

## Conserving forest biodiversity in times of violent conflict

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**Abstract** Forests are often frontiers, and like all frontiers, they are sites of dynamic social, ecological, political and economic changes. Such dynamism involves constantly changing advantages and disadvantages to different groups of people, which not surprisingly can lead to armed conflict, and all too frequently to war. Many governments have contributed to conflict, however inadvertently, by nationalizing their forests, so that traditional forest inhabitants have been disenfranchised while national governments sell the rights to trees in order to earn foreign exchange. Biodiversity-rich tropical forests in Papua New Guinea, Indonesia, Indochina, Myanmar, Sri Lanka, Central and West Africa, the Amazon, Colombia, Central America and New Caledonia have all been the sites of armed conflict in recent years, sometimes involving international forces. Forests have sometimes been part of the cause of conflict (as in Myanmar and Sierra Leone) but more often victims of it.

Violent conflicts in temperate areas also typically involve forests as shelters for both civilians and combatants, as in the Balkans. While these conflicts have frequently, even invariably, caused negative impacts on biodiversity, peace can be even worse, as it enables forest exploitation to operate with impunity. Because many of the remaining forests are along international borders, international cooperation is required for their conservation. As one response, the concept of international "Peace Parks" is being promoted in many parts of the world as a way of linking biodiversity conservation with national security. The Convention on Biological Diversity, which entered into force at the end of 1993 and now has 187 State Parties, offers a useful framework for such cooperation.

**Keywords** Biodiversity, conflict, forest, Peace Park, transfrontier, war.

### Introduction

The 'peace dividend' expected from the end of the Cold War has not paid off in terms of reduced conflict, and the recent events in New York, Washington, Afghanistan, Ivory Coast and Iraq demonstrate the continuing potential for highly destructive war. Some tropical countries are facing general lawlessness and banditry, including that by demobilized and current soldiers in several African nations, and drug cartels in some parts of Latin America (Renner, 1996). Tension in various parts of Africa, Central America, Colombia, Indonesia, the Philippines, Sri Lanka, India, the Balkans and elsewhere are further indications of the threat of war in many of the countries that contain significant forested areas important for conserving biodiversity.

Despite these widespread threats to national sovereignty, governments are obliged under the 1992 Convention on Biological Diversity (CBD, 2003) to conserve their own biodiversity (Article 1) and to ensure that activities within their jurisdiction or control do not cause damage to the environment of other states (Article 3). Any

negative impacts of war on biodiversity are clearly contrary to this international agreement, although this constraint has carried little weight with the belligerents. The NATO countries signatory to the CBD apparently did not consider biodiversity in their bombing runs over Kosovo, judging from the results. But what, specifically, are the impacts on biodiversity of war, preparations for war, and managing the aftermath of war?

The issues are complicated and the available evidence does not provide simple answers. It is hard, however, to avoid the conclusion that modern means of communication, growing human populations and levels of resource consumption, increased vulnerabilities of inter-dependent, integrated civil societies, and the spread of modern instruments of war, including chemical and biological weapons, are likely to make any future wars extremely destructive for both people and the rest of nature.

On the other hand, war has often been part of the way human societies have adapted to changing conditions (e.g. Harris, 1974; Keeley, 1996; Vayda, 1974). The International Commission on Peace and Food (1994) concluded that "Historically, all landmark changes in the international political and security system have been the result of armed conflicts, wars and revolutions". It appears that many, even most, societies have been defined by war, and that the organization of a society

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for the possibility of war has been its principal political stabilizer; this appears to be the case for even the most developed countries today. The victors of war have sown the seeds that would produce subsequent advances, as well as tensions, disputes and conflicts. It often seems that an institutional lack of capacity to adapt to change, or the inertia of vested interests in the status quo, means that societies inevitably become maladapted over time, eventually requiring a shock such as war or another form of substantial regime change to set them on a different course that may be more adaptive (Edgerton, 1992). 'Traditional' tribal wars and modern high-technology wars are functionally equivalent in this regard.

A fundamental issue is how humans stay within the productive limits of their supporting ecosystem. While most would agree that such adaptation should be possible through the application of knowledge and wisdom that enables effective management of resources and trading relations, history does not support such a rational view, and in fact war is virtually universal in human societies as a means of resolving conflicts arising from various sources of maladaptation (Keeley, 1996; Diehl & Gleditsch, 2001; Klare, 2001). Underlying stress factors can produce or deepen rifts in societies, with disputes triggered by glaring social and economic disparities and exacerbated by the growing pressures of resource depletion, natural calamities, environmental degradation, and perceived excess population. Biodiversity-related problems such as desertification, soil erosion, deforestation, and water scarcity reduce the potential to grow food, worsen health effects, and diminish life-support capacity, contributing to civil conflict and increasing the likelihood of war. As Nietschmann (1990a) concludes, on the basis of experience from Nicaragua: "Degraded land and resources are as much a reason for taking up arms as are repression, invasion, and ideology". Thus biological resources are intimately related to war, as causes, victims, and beneficiaries.

Environmental stress and competition for resources can be fundamental causes of armed conflict, or at least contribute to it (Klare, 2001; Renner, 2002). Therefore, issues of conserving biodiversity, using biological resources sustainably, and sharing the benefits of such use in a fair and equitable manner (the three objectives of the Convention on Biological Diversity) are critical elements in discussions of national security. Investments in activities such as sustainable forestry, water conservation, land reform, and protected areas management, it can be argued, are vital contributions to peace.

This paper will begin by briefly assessing war as one of the traditional social means that human societies have used to adapt to changing environmental conditions, then assess some of the impacts of war on forest bio-

diversity before suggesting several issues that must be addressed if modern civilization is to meet the growing security challenges of the 21st century. I conclude by showing how conserving biodiversity can contribute to peace, building on the preamble to the Convention on Biological Diversity, which states, perhaps idealistically, that, "Ultimately, the conservation and sustainable use of biological diversity will strengthen friendly relations among states and contribute to peace for humankind".

### **The history of war and biodiversity**

The way in which today's biodiversity is arranged across the landscape is to a considerable extent the result of long-term interactions between people and their environments reaching back at least as far as the origins of fire (e.g. Martin & Klein, 1984; Ponting, 1992; Flannery, 1994; McNeely, 1994). The greatest diversity of terrestrial species today is found in the vast forested areas inhabited by tribal and other indigenous peoples, where relatively large areas of 'unoccupied' territory serve as a sort of buffer zone between communities that may be embroiled, at least historically, in virtually constant warfare, including sneak attacks, revenge killing, kidnapping, and raids on livestock (Keeley, 1996). It is instructive, therefore, to briefly examine the impact on biodiversity of warfare among traditional and indigenous societies, and the influence such relations have had on biodiversity.

Higher frequencies of war in traditional societies can be forecast by a history of unpredictable natural disasters and severe food shortages, as people have tried to protect themselves by going to war to take resources from enemies (Ember & Ember, 1992). In the Americas, Europe, Polynesia, New Guinea and Africa, raids often included plundering food stores and gardens of neighbouring groups, leaving an enemy facing starvation, and rendering large areas of territory at least temporarily uninhabited. While this could serve to provide larger areas of habitat to various species of wildlife, it could also lead to significant increases in the pressure of the human population on remaining wildlife populations. Losses and gains of territory were a frequent result of warfare among pre-industrial societies, leading to dynamic boundaries, and these frontiers, emptied of human populations, were often places that supported great diversity of species. Keeley (1996) concludes: "Even in situations where no territory exchanges hands, active hostilities along a border can lead to development of a no-man's-land, as settlements nearest an enemy move or disperse to escape the effects of persistent raiding. Although such buffer zones could function ecologically as game and timber preserves, they

were risky to use even for hunting and wood cutting because small isolated parties or individuals could easily be ambushed in them''.

New Guinea is a tropical forested island that has been a particularly fertile ground for the study of war, because warfare has been frequent, deadly, and a defining factor in the life of most tribal peoples of the island during the 100 years or so that anthropologists were available to study its highly diverse societies (over 700 languages are known from New Guinea). For example, warfare among the Maring, a people of the New Guinea Highlands, facilitated demographic shifts, adjusted relationships between population and land, and alternated the build-up of pig herds with slaughter for pig feasts that played an important role in warfare. Rappaport (1968) saw warfare as part of a self-regulating ecological system that maintained the population of both people and pigs below the carrying capacity of the land. Some of the New Guinea highland cultures have particularly bloody histories. For example, the Mae Enga fought 41 wars for land between 1900 and 1950, of which six resulted in complete routs of the enemy that led to acquisition of new territory from the defeated clan (Meggitt, 1977). Among the Dani people of the New Guinea Highlands, warfare was responsible for almost 30% of mortality (Heider, 1970). Warfare in association with hunting has been well documented among a number of other New Guinea groups, including the Purari, the Kiwai, the Trans-Fly peoples, the Marind-Anim, the Kolopom, the Jacquia, and the Asmat.

Heider (1970) described New Guinea warfare as a cycle of battles and raids over many years that constantly splits alliances and rearranges confederations, thus setting the stage for subsequent battles. The result of such fighting is that fields and home sites are abandoned, thereby redistributing land and other resources and creating buffer zones that provide sanctuary to at least some components of biodiversity.

These buffer zones are often where biodiversity is richest, especially in terms of large mammals. As just one example, in South America at the time of the first contact with Europeans, large settled villages were found along the major rivers in various parts of the Amazon. The chieftains of these societies practised a type of warfare that often involved forces numbering hundreds of men, drawn from multiple confederated villages, who travelled by canoes and used sophisticated tactics to attack their enemies. The chieftains often fought over territory, with large buffer zones separating them; these buffer zones were refugia for wild game (Ferguson, 1989).

One of the world's biologically-richest areas is in the upper Amazon, including Venezuela, Colombia, and Brazil: a true 'biodiversity hotspot' (McNeely *et al.*, 1990)

where borders are not well demarcated. Perhaps not coincidentally, this is also an area that is occupied by a large number of culturally distinct Indian groups that have formed long-term relationships with their environment and neighbours, including elements such as warfare, infanticide, and raiding, that are unacceptable in modern society (except, of course, where they are sanctioned by the government as part of modern warfare). For example, Chagnon (1988) has found that among the Yanomamo Indians, the largest Indian group in the Amazon rainforest, 44% of males 25 years or older had participated in the killing of someone, about 30% of adult male deaths were due to violence, and nearly 70% of all adults over 40 had lost a close genetic relative due to violence.

While the existence or intensity of warfare in pre-state societies is not a simple linear function of population density, population pressure on the land, or protein scarcity, all of these factors are likely to be important contributors, and it seems reasonable to conclude that ecological pressure works together with cultural and political dispositions towards warfare. The perception of individual or group land scarcity is a function of socio-cultural as well as ecological organization; perceptions of scarcity are often as important as the pattern of rainfall, the numbers of pigs, or the game animals in the forest (Knauft, 1990). Thus the actual warfare carried out by the indigenous peoples of the tropical forests have involved numerous factors reinforcing each other, including increasing human population density, related clearance of forests to increase domestic food production, and declining wild food resources at the same time that demand for resources is increasing, leading to increased opportunities for conflict. The subsequent population redistribution certainly had profound implications for biodiversity.

It appears that various forms of war have been part of the way traditional societies adapted to changing conditions and, at least coincidentally, by fostering buffer zones in areas occupied by traditional and indigenous peoples, helped contribute to the rich biodiversity found today in many tropical forests. Bringing peace to these regions will remove this means of adaptation, requiring other ways to conserve biodiversity and maintain the capacity to adapt to changing conditions.

## The impacts of war on forest biodiversity

### Negative impacts

The negative impacts of modern war on forest biodiversity (Table 1) result from the collective actions of large numbers of people (mostly post-adolescent males) for whom war is a dispensation to ignore normal restraints on the

**Table 1** The negative and positive impacts that war may potentially have on biodiversity.

Negative impacts	Positive impacts
Deforestation	Creates 'no-go' zones
Erosion	
Habitat destruction	
Pollution of land and water	Allows vegetation to recover in some areas Reduces pressure on some habitats
Arms rural population, leading to poaching	
Creates refugees who destroy biodiversity	Disarms rural populations, thereby reducing hunting Slows or stops developments that lead to loss of biodiversity Can increase biodiversity-related research
Reduces funds for conservation	
Halts conservation projects	
Forces people on to marginal lands	
	Focuses state resolve to control rural populations

activities that cause environmental damage. War, and preparations for it, has negative impacts on all levels of biodiversity, from genes to ecosystems. These impacts can be direct, such as hunting and habitat destruction by armies, or indirect, for example through the activities of refugees or other displaced persons or the removal of conservation staff.

Sometimes these impacts can be deliberate, and a new word has been added to the vocabulary: "ecocide", the destruction of the environment for military purposes, clearly deriving from the scorched earth approach of earlier times. This discussion could be long and dreary, but only a few illustrative cases will be mentioned. Perhaps the most outstanding example is Vietnam, where US forces cleared 325,000 ha of land and sprayed 72,400 m<sup>3</sup> of herbicides in the name of security (Westing, 1982). The impact on biodiversity was severe; spreading herbicides on 10% of the country (including 50% of the mangroves) led to extensive low-diversity grasslands replacing high-diversity forests, mudflats instead of highly productive mangroves, and major declines in both freshwater and coastal fisheries (Nietschmann, 1990a). Many other examples could be provided of massive and extended applications of disruptive techniques to deny to the enemy any habitats that produce food, refuge, cover, training grounds, and staging areas for attacks.

Another approach involves relatively small disruptive actions that in turn release large amounts of 'dangerous forces' or become self-generating (Westing, 1976). Examples of the latter are the release of exotic micro-organisms that could cause disease, or the planting of landmines, >100 million of which now litter active and former war zones around the world (Strada, 1996). While some species, especially birds, may find hunting pressures reduced because of landmines, these are also dangerous to the wildlife. Press reports indicate that landmines have injured elephants *Elephas maximus* along the Thai-Burma border, killed wild camels *Camelus bactrianus* in western China, tigers *Panthera tigris* in Cambodia, water buffalo *Bubalus bubalis* in Vietnam,

elephants in Sri Lanka, gazelles (*Gazella* spp.) in Libya, snow leopards *Uncia uncia* in Afghanistan, blue sheep *Pseudois nayaur* and musk deer *Moschus chrysogaster* in Kashmir, numerous species in Croatia, and mountain gorillas *Gorilla beringei* in Central Africa. Even worse, some hunters reportedly use landmines in traps, tying a small animal as bait and waiting for a tiger or other large species to detonate the mine.

Other problems are more systemic. The State Law and Order Restoration Council, the military government of Myanmar (formerly Burma), has been involved in violent confrontations with many of the tribal groups who inhabit the densely forested mountain regions along the country's borders with Bangladesh, India, China, Laos and Thailand. Some of these tribal groups, such as the Karen, have turned to intensive logging to fund their war effort, even though such over-exploitation will eventually destroy the forest cover and make them more vulnerable to attack (Harbinson, 1992). The general lawlessness along the border with Thailand has greatly increased the flow of logs, both with and without government permission, leading to the virtual clear-felling of many of the country's most productive forests. The trade in wild animals, especially to China, is also booming.

In Laos, the military is deeply involved in logging activities, as well as in other industries such as mining, construction, cement production and tourism. A prime ministerial order in 1994 gave military companies control over the logging quotas within their areas of interest, essentially marginalizing the Department of Forestry. They also own sawmills and plywood plants, although the military companies are very secretive about their activities, including the volume of timber harvested or the capacity of their plywood plants. These military companies do not prepare management plans and tend to significantly exceed the sustainable annual harvest. The military is also involved in logging in many other ways, including applying for permission to cut timber to construct camps (but requesting volumes far in excess of that required for camp construction, with the 'surplus'

then sold). The military may also be involved in logging operations near the Cambodian border and in the movement of Cambodian and Burmese logs through Laos to Thailand and Vietnam (Talbot & Brown, 1998).

The Indochina war was also disastrous to Cambodia, in both human and ecosystem terms. Years of fighting have created a climate of lawlessness in which those who control the guns also control the country's most valuable natural resources, namely forests and fisheries. Uncontrolled logging, much of it illegal, could virtually clear all economically productive forests in the country within 5 years, according to the Asian Development Bank, with current harvesting at over three times the sustainable yield. Since 1993, military commanders of both the Khmer Rouge and the government have come to regard the forest resources as their own, treating them as a supplemental source of finance irrespective of the long-term impact on the country's security; US \$220–390 million per year was being siphoned off by military forces in the mid-1990s (Renner, 2002). Continuing loss of forests will further affect the climate, cause erosion that fills irrigation channels and fishing grounds with silt, and leave Cambodian farmland more vulnerable to both drought and flooding. This complex of problems has many similarities to the challenges that faced Cambodia some 500 years ago, when the great civilization centred on Angkor Wat collapsed under environmental pressure (McNeely & Wachtel, 1988).

Africa provides several recent war-related disasters for biodiversity in tropical forests. Like the upper Amazon, the Virunga Volcanoes region (including parts of the Central African countries of Rwanda, Democratic Republic of Congo (DRC) and Uganda) is exceptionally rich in species, including the rare and endangered mountain gorilla *Gorilla beringei* whose total population is approximately 600. The civil war against the government of Rwanda was launched in 1990 from within the Virunga Volcanoes region, spreading deeper into Rwanda until 1994, and sending large numbers of refugees fleeing to North Kivu District in what was then Zaire, which then began a civil war of its own. The headquarters of several tropical forest World Heritage sites in DRC were taken over by the military, including Virunga National Park, Kahuzi-Biega National Park and the Okapi Wildlife Reserve. In 1994 c. 850,000 refugees were living around Virunga National Park, partly or completely deforesting some 300 km<sup>2</sup> of the park in a desperate search for food and firewood. Up to 40,000 people entered the park every day, taking out between 410 and 770 tons of forest products. In particular the bamboo forests were seriously damaged, and the populations of elephants *Loxodonta africana*, buffalo *Syncerus caffer*, and hippos *Hippopotamus amphibius* have been much reduced; amazingly, the Virunga gorilla population was little disrupted, although

half the gorillas in Kahuzi-Biega were killed, mostly for bushmeat (Yamagiwa, 2003). Organizations such as the Red Cross, Médecins Sans Frontière, and CARE supported well-meaning relief operations on the park boundaries and even established a dump for medical wastes inside the park, with the obvious disease transmission risks associated with such practices (Pearce, 1994). At least 80 of Virunga's park staff have been killed in battles with insurgents since 1996.

A few other examples (among the many that could be provided), taken from press reports, and sources as cited:

- In late June 2002 rebels from the Lord's Resistance Army raided Uganda's Murchison Falls National Park, killing seven rangers, abducting at least 10 others, and poaching protected wild animals.
- In 1996 the Kibira and Ruvubu national parks in Burundi were used as sanctuaries and entry points for guerrillas fighting the government. As a result they also became operational areas for government troops, with both sides heavily involved in poaching (Winter, 1997).
- India's Manas Wildlife Sanctuary, a World Heritage site, has been taken over by guerrillas from the Bodo tribe, who have burned down park buildings, looted most park facilities, killed guards, destroyed bridges, poached rhinos *Rhinoceros unicornis*, elephants, tigers, and other wildlife, cleared forests, and depleted fish stocks in the Manas river.
- In Sri Lanka, Wilpattu National Park was attacked by Tamil rebels in 1989, killing over a dozen guards and destroying facilities. This caused a withdrawal of conservation staff, and a great increase in military activity.
- Liberia's civil war has forced rural people to hunt duikers (*Cephalophus* spp.), pygmy hippos *Choeropsis liberiensis*, elephants, and chimpanzees *Pan troglodytes* for food (Wolkomir & Wolkomir, 1992).
- In the Democratic Republic of Congo, civil war has stopped efforts to protect the last habitat of the endemic bonobo *Pan paniscus*. Fewer than 15,000 of the apes survive, but they are increasingly threatened by local people who are forced to depend on the forest for survival. This includes hunting of bonobos for bushmeat; one researcher reported that poachers and army deserters armed with machineguns are hunting in Salonga National Park, a World Heritage site that is a stronghold of this species.

The conclusion is unsurprising: war is bad for biodiversity.

### Positive impacts of war on biodiversity

But war, or the threat of war, can also be good for biodiversity (Table 1), at least in some places and under certain conditions. As Myers (1979) put it: "In some respects, indeed, wildlife benefits from warfare: combatant armies effectively designate war zones as 'off limits' to

casual wanderers, thus quarantining large areas of Africa from hunters and poachers". Of course, any benefits of war to biodiversity are incidental, inadvertent, and accidental rather than a planned side-effect of conflict. But even so, it is useful to review some cases where war or preparations for war have benefited biodiversity, perhaps supporting the view of some anthropologists that war helps societies adapt to their dynamic environmental constraints.

For example, the border between Thailand and Peninsular Malaysia was a hotbed of insurgency from the mid-1960s to mid-1970s. On the Malaysian side of the border, the military closed off all public access and potential logging activity in the Belum Forest Reserve. As a result, this extensive area of some 160,000 ha has remained untouched by modern logging pressures and is therefore rich in wildlife resources. Malaysia is now converting this into a National Park that will form a transboundary protected area with matching protected areas in southern Thailand (provided the boundary wall can be removed so that wildlife can again move freely across the border).

Demilitarized zones, or 'no man's lands' maintained by the military, are often beneficial for biodiversity, at least temporarily. An outstanding example is the demilitarized zone (DMZ) of the Korean Peninsula, which is a no-man's land 4 km wide stretching 240 km across the Peninsula; the South maintains an additional strip that averages 5.4 km in width and totals 1,529 km<sup>2</sup>, to which access is severely restricted. This cross-section of Korean biodiversity provides a sanctuary for a wide diversity of Korea's species, many now rare elsewhere. About 150 Red-Crowned Cranes *Grus japonensis* from Manchuria come annually to the DMZ's central basin around Cholwon. Further west, around the truce village of Panmunjom, up to 300 White-Naped Cranes *Grus vipio* pass through every winter. It has been found that the Korean demilitarized zone is an essential migratory habitat of these cranes and that they stop at some sites in the DMZ for up to 87% of their total migration time (Higuchi *et al.*, 1996). As Poole (1991) puts it: "Here the presence of the Cranes is especially haunting. These symbols of oriental peace and tranquillity stand sentinel between the gun-toting border guards."

Another example comes from the central and eastern European countries formerly occupied by Soviet troops, where c. 2% of the land was given over to military bases (Wolff, 1997) and the Iron Curtain functioned as a long, well-protected nature reserve. In countries such as Latvia, much of the military land was in the form of undeveloped training areas that retained values for biodiversity conservation, although in many other areas the Soviet army left behind a legacy of devastation and environmental pollution.

While the second Vietnam War was generally an ecological disaster due to pervasive use of herbicides and systematic destruction of vegetation, the watersheds through which the Ho Chi Minh trail ran, some of the most heavily-bombed parts of Indo-China during the second Vietnam War, have more recently been remarkably productive for discoveries of previously unknown species. New discoveries of large mammals include two species of muntjak or barking deer (*Megamuntiacus vuquangensis* and *Muntiacus truongsongensis*), a unique variety of forest antelope *Pseudoryx nghetinhensis*, and a bovid *Pseudonovibos spiralis* related to wild cattle (Dillon & Wikramanyake, 1997), as well as the rediscovery of a species of pig *Sus bucculentus* that was formerly known only by a few fragmentary specimens. That large mammals could survive in such a heavily-bombed area is testimony to the recuperative power of nature and the ability of wildlife to withstand even the most extreme kinds of human pressure during warfare. However, these species are now even more severely threatened by the peacetime activities of development than they were by the Indochina wars. Tigers, rhino *Rhinoceros javanicus*, kouprey *Bos sauveli*, and many other species attractive to human hunters are now well on their way to disappearing from Vietnam, if not already gone.

Some species earned at least a temporary respite from the war in Vietnam. Orians and Pfeiffer (1970) observed that tigers during the war "learned to associate the sounds of gunfire with the presence of dead and wounded human-beings in the vicinity. As a result, tigers rapidly move towards gunfire and apparently consumed large numbers of battle casualties. Although there are no accurate statistics on the tiger populations past or present, it is likely that the tiger population has increased much as the wolf population in Poland increased during World War II". Many species of amphibians have found ponds formed by bomb craters to be good breeding grounds, a ray of hope in the gloomy global picture for frogs and toads (Stuart & Davidson, 1999).

Many examples can be cited for Africa. For example, Fairhead and Leach (1995) report that parts of the Ziam region of Guinea, which includes an extensive biosphere reserve, became forested following a series of wars that affected the area from 1870 to 1910. The resident Toma people first fought with Mandinka groups from the north and subsequently with the French colonial armies, causing major depopulation and economic devastation that in turn allowed the forest to reclaim agricultural land. The human disaster of war enabled nature to recover.

#### Mixed impacts of war on biodiversity

The impact of war on biodiversity is often decidedly mixed, with a complex combination of damages and

benefits. Nicaragua provides an illuminating example. Engaged in civil war for over 20 years, nearly half of the country's population was relocated in one way or another, and there were nearly 100,000 casualties. The human tragedy was immense, but biodiversity was able to recover from a long history of exploitation, as trade in timber, fish, minerals, and wildlife was sharply reduced. The domestic cattle population, which was roughly equivalent to the human population when the war started, was reduced by two-thirds, freeing pastures for recolonization by forests, enabling the recovery of animal populations such as white-tailed deer *Odocoileus virginianus*, collared peccaries *Tayassu angulatus*, mantled howler monkeys *Alouatta villosa*, white throated capuchins *Cebus capucinus*, night monkeys *Aotus paniscus*, red backed squirrel monkeys *Saimiri oerstedii*, crocodiles *Caiman crocodilus*, iguanas *Iguana iguana*, large birds, and various mammalian predators. Fishing boats were destroyed and fishermen fled, leading to drastic declines in the catches of fish, shrimp and lobsters, which in turn revitalized these fisheries. On the other hand, some hunting by soldiers had, at least locally, negative impacts on wildlife, and new military bases and roads were established in formerly remote areas, opening them up to exploitation. Furthermore, the country's once outstanding system of protected areas fell into neglect, and new areas planned were not established; the collapsing economy forced villagers into environmentally destructive activities, including clearing forest for firewood and harvesting wildlife for food to replace meat formerly provided from livestock. Nietschmann (1990b) concludes that a significant portion of this conflict was over resources and territory, not ideology. Biodiversity rejuvenated by the war came under renewed threat by people impoverished by the war; the post-war period saw a great acceleration of such impacts and, now that peace has broken out, biodiversity is under renewed pressure.

Areas of human encroachment and expansion into the biologically important remnant forests of Colombia are mostly under guerrilla or paramilitary rule, essentially beyond the reach of governmental conservation or development efforts (Davalos, 2000). Violent conflict can have three main kinds of effects on forests. First, what Davalas calls "gunpoint conservation" includes active exclusion of most productive activities enforced by landmining or civilian curfew. The second involves the pressure for forest conversion from drug cultivation and cattle ranching in areas beyond the rule of law and/or contested by armed groups. The last is a consequence of the collapse of the institutional framework for civilian law. The National Liberation Army (ELN), a left-wing guerrilla group, enforces forest protection in some parts of the Serrania de San Lucas, purportedly for the role of forests in protecting the local hydrology. The forests

also serve to shelter the guerrillas from air surveillance by government forces. They achieve this protection by placing landmines, or at least signs claiming that they have placed landmines, where they can be seen by villagers. The Revolutionary Armed Forces of Colombia (FARC-EP) exclude almost all agriculture from the southern half of the Macarena range, ostensibly to preserve the wealth and beauty of the forest for future generations, but the forests also house their national headquarters. Their protection of the forest can be very effective. During the 1997 El Niño droughts, farmers seeking to expand their landholdings burned the lowlands of the Munchique National Park, until the FARC threatened to kill the arsonists; the fires quickly stopped. Both FARC and ELN tout their environmental interests on their websites (ELN, 2003; FARC-EP, 2003), appropriating the discourse of sovereignty over biodiversity on the ground that their application of these policies also provides shelter from air raids, protects water supplies, and conserves biodiversity. It appears that the guerrillas are willing to conserve some of the charismatic wildlife of the region.

Far more damaging are the paramilitaries, essentially mercenaries for cattle ranching and narcotics trafficking interests; once they have cleared a region of guerrillas, they consolidate the landholdings and clear forests for cattle ranching or coca cultivation. Violence in the countryside has also reduced population pressure, with the rural population only increasing 0.3% per year between 1990 and 1995, despite the countrywide annual population increase of 1.7%. On the other hand, given the constant threat of war, few incentives encourage long-term conservation or management of resources. Areas characterized by conflict may have been emptied of villagers, but it is also essentially impossible to practice forest management, restoration or conservation. It appears that peace negotiations can lead to full-blown, large-scale unplanned exploitation in areas that are now off-limits because of security considerations.

So while war is bad for biodiversity, peace can be even worse: in the 1960s, when Indonesia and Malaysia were fighting over border claims on the island of Borneo, they did relatively little damage to its vast wilderness, but in the 1990s they peacefully competed to cut down and sell its forests. In Indonesia the 1997–1998 forest fires that caused US \$4.4 billion in damage were set primarily by businesses and the military to clear forests in order to plant various cash crops. Vietnam's forests are under greater pressure now that peace has arrived than they ever were during the country's wars, Nicaragua's forests are now under renewed development pressures, and Laos is paying at least part of its war debts to China and Vietnam with timber concessions. The motivations may be more noble in times of peace, but the impacts

of inappropriate development on biodiversity are often even worse than the impacts of war. Market forces may be more environmentally destructive than military forces, but the latter may moderate the former.

### Some possible solutions

Times of violent conflict also are times of change, and those who remain in the field can have a very great influence on subsequent events. Thus it is very important that international support to protected areas is maintained during times of conflict; it is likely that investment at these times will yield results that are disproportionately high in return for a relatively modest investment, although at considerable risk to staff. Financial support, for example, can be channelled if necessary via local NGOs as a means of keeping dedicated and loyal staff on the job and continuing to carry out necessary management operations. Substantial efforts have been made by numerous conservation organizations to maintain a conservation presence in the Democratic Republic of Congo, even under the most difficult of conditions (Draulans & van Krunkelsven, 2002).

For conservation organizations seeking to work in times of conflict, it may be essential to maintain as much neutrality and impartiality as possible, because predicting a victor in a violent conflict is not always straightforward. Thus relationships and trust need to be cultivated with all parties, yielding important benefits for conservation activities, particularly when these are seen to be contributing to the welfare of local communities. Of course, building trust and good relationships should not wait until times of conflict, but be nurtured at all times.

It goes without saying that the protected areas and other conservation programmes that have the best relations with local people are the ones that are most likely to be able to adapt to the radical changes that may be imposed in times of violent conflict. But times of violent conflict also mean changes in priorities, and local communities may depend on subsistence activities that would be unacceptable in times of peace. The fact that protected areas are often called "reserves" is an indication that the resources they are protecting may be considered as a strategic reserve in times of emergency. The conservation staff need to be realistic in such situations, and give higher priority to livelihood security while maintaining a concern about biodiversity conservation. If the conservation agencies are able to demonstrate a commitment to the welfare of local communities in times of violent conflict, this may also provide an improved basis for collaboration over the longer term.

In the chaotic conditions that often surround violent conflict and its aftermath, conservation is not always

given a sufficiently high priority, even though actions taken at this time may be essential to ensuring a productive subsequent environment. This requires appropriate short-term actions that are based on a long-term strategic vision. Methods to reinvigorate the local economy or pay off war debts need to ensure that the environmental costs are minimized; this requires working with all relevant parties, including the military, relief agencies, and the private sector.

It is also important to ensure that other institutions are well aware of how their activities relate to biodiversity conservation objectives. Relief agencies need to be shown that the environment is also a humanitarian concern, and that problems of refugees can also be problems of an affected protected area. An important opportunity that can become available soon after a conflict ends is disarmament of demobilized soldiers and local people. This both helps to ensure that people no longer have the means to engage in gun battles, and removes an important means to poach in the newly accessible forests.

Finally, a window of opportunity is often open immediately after conflict for updating resource management policies, helping to address problems that may have arisen during the conflict, or even led to it. This is often the moment to improve policy formulation, design new legislation, build capacity among new staff, ensure that new policies are based on the most relevant information, and design a robust decision-making process (Shambaugh *et al.*, 2001).

Because prevention is better than cure, some countries are recognizing the possibility of using protected areas for biodiversity along their borders as ways of promoting peace (e.g. Hanks, 1998; Sandwith *et al.*, 2001). In many countries, boundaries are found in mountainous areas that also tend to be biologically rich because of the great variety of habitats and ecosystem types found within relatively small areas, affected by differences in elevation, microclimate and geological factors. While such ecologically diverse areas are often particularly important for conservation of biodiversity, they are also frequently sanctuaries for combatants in war, especially civil wars and guerrilla wars.

Given that national frontiers are sensitive areas where conflict is frequent and biological resources are often particularly rich, the idea of establishing protected areas on both sides of the border as so-called "Peace Parks" has attracted considerable attention, providing a symbol of the desire of the bordering countries to deal with their problems in a peaceful way (e.g. Westing, 1993, 1998; Thorsell, 1990). Zbicz and Greene (1998) have found that transfrontier protected areas cover well over 1.1 million km<sup>2</sup>, representing nearly 10% of the total area protected in the world (Table 2). In addition to indicating the importance of transfrontier protected



**Table 2** Many protected areas are located on national borders, and some have adjacent protected areas on the other side of the border, forming complexes that could be the focus of collaboration. IUCN (1997) calls these, perhaps optimistically, "Parks for Peace". The following is an indication of how widespread and important such areas are (compiled on the basis of information in Sandwith *et al.*, 2001).

Continent	No. of designated transfrontier Protected Areas	No. of transfrontier Protected Area complexes	No. of complexes involving three countries
North America	48	10	0
Africa	150	36	12
Asia	108	30	5
Latin America	121	29	6
Europe	239	64	8
Totals	666	169	31

areas, this also demonstrates how much of the world's land area devoted to biodiversity conservation is in remote frontier areas where risks of war are historically high because of insecure borders.

Peace Parks are far more than a fond hope. Peru and Ecuador fought three territorial wars in the 20th century, but Peruvian President Alberto Fujimori and Ecuadorian President Jamil Mahuad resolved their violent border dispute in 1998 with an innovative plan that included creation of the "Cordillera del Condor", including two national Peace Parks near the most contested stretch of their frontier. Four mediators, the United States, Argentina, Brazil, and Chile, helped resolve the dispute through binding arbitration. The agreement also granted Ecuador free trade and navigational access to the economically important shipping routes of Peru's Amazonian territory. While the agreement fell far short of Ecuador's desire for sovereignty over the disputed territory, leading to demonstrations against the government, many of Ecuador's economic goals were achieved. The area is also the territory of several Jivaro-speaking tribes, who are frequently at war with each other, and against invaders (Descola, 1996; Brown & Fernandez, 1991). The new peace with protected areas will need to involve the indigenous peoples as well (Faiola, 1998), but biodiversity is likely to be a significant beneficiary.

Although Peace Parks have probably had relatively little independent effect on international relations, transfrontier cooperation on biodiversity issues has the potential to develop into an important factor in at least regional politics by helping to internalize norms, establish regional identities and interests, operationalize routine international communication, and reduce the likelihood of the use of force (Brock, 1991). Peace Parks also have significant benefits for biodiversity, through better management of larger protected areas. They seem to be growing in popularity, and a treaty among South Africa, Zimbabwe and Mozambique was signed in December 2002 to establish the Great Limpopo Transfrontier Park, covering 3.5 million ha; this was South Africa's fourth transfrontier protected area, clearly demonstrating that

it considers conservation to be an important part of its border defence policy.

## Conclusions

One conclusion is that national and international security can no longer be conceived in narrow military terms. Ethnic conflict, environmental degradation, and famine leading to civil unrest or massive migrations of refugees, constitute threats to both social stability and the preservation of a productive material base: the planet's biodiversity. Thus governments should assume that reversing deforestation or augmenting food production capabilities in deficit areas can directly and substantially contribute to the security of society and can help prevent, or at least postpone, armed conflict. Allocating international resources to environmental monitoring and impact assessment, protection of economically important species, quick response to disasters and accidents, and the minimization and management of waste are all highly appropriate activities that will prevent strife and therefore reduce the likelihood of conflicts leading to war. As Thacher (1984) put it: "Trees now or tanks later".

Hart and Hart (1997), drawing on African experience, concluded that "the best preparation for conservation in the face of regional instability is the professional development of national staff and strong site-based conservation programmes". But a key element is that these site-based initiatives must be tied to an international structure that endures when nations crumble. The Harts propose establishing a fund that provides for continued professional development and support for field activities by the staff of protected areas during crisis periods. Such support may be focused on specific sites of international biological significance, with the goal of developing semi-autonomous management within those areas. The mission of the proposed fund would be to build professional identity in national staff where national institutions have failed, and to facilitate their reintegration into conservation activities after the crisis has passed.

Trying to tease out causality in the relationship between war, conflict, and biodiversity issues in forested areas is highly complex, because individuals make multiple, mutually constraining decisions that are shaped by interacting environmental and social conditions, all of which themselves have multiple interrelationships. People often learn through conflict, as fundamental interests are challenged. As Lee (1993) points out: "Conflict is necessary to detect error and to force corrections. But unbounded conflict destroys the long-term cooperation that is essential to sustainability. Finding a workable degree of bounded conflict is possible only in societies open enough to have political competition". In other words, the solution to the destructive conflict of war is constructive conflict that leads to improved conservation of the natural resources upon which people depend.

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