act, in one bold move, outlawed game hunting throughout the country, except for wild boar, junglefowl, and other animals as allowed by local tribal rights.

India's National Forest Policy of 1988 calls for managing state-administered forests to conserve biological diversity. The objectives of the Policy include: maintaining environmental stability of depleted forests; preserving remaining natural forests; checking soil erosion and denudation of vegetation; halting desertification caused by poor land-use practices; establishing afforestation and social forestry programs; meeting rural peoples' needs for fuelwood, fodder, small timber, and forest products; increasing forest productivity to meet essential national needs; encouraging efficient use of forest products and maximizing wood substitutes; and creating a people's conservation movement.

The Policy also calls for conservation of India's total biological diversity by strengthening and extending the network of national parks, sanctuaries, biosphere reserves, and other protected areas. Buffer areas will provide fodder, fuel, and pastureland, while rural areas will be afforested to provide sources of fuelwood. The Policy also calls for protecting and improving production of a host of minor forest products for tribal populations, with goals of generating employment and income.

The Policy calls for maintaining at least one-third of the total land area of India under forest or tree cover through reforestation and protection of existing forests. Hills and mountains should have at least two-thirds forest cover to stave off erosion. To accomplish this goal, a massive tree planting program will emphasize growing fuelwood and fodder on all degraded and denuded lands in the country. However, acknowledging the need for increased food production, productive agricultural lands are not to be reforested. Village areas can be procured and villages moved, with protection of villager livelihoods, if the site is needed to reproduce forests. The policy stipulates that rainforests in tropical Indian states and the Nicobar Islands are to be "totally safeguarded." Further, no clear-felling of timber shall be allowed; reforestation shall proceed scientifically; and no exotic species are to be introduced without full study of potential

effects. Other portions of the Policy address rights and concessions of tribes, scheduled castes, and other poor living within and near forests. In fact, much of the Policy addresses providing for human needs for forest resources.

Most protected areas in India average 200 to 250 square km and are surrounded by dense human populations. These habitat fragments individually are too small to support viable populations of primates, elephants, large cats, native ungulates, and other species, and commonly set the stage for dangerous conflicts between large predators and humans. Only a conservation strategy that links forest reserves will provide for long-term viability of the large-bodied, wide-ranging species. To address this need, the Policy calls for establishing corridors linking protected areas of the country. This is a bold mandate that exceeds even the policy mandates of public land management in the U.S. It forces development of a process to plan land use and forest management over the entirety of the country, across all land use classes and ownerships. These steps are currently underway but have not yet been implemented nationally. The final sections of the Policy address the need to extend and develop forestry education, research, management, inventories, and budgets.

Is It Working?

India's new list of forest policy objectives is remarkable in a country that once focused on maximizing production of wood and other forest products. Although the new policy has been criticized as being too encompassing to be practical, it also may be viewed as a visionary statement that provides a new and sanguine future for forest conservation.

Advances have been made in the past decade toward establishing a national system of forest reserves, parks, and wildlife sanctuaries, and in recognizing the need for habitat corridors between such areas (Rodgers & Panwar 1988). Facilities for environmental education have been created within many reserves, and ecotourism is growing as a major sustainable use of the forests. Under India's Wildlife Protection Act, entire tribal villages have been relocated outside forest reserves to protect the forest and provide for the tribe's resource needs. Professional foresters are being cross-trained in wildlife management and conservation through innovative programs at the National Wildlife Institute of India and the Indira Gandhi Forest Academy. Clear-felling and commercial and sport hunting have been outlawed. In some old forest plantations, programs have been instituted to replenish noncommercial, fruit-bearing shrub and tree species for wildlife and to restore national forest conditions. Recent advances in satellite imaging and geographic information systems have been combined with inventories of vegetation and land use to monitor changes in forest conditions.

However significant, such successes are but small steps in the process of meeting the overall goals of the new Forest Policy. Unfortunately, the new policies are not enforceable under the current bureaucratic and economic environment. There are far too few forest guards and officers to police illegal tree felling and lopping, gathering of forest products, setting of fires, grazing of livestock, and poaching. There are also too few economic incentives for ensuring that forest resources are indeed guarded diligently, and for forest users to be self-policing. Hungry people cut down trees and hunt game; legality is secondary to sustenance. Results include increased degradation of habitat within wildlife corridors between parks and forest reserves (Badola 1989), which has led to dangerous conflicts between humans, tigers, Asian lions (*Panthera leo*), and Indian elephants (*Elaphus maximus*).

Long-term conservation of India's forests and wildlife requires consideration of the demands of an increasing human population. The first steps in this process include: checking rural population growth; identifying and developing economical and reliable sources of food, fuelwood, and income, particularly for rural peoples; using the vast reservoir of human labor to expand programs of ecological restoration and environmental education; allowing for a diversity of cultures and resource rights; and weaving conservation into daily land and resource use patterns of both rural and urban peoples. As one measure of success in implementing this ambitious conservation plan, the Indian government must ultimately demonstrate on a national scale that it is to every citizen's advantage to incorporate conservation planning in their life styles. Until then, Indian forests will continue to diminish in area and diversity.

Literature Cited

Agarwala, V. P. 1990. Forests in India, environmental and production frontiers. Second edition. Oxford & IBH Publishing Co., New Delhi, India. Page 338

Badola, R. 1989. Corridor in peril. Wildlife Institute of India Newsletter 4(4&5):33–34.

Champion, H. G., and S. K. Seth. 1968. A revised survey of the forest types of India. Manager of Publications, Delhi, India. Page 404

Gogate, M. G. 1988. Management plan for the Melghat Tiger Reserve (1988–1998). Indian Forest Service Paratwada, India.

Hawkins, R. E., editor. 1986. Encyclopedia of Indian natural history. Centenary Publication of the Bombay Natural History Society, 1883–1983. Oxford University Press, Delhi, India.

Lal, J. B. 1989. India's forests, myth & reality. Natraj Publishers, Dehra Dun, India.

Panwar, H. S. 1978. Project Tiger: the reserves, the tigers and their future. Pages 110–117 in R. L. Tilson and U. S. Seal,

eds. Tigers of the world: the biology, biopolitics, management and conservation of an endangered species. Noyes Publications, Park Ridge, New Jersey.

Prasad, S. N., P. V. Nair, H. C. Schratchandra, and M. Gadgil. 1978. On factors governing the distribution of wild mammals in Karnataka. J. Bombay Natural History Society **75**:718–743.

Rodgers, W. A., and H. S. Panwar. 1988. Planning a wildlife protected area network in India. Volume I—The report, and Volume II—State summaries. Wildlife Institute of India, Dehra Dun, India.

Saharia, V. B. 1982. Wildlife in India. Natraj Publishers, Dehra Dun, India. 278 pp.

Salwasser, H. 1991. Opening remarks: National Workshop on Integrated Forest Planning and Management for Conserving Biological Diversity. Presentation at a national conference, 21 January 1991, Pachmarhi, Madhya Pradesh, India.

Troup, R. S. 1975. The silviculture of Indian trees. 3 vols. Controller of Publications, Delhi, India.

Bruce G. Marcot
USDA Forest Service
Pacific Northwest Research Station
333 S.W. First Avenue, P.O. Box 3890
Portland, Oregon 97208, U.S.A.

Announcements

Conferences and Meetings

The Fourth North American Symposium on Society and Resource Management will take place at the Memorial Union at the University of Wisconsin in Madison from 17–20 May 1992. Resource professionals, researchers, and students will be offered plenary addresses and concurrent sessions on a wide variety of topics including management of agricultural production systems and environmental quality, conservation and sustainable resource development, environmental ethics, GIS applications, integrated resource management, and social science and global resource issues. For more information contact: Donald Field or Mary Miron, School of Natural Resources, 1450 Linden Drive, Room 146, University of Wisconsin, Madison, WI 53706, (608) 262-6968. (*Source:* University of Wisconsin)

A symposium addressing science and education for maintaining biodiversity will be held at the University of Basle in Switzerland, 30 September–3 October 1992. For details please contact: D. Seiler, ATAG, Aeschengraben 9, CH-4002 Basle, Switzerland, FAX (61) 23-40-60. (*Source:* University of Basle)

The Fourth Annual Conference of the Society for Ecological Restoration will be convened at the University of Waterloo, Ontario, Canada from 9–14 August 1992. Themes will include park and forest management, restoration of urban and rural lands, regional landscape planning, environmental education, community-based restorations, and Great Lakes bioregional issues. Guided field trips are planned to restoration sites in conjunction with the North American Prairie Conference (to be held in Windsor, Ontario, 6–9 August). For additional information contact: Nik Lopoukhine, Natural Resources Branch, Environmental Canada, 10 Wellington Street, Hull Quebec, K1A 0H3, (819) 997-4900. (*Source:* Conference organizers)

Parks, People, and Snow Leopards will be the theme of the Seventh International Snow Leopard Symposium to be held 27–31 July 1992 in Xining, Qinghai Province, People's Republic of China. For information contact: Helen Freeman, International Snow Leopard Trust, 4649 Sunnyside Avenue North, Seattle, WA 94103. *(Source: Oryx)*

The Association of Systematics Collections will hold its 1992 annual meeting in conjunction with the American Institute of Biological Sciences 9–11 August 1992 in Honolulu, Hawaii. Events will include a workshop on *Data Sharing and Database Ethics* and a session on research needs and priorities in systematics. For program information contact: The Association of Systematics Collections, 730 11th Street NW, 2nd floor, Washington, DC 20001, (202) 347-2850. (*Source:* ASC)

The 22nd Congress of the International Organization for Succulent Plant Study will be held 5–14 April 1992 at the Desert Botanical Garden in Phoenix, Arizona. Several sessions will focus on succulent conservation and a special symposium will consider *Conservation of Mutualisms: Threatened Succulents and Their Endangered Pollinators.* Extensive field excursions are planned. For more information contact: The Desert Botanical Gardens, IOS Congress, 1201 North Gavin Parkway, Phoenix, AZ 85008. (*Source:* Desert Botanical Garden)

New Journal

The new journal *Environmental Values* will be launched in 1992. This international journal focuses on the rational basis and justification of environmental policy by bringing together contributions from philosophy, law, economics, and other disciplines. Subject areas include economic valuation of nonrenewable resources and species diversity; philosophical bases for cost/benefit analyses, risk analysis, and decision theory, ethical and aesthetic justifications for environmental concern; ethical implications for biotechnology; and international law and the global environment. Instructions for authors are available from the editor: Alan Holland, Department of Philosophy, Lancaster University, Lancaster LA1 4YT, U.K. FAX 0524 843085. For subscriptions write: The White Horse Press, 1 Strond, Isle of Harris, Scotland PA83 3UD, FAX 085 982 204. (*Source:* White Horse Press)

Training Opportunity

The National Ecology Research Center of the U.S. Fish and Wildlife Ser-

vice, in cooperation with Colorado State University, is offering a series of courses in *Habitat Evaluation Procedures* at various locations throughout the United States during 1992. The courses are designed for biologists, managers, resource planners, foresters, and other natural resource personnel from local, state, and federal agencies, and private organizations that work on impact assessment, planning, and natural resource management. Tuition and lengths of classes vary. For more information contact: Charles Solomon, 4512 McMurry Avenue, Fort Collins, CO 80525, (303) 226-9421. (*Source:* USFWS)

Research and Fellowships

The Christensen Research Institute is a privately funded research facility on the north coast of Papua New Guinea at Madang. The Institute is dedicated to terrestrial and marine research. Facilities include six dormitory rooms, two self-contained houses, kitchen–dining complex, wet lab plumbed with fresh and salt water, air conditioned dry labs, library, darkroom, computers, and limited museum. A workshop, four-wheel drive vehicles, boats, diving and other field equipment are available. Bench fees are currently fully subsidized by The Christensen Fund. Christensen Fellowships for travel and other costs are offered annually. Inquiries should be addressed to: Matthew Jebb, Christensen Research Institute, P.O. Box 305, Madang, Papua, New Guinea, FAX 675 82 3306. (*Source:* CRI)

The Garden Club of America annually offers two $5,000 awards to assist graduate students conducting doctoral dissertation field work on the conservation of tropical plants. Applicants should provide a curriculum vitae, evidence of foreign language capability, outline of research (and relevance to conservation), a statement of long term commitment to conservation, and a letter of recommendation. Funded work includes ecosystem-level studies, applied research, and autoecological and taxonomic studies. Students must be enrolled in a U.S. university. Applications should be submitted to: Maritza Pinilla, World Wildlife Fund—Garden Club of America Scholarships in Tropical Botany, World Wildlife Fund, 1250 24th Street NW, Washington, D.C. 20037. (*Source:* WWF)

The trustees of the Switzer Foundation and the San Francisco Foundation invite nominations of outstanding masters and doctoral degree students for Switzer Environmental Sciences Fellowships of $10,000 each to assist graduate students to pursue degrees in environmental sciences. Candidates' career objectives must focus on improving, not merely preserving, the quality of our environment. Scientists and engineers dedicated to pollution reduction or restoration of polluted resources are encouraged to apply, as are policy makers, economists, writers, lawyers, and other professionals seeking training in environmental sciences. Nominations and inquiries should be directed to: Carol Campbell, The San Francisco Foundation, 685 Market Street, Suite 910, San Francisco, CA 94105, (415) 495-3100.

Submission of News Items

Conservation-related news items should be sent to the Associate Editor for International Conservation News: Dr. Dennis D. Murphy, International News, Center for Conservation Biology, Stanford University, Stanford, CA 94305, U.S.A. Decisions concerning publication of submitted material rest with the news editor.