THE
ARGUMENTS FOR PROTECTION
SERIES

Vital**Sites**

The contribution of protected areas to human health

A research report by WWF and Equilibrium

Arguments for Protection

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Foreword

Healthy ecosystems play a vital role in providing food and clean water, controlling infectious diseases, absorbing wastes, regulating climate and are the source of much of the cultural, spiritual and recreational inspiration needed to maintain mental and physical health. Unfortunately human actions are putting increasing pressure on ecosystems. This, the seventh report in the *Arguments for Protection* series, takes as its starting place the health crisis caused by environmental destruction and discusses the role protected areas can play in promoting well-being.

Most people think of protected areas like national parks and nature reserves as tools for wildlife conservation, but by protecting whole habitats and ecosystems the world's protected areas network offers us some very practical social benefits as well. Along with wild species, protected areas also maintain healthy ecosystems, with all the positive contribution to human health that this implies. Although many protected areas have been established for conservation or recreation purposes, many have also been set aside partly or wholly because their wider benefits were recognised by local people, governments or others.

Protected areas are the source of herbs for traditional medicines (still the primary health care option for many of the world's population) or the constituents of modern pharmaceuticals. As natural ecosystems come under increasing pressure, the importance of protected areas as sites where researchers can look for new genetic material is increasingly being recognised. The fate of natural habitats, local medicinal practices, local knowledge and traditions and the well-being of communities are also inexorably linked. Protected areas ensure that resources are conserved sustainably and management traditions are maintained and passed on to younger generations.

Lastly, protected areas can contribute to physical and mental well-being. At a time when obesity has become a more serious health problem than malnutrition on a global scale, the role of exercise and personal responsibility for health is being more widely acknowledged. In many parts of the world national parks and nature reserves provide some of the few spaces where people can take exercise in safe and pleasant surroundings. Many conservation organisations are actively working with health authorities to encourage such approaches. More recently it has been recognised that beautiful landscapes and seascapes are not only good places to exercise for physical health, but can have important therapeutic benefits for the mind as well. This report describes some innovative collaborations between protected area authorities and those responsible for people with mental health or drug dependency problems.

As with the other reports in the *Arguments for Protection* series, this report shows that protected areas are not a luxury but are key sites to protect not only biodiversity, but also ecosystem services and our wider well-being.

Dr Kathy MacKinnon
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Preface

Like all the *Arguments for Protection* series, this report is primarily an attempt to assemble evidence about the positive benefits that can be provided by protected areas, in this case focusing on human health. Benefits explored here range from various ways of accessing genetic material to use as local or global medicines, to the use of wild, open and quiet spaces for physical exercise and emotional healing. We also give practical advice for both protected area managers and health professionals about how these benefits can best be realised and what this means in terms of day-to-day management.

It would be disingenuous to pretend that only positive benefits are possible. Badly planned or managed protected areas can also increase some health problems. This is true both for the spread of some specific diseases but can also occur more generally if creation of a protected area results in loss of homes or resources for dispossessed local communities, who can suffer badly as a result. We also document these problems and outline strategies for how protected areas can help to maximise the health gains and minimise the risks.

In this particular case, another important caveat is necessary. We make no comment on the efficacy of particular treatments. We recognise that the field of medical treatments is one where there is often enormous controversy and the fact that something is used as a medicine does not necessarily mean that it is effective[1]. Analysis of the thousands of traditional, mainstream, alternative and complementary health products derived from nature is beyond the scope of the report and also beyond our own expertise.

This report in the seventh in the Arguments for Protection series; earlier volumes have looked at drinking water, agrobiodiversity, faiths and religions, poverty reduction strategies, disaster mitigation and climate change. A book summarising these and other issues relating to benefits from protected areas is planned for publication later in 2010.

Summary

This is the seventh volume in a WWF series of reports developed as part of the *Arguments for Protection* project, which aims to identify and where possible quantify the range of benefits derived from protected areas, increase support for protection, develop new interdisciplinary partnerships, identify innovative financing mechanisms and broaden and strengthen protected area management strategies. In this case we focus on the positive benefits that can be provided by protected areas for human health. Our understanding of the term 'human health' in this context is based on the definition of the World Health Organization (WHO): "*a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity*".

The report starts with a brief review of the links between human health and the environment. Environmental degradation is resulting in serious detrimental health impacts; WHO estimates that between 23 and 25 per cent of the global burden of disease could be avoided by improved management of environmental conditions. Degradation is also threatening the use and understanding of genetic material that could help to provide health solutions. The use and sustainable management of traditional medicines usually depends on ecosystem integrity; when this is lost so is knowledge.

Protected areas can contribute positively to human health in a variety of ways, from providing medicinal resources to being places of important recreational value that can aid physical and mental health. Chapter 2 is a thorough survey of the ways in which protected areas can contribute positively to human health, looking at four main areas:

1. **Environmental benefits:** which are divided into two: the direct benefits that come from the conscious management of ecosystems to reduce the risk of disease and the indirect benefits related to management activities within protected areas that contribute to better health.
2. **Sources of local medicines:** reviews the wide range of plants that are found in protected areas and used for medicinal purposes
3. **Sources of global medicines:** looks first at plants from protected areas that are used raw or in only lightly processed form for the growing use of, and trade in, complementary and alternative medicine; and second at the role of protected areas as sources for materials that are components of pharmaceuticals.
4. **Provision of direct health benefits:** considers the role of protected areas in providing opportunities for a wide range of physical exercise; issues related to mental health; and a range of other well-being benefits linked to therapeutic activities – all three of which also make important contributions to overall well-being.

Each of the four areas listed above are discussed in detail and examples are given of these benefits from over 200 protected areas around the world.

In Chapter 3 we look at seven countries in more detail to illustrate some of the policies and practices which have been developed, or in some cases need to be developed, to make the links between protected areas and health more explicit. The case studies are from:

- Australia: a discussion of Park Victoria's *Healthy Parks Healthy People* message, which seeks to reinforce and encourage the connection between a healthy environment and a healthy society in all of the organisation's activities.
- England: the case study looks at the recent policy position statement on *Health and Wellbeing* by Natural England, the public body whose purpose is to protect and improve England's natural environment.

- Colombia: introducing the latest addition to the country's national protected area system, the Alto Orito Ingi-Ande Medicinal Plants Sanctuary, which was proposed by the local indigenous people as part of their strategy to strengthen and restore their traditional culture and associated landscapes.
- China: where a consortium of NGOs is developing a project that aims to reconcile use of the resources needed for traditional Chinese medicine, with the needs for conservation, and in particular panda habitat, and to develop more sustainable local livelihoods and thus well-being.
- Malaysia: where WWF is trying to ensure traditional honey collection, which has medicinal and nutritional values, is not threatened by forest loss.
- Kenya: provides an example of a PHE (population-health-environment) project in Kiunga Marine National Reserve, which aims to integrate health and family planning with conservation activities.
- USA: looks in depth at the challenges of developing appropriate policies for bioprospecting in protected areas through the example of Yellowstone National Park.

Chapter 4 builds on the evidence of the role of protected areas in health and well-being provided in the preceding chapters and considers how these examples can be formulated into general advice to both health practitioners and protected area professionals on linking conservation and health care practices. The chapter is based around an analysis by the WHO of the major risks to human health at a global scale and looks at the practical ways in which protected areas might contribute to reducing these health risks. As risk factors form the basis of many national and international health policy agendas, the review provides a convenient focus for policy setting initiatives. The chapter looks at risk factors categorised under the seven headings used by WHO: (1) childhood and maternal under-nutrition; (2) other diet-related risk factors and physical inactivity; (3) sexual and reproductive health; (4) addictive substances; (5) environmental risks; (6) occupational risks; and (7) other selected risks to health. Each of these risks is reviewed and then the contribution of protected areas discussed. This major section of the report aims to help both health care professionals and policy makers to identify the full range of contributions that protected areas can make to health and will also allow protected area experts to gain a little inspiration about how the area that they protect for the conservation of nature can also contribute to the goals of reducing the risks to health.

The final chapter, Chapter 5, concentrates on how protected areas, these ***vital sites*** for both conservation and human well-being, can further develop research, policies and practices related to health. The recommendations are divided into several sections, aimed at specific user groups:

Policy makers should be encouraged to:

1. Note the WHO definition of health that embraces overall well-being
2. Link national health and environmental policies to protected areas as a delivery mechanism for health services where appropriate
3. Develop and promote benefit-sharing mechanisms for relevant health resources (particularly genetic material)
4. Ensure values are conserved within and outside protected areas that already or might in the future provide health benefits
5. Promote compatible and equitable policies and legislation regarding access to materials and health benefits of medicinal resources from protected areas
6. Consider the implications for existing and emerging infectious diseases when making planning decisions that relate to natural or semi-natural habitats
7. Develop and/or support initiatives such as the payment for environmental services schemes which ensure essential services for health and well-being, such as water

Social and health professionals should be encouraged to:

8. Develop awareness of the various roles that protected areas can play in health promotion
9. Further research links between emerging infectious disease and habitat management

10. Continue to carry out ethnobotanical studies in protected areas to increase understanding of resource use and to identify potentially useful medicinal material
11. Ensure equitable benefit-sharing options from positive research outcomes from protected areas
12. Ensure that ingredients in medicinal resources are sourced sustainably and where appropriate benefits from the resource used are equitably shared
13. Develop partnerships with protected area managers to implement health-related activities.

Protected areas professionals should be encouraged to:

14. Develop health arguments and communication strategies and promote these with health professionals
15. Develop – with partners where possible – health activities and ensure access to these by the public
16. Ensure sustainable use of resources including those related to health (e.g. collection of medicinal herbs in protected areas)
17. Minimise risk of adverse health impacts to protected area staff and local communities through sound management decisions
18. Practice benefit-sharing mechanisms relating to health benefits
19. Consider specific habitat management for health impacts
20. Consider the values of medicinal knowledge (e.g. sustainable harvesting, cultural traditions, etc) as objectives of protected area management

Conservation professionals should be encouraged to:

21. Raise awareness of health issues across all projects and activities
22. Integrate health more fully into visitor programmes in protected areas
23. Raise awareness of the risks of emerging diseases from wildlife, due to increased contact between people and wildlife, with national policy makers, the health sector and the public, and collaborate on research and control measures
24. Develop and scale up PHE (population-health-environment) approaches in close collaboration with the health and development sectors
25. Help develop monitoring and harvesting protocols for medicinal plant resources

Researchers and academics should be encouraged to:

26. Incorporate integrated health-environment teachings in health and in environment courses at all levels including technical training and university courses

Finally, two important caveats should be noted. Firstly, we make no comment on the efficacy of particular treatments discussed in the report. We recognise that the field of medical treatments is one where there is often enormous controversy and that the fact something is used as a medicine does not necessarily mean that it is effective. Secondly, it should be stressed that, although not the primary focus of this report, badly planned or managed protected areas can also increase some health problems. The report documents some of these problems and outline strategies explaining how protected areas can help to maximise the health gains and minimise the risks.

Chapter 1
Introduction: Healthy people and healthy environments

Does nature help us keep healthy; and could protecting nature also help us to protect our health and well-being? From the moment we left 'the wild' and particularly since many of us took to an urban existence it seems that we have been aware of missing something in our lives, and have developed strategies to replace our loss. From the Persian walled gardens of Mesopotamia to the big business surrounding individual and municipal gardens today, we are prepared to go to great lengths to maintain some contact with nature[2]. Protected areas provide one of our most global, and arguably most ambitious, strategies for ensuring that we protect and maintain this contact. Perhaps one reason for the protection of over 100,000 protected areas around the world is a feeling that they might be good for us – as well as for the species and habitats they are set up to protect.

In fact protected areas have much more to offer human health than just contact with nature and, as we shall show, wild species are the source of many of our medicines, both so-called traditional medicines and compounds for the ever growing pharmaceuticals trade. Many protected areas also offer important opportunities to improve our mental and physical health. This report attempts, we think for the first time, to describe the many links between protected areas and human health, both good and bad.

What is health?

Human health is defined by the World Health Organization (WHO) as "*a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity*"[3]. This holistic view of health reflects the origin of the word, which is derived from the Greek 'hal' or whole[4]. This broader definition of health as well-being is increasingly reflected in national health strategies (see case studies in chapter 3), which are providing an opportunity for environmental and conservation strategies to play a much greater role in ensuring health than has been the case in the past. However, as we shall see in this chapter, if we take the whole to include the social and environmental context in which we live, at present many aspects of our health are continuing to be eroded.

As discussed in our earlier report for the Arguments for Protection series[1], *Safety Net: Protected areas and poverty reduction,* the concept and definition of 'well-being' has evolved over the last few years[5]. We interpret well-being as having five fundamental dimensions:

- ✓ *Subsistence*: non-economic benefits that contribute to well-being, e.g. health, nutrition, clean water and shelter
- ✓ *Economic*: benefits which provide the ability to earn an income, to consume and to have assets
- ✓ *Cultural and spiritual*: pride in community, confidence, living culture, spiritual freedom, education
- ✓ *Environmental services*: role in environmental stability and provision of natural resources
- ✓ *Political*: relating to issues of governance and thus influence in decision-making processes

These dimensions were discussed in detail in *Safety Net*, on the premise that to eradicate poverty – a state in opposition to well-being – all five dimensions of well-being need to be addressed. This perspective challenges the assumption that poverty reduction simply refers to an increase in economic well-being. Issues relating to well-being have also been discussed in other reports in the Arguments for Protection series, in relation to clean drinking water in *Running Pure: The importance of forest protected areas to drinking water*[6]; spiritual values in *Beyond Belief: Linking faiths and protected areas to support biodiversity conservation*[7] and environmental stability in *Natural Security: Protected areas and hazard mitigation*[8].

[1] See: www.panda.org/protection/arguments for more information to download the reports

Alberto Mancariapa, of the Huachipaeri Indian Community, living on the southeastern border of Manu National Park, Peru explains effects and use of medicinal plants such as Dr. Ojé fig tree (*Ficus insipid*) to school children and their teacher. The latex of big trees is taken internally as highly effective cure for intestinal parasites.

Environment and health: impacts of degradation

Our environment and our health are inexorably linked. As one instance of this, more species of medicinal plants are harvested than of any other product from the natural world[9]; not such a surprising fact when you consider that over a quarter of all known plants has been used medicinally at some period[10]. This report will focus on links between health and protected areas – but to set the scene we will begin by looking at a few of the health problems that are arising from our neglect of the natural environment.

Environmental degradation is literally killing many of us. Globally, WHO estimates that between 23 and 25 per cent of the global burden of disease could be avoided by improved management of environmental conditions[11]. This environmental degradation affects our health in many different ways, from the impacts of air pollution to changes caused by alterations to ecosystems; research is rapidly increasing our understanding about the importance of these links. For example, between 1976 and 1996 WHO recorded over 30 emerging infectious diseases[2], including HIV/AIDS, Ebola, Lyme disease, Legionnaires' disease, toxic E. coli and a new hantavirus; along with an explosion of rapidly evolving organisms resistant to antibiotics[12]. Research has linked forest change, particularly deforestation and forest fragmentation, specifically with the emergence of HIV and Ebola, through increased contact between humans and primate carriers[13]. In 2003 the World Health Assembly described SARS as the first severe infectious disease to emerge in the twenty-first century that posed a serious threat to the stability and growth of economies and the livelihood of human populations. One of the lessons from the SARS outbreak is that the underlying roots of emerging infectious diseases may have unexpected links with the biodiversity extinction crisis. Three animal species which have been implicated as hosts of the disease, the masked palm civet (*Paguma larvata*), a raccoon dog (*Nyctereutes procyonoides*) and the Chinese ferret badger (*Melogale moschata*), all enter China from the surrounding region through an expanding regional network of illegal, international wildlife trade [14].

Research by WHO suggests that the increase in many infectious diseases, not just those which are newly emerging, can be linked to a range of environmental threats. These include the destruction of, or encroachment into, wildlife habitat (particularly through logging and road building); changes in the distribution and availability of surface waters (e.g. through dam construction, irrigation and stream diversion); agricultural land-use changes, including proliferation of both livestock and crops; uncontrolled urbanization or urban sprawl; resistance to pesticide chemicals used to control certain disease vectors; climate variability and change; migration and international travel; trade (legal and illegal); and the accidental or intentional human introduction of pathogens[15].

[2] An infectious disease whose incidence has increased in the past 20 years and threatens to increase in the near future

Increases in the impacts of other established diseases including malaria and leishmaniasis have also been linked to deforestation[16]. A major study of the rapid increase in malaria in the Amazon established that mosquitoes carrying malaria were found in greater numbers in more heavily deforested landscapes, with this relationship remaining strong regardless of the human population density in these locations[17]. Increased cases of Argentine hemorrhagic fever have been associated with the replacement of natural grasslands with corn monoculture, which favours the rodent host[18]. An overview of factors related specifically to increased disturbance of forests, which can contribute to disease spread, include: expansion of human populations into forest areas, with increased human exposure to wildlife; modified abundance or dispersal of pathogen hosts and vectors as a result of forest alteration; and altered hydrological functions that may favour waterborne pathogens[19]. Diseases can also be spread by natural resource extractors, for example, the spread of HIV/AIDS by logging truck drivers or by fishermen, who often have very high HIV prevalence rates, and spread the disease along rivers and coastlines. It is also clearly acknowledged that the prevalence and incidence of diseases linked to freshwater areas are influenced by hydrological changes that occur when water resources are developed and managed[20]. A review of human illness linked to stressed estuarine and coastal environments, identified a range of factors including: consumption of contaminated seafood; spread of human pathogens (e.g., cholera) via the release of poorly treated or untreated sewage into coastal waters; exposure to toxins from harmful algae; and effects of weather and climate on the rates and means of transmission and severity of infectious diseases[21]. With respect to the health impacts of global warming, some emerging indicators of impacts include the northerly spread of tick-borne encephalitis in Sweden associated with warming winters; the recent spread of malaria and dengue fever which may be linked to climate change over the past quarter-century[22]; and increases in cholera in the Bay of Bengal linked with El Niño effects[23]. Changes are likely to be complex and simple modelling exercises are unlikely to give reliable predictions; however impacts of climate change are also likely to include increased malnutrition; increased mortality due to floods, drought and heat waves; increased diarrheal disease; and greater risk of disease transfer between people, livestock and wildlife.

Resources under threat

Unfortunately, at the same time that environmental degradation is apparently increasing several important health problems, it is also threatening some of the genetic materials that could help to provide solutions, thus creating a double blow for health.

Humans are very good at cultivating plant species that they value, but have a poor track record at conserving those seen as having little human use. However, new medicinal uses of plants are being discovered all the time. For example, the Pacific yew (*Taxus brevifolia*) is not commercially valuable as a timber species and was routinely discarded during logging operations in the Pacific Northwest region of the US. However it contains the compound taxol, which clinical trials have recently shown to be one of the most promising new drugs available for the treatment of breast and ovarian cancer[24].

Just as we have traditionally tended to have scant regard for plants which are perceived to have little value to humans, we are also degrading many environments that remain poorly or incompletely studied, and are likely to be losing potentially valuable species even before they are identified by science. As the authors of the authoritative book on human health and biodiversity, *Sustaining Life*, observe: "*… the current crisis of biodiversity loss represents nothing less than an enormous threat for biomedical research, the full magnitude of which we can now only guess*"[25].

As infectious diseases evolve and develop resistance to existing pharmaceuticals, the marine environment is considered by researchers as an important source of chemicals for new medical drugs. There are several potential medical treatments derived from marine products now in the late stages of clinical trials and several more which have been selected for preclinical assessment, including some 30

possible treatments for cancer[26]. Coral reefs are one of the most endangered habitats on the planet, but have high value both for biodiversity conservation and for their contribution to medicines to protect human health. Since the mid-1980s, more than 2,500 different chemical compounds have been found in marine plants and animals[27]; for example compounds from the venom of cone snails (a genus of predatory snails numbering about 500 species that mainly inhabit tropical coral reefs), is used in its synthetic form for the treatment of chronic pain associated with cancer, AIDS and damage to the peripheral nervous system[28].

Forests are also important repositories of medicinal compounds from wild organisms[29]. However, it has been estimated that fewer than 5 per cent of tropical plant species have been examined for their medicinal value[30]. A nine-year market study in the eastern Amazon found the degradation of forests may lead to the loss of potential modern medicines and the erosion of the only health care option for many of Brazil's rural and urban poor. Eight of the twelve top-selling medicinal plants were forest based; and five of the top-selling species are being harvested for timber, decreasing the availability of their barks and oils for medicinal purposes. Many of these medicinal plants have no botanical substitute, and pharmaceuticals do not yet exist for some of the diseases for which they are used[31].
In 2006, the WWF report *Biodiscoveries, Borneo's Botanical Secret* reported research in the region that had identified a possible anti-cancer substance in a shrub (*Aglaia leptantha*) found in Sarawak, a possible treatment against HIV from a compound found in the Bintangor tree (*Calophyllum lanigerum var. austrocoriaceum*) and a previously unknown anti-malarial agent in the bark of a local tree traditionally used by the Kenyah people of Kalimantan. But the main message of the report is that rapid deforestation in Borneo is putting such discoveries at risk. The report noted that 422 new plant species have been discovered in Borneo in the last 25 years, and many others are 'waiting to be found and studied' – judging from previous experience some of these are likely to contain potentially important medical properties that can be exploited if the species are not forced into extinction first[32]. Indeed, concern over the populations of Bintangor species led in 1993 to the government making an order to ensure that the source of the raw materials of two Bintangor species is conserved, by the prohibition of felling and the restriction of export of trees without the permission of the Director of Forests[33].

Amphibians (frogs, toads, salamanders and caecilians) are one of the most endangered groups on earth. They are also a group that possesses an enormous variety of biologically active compounds, mainly linked to defence mechanisms against predators and infection, from which several important drugs have already been developed and many more medicinal applications are expected. North, Central and South America and the Caribbean are home to more than half of the world's 5,743 known species of amphibians, but 39 per cent of these are under threat. Regionally amphibians in the Caribbean are most threatened (84 per cent of the region's 171 species), followed by Mesoamerica (Mexico through Panama) with 52 per cent of its 685 species at risk according to the IUCN Species Survival Commission. Clearly species are going to be lost – and one of the many repercussions of this is that important medical discoveries are also being threatened. Unfortunately, existing networks of public and private protected areas only cover about 63 per cent of threatened amphibian habitat[34].

Furthermore, as human populations rise and the demand for medicine increases (a demand further fuelled by the need to treat emerging infectious diseases), the over exploitation of traditional medicines is of growing concern; particularly as at the same time continued environmental destruction means that available resources are decreasing. For example in Malawi and Mozambique, woodland degradation, as evidenced by decreasing resource availability (e.g. scarcity of both fuelwood and medicinal plants), has been observed in communities where HIV prevalence is high[35]. Around 200 medicinal plant species have been added to the Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES) appendices indicating that the international community considers them to be at risk and about 15,000 of the estimated 50,000 – 70,000 plant species used for medicine, cosmetics or dietary supplements are threatened according to research by WWF and TRAFFIC[36].

Losing the traditions

Sustainable sources of traditional medicines also depend to a large extent on ecosystem integrity, both from the practical perspective of maintaining the species involved but also from a cultural perspective. Landscapes are associated with human cultural practices including health practices[37]. However this integrity is under threat and traditional healthcare is not always effective in a rapidly changing world; particularly when it is closely related with natural ecosystem conservation[38]. Indigenous peoples' health, for example, is consistently poorer than comparable indicators for non-indigenous communities within the same country and is often made worse by social and cultural marginalisation[39]. One of the reasons for this is that indigenous health care is often unable to cope with the consequences of colonisation and migration bringing in new diseases, habitat degradation or loss of resources and homelands. Health for many indigenous peoples is not merely absence of ill health, but also a state of spiritual, communal, and ecosystem equilibrium and well-being[40]. When one of these elements is degraded then the whole healthcare system is threatened.

Just as the plants used in traditional medicine are in danger, so is the knowledge system. The history of study and application of plants for medicinal use goes back as long as human history itself. At the end of the nineteenth century a new term, *ethnobotany*, was suggested by John Harshberger to define 'the use of plants by aboriginal peoples' as a specific field of botany and plant uses. Since then there has been something of a race against time to capture ethnobotanical knowledge. The complete extinction of whole groups of indigenous peoples, such as the Tetetes of Ecuador, possibly the Curuaia, Xipaia, and Creniê in Brazil, or the Tonocotés, Lule-Vilela, Sanavirones and Chana-Timbúes in Argentina, has almost certainly resulted in a loss of rich information on local medicinal plants and their ecosystems[41]. In Brazil, for example, studies have shown the process of modernization, particularly increasing access to formal education, is going hand-in-hand with the loss of traditional knowledge of medicinal plants[42].

Traditional management systems often aim to maintain important medicinal plants, but unfortunately these systems are also often breaking down due to changing social conditions and development pressures. Many sacred natural sites – particularly sacred groves – have a secular role in supplying herbal remedies; research on sacred groves gives us an indication of how medicinal values are now increasingly at risk. For example, in Manipur valley in northeast India, 166 sacred groves were inventoried. 173 plant species were recorded, 96 per cent of which had some form of medicinal uses and several of which were confined to the groves, yet only 11 per cent of the groves were judged to be in good condition and many were already seriously degraded[43]. Similarly, there are approximately 400 holy hills in Xishuangbanna, China, covering 50,000 ha in total[44] and containing amongst other things about 100 species of medicinal plants[45]. However, it was reported that only 10-15 per cent of the hills were in a pristine state. Surveys in one holy hill forest in 1959 and again in 1991 found that 21 tree and shrub species were lost over this period[46].

Conclusion

So changes in the natural environment are creating a double-edged sword for those concerned with maintaining human health: they are spreading a range of diseases, while simultaneously eliminating some of the wild genetic resources and the knowledge of their use that can help to alleviate these diseases. In the next chapter we look at the role of protected areas, both in addressing these and other problems and also in occasionally creating a few health problems of their own. In total, this analysis should allow us to look at the net costs and benefits of protected areas to human health and make recommendations for planners and managers about how potential benefits might be maximised.

Chapter 2
The links between protected areas and human health

How can protected areas contribute positively to health?

IUCN's World Commission on Protected Areas (WCPA) states that a protected area is: "A clearly defined geographical space, recognised, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values" (revised definition)[47]. This definition and associated classification of six management categories (see box) define the approach taken to protect land and water areas for the last century. This remarkable commitment to conservation means that today we have over 100,000 areas around the globe protecting over 10 per cent of our land area (but still less than one per cent of our seas).

IUCN protected area categories

- ✓ Category I: strict protection [Ia Strict Nature Reserve and Ib Wilderness Area]
- ✓ Category II: ecosystem conservation and protection [National Park]
- ✓ Category III: conservation of natural features [Natural Monument or Feature]
- ✓ Category IV: conservation of species and habitats [Habitat/Species Management Area]
- ✓ Category V: landscape/seascape conservation and recreation [Protected Landscape/ Seascape]
- ✓ Category VI: sustainable use of natural resources [Protected Area with Sustainable Use of Natural Resources]

As the definition makes clear, the primary aim of these protected areas is to ensure the long-term conservation of nature; but achievement of this goal brings with it many associated ecosystem services and cultural values. The current report highlights one such value – the contribution that protected areas play in ensuring our good health. Overall, as this chapter will show, this is a good news story: protected areas have contributed positively to a whole range of health-related issues from providing medicinal resources to being places of immeasurable recreational value. But of course real-life stories are rarely 100 per cent positive. We will thus touch on some more problematic issues relating to 'biopiracy' (i.e. the appropriation, generally by means of patents, of legal rights over local and indigenous knowledge) and benefit sharing, or rather the lack of it; the problems related to the over-collection of wild medicinal resources; and various health problems associated with protected areas. This chapter will however concentrate on illustrating the many and varied beneficial links between protected areas and health. To do this we draw, wherever possible, on literature from peer-reviewed medical journals. We however make no claims for the particular efficacy of any the medical treatments or preparations discussed here.

The survey which follows considers four key ways in which protected areas contribute positively to human health:

1. **Environmental benefits:** which can be divided into two: the direct benefits that come from the conscious management of ecosystems to reduce the risk of disease and the indirect benefits related to management activities within protected area that contribute to better health.
2. **Sources of local medicines:** drawing primarily on ethnobotanical studies carried out in protected areas, to show the wide range of values that these areas contain.
3. **Sources of global medicines:** looking firstly at plants which are used raw or in only lightly processed form (e.g. the growing use of, and trade in, complementary and alternative medicine); and secondly as sources for materials that are components of pharmaceuticals.
4. **Provision of direct health benefits:** looking at the role of protected areas in providing opportunities for a wide range of physical exercise, issues related to mental health and a range of other well-being benefits linked to therapeutic activities; these three issues also make important contributions to overall well-being.

2.1. Environmental benefits

The environmental benefits that protected areas can contribute as strategies for helping to ensure health and well-being are two-fold: the *direct benefits* that come from conscious management of ecosystems against disease and the *indirect benefits* related to management activities that contribute to better health (e.g. provision of clean drinking water, soil stabilisation etc) or for the resources they contain. Both of these strategies, and examples of where they have been used, are discussed below.

✓ Direct – conscious management against disease

We have already seen in chapter 1 that ecosystem degradation can often help to spread disease; conversely protection of ecosystems can have a preventative effect. Malaria is one of the world's most pernicious diseases; it is also a disease with strong links to the environment. There are an estimated 247 million cases of malaria per year (2006 figures), which cause some 880,000 deaths, mostly among African children[48]. Efforts to find a truly reliable cure have so far been unsuccessful, but avoiding the bite of the mosquito is the best way to avoid the disease. There are many ways this can be achieved and land management can play a role in both the spread and the control of the mosquito and thus the disease. Deforestation has been linked to changes in mosquito populations, often resulting in their increased abundance[49]. A study in the Peruvian Amazon found that the primary malaria vector, *Anopheles darlingi,* had a biting rate that was more than 278 times higher in deforested areas than in areas that were heavily forested[50]. Avoiding deforestation or restoring natural vegetation can thus reduce risk of malaria and certain other diseases[51].

Many of the areas where malaria poses a serious risk have seen major natural habitat loss and relatively low levels of conservation[52]. However, where protection does exist research is beginning to show the benefits. In Indonesia, the 32,000 ha Ruteng Park on the island of Flores protects the most intact submontane and montane forests on the island. Researchers studying the impacts of deforestation on rural economies and livelihoods through the spread of infectious diseases such as malaria found statistically significant correlations between forest protection and the reduction in the incidence of child malaria. The study found that communities living near the protected area had fewer cases of malaria and dysentery, children missed school less because of ill health, and there was less hunger associated with crop failure, than in communities without intact forests nearby[53].

There is good evidence going back over a century, illustrating that habitat restoration can reduce malaria in some cases. Malaria was, for example, finally removed from Italy in the 1950s, following an extensive eradication programme, which included long-term land use planning. In the 1880s the previously dense Mediterranean maquis in Tuscany had become severely degraded by human activities and grazing, creating a marsh exacerbating the spread of malaria. A government-led reforestation process was initiated in the early twentieth century involving the construction of a dam towards the sea, placement of several rows of wattle fences to arrest the movement of the sand, and the planting of *Pinus pinaster* along the sea line and *Pinus pinea* on the inner part of the dune. The seedlings were protected by planting herbaceous species (e.g. *Arundo arenacea, Ulix europaeus, Medicago marina, Euphorbia parialis* and *Cakile maritima*)[54]. The restoration eventually also led to the area being designated as Duna Feniglia State Nature Reserve (474 ha, Category IV[55]) in 1971.

Traditional management of resources and habitats has also in many cases focused on plants with medicinal value. For example, in West Africa, *Irvingia gabonensis* and *Ricinodendron heudeloti*, have long been managed for their bark, which was used to treat diarrhoea and dysentery[56]. In southern India, areas have been set aside since the early 1990s to conserve wild medicinal plants through joint initiatives between the State Forest Departments of Karnataka, Kerala and Tamil Nadu, research institutes and NGOs, coordinated by the Foundation for Revitalisation of Local Health Traditions (FRLHT) in Bangalore. These areas include 55 Medicinal Plants Conservation Areas (MPCAs) established by State Forest Departments. MPCAs cover between 200 and 400 ha and represent all

major forest types and bio-geographical zones in the region. Together they protected nearly 45 per cent of the total medicinal plant diversity (around 2,500 species) of peninsular India. They also protect 96 Red Listed species. MPCAs are treated as 'no harvest zones' with local communities involved in the conservation activities. The MPCAs serve as study sites for conservation biology research and also the source of authentic and quality planting material for propagation for local use[57]. These MPCAs are an important part of the Medicinal Plants Conservation Network (MPCN), which is creating a sustainable conservation movement providing benefit to non-commercial and commercial users of medicinal plants[58]. More recently this type of land management has in some countries been encompassed into more official protected area networks with for instance the Sanctuary of Orito Ingi-Ande, the 54th protected area in Colombia, being specifically set-up to protect the indigenous knowledge of medicinal plants (see case study).

Through traditional medicine, the knowledge of medicine preparation is preserved as a capacity building process for the communities of the Chocó Biogeographic Rainforest in Colombia.

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✓ Indirect – management for better health

In order to protect wild biodiversity, protected areas also usually maintain natural or near-natural ecosystems, which in turn perform environmental services that would otherwise in many cases have been lost. Some of these services have direct human health benefits and can be an important contributory factor in encouraging protection area establishment.

Earlier research by the *Arguments for Protection* project has demonstrated the role of forest protected areas in supplying sources of clean drinking water: a third of the world's hundred largest cities rely on forest protected areas for a substantial proportion of their drinking water supply (see table 1)[59]. Although estimates range widely, the UN estimates that over three million deaths a year are due to diseases caught from contaminated water[60] and a billion city dwellers have inadequate supplies of clean water[61]. The *Arguments for Protection* report, *Natural Security*, illustrated how natural ecosystems are also increasingly recognised as being able to reduce the impacts of extreme weather events and earth movements that can otherwise lead to natural disasters, such as flooding and mudslides, which if they occur often result in an attendant rapid spread if diseases such as cholera and diarrhoea[62].

Table 1: **Examples of cities drawing some or all of their water from protected areas**[63]

City	Protected Area
1. Mumbai, India	Sanjay Ghandi National Park (category II, 8,696 ha)
2. Jakarta, Indonesia	Gunung Gede Pangrango (category II, 15,000 ha) Gunung Halimun (category II, 40,000ha)
3. Karachi, Pakistan	Kirthar National Park (category II, 308,733 ha) Dureji Wildlife Sanctuary (category IV, 178,259 ha) Surjan, Sumbak, Eri and Hothiano Game Reserves (40,632ha) Mahal Kohistan Wildlife Sanctuary (70,577ha) Hub Dam Wildlife Sanctuary (27,219ha)

City	Protected Area
	Haleji Lake Wildlife Sanctuary (category IV, 1,704ha
4. Tokyo, Japan	Nikko National Park (category V, 140,698 ha) Chichibu-Tama (Titibu-Tama) National Park (category V, 121,600ha)
5. Singapore	Bukit Timah (Bukit Timah and the Central Catchment Area, category IV, 2,796 ha)
6. New York, USA	Catskill State Park (category V, 99,788 ha)
7. Bogotá, Colombia	Chingaza National Park (category II, 50,374 ha)
8. Rio de Janeiro, Brazil	Within Rio de Janeiro Metropolitan area: Tijuca National Park (category II, 3,200 ha) Tingua Biological Reserve Pedra Branca State Park Gericinó-Mendanha APA Atlantic Rainforest Biosphere Reserve and fourteen protected areas (covering a total area of 320,180 ha) also provide protection for the sources of the catchment areas supplying the city.
9. Los Angeles, USA	Angeles National Forest (category VI, 265,354 ha)
10. Cali, Colombia	Farallones de Cali National Park (category II, 150,000 ha)
11. Brasília, Brazil	Brasilia National Park (category II, 28,000 ha)
12. Santo Domingo, Dominican Republic	The Madre de las Aguas (Mother of the Waters) Conservation Area: Armando Bermúdez National Park (category II, 76,600 ha) Juan B. Pérez Rancier (Valle Nuevo) National Park (category Ia, 40,900 ha) José del Carmen Ramírez National Park (category II, 73,784 ha) Nalga de Maco National Park Ebano Verde Scientific Reserve (category Ia, 2,310 ha)
13. Medellín, Colombia	Alto de San Miguel Recreational Park and Wildlife Refuge (721 ha)
14. Caracas, Venezuela	Guatopo National Park (category II, 122,464 ha) Macarao National Park (category II, 15,000 ha) Avila National Park (category II, 85,192 ha)
15. Maracaibo, Venezuela	Perijá National Park (category II, 295,288 ha)
16. São Paulo, Brazil	Cantareira State Park (category II, 7,900 ha) Guarapiranga Ecological Park, Morro Grande State Reserve, Itapeti Ecological Station, Juquery and Alberto Loefgren State Parks
17. Salvador, Brazil	Lago de Pedra do Cavalo Environmental Protection Area (category V) Joanes/Ipitinga Environmental Protection Area (category V, 60,000 ha)
18. Belo Horizonte, Brazil	Mutuca, Fechos, Rola-Moça, Taboões, Catarina, Bálsamo, Barreiro, Cercadinho, Rio Manso and Serra Azul (17,000 ha)
19. Madrid, Spain	Natural Park of Peñalara (15,000 ha) Regional Park Cuenca Alta del Manzanares (category V, 46,323 ha)
20. Vienna, Austria	Donau-Auen National Park (category II, 10,000 ha)
21. Barcelona, Spain	Sierra del Cadí-Moixeró (category V, 41,342 ha) Paraje Natural de Pedraforca (category V 1,671 ha)
22. Sofija, Bulgaria	Rila National Park (category II, 107,924 ha) Vitosha National Park (category IV, 26,607ha)

City	Protected Area
	Bistrishko Branishte Biosphere Reserve (category Ia, 1,062 ha)
23. Ibadan, Nigeria	Olokemeji Forest Reserve (7,100 ha) Gambari Forest Reserve
24. Abidjan, Cote d'Ivoire	Banco National Park (category II, 3,000 ha)
25. Cape Town, South Africa	Cape Peninsula National Park (29,000 ha) Hottentots Holland Nature Reserve (category IV, 24,569 ha)
26. Nairobi, Kenya	Aberdares National Park (category II, 76,619 ha)
27. Dar es Salaam, Tanzania, United Republic of	Uluguru Nature Reserve (category II) Selous ecosystem: Selous Game Reserve (category IV, 5,000,000 ha and World Heritage site) Mikumi National Park (category II, 323,000 ha) Kilombero Game Controlled Area (category VI, 650,000 ha)
28. Durban, South Africa	Ukhlahlamba-Drakensberg Park (category I [48 per cent] and II [52 per cent], 242,813 ha, World Heritage Site, Ramsar site)
29. Harare, Zimbabwe	Robert McIlwaine Recreational Park (category V, 55,000 ha) Lake Robertson Recreational Park (category V, 8,100 ha)
30. Johannesburg, South Africa	Maluti/Drakensberg Transfrontier Park Ukhlahlamba-Drakensberg Park, (category I [48 per cent] and II [51.5 per cent], 242,813 ha, World Heritage Site, Ramsar site)
31. Sydney, Australia	The Blue Mountains National Park (category II, 247,021 ha) Kanangra-Boyd National Park (category Ib, 65,280 ha) Dharawal Nature Reserve (category Ia, 341 ha) Dharawal State Recreation Area (5,650 ha)
32. Melbourne, Australia	Kinglake National Park (category II, 21,600 ha) Yarra Ranges National Park (category II, 76,000 ha) Baw Baw National Park (category II, 13,300 ha)
33. Perth, Australia	Yanchep National Park (category Ia, 2,842 ha)

The *Arguments for Protection* series and related work by WWF has also discussed how protected areas help to maintain stable food supplies, both by providing secure places for reproduction of valuable species, especially in the case of marine protected areas[64] and by protecting genetic material that can be used to help crop breeders to adapt crops to changing conditions[65]. Finally in some cases protected areas themselves help to provide sustainable sources of wild food for the poorest members of society that can provide important nutrition particularly in the case of crop failure[66].

Although there has been considerable work carried out on the ecosystem service benefits of protected areas, there have been few attempts as yet to translate these into national or global health benefits, but it is increasingly recognised that such benefits do exist.

2.2. Sources of local medicines

Traditional herbal medicines have been defined as: "*naturally occurring, plant-derived substances with minimal or no industrial processing that have been used to treat illness within local or regional healing practices*"[67]. Some of these traditional medicines are now traded globally (see point 3 below), but for many countries particularly in Africa, Asia and Latin America, locally-collected traditional medicines are a major resource for meeting primary health care needs. In developed countries it is often a conscious choice to use traditionally-based or alternative medicines, whilst in developing countries there are often few alternatives to traditional medicines, which are both cheaper and generally more available than 'western' medicines. In Africa, for example, up to 80 per cent of the population uses traditional medicine for primary health care[68]. In Uganda, the ratio of traditional practitioners to population is between 1:200 and 1:400, whilst the availability of practitioners of western medicine is typically 1:20,000[69].

Overall, researchers estimate that roughly 28 per cent of plants on earth have been used medicinally[70]; and over 50,000 higher plant species are used worldwide for medicinal purposes[71]. Researchers in Nepal, for example, recognise about 1,624 plant species as having medicinal and aromatic values, Sri Lanka about 1,400, India about 2,500 and China about 5,000[72].

Globally at least 60 per cent of medicinal plants are gathered from the wild, and countries like India and China reportedly harvest 90 per cent and 80 per cent respectively of their medicinal plants from uncultivated sources[73]. Ethnobotanical studies have been conducted in numerous protected areas, showing not only the wide range of values these places contain, but also that in many parts of the world some species, and sometimes also the knowledge on using these species, is increasingly being confined to protected areas. Without these studies (which still only cover a tiny proportion of the world's protected areas) information would go unrecorded and perhaps, as the knowledge-base changes, would eventually be lost. Some examples of ethnobotanical studies in protected areas are given below:

- ✓ From 1993 to 2000, 180 people were interviewed in Montseny Biosphere Reserve, Spain (30,117 ha[74]) to collect ethnobotanical information on over 35 medicinal plants, with 4,023 use-reports. When compared with literature, 501 unreported or uncommon uses that corresponded to 201 plant species were recorded; 57 of which had never or very rarely been cited[75].
- ✓ An ethnobotanical survey of Arrábida Nature Park (10,821 ha, category V[76]) in the southwest of the Iberian Peninsula, Portugal, worked with 72 local people to gather data on the medicinal uses of 156 taxa, belonging to 56 botanical families. This included 214 previously unreported uses corresponding to 81 species[77].
- ✓ Another ethnobotanical study in a Portuguese protected area, Serra de Sao Mamede Nature Park (29,694 ha, category V[78]) interviewed 45 people who provided data about 165 useful plants, 150 of which had medicinal and/or aromatic use; 224 popular names were noted, 98 of which had not been documented before[79].
- ✓ An ethnobotanical study carried out in Cilento e Vallo di Diano National Park, Italy (178,172 ha[80]) documented the local use of 90 plant species for medicinal, food and domestic purposes. 59 local people were interviewed and 883 use-reports were recorded. In total, 63 species were documented as medicinal. In general the recorded species are well known in the region, however some uses were unusual[81].
- ✓ A study of the uses of medicinal plants in the Alto Tirreno Cosentino area of Calabria in Southern Italy, a small area lying between the Tyrrhenian coast and the Pollino National Park (171,132 ha, category V[82]), reports 52 medicinal species belonging to 35 families. The study concluded that local use is greatly reduced and largely abandoned, in the wake of modern pharmaceuticals. What remains relates mainly to minor diseases and ailments such as those concerning the skin (15 species), rheumatic pains (8 species), ailments such as colds, coughs and even bronchitis (11 species) and toothache, decay and gingivitis (10 species)[83].

- ✓ A survey of Kopaonik National Park, Serbia (11,800 ha, category V[84]) found 83 wild species from 41 families and 96 preparations for use in human therapy. The most frequently reported medicinal uses were for treating gastrointestinal ailments (50 per cent), skin injuries and problems (25.6 per cent), followed by respiratory, urinary-genital and cardiovascular problems (20.5 per cent, 20.5 per cent, 19.2 per cent, respectively). Plants with unusual phytotherapeutic uses are *Galium verum* L. (sedative properties) and *Eupatorium cannabinum* L. (influenza-like illnesses), while plants with interesting but lesser-known properties include *Daphne laureola* L. (rheumatism and skin ailments) and *Ficaria verna* Huds. (tubers for treating haemorrhoids)[85].
- ✓ To date 63 plant species used by local people as medicinal, aromatic, alimentary and ceremonial plants, have been identified in Piatra Craiului National Park in Romania[86].

Village of Magura, Piatra Craiului National Park, Transylvania, Romania.

- ✓ 'Zagori' is the name given to a group of villages in and around Vikos-Aoos National Park in Greece (12,600 ha (core zone) and 9,200 ha (peripheral zone), category II[87]). Renowned in previous centuries as a major centre of folk medicine, its practitioners, called 'vikoyiatri' or 'komboyiannites', were famous beyond the borders of Greece. Research, carried out using literature sources and interviews, reported about 100 plants and their therapeutic uses[88].
- ✓ Ethnobotanical research recorded the local use of medicinal herbs in Margalla Hills National Park (17,386 ha, category V[89]), a rapidly developing area of Pakistan, to ensure information on the native uses of these herbs was not lost. About 100 people were interviewed and a total of 50 species belonging to 27 families were recorded as being used by inhabitants of the park, ten species of which are also sold in the local market[90].
- ✓ About 100 local people were interviewed concerning 21 important herbs belonging to 19 families used medicinally in Ayubia National Park, Pakistan (1,684 ha, category V[91]). Most of the plant species are reported to be quite effective remedies for different diseases such as diarrhoea, diabetes, jaundice, backache, stomach ache, ulcers, cold and even cancer. These plants are also used by the local herbal healers and hakims as traditional medicines[92].
- ✓ Ten plant species (*Bistorta affinis*, *Cremanthodium arnicoides*, *Heracleum candicans*, *Koenigia delicatula*, *Pedicularis longiflora*, *Pedicularis pectinata*, *Pleurospermum candollii*, *Veronica biloba*, *V. biloba* var. *minima* and *Waldheimia stoliczkai*) are traditionally used by tribal people in Pin Valley National Park (67,500 ha, category II[93]), in the Himachal Pradesh region of India for the treatment of dysentery[94].
- ✓ 112 species of medicinal plants have been recorded as used by the local population in the Valley of Flowers National Park, India (8,750 ha, category II[95]), with five of these species listed in the Red Data Book of Indian Plants[96].
- ✓ In Nagzira Wildlife Sanctuary, India[97], 28 plant species belonging to 22 families are used in ethnomedicine practice by tribal and local people in the sanctuary and nearby area to treat different ailments affecting human health[98].

- ✓ Betla National Park, India (23,167 ha, category II[99]) is rich in floristic diversity with more than 600 species. Important medicinal plants include *Andrographis paniculata*, *Asparagus racemosus*, *Phyllanthus emblica* and *Hemidesmus indicus*[100].
- ✓ In India, nearly 15–20 per cent of the Ayurvedic medicine is based on animal-derived substances. Traditional knowledge of 15 animals and animal products used as medicines by the inhabitants of three villages (Bawaria, Mogya and Meena), surrounding the Ranthambore National Park, India (39,200 ha, category II[101]) have been studied. Interviews through structured questionnaires with 24 informants (16 men and 8 women), provided the information regarding therapeutic uses of animals, for diseases including tuberculosis, asthma, paralysis, jaundice, earache, constipation, weakness and snake poisoning. The zootherapeutic knowledge was mostly based on domestic animals, but some protected species like the collared dove (*Streptopelia* sp.), hard shelled turtle (*Kachuga tentoria*) and sambhar (*Cervus unicolor*) were also mentioned as important medicinal resources[102].
- ✓ Interviews in two remote settlements within Gunung Leuser National Park, Indonesia (792,675 ha, category II[103]) with practitioners of traditional medicine (dukuns) documented the parts used, methods of preparation and the medicinal uses of 158 species[104].
- ✓ An ethnobotanical study from Shey-Phoksundo National Park, Nepal (355,500 ha, category II[105]) notes the very large number of plant species used as traditional medicines in the area. There were 107 and 166 species of ethnomedicinal importance in surveyed areas of Dolpa and Mustang district respectively. Communities living inside the Shey-Phoksundo National Park rely on agriculture, grazing and seasonal trade. Due to low agricultural production, largely related to limitations of production at high altitude, most of the people rely on the collection of wild medicinal plants for subsistence[106].
- ✓ A detailed survey in Langtang National Park, Nepal, over five years (2001-6) interviewing 700 households found 411 medicinal and aromatic plants being used, with about 90 per cent of people in the protected area relying on traditional medicine[107].
- ✓ 52 species are used in traditional medicine by the Orang Hulu community of Kampung Peta in the Endau Valley, Endau-Rompin National Park, Malaysia[108].
- ✓ 20 species of trees, shrubs, epiphytes, climbers and herbs found in Gunung Mulu National Park in Malaysia are used by the Penan and Berawan people for medicinal purposes[109].
- ✓ Between 1986 and 2004, the National Institute for Materia Medica of Vietnam conducted comprehensive surveys of medicinal plants in nine protected areas, chiefly in northern and central Vietnam. Numbers of medicinal species found varied between 326 and 744, with Hoang Lien National Park in Lao Cai province supporting the highest number. Comprehensive surveys of medicinal plant species are reportedly planned for all national parks and special-use forests, but will probably take some years to complete[110].
- ✓ Of the 652 species recorded in an initial survey of Cat Tien National Park, Vietnam in 1991, 120 were recorded as being of medicinal use[111].
- ✓ As in the rest of Ethiopia, people in the Bale Mountains National Park (247,100 ha, category II[112]) rely on ethnomedicinal plant species to manage human ailments. Observations and semi-structured interviews were used to gather ethnobotanical data detailing how 56 ailments were managed using 101 different ethnomedicinal plant species. Most of the medicinal plant species reported were threatened[113].
- ✓ A study of the Yuracaré-Trinitario people in the Isiboro-Sécure National Park (1,200,000 ha, category II[114]) in the Bolivian Amazon found that up to 38 different medicinal plants are used by traditional healers[115].
- ✓ In Cumbres de Monterrey National Park (177,396 ha; category II[116]) Mexico, data on 240 species (comprising 170 genera and 69 botanical families) and 146 different uses of plants were recorded, based on 95 interviews with local people. Most of the cited uses (98) were found to be medicinal; the most common are the control of colic (21), diabetes (19), stomach aches (9) and headaches (8); in all these cases, plants are boiled and ingested orally[117].

It is clear that protected areas can provide the people living in or near them with a wealth of medicinal resources. However, resource use by indigenous, traditional and local people in protected areas is not without its own controversy and management challenges. Traditional systems to protect medicinal plants through taboos, seasonal and social restrictions on gathering, the nature of plant gathering equipment, etc[118], are often disrupted by protected area management and legislation. Some protected area legislation restricts or totally forbids collection of resource from certain categories of protected area – even when there has been a long history of resource use from an area before being designated as a protected area. This can cause local resistance to the protected area and can place unsustainable harvesting pressure on medicinal species outside the protected area. Some 70 countries have also developed national regulations on herbal medicine collection[119], which can also apply to protected areas. Additionally, as many protected areas conserve often isolated remnants of habitats the pressures on the resources that remain within them are ever greater – and the services they are able to offer can decline without careful management.

Whatever the regulatory or policy environment, where medicinal resources are legally collected from protected areas this collection should clearly be done in a sustainable manner. Sustainable use is defined by the CBD as: *the use of components of biological diversity in a way and at a rate that does not lead to the long-term decline of biological diversity, thereby maintaining its potential to meet the needs and aspirations of present and future generations*[120]. Putting such fine ideals in practice is not always easy; fundamental conditions needed to achieve sustainable harvesting of wild medicinal plants could include:

- A defined area, under adequately strong tenure
- Presence of a responsible person or organisation
- A management plan, which is periodically reviewed
- Procedures to ensure that harvesters are involved in the preparation of the management plan and the setting of management prescriptions
- Procedures to monitor harvested species and set management prescriptions for them
- Procedures to ensure sustainable harvesting techniques (e.g. only taking so many leaves, so much bark; cutting them in a certain way; etc)
- Procedures to ensure good quality produce
- Procedures to ensure acceptable working conditions for harvesters[121].

Where such systems exist protected areas can provide a safe and sustainable resource for local medicines. In Bwindi Impenetrable National Park (BINP) in southwest Uganda, for example, the park management has been working with local people to develop sustainable resource use after many years of conflict over access to resources in the protected area. Community consultation meetings were convened by BINP managers and researchers to develop recommendations for monitoring programmes and community memorandums of understanding (MoUs) on resource use in the park[122]. The meetings confirmed that demand for forest resources are high and continued monitoring is important; they also agreed zoning options[123]. Monitoring programmes for three plant species (*Ocotea usambarensis*, *Rytigynia kigeziensis* and *Loeseneriella apocynoides*) that are used for medicine and craft materials have been developed and agreements on resource use agreed with members of the local community[124].



Ethnobotanical garden Ruhija, Bwindi Impenetrable National Park, Uganda (left) © Frederick J. Weyerhaeuser / WWF-Canon. Bwindi forest (middle) and local community (right) © Marc Hockings

2.3. Sources of global medicines

Much of the medical wisdom that has been developed over millennia is also now being used as the building blocks of an increasingly global, and profitable, trade in health products. Ethnobotanical knowledge is being studied by research institutes to see if it can be adapted for use in 'western medicine'; for instance the US National Cancer Institute spent nearly US$89 million in 2004 in studying a range of traditional therapies and the pharmaceutical company Novartis invested over US$100 million in 2006 to investigate traditional medicine in Shanghai alone[125]. Such activities can however raise questions about who owns the knowledge being researched – an issue which is discussed in more detail below.

There are two main links between global medicines and protected areas; firstly protected areas can act as the sources of material, primarily plants, which are used raw or only lightly processed form; and secondly they can be sources for materials that are processed as components of pharmaceuticals.

Medical research on Everest

Although the links between protected areas and medical research are primarily related to resources from protected areas, sometimes it is the special qualities of the area itself which attracts researchers. The understanding of human physiology, for example, can be aided by medical research which takes place in conditions which are at the limits of our survival ability. The unique conditions of Sagamartha National Park in Nepal have been used for medical research for nearly half a century. Between 1960 and 1961 six doctors and scientists over-wintered at 5,800m on a glacier a few miles from Everest Base Camp; the vast amount of unique data gathered during this period literally rewrote the textbooks of high altitude physiology. In 1981 the American Medical Research Expedition to Everest (AMREE) went higher still and conducted detailed studies at Everest Base Camp (5,300m) and in the Western Cwm (6,300m). The data gathered provided the closest estimate of the limits of low oxygen tolerance in humans. In 2007 this research area was further developed by Caudwell Xtreme Everest, the largest high attitude research project to date.

The Caudwell Xtreme Everest research aimed to provide clinicians with information on oxygen deprivation toleration. The practical application of this information is focused on the hypothesis that some critically ill patients may have adapted to the low oxygen levels and may not need the aggressive interventions, such as ventilation, that are currently given to get blood oxygen levels closer to normal ranges. All medical interventions carry some risk, so any research which leads to the possibility of less aggressive treatments is clearly of great use. The results of this research should eventually lead to better treatments for patients with conditions such as acute respiratory distress syndrome, cystic fibrosis, emphysema, septic shock and 'blue baby' syndrome[126].

✓ In raw or only lightly processed form

Chinese traditional medicine is perhaps the best example of a traditional medicine which is now a major global medical business. In China the traditional medicine industry accounted for 26 per cent of the total output of the pharmaceutical industry in 2006 and exports of traditional medicine products account for five per cent of all exported pharmaceuticals made in China. Imports of traditional medicine products reached US$318 million in 2007, 17 per cent higher than a year before, and overall it is estimated that the international trade in Chinese traditional medicine is growing at any annual rate of about 10 per cent. Driven by this market demand, many wild plant medicinal resources used in Chinese traditional medicine have been collected beyond their regenerative capacity and between 15 and 20 per cent of medicinal plants and animals used in Chinese medicine are now considered endangered[127] (see case study).

A herbal medicine shop in Barcelona, Spain. In 2003, European countries spent almost US$5 billion (at manufacturers' prices to wholesalers) on over-the-counter herbal medicines.

As well as these international markets in traditional medicines, the use of complementary and alternative medicine is increasing rapidly. The term "complementary and alternative medicine" covers a wide range of therapies, from acupuncture and reflexology, to aromatherapy and herbal medicine[128]. The percentage of the population in developed countries which has used complementary and alternative medicine at least once is high; with WHO estimating that 48 per cent of people in Australia having used complementary and alternative medicine, 70 per cent in Canada, 42 per cent in USA, 38 per cent in Belgium and 75 per cent in France[129].

The value of medicinal plants in the international marketplace is more than US$50 billion annually[130]. The impact of this growing herbal industry on plant material can be considerable. About 3,000 medicinal and aromatic plants species are traded internationally and most are wild collected[131]. In Europe alone, at least 2,000 medicinal and aromatic plant taxa are used on a commercial basis. Of these two-thirds, 1,200-1,300 species are native to Europe and in the 1990s at least 90 per cent were still wild-collected. More specifically, 30-50 per cent of medicinal and aromatic plant material in trade in Hungary is wild-collected, 50-70 per cent in Germany, 75-80 per cent in Bulgaria, and almost 100 per cent in Albania and Turkey[132].

This concentration on wild-collected resources occurs for three reasons:

- ✓ There is relatively little known about the growth and reproduction requirements of most medicinal and aromatic plant species, which are derived from many taxonomic groups for which there is little or no experience of cultivation.
- ✓ The time, research and experience leading to domestication and cultivation are costly, and often unsuccessful, and relatively few medicinal and aromatic plant species have the large and reliable markets required to support these inputs.
- ✓ In many communities where wild collection of medicinal and aromatic plants is an important source of income, land for cultivation of non-food crops is limited[133].

As our landscapes are modified through urbanisation and agricultural expansion, the areas suitable for the collection of herbal medicines are restricted and protected areas can become some of most important sources of available plant material. In North Korea, for example, over 500 plant species in the Myohyang Mountains Protected Area in South Pyongan and Chagan Provinces are recorded as having medicinal value and around 100 of these are believed to experience significant harvests, for both subsistence and trade use. Management priorities for the medicinal species in the area have been assessed and 34 of the harvested medicinal species are considered priorities for conservation action. North Korea's Medicinal Plant Resources Management Unit is developing cultivated sources for some of these species and others come from forests outside the protected area, but at present Myohyang remains the only source within the country for at least 11 species used in herbal medicines[134].

The potential to link effective conservation with medicinal plant collection in protected areas has been considered in detail in Southeast Europe, which has traditionally been one of Europe's most important source regions for medicinal and aromatic plants. Whilst the trade in these plants is a major economic

activity in many countries in the region, nature conservation has traditionally not been regarded as a priority. However as a network of protected areas is gradually developing in the region, the possibility of linking this with sustainable collection of medicinal and aromatic plants is also being considered. If effective, such a link could provide much needed income for local people and contribute to protected area management costs. The German Bundesamt für Naturschutz (BfN) has been developing a project to study the current sourcing of and trade in medicinal and aromatic plants and the possibility of using income generated from trade in these plants for nature conservation in protected areas in five selected countries: Albania, Bosnia-Herzegovina, Bulgaria, Croatia, and Romania[135]. In Albania this synergistic relationship has been explored in Prespa National Park and Ohrid Protected Landscape, both of which offer the opportunity for the collection of plant material which can be traded with Germany – Europe's largest importer of medicinal and aromatic plants and Albania's most important export destination. More than 70 medicinal plant species are collected in the protected areas, most of which are for sale in Germany. The study suggested that control and monitoring of wild collection should be embedded in a comprehensive monitoring system as part of a management plan to ensure that conflicts between sustainable harvesting and conservation aims are detected and avoided. Proposals for a control and monitoring system, a licensing and training system for collectors as well as requirements for labelling of products were all elaborated in the study[136].

Similar work is being carried out in many other regions; as noted above subsistence collection of traditional medicines is very important to the local populations living around Shey-Phoksundo National Park in Nepal[137]. Commercial collectors also operate in the southern periphery of park, and a project run by the WWF Plants and People programme in the late 1990s aimed to understand the social and ecological strategies of commercial collectors with a view to proposing improved management systems[138], WWF has also been supporting the training of traditional healers (amches) in Nepal in order to help preserve traditional knowledge and practices.

The development of effective management for protected areas where commercial resource use is acceptable is the key to sustainable trade and hopefully to locally equitable benefit sharing. Effective management can also help combat the well documented problems of over-exploitation of medicinal plants – which is often illegal and an all too common feature inside and outside protected areas. The many examples of trade in illegally collected plants for use in complementary and alternative medicine need not be recounted here, but the example from Great Smoky Mountain National Park in the USA, is illustrative. The equivalent of approximately 8,000 ginseng plants (*Panax quinquefolius*) were confiscated from two different groups of poachers in 1993 leading to the development of detailed protection methods for vulnerable plant species[139]. In Vietnam trade in traditional medicinal plants is poorly researched but in some areas is clearly having a major impact. In Binh Chau Nature Reserve in southern Vietnam, *Tinospora crispa* was extensively harvested between 1996 and 1998, and is now very rare; similarly in Bach Ma National Park, local herbalists report that several medicinal species have become rare[140].

Production of herbs and medicinal plants for the local market by the village community of Topchu, in the buffer zone of the Ismailly Nature Reserve, Azerbaijan.

Global policies to conserve medicinal plant species

There have been several international initiatives to conserve important plant species including the CBD's *Global Strategy for Plant Conservation*, in the current context Target 13 is particularly relevant: *The decline of plant resources, and associated indigenous and local knowledge innovations and practices that support sustainable livelihoods, local food security and health care, halted*[141]. Other efforts have focused more specifically on medicinal plants: in 1993 WHO, IUCN and WWF published *Guidelines on the Conservation of Medicinal Plants*[142] and in 2003 WHO published *Guidelines on Good Agricultural and Collection Practices for Medicinal Plants*[143]. These primarily address the national and international policy level, whilst a new initiative from IUCN's Medicinal Plants' Specialist Group has been developing standards aimed at providing the medicinal plant industry and other stakeholders, including collectors, with specific guidance on sustainable sourcing practices. The first version of these *International Standard for Sustainable Wild Collection of Medicinal and Aromatic Plants* (ISSC-MAP) was published in 2007[144]. The ISSC-MAP were published by the IUCN Species Survival Commission, BfN, WWF Germany and TRAFFIC, following consultations with an international advisory group of more than 150 experts. The standards include a set of principals and criteria (which are reproduced in Appendix 1), as well as ISSC-MAP Proposed Indicators covering six areas: maintaining wild MAP resources; preventing negative environmental impacts; complying with laws, regulations, and agreements; respecting customary rights; applying responsible management practices and applying responsible business practices.

It is not only wild plants that provide medicines in raw or only lightly processed form. The healing of human ailments with medicines obtained from animals or ultimately derived from them is known as zootherapy. Although animal-derived remedies constitute an integral part of traditional medicine in many parts of the world, particularly for people with limited or no access to mainstream medical services, their role in health care has generally been overlooked in discussions about public health, conservation and management of faunal resources, and ecosystem protection[145].

In Pakistan, 31 substances from animal parts and products constitute nine per cent of all the medicinal substances in the inventory of traditional medicines and a survey of traditional medicine in use in the markets of Israel recorded 20 substances of animal origin[146]. Research into animal-based medicines from insects, arachnids, amphibians, reptiles, birds, and mammals in Brazil found 46 raw materials that are recommended to treat a wide range of common illnesses and injuries[147]. In Brazil, 96 per cent of medicinal animal species are wild caught and 27 per cent are on one or more lists of endangered species[148]. The challenge of protecting endangered species that are important in Chinese medicines is well known, and has had major impacts on populations of animals such as the greater one-horned rhinoceros (*Rhinoceros unicornis*); tiger (*Panthera tigris*), bears, various turtle species etc. In Vietnam, TRAFFIC estimate that between 5-10 tiger skeletons are sold annually to be used in traditional medicine; with each skeleton fetching approximately US$20,000, creating a strong incentive to poach and trade tigers[149]. Protected areas that have successfully protected endangered species are unfortunately often the targets of illegal poachers of animals used in traditional medicines – as they represent a reliable source of the species concerned.

Honey has many uses, including medicinal (see case study) and nutritional, and is a potentially sustainable resource from protected areas; organic standards exist for honey production, which can help to ensure good management and hence sustainable supplies. Honey collection is permitted from many protected areas throughout the world including for instance forest reserves in Malawi[150] and Kenya[151], the Sundarbans National Park in Bangladesh[152], Ritalgala Forest in Sri Lanka[153] and Mudumalai Wildlife Sanctuary in India[154].

✓ As a component of pharmaceuticals

Developing new drugs is often a long, complex and costly process – but the rewards of finding a reliable cure can be very great. The global pharmaceutical market is worth billions of dollars and is growing all the time (it is forecast to reach US$1,043.4 billion by 2012[155]). However, there is a long time-lag between initial research and a profitable pharmaceutical product; and very few potential pharmaceuticals make it through the rigorous research, testing and development process.

The first challenge in finding a new pharmaceutical product is the quest for new materials. The building blocks for new treatments vary widely, but one major area for research is bioprospecting, i.e. the search for wild species that contain chemicals with potential medicinal or commercial applications. All organisms contain compounds which protect them against disease; and sometimes these compounds can lead to the discovery of new drugs. Because all living things are remarkably similar, particularly at the genetic and molecular level, these 'natural' building blocks can provide vital leads to new treatments. Thus for instance by studying the paralysing compounds (i.e. toxic peptides) that provide a defence mechanism for cone snails, snakes, scorpions and spiders, researchers have found new pain relief treatments. Similarly, the alkaloid toxins which amphibians use to defend themselves from attack have been the basis, amongst other things, of antibacterial treatments[156].

Although over half the synthetic medicines produced today originate from natural precursors; including some well-known pharmaceuticals such as aspirin, digitalis and quinine[157], the systematic search for new compounds from the plant world is quite new. In the early 1980s no US pharmaceutical companies were involved in researching plants in developing countries; by 2000 there were over 200 corporations and US government agencies studying rainforest plants for their medicinal capacities and plant-based pharmaceuticals were estimated to earn over US$30 billion per year[158]. Today natural products play a dominant role in the development of drugs for the treatment of human diseases[159].

Protected areas are thus now viewed, rightly or wrongly, as reservoirs of potentially important chemicals by the pharmaceuticals trade. Bioprospecting within protected areas is often regarded as a good option by pharmaceutical companies for three main reasons:

1. The establishment of clear agreements concerning resources is much easier when property rights are clearly established, as is often the case with state-owned properties.
2. Relatively simple governance structures, as is again the case with state-owned protected areas, simplify negotiations (although resultant lack of wider stakeholder involvement can result in major issues of equity of benefit sharing).
3. High levels of both biodiversity and knowledge about wild species (e.g. park staff often know where rare species can be found)[160].

However, as we review below, access to genetic material needs careful consideration, wherever they are collected. Pharmaceutical companies initially usually only need quite small amounts of material so that collection can be consistent with conservation objectives. However links between protected areas and bioprospecting will only be equitable if there is clarity in the sharing of any benefits accrued from the compounds discovered from protected areas. There are already numerous examples not only of the role of biodiversity in providing pharmaceutical compounds, but also unfortunately of the sources of these compounds being taken from protected areas without prior-informed consent and equitable benefit sharing: i.e. biopiracy. This can either involve direct removal from a protected area or occur because the traditional knowledge of those living in or around a protected are has provided information that a species may have a medical use. At least 89 plant-derived medicines used in the industrial world were originally discovered by studying indigenous medicine[161]. Indeed many of the examples given in this chapter (e.g. the patent received by Merck for an antibacterial compound collected from Etosha National Park, Namibia[162]) illustrate not only the medicinal benefits from protected areas but the lack of sharing of these benefits with the original sources.

INBio Bioprospecting Agreements

The National Institute of Biodiversity of Costa Rica (INBio), a non-governmental and non-profit making public body, has been a front runner in the development of bioprospecting research agreements. Since its inception in 1989 INBio has signed 19 agreements with industry and 18 with academic institutions agreements. INBio's strategy has been focused on developing a diversified portfolio of bioprospecting agreements promoting innovation, learning and an increase in national scientific capacity. Its strategy is based on the premise that '*the best way to conserve biodiversity is to study it, value it, and utilize the opportunities it offers to improve the quality of life of human beings'*.

The bioprospecting research agreements developed by INBio include key elements such as:

- ✓ Access (limited in time and quantity)
- ✓ Equity and compensation (research costs and royalties)
- ✓ Technology transfer (infrastructure and equipment)
- ✓ Training of national scientists
- ✓ Non-destructive uses

Each agreement has a work plan and research budget that includes a 10 per cent donation to the Ministerio del Ambiente y Energía (MINAE) (Ministry of the Environment and Energy), which helps cover direct biodiversity conservation costs. The agreements can also contribute to species identification, sample collection and preparation, collection records, information management, training, management, etc. The agreements stipulate that if benefits are derived from the discovery of a successful product, 50 per cent of the royalties which INBio receives according to the agreement will be donated to the Sistema Nacional de Areas de Conservación (National System of Conservation Areas) and the rest will be invested in continuing the process and other INBio activities.

Braulio Carrillo National Park, Costa Rica © Sue Stolton

Many of the protected areas in Costa Rica have been used for bioprospecting activities. For example, INBio has coordinated sample collection projects in Braulio Carrillo National Park, which is located close to the capital San José, with Merck & Co., Indena Spa, Phytera, Ehime Women College of Japan, Harvard University, Utah University and the National Institute of Cancer in the United States of America.

Constructive links between the pharmaceutical industry and protected areas which have resulted from INBio projects include royalties paid to the National System of Conservation Areas (SINAC) and to the National Institute of Biodiversity (INBio) by the Costa Rican pharmaceutical company Laboratorios Lisan S.A. for the sale of its Q-assia pill. The pills, which treat digestive problems, are produced from the Hombre Grande tree (*Quassia amara*)[163].

It is not the purpose of this report to review in detail all the issues related to bioprospecting (or indeed biopiracy), as this has already been done in detail elsewhere[164]. However, with only a small proportion of the Earth's biodiversity being taxonomically described and biodiversity undergoing a major extinction event, it is clear that we may be losing species of potential importance to our health. As protected areas increasingly become the reservoirs of remaining biodiversity the pressure to open them up for bioprospecting could increase rapidly. If managed effectively the relationship between conservation, local stakeholders and pharmaceuticals could be a model for providing important benefits for both.

The key to developing a beneficial relationship is in benefit-sharing. The box above from Costa Rica shows how including consideration of conservation in bioprospecting budgets can provide much needed funding for protected areas. The United Nations University Institute of Advanced Studies, for example, has published an excellent introduction to *Biodiversity Access and Benefit-Sharing Policies for Protected Areas*[165]. In cases where such benefit sharing has not been so equitable conflicts can be long and complicated (see case study from the USA for just one of many examples) and protected areas and/or the people living locally to them have in the past generally been the losers[166].

The experiences of the International Cooperative Biodiversity Group's (ICBG) programme to address the linked issues of drug discovery, biodiversity conservation and sustainable economic growth show how difficult it can be to ensure truly beneficial relationships are developed. The ICBG supports a range of projects designed to guide drug discovery from natural products in such a way that local communities and other source country organisations can derive direct benefits[167]. Several of the projects involve protected areas, for example, the University of Illinois is leading a study on biodiversity and the discovery of pharmacological agents from tropical forest plants of Laos and Vietnam (see box below). However, ICBG has also attracted criticism, in particular in relation to indigenous rights, and has in consequence withdrawn from some projects[168].

ICBG funded bioprospecting for tropical forest plants in Laos and Vietnam

Finding treatments or cures for AIDS, cancer and malaria is rather like the search for the Holy Grail. Tried and tested treatments can be worth billions of dollars and huge prestige for pharmaceutical companies. But research and trials can cost millions.

An ICBG grant is funding the University of Illinois in Chicago to work in Laos and Vietnam, in collaboration with the US National Center for Natural Sciences and Technology, the Cuc-Phuong National Park in Vietnam, the Research Institute for Medicinal Plants in Laos, Purdue University, and Bristol Myers-Squibb Pharmaceutical Research Institute, to find treatments for AIDS, cancer, malaria and tuberculosis from tropical forest plants.

As well as aiming for major medical breakthroughs, the project also has conservation objectives, including: (i) biodiversity inventory and conservation at Cuc Phuong National Park (CPNP) in Vietnam, that will include the preparation of a manual for taxonomic identification of the flowering plants in the park, the establishment of a Threatened Plants Rescue Center, the implementation of a conservation education programme, and the transfer of GIS-based biodiversity assessment technology to Vietnam; (ii) developing infrastructure and human resources for the preservation of traditional knowledge in the uses of plants in primary health care of local communities through the establishment and/or upgrading of ethnomedical gardens; and (iii) strengthening the capacity (institutional infrastructure and human resources) of host institutions in Vietnam and Laos, in higher level of expertise, to undertake research in biodiversity study and conservation, ethnobotany, and plant-based drug discovery far into the future, beyond ICBG[169].

A major step in creating a better policy base for access and benefit sharing to materials from protected areas comes in the form of the CBD's *Bonn Guidelines on Access to Genetic Resources and the Fair and Equitable Sharing of the Benefits Arising from their Utilization*[170]. These voluntary guidelines are designed to assist Parties to the CBD, governments and other stakeholders in establishing legislative, administrative or policy measures on access and benefit-sharing and/or when negotiating contractual arrangements for access and benefit-sharing. Over fifty Parties have so far reported efforts to develop national legislation or policies to implement the CBD's provisions on the use of genetic resources[3]. If truly equitable systems of benefit-sharing were to be agreed and implemented, the rewards for developing countries could be notable. In the early 1990s a report for the United Nations Development Programme estimated that the value of developing-country germplasm to the pharmaceutical industry was at least US$32,000 million per year, however in reality only a fraction of this amount has actually been paid for the raw materials and knowledge that local and indigenous people contribute[171]. It is worth adding here what is meant by benefit-sharing. The CBD currently has a working group working on definitions, which aims to help adoption of an international regime on access and benefit sharing at the 10th meeting of the Conference of Parties in 2010.

The complexities (and probably the costs) involved in ensuring these equitable partnerships with resource providers is in some cases leading major pharmaceutical companies and the ICBG programme to move away from collecting wild plants, with research activities being directed to collecting microbes from the ocean floor, data stored in bioinformatics databases or from other so-called 'troublefree' collecting sites[172]. If the right conditions could be met, this could be a potentially profitable relationship among protected areas, local stakeholders and pharmaceutical companies, which is in danger of being lost. This could be detrimental to both protected area funding and thus long-term security and to the development of treatments for major diseases.

Below we give some examples of pharmaceuticals, which have been developed from natural resources collected from protected areas:

- ✓ **Animals**: Many forest animals serve as sources of medicines, for example 23 per cent of the compounds in 150 of the most commonly prescribed drugs in the United States in 1993 came from animals[173]. A specific example is Angiotensin I, a drug to treat high blood pressure derived from the Brazilian arrowhead viper (*Bothrops jararaca*), a tropical forest species, which brought the US company that developed it (but not the people of Brazil) billions of US$ profits annually[174]. A compound which has antimicrobial and fungicidal properties and may be useful for controlling fungal infections in humans was isolated from giraffe dung collected in Namutoni at the entrance of Etosha National Park in Namibia[175].

- ✓ **Plants**: In China, approximately 7,000 unique compounds have been found in over 8,000 herb plants[176], for example, the herbal remedy *Artemisia annua*, used in China for almost 2000 years is effective against resistant malaria[177]. Pharmaceutical products derived from tropical forest species include quinine from *Cinchona* spp.; cancer-treating drugs from rosy periwinkle (*Catharanthus roseus*); treatments for enlarged prostate gland from *Prunus africana*; diabetes treatments from *Dioscorea dumetorum* and *Harungana vismia*; and several medicines based on leaves of the succulents of the Mesembryanthemaceae family[178]. In 1987 collections of the forest liana *Ancistrocladus korupensis* were made in Korup National Park, Cameroon (129,481 ha, category II[179]) by researchers working for the non–profit Missouri Botanical Garden and the Centre for the Study of Medicinal Plants in Yaoundé, on behalf of the US National Cancer Institute. A possible anti–HIV compound, michellamine B, was identified in the sample[180]. Another possible anti-HIV compound was isolated from *Chrysobalanus icaco* subsp. *Atacorensis* collected from Manovo-Gounda-St. Floris National Park, Central African Republic (1,890,868 ha, category II[181])[182].

[3] The CBD also maintains a database of legislation on access and benefits sharing at: www.cbd.int/abs/intro.shtml

Research carried out in Cotapata National Park (26,934 ha, category II[183]) a mountainous tropical forest on the east side of the Andean Cordillera in Bolivia, has led to the discovery of plants with antiplasmodial or antileishmanial activities[184]. A traditionally-used malaria treatment from Madagascar has recently been investigated by the Universite Pierre et Marie Curie-Paris. The compound isolated from the bark of *Strychnopsis thouarsii*, collected in Andasibe National Park, completely protected mice from malaria in experiments[185].

- ✓ **Microorganisms**: One of the most famous examples of microganisms from national parks is the thermophile *Thermus aquaticus*, which was collected in a hot spring at Yellowstone National Park (899,139 ha, Category II[186]) by researchers in 1966 (see case study). In Europe, the immunosuppressant property of cyclosporine was identified in 1972 from a soil sample collected in the Hardangervidda National Park in Norway (342,200 ha, category II[187]) by a researcher in 1969. This was eventually used in the production of the drug Sandimmun, which was introduced to the market in 1983 by Novartis. By 2000, it was one of world's top-selling drugs with total sales of US$1.2 billion[188]. A bacterium found in the soils of Easter Island (much of Easter Island is protected within Rapa Nui National Park) led to the development of the drug rapamycin as an immunosuppressant used to prevent rejection in organ transplant[189]. Studies of the caves in Carlsbad Caverns National Park, New Mexico led to the discovery of previously unknown bacteria on the walls and in the pools of several caves. By releasing enzymes that kill competitors, the bacteria in the pools compete fiercely with each other for the few available nutrients. Testing in the laboratory revealed that some of these enzymes attack leukaemia cells and may someday become instrumental in medical treatments[190].

- ✓ **Coral reefs**: Protected areas have an important role to play if our coral reefs and the many benefits they provide are to be conserved. The island of Coiba in Panama has been studied by scientists at the Smithsonian Tropical Research Institute (STRI) for over 30 years. Ongoing STRI research has revealed Coiba has a wealth of new species, especially among its soft corals (e.g. seven species new to science were found in 2002). Twelve species of sponge have been analyzed and tested for medicinal value. Two of these were found to contain active components used in cough medicine while the International Co-operative Biodiversity Group (ICBG) recently discovered a soft coral species (octocoral) that has powerful anti-malarial properties[191]. A reason for the establishment of the Coiba National Park (430,825 ha[192]) and recognition as a World Heritage Site was the demonstration of the economic utility of conserving the park's biotic resources[193]. Similarly, the discovery of an anti-inflammatory agent from the soft coral *Pseudopterogorgia elisabethae* found in the reefs off the Bahamas initially led to fears of declining populations, however study of the corals' reproduction and regrowth led to a management programme for coral reefs near Grand Bahama Island for the sustainable cultivation of *P. elisabethae*[194]. As well as conserving populations of *P. elisabethae* the management is helping conserve the reef. Previously island residents overfished the reef ecosystems until according to local researchers there was little left. Now island residents can make US$35 for a little less than half a kilo of *P. elisabethae* harvests, compared to US$10 for harvesting the same weight of local lobsters[195].

Doctors working on medicines derived from wild plants in Yaoundé University, Cameroon. An ethnobotanical survey was conducted in March 2000 at five markets in Yaoundé. A total of 35 medicinal plants were obtained from 18 sellers at the Yaoundé markets in March 2000. The plant species comprised 35 genera and 19 families.

2.4. Provision of direct health benefits

Direct health benefits can be broadly grouped as: i) those linked to the role of protected areas in providing a wide range of physical exercise; ii) issues related to mental health; and iii) a range of other well-being benefits linked to therapeutic activities. These three issues are also strongly linked with and contribute to overall well-being.

✓ Physical exercise

It has been calculated that in the US every US$1 invested in physical activity leads to a saving in medical costs of US$3.2[196]. However, as population and population density increases worldwide finding safe places to exercise in can be a challenge. Protected areas are for many a life-line in these circumstances. It is not surprising perhaps that people with good access to large, attractive public open space are more likely to walk more[197].

In the UK, around 60 per cent of the population do not undertake sufficient physical activity to maintain good health (recommended as 30 minutes of moderate activity at least 5 days a week). This presents a major preventable health risk and correcting this is a public health priority[198]. Exercise has a major role in the prevention of chronic heart disease, strokes and vascular disease[199]. Many protected areas in the UK are thus actively developing outdoor activity programmes (see case study). For example regular health walks are organised at the Royal Society for the Protection of Birds' Sandwell Valley nature reserve and Forge Mill local nature reserve, a few miles from the middle of the city of Birmingham in England. Feedback from the walkers indicates that they feel safer walking as part of an organised and sociable group[200]; and are thus presumably more likely to take part in such activities on a regular basis. Indeed, a key aim of the UK's Countryside and Rights of Way Act 2000 was to increase public access to mountain, moor, heath, down and common land. In Wales, 'Let's Walk Cymru' is a nation-wide initiative developed in partnership with the Sports Council for Wales, the Welsh Assembly Government and Countryside Council for Wales, which aims to increase the number of people participating in walking as a regular activity. Since 2003, over 22 walking projects have been established across Wales, with over 10,000 led walks, more than 18,000 participants joining these group-led walks and approximately 1,500 volunteer trained as walk leaders.

The health benefits of bathing in forest air: Shinrin-yoku

Shinrin-yoku is the Japanese practice of taking in the atmosphere and energy of the forest to improve health and reduce stress[201]. A recent scientific study considered the psychological effects of Shinrin-yoku and found that immersion in the forest environment reduced hostility and depression and increased energy levels[202]. The research concluded that the practice balanced out acute emotions, particularly amongst those suffering from chronic stress, and that therefore forest landscapes could be considered as therapeutic landscapes.

Another study looked at Shinrin-yoku's effect on diabetic patients[203]. It found that this practice of forest-air bathing and walking substantially decreases blood glucose levels, which in their tests dropped on average from 179 to 108. The researchers suggested that this was due to the changes in hormonal secretions and autonomic nervous functions which result from taking in the forest environment. Shinrin-yoku is therefore a type of aromatherapy that has enormous potential for many health disorders. Much more still has to be learned about the effects of the volatile compounds in the forest air and effectively protected areas will ensure that this natural treatment can be maintained and enhanced.

Taking exercise in protected nature is not a new phenomenon. As the Australian city of Sydney in New South Wales developed in the 18th and 19th century, so the value of the mountains to the west of the city grew as a place of recreation. In the area now protected as the Blue Mountains National Park and World Heritage site (264,848 ha, Category II[204]), a number of walking tracks were built in the 1830s

and 40s, the popularity of which increased dramatically with the completion of a rail connection in 1860s. The earliest gazetted public recreation reserves in the area were the Fish River Caves (later Jenolan Caves) in 1866 and the Grand Canyon in 1872. Katoomba Falls was gazetted in 1883 following presentation of a public petition arguing their value for the 'health, morale and intellectual advancement' of the residents of Sydney[205].

Other direct physical exercise taken in protected areas can be organised through working on management tasks such as infrastructure development and restoration activities. Many countries have volunteer networks which provide a vital contribution to protected area management. Some of these volunteering networks are now also noting the health benefits that working on protected areas offer. In the UK, for example, the British Trust for Conservation Volunteers (BTCV) runs a 'Green Gym' scheme across the country using the natural environment as a health resource. Evaluations of the project have shown improvements in physical and mental health after participating in the scheme[206]. Many of these Green Gyms are active in national nature reserves. The Wallingford Green Gym in the South of England, for example, contributes to management activities on a range of reserves including the Aston Rowant National Nature Reserve, Riverside Meadow, Castle Meadow and Mowbray Fields Nature Reserve. The group meets once a week and has its own website to organise events, typical activities include tree planting and fencing[207].

The morning walkers of Keoladeo by Vinod Mathur of Wildlife Institute of India

Keoladeo National Park (KNP) in India was designated as a World Heritage Site in 1985 primarily for protecting a large number of migratory aquatic birds particularly the Siberian Crane (*Grus leucogeranus*). KNP covers 28.73 km^2 and is located close to the town of Bharatpur in Rajasthan State. The town has a population of some 250,000.

Amidst the urban landscape of Bharatpur town, the forests and wetlands of KNP attract hundreds of people, both men and women, who visit the park every morning to walk inside and enjoy the fresh air, beauty and tranquility. The park has designated *ca* 2km stretch which '*morning walkers*' enjoy every day between 5 and 7 am.

Morning walkers (© Bhumesh Bhadauria) and rickshaw pullers at KNP (© Vinod Mathur)

During summer, when daytime temperature in Bharatpur town can reach over 45^0 C, the number of '*morning walkers*' touches nearly 1,000. The park management has waived the entry fee for these local people, who enjoy the vital environmental services of fresh, un-polluted air inside the park. No motorized vehicles are permitted inside the park and the only means of transport allowed is the 'cycle rickshaw-pullers', who also serve as nature guides. The walking paths in KNP provide a good example of intangible benefits that local people derive from a protected area which also helps to maintain peace and harmony.

✓ Mental health

What many of us instinctively feel about the value of being in a natural landscape to our health and well-being, has been the subject of research for the past 40 years or more, leading to considerable theoretical development and a newly developing terminology. The 'biophilia' hypothesis describes a bond between humans and other living systems; popularised by E O Wilson the term describes "*the connections that human beings subconsciously seek with the rest of life*"[208]. Then there is 'stress recovery' or 'stress restoration' theory, which notes the value of natural settings (often through visual if not actual contact) in providing solace and refuge from the pressures of life and environmental stress[209]. Attention restoration theory suggests that contact with nature helps improve attention functions[210]. Another theory is that of 'restorative environments', which describes those settings that foster recovery from mental fatigue[211]; as well as the similar concept of 'therapeutic landscapes'[212]. The notion of 'topophilia' distinguishes between a sense of 'rootedness' and 'sense of place'. The former depends less on knowing what you value about an environment than habitually living within it, whereas the latter involves awareness of a landscape's special worth and importance[213]. Nature Deficit Disorder defines a range of health problems associated with a lack of connection and direct experience of nature by children[214].

To complement the theoretical approach to understanding the links between natural places and well-being, there is a considerable body of research that reinforces the importance of these links. Maller *et al*[215], published a summary of the evidence supporting the assertion that contact with nature promotes health and well-being, and found the following statements were clearly demonstrated by research:

- ✓ There are some known beneficial physiological effects that occur when humans encounter, observe or otherwise positively interact with animals, plants, landscapes or wilderness
- ✓ Natural environments foster recovery from mental fatigue and are restorative
- ✓ There are established methods of nature-based therapy (including wilderness, horticultural and animal-assisted therapy among others) that have success healing patients who previously had not responded to treatment
- ✓ When given a choice people prefer natural environments (particularly those with water features, large old trees, intact vegetation or minimal human influence) to urban ones, regardless of nationality or culture
- ✓ The majority of places that people consider favourite or restorative are natural places, and being in these places is recuperative
- ✓ People have a more positive outlook on life and higher life satisfaction when in proximity to nature (particularly in urban areas)
- ✓ Exposure to natural environments enhances the ability to cope with and recover from stress, cope with subsequent stress and recover from illness and injury
- ✓ Observing nature can restore concentration and improve productivity
- ✓ Having nature in close proximity, or just knowing it exists, is important to people regardless of whether they are regular 'users' of it

A study in six rural communities across Victoria, New Zealand looked at the health, well-being and social capital benefits gained by community members involved in the management of land for conservation. The results indicate that involvement in practical conservation work may contribute to both health and well-being. A total of 102 people participated in the study (64 men and 38 women) comprising 51 members of a community-based land management group and 51 controls matched by age and gender. The members of the land management group rated their general health higher, reported visiting the doctor less often, felt safer in the local community, and utilised the skills that they have acquired in their lifetime more frequently than the control participants[216]. A similar study in the Netherlands, using data on the self-reported health of over 10,000 people with land-use data on the amount of green space in their living environment, found that a green environment was positively related to a range of positive health indicators[217].

Promoting Silence in Protected Areas by Liza Higgins-Zogib

Noise pollution has a negative impact on the health of millions of people around the world, particularly urban dwellers. Unwanted and injurious noise emissions from transport, industries, lighting, electrical appliances and other noisy people is the cause of inconvenience and stress and can lead to both physiological and psychological problems. Hypertension, tinnitus (ringing in ears), hearing loss, sleep disturbance and aggression have all been identified as noise-pollution related[218]. In a Spanish study in 2005, Barreiro *et al* concluded that people were willing to pay approximately 4 Euros per decibel of unwanted noise per year for a reduction in noise[219].

Protected areas do not just protect biodiversity – they also provide areas of calm, serenity and silence. They protect a huge diversity of 'soundscapes', which all arguably have healing properties. In the US National Parks system the value of protecting silence and natural soundscapes is recognised as a major benefit for visitors and Gordon Hampton with his project 'One square inch of silence' is a major promoter of this. In Washington State's Olympic National Park, where 95 per cent is preserved for its wilderness value, he found a huge variety of soundscapes. But even here the silence is threatened. He says: "Today silence has become an endangered species. Our cities, our suburbs, our farm communities, even our most expansive and remote national parks are not free from human noise intrusions. Nor is there relief even at the North Pole; continent-hopping jets see to that. Moreover, fighting noise is not the same as preserving silence. Our typical anti-noise strategies, earplugs, noise cancellation headphones, even noise abatement laws, offer no real solution because they do nothing to help us reconnect and listen to the land. And the land is speaking"[220].

The large open expanses of east Africa have proved popular tourist destinations, and for many countries in the region their vast protected areas have proved of major economic benefit. Perhaps as well as the experience of seeing the herds of wildebeests and predatory lions, the landscape itself is also a draw. For early humans, a place with an open view would have offered better opportunities to identify food and shelter and to avoid predators; and there is considerable evidence that people's aesthetic preferences conform to this scenario today. When offered a variety of landscapes, people react most positively to savannah-like settings, with moderate to high depth or openness, relatively smooth grassy vegetation or ground surfaces, scattered trees or small groupings of trees, and water. These findings emerge cross-culturally, in studies of North Americans, Europeans, Asians, and Africans. This effect may extend beyond aesthetics, helping to recover health. Research on recreational activities has shown that savannah-like settings are associated with self-reported feelings of 'peacefulness', 'tranquility' or 'relaxation' and viewing nature scenes is associated with enhanced mental alertness, attention and cognitive performance[221]. Although much of this research is based on the benefits that occur by viewing nature (often a picture many thousands of miles from the source of the image); being in nature also impacts upon health.

Wilderness experiences, *ecopsychology* or *nature-guided therapy* are terms used in health-related literature to define activities which require *entering* a landscape rather than just viewing it. Such actions are described as therapeutic in many studies. There are several examples of so-called wilderness therapy for psychiatric patients, emotionally disturbed children and adolescents, bereaved people, rape and incest survivors, cancer patients, renal disease, post-traumatic distress syndrome and addiction disorders[222]. A literature review of 187 research papers in 1995 supported the idea that participation in wilderness experience programmes results in positive benefits, such as enhanced self esteem and sense of personal control, and negative results from participation are virtually non-existent. However, much of the research was not peer reviewed, tended to lack of rigor and there were few long-term studies[223], suggesting that further study of these issues is still required.

Natural therapy in English protected areas

✓ **Rye Meads Nature Reserve, Hertfordshire by Dr William Bird**

The Royal Society for the Protection of Birds (RSPB) runs several nature reserves in the UK. The following example comes from a report commissioned from Dr William Bird on the links between their conservation work and positive impacts on human health. The Rye Meads nature reserve is a wetland reserve in an urban area near to the River Lee in Hertfordshire, England. The reserve is managed to ensure high levels of accessibility with wheelchair-friendly trails and 10 hides from which a variety of habitats including reedbeds, wet meadows, open water and artificial sandbanks, can be viewed. The report focused on one individual, David Crew, who suffers from both epilepsy and Asperger's syndrome (which is similar to autism) and came to the RSPB to start volunteering following a difficult period in his life. As William Bird stated in the report: *"Unemployment and bouts of depression saw David in a pretty low state, and his illness meant he faced mixed reactions in the world of work and volunteering; it took all the efforts of his friends and family to get him back out into the world.*

Despite facing these difficulties David's situation greatly improved thanks to links with the local reserve. As Dr Bird goes on to relate: "*David has been volunteering at RSPB Rye Meads nature reserve for over three years, and carries out a range of physically demanding tasks. He says: '*I like outdoor work but had spent several months in my house not really mixing with other people. I thought this would be a good opportunity to enjoy some physically demanding outdoor work.*' In fact, David credits volunteering for the RSPB at Rye Meads with building up his strength as well as his mind, saying he has never felt this fit. '*Tasks like digging holes are a real source of stress relief and act as a therapy – a way of letting off some steam. I can also feel myself getting fitter and stronger and this all adds to my confidence. I enjoy lending my time to worthy causes and find that doing so gets me out and about and back into society following a very dark spell. Volunteering at the RSPB has completely changed my outlook and given me a new focus, making me feeling better both mentally and physically'.*" [224].

✓ **The Phoenix Futures Programme**

The Phoenix Futures Conservation Therapy Programme has been helping rehabilitation of people with substance misuse problems through active involvement in conservation projects in National Nature Reserves (NNRs) in England since 2001. Every week, groups from three of Phoenix Futures' residential care units travel to local NNRs to take part in activities such as habitat management, boundary construction and footpath repairs. The groups are supervised by professionals who can offer both the practical expertise and the social skills necessary. After ten weeks on the programme, and subject to their completing risk assessments, task reports and learning logs, participants are presented with a certificate noting their achievements. The NNRs involved in the project are: Derbyshire Dales NNRs in the Peak District National Park, Castle Eden Dene NNR near Peterlee, County Durham and Lindisfarne NNR and Natural England's Kingley Vale NNR on the South Downs[225].

Although the project notes that measuring the success of this type of activity is difficult, an assessment of the effectiveness of the project is made by comparing the percentage of drug users who remain in the treatment programme (with treatment defined as being effective when clients stay in it for 12 weeks or more). From mid-2007 to mid-2008, 73 per cent of Conservation Therapy Programme attendees stayed in treatment for 12 weeks or more, compared to 49 per cent of non-participants[226]. One of the participants in the scheme summed up the experience of being involved in the project: "*My life has been on self destruct for at least ten years, I put all my efforts into harmful things for my body and mind. From a dark place where I thought I was trapped and must admit I became comfortable with and was willing to be that way for the rest of my days. My way of thinking finally changed which led to Phoenix Futures. Ecology has just been a breath of fresh air to rekindle what I once had and can have again, only much improved. Not only does it give me what I need physically but mentally it is very therapeutic and is, and will, help my recovery.*" [227].

✓ Therapeutic activities

In the 19th Century, before antibiotics were available to treat disease such as tuberculosis, sanatoriums hoped to create the ideal conditions for fighting infections by providing a regime of good food, rest and a healthy environment. The first sanatoriums were opened in Germany in the 1850s with treatments based around exposure to open-air, preferably at high altitude[228]. Today, many protected areas still have sanatoriums within them: for example, Sanatorium Energetick in Tunkinsky National Park in Siberia, Sanatorium Amber Shore in Kemeri National Park in Latvia and Rakhmanov's Springs Sanatorium in Katon-Karagai State National Nature Park in Kazakhstan.

The petrified springs at Pamukkale Protected Area, Denizli Province, Turkey

Because heated water can hold more dissolved solids, warm and especially hot springs also often have a very high mineral content, containing everything from simple calcium to lithium, and even radium. Because of both the folklore and the claimed medical value of some springs, they are often popular tourist destinations, and locations for rehabilitation clinics for those with disabilities or ill health. Many protected areas include hot springs. Perhaps two of the most famous are at Pamukkale in Turkey and Hot Springs National Park in the USA. Pamukkale is recognised as a World Heritage Site. The medical properties of the spring water were, according to legend, bestowed by the gods, especially Asklepios (demigod of medicine) and his daughter Hygieia (goddess of health, cleanliness and sanitation), under the protection of Apollo (god of medicine and healing). The thermal springs of Hot Springs National Park (2,330 ha, category V[229]) in the Ouachita Mountains of central Arkansas have been valued for the recreational and therapeutic benefits of the thermal baths, as a source of drinking water since the history of the area was first recorded[230]. In Latvia, the Kemeri National Park includes many culturally important buildings linked to the Kemeri Spa which became famous for its curing springs. The first water analysis was done in 1801 by an academic from St. Petersburg, T. Lovics, and the first data about using the mud from the springs for medical purposes was published in 1891[231].

A more controversial activity is swimming with wild mammals such as dolphins. Dolphin swimming is advertised on the visit Kenya web site at Kisiti Marine Park, Kenya[232,233]. Although in this case the main purpose is recreation, animal facilitated therapy with dolphins has been used as an alternative therapy for a wide range of physical and mental disabilities and illnesses in humans; and has been suggested as an effective treatment for mild to moderate depression[234]. However, in some locations, dolphins are disturbed by such activities, and dolphins have been recorded as leaving their usual territories in favour of quieter areas[235].

Many of these therapeutic activities are today linked with tourist activities. For example, Green Line Safaris offers wellness tours in Oulanka National Park, Finland in collaboration with a registered relaxation and physiotherapist, for special groups such as business employees and senior citizens[236].

Disbenefits

In the sections above we have discussed the strong links between protected areas and our health in a number of ways. But such a discussion would not complete without acknowledging that there can be less positive outcomes from these links as well; some of the main ones are briefly noted below.

- ✓ Forest animals and insects can serve as hosts and vectors to a number of important diseases such as rabies, yellow fever, leishmaniasis and Chagas disease[237]. Today about three quarters of all emerging infectious diseases[4] are, or have been, transmitted between animals and humans; with the pathogens causing these diseases usually traceable back to wildlife[238]. As protected areas become more isolated in the landscape and animals possibly become overcrowded in these restricted areas, concern has arisen over the evolution of parasite virulence and it has been suggested that conservation policies should be prepared to address this problem, especially given the serious health risks currently posed by the spread of virulent viruses (e.g., avian influenza)[239].

- ✓ Diseases can be transmitted between closely related species such as people and primates or cattle and buffalo. Transmission can take place when, for example, domestic animals graze with wild animals in or around protected areas or when tourists, researchers and field staff enter protected areas to view primates[240]. Zoonotic diseases are those caused by infectious agents that can be transmitted between (or are shared by) animals and humans. For example, Ebola was transmitted from a chimpanzee (*Pan troglodytes*) in Cote d'Ivoire in the 1990s and more recently from western lowland gorillas (*Gorilla gorilla gorilla*) and chimpanzees[241].

- ✓ Park management can sometimes inadvertently be the cause of health problems. The fact that many protected area rangers and managers need to stay away from home for long periods of time has been identified as a contributory factor in the increased spread of AIDS. In cases where communities are forcibly relocated to make way for protected areas this can also spread disease through exposure to new diseases. For example, when communities were relocated from the high plateau of Nyika National Park in Malawi, many went to the lowlands and succumbed to malaria, against which they had built up little natural resistance[242].

- ✓ There is growing number of reported confrontations around the world between humans and wild animals – a phenomenon termed 'Human Wildlife Conflict' (HWC). The main drivers behind HWC are that growing population pressure often leads to the poorest in society pushing agricultural frontiers to more marginal areas that have become the sanctuary of many wildlife species and have often thus been designated as protected areas. As wild species lose more and more of their natural habitat and have reduced access to natural food sources, they eat agricultural crops and livestock, can destroy property and can injure or kill people. Conservation success, in terms of increasing animal numbers, can also lead to increased pressure on the boundaries of protected areas. And these problems are likely being made worse by increased drought and/or floods, both manifestations of climate change. As conservation succeeds and wildlife increases the problems of HWC are becoming worse. In Namibia, a rough estimation of the combined costs of HWC to communal area farmers is US$1 million annually; in Nepal, the average damage by elephants is as much as 27 per cent of the yearly income for each individual household in some regions. The consequences for local people are not only on their livelihoods but at the most extreme can lead to injury or death[243].

[4] An infectious disease whose incidence has increased in the past 20 years and threatens to increase in the near future

Chapter 3
Case Studies: Protected areas working for health

The chapter above illustrated the links between protected areas and a variety of health related factors; ranging from the conscious management of ecosystems to reduce the risk of disease, to sources of local and global medicine and the direct provision of health benefits. In this chapter seven case studies look in detail at some of the policies and practices which have been developed, or in some cases need to be developed, to make the links between protected areas and health more explicit.

The first two case studies review experiences in Australia and the UK – where policies now enshrine some of the principles and best practices that have been developed consciously to link human health and conservation needs. In Australia, Park Victoria's *Healthy Parks Healthy People* message seeks to reinforce and encourage the connection between a healthy environment and a healthy society in all of the organisation's activities. The case study reviews how this message is being communicated through a wide range of innovative partnerships and projects. In the UK attempts are being made to re-orientate the human health agenda alongside biodiversity health. In a country where a nationalised health service is being increasingly pressurised by ill health related to lack of exercise, it is hoped that developing synergies between government conservation and health policy will help to ensure that conservation plays a more prominent role in human well-being and the promotion of well-being linked to the use of the natural world helps deliver conservation and restoration activities. The case study reviews the recent Policy Position Statement on *Health and Wellbeing* by Natural England, the public body whose purpose is to protect and improve England's natural environment, and looks specifically at how this policy is being implemented at ground level.

The case study from Colombia introduces the latest addition to the country's national protected area system. The Alto Orito Ingi-Ande Medicinal Plants Sanctuary was proposed by the local indigenous people as part of their strategy to strengthen and restore their traditional culture and the associated landscapes. As such, the protected area is perhaps a beacon of hope and an exemplar for many communities around the world struggling to conserve traditions and the natural areas that they are associated with. We quote the former Minister of the Environment for Colombia in the case study who stresses the importance of the Santuary, because it "*harmonizes the western point of view of the conservation of biodiversity with the traditional integrated management of the Cosmovision of the Kofán People*".

Such harmony is required in many parts of the world. The case study from China reviews a joint project being run by WWF-China, TRAFFIC and IUCN, which aims to find harmony between the resources needed for traditional Chinese medicine, the needs for conservation, and in particular panda habitat, and more sustainable local livelihoods and thus well-being. The case study reviews the project's aims and activities to date. The example from Malaysia illustrates the problems faced by local and indigenous people in conserving their traditional resources. In this case the collection of honey, which has medicinal and nutritional values, is being threatened by forest loss. If the forest is logged the production of high quality honey will cease, local livelihoods and traditions will be lost, an important medicinal product will disappear and biodiversity will be reduced.

Local doctor prescribing traditional medicine to a patient in the Annapurna Conservation Area, Nepal

As the case studies from Colombia, China and Malaysia show, conservation and development organisations are active in many parts of the world where traditional livelihoods are under threat due to resource loss. The fifth case study in this chapter looks at how the links between conservation and health are being actively included in many of the projects run by conservation organisations. PHE (population-health-environment) projects specifically aim to integrate health and/or family planning with conservation activities, seeking synergies to produce greater conservation and human well-being outcomes. The case study introduces the concept of PHE and looks specifically at the objectives and achievements of such a project in the Kiunga Marine National Reserve in Kenya.

The final case study, from the world-famous Yellowstone National Park in the US, looks in more depth at the challenges of developing appropriate policies for bioprospecting in protected areas. The case study looks at how the park has worked with biotechnology companies; including the policy and product developments and the difficulties and responses which have been experienced along the way. It is not a wholly positive story and illustrates that the links between protected areas and health need to be managed with care and, as with so many of the benefits that protected areas can provide, thus contribute to the long-term aims of protected areas and not visa versa.

3.1. Parks Victoria – *Healthy Parks Healthy People*

by John Senior, Manager Strategic Partnerships, Parks Victoria

Parks Victoria is a unique agency in that as a statutory authority it manages a diverse array of environments extending over 4 million hectares (15,500 sq miles) in the State of Victoria, Australia. These areas include national (terrestrial and marine) and state parks, conservation reserves as well as major metropolitan parks in Melbourne. In addition it has responsibility for the recreational management of Port Phillip and Western Port bays and navigable rivers flowing through Melbourne. Through effective environmental and visitor management, Parks Victoria is dedicated to preserving the natural and heritage values of Victoria's parks, bays, and waterways, including full protection of sensitive areas.

Parks Victoria's annual turnover is AUS$160 million. It is a diverse, decentralised agency with more than 1,000 employees located at 120 work centres in five regions throughout Victoria. Parks Victoria employs staff across the State in a wide range of roles, 850 of whom are trained emergency wildfire response personnel. Approximately 70 per cent of the staff are professionals with formal qualifications in park and reserve management, environmental management and recreation. This highly skilled and experienced team includes specialists in business systems, financial management, planning and marketing, and over 400 rangers based in parks, bays, and waterways. Over recent years Parks Victoria has developed a strong reputation nationally and internationally as a leading park management agency.

Like many protected area management agencies around the world, Parks Victoria needs to remain relevant to communities and governments in the midst of many other important considerations. Issues affecting education, health, security, transport, energy, and water, among others, can overshadow parks when legislators are considering environmental priorities. However, there is no need to exclude one priority at the expense of another. Increasingly governments are encouraging more holistic strategies that foster partnerships between sectors and which involve collaborations that realign common interests. Its unique range and scale of responsibilities enables it readily to communicate with its urban constituencies about the value of biodiversity in relation to human well-being and thereby positively influence both their advocacy and visitor impact.

✓ Research

An independent international literature review on the health benefits of contact with nature was published by Deakin University's Faculty of Health and Behavioural Sciences in 2002[244] and updated in 2008[245]. The research revealed a large body of empirical evidence supporting the seemingly obvious and reflected original presumptions such as this demonstrated by a 1929 extract from the Metropolitan Town Planning Commission report, Melbourne: "*Abundant evidence is available to substantiate the views of city planners, the medical profession, and psychologists that proper outdoor recreation has a most beneficial effect on the health, morals, and business efficiency of communities, and consequently on the national life*" which can be likened to many similar US and UK statements in the 19th century.

Continuing research around the world has further reinforced the findings which relate to the value of nature to health and well-being at both individual and community levels, and to preventative as well as restorative outcomes.

Twelve Apostles Marine National Park, Victoria

Strategic Direction

On the basis of the research Parks Victoria has progressively adopted a *Healthy Parks Healthy People* approach to all aspects of its business. This philosophy seeks to reinforce and encourage the connection between a healthy environment and a healthy society, particularly as more people are now living in urban-dominated environments and have less regular contact with nature.

The organisation recognised that it has a clear role to play enabling people to experience the health benefits associated with the precious natural environment. In line with this more symbiotic approach to service delivery, Parks Victoria is repositioning itself as a provider of services with deep societal benefits rather than a custodian of natural values alone. In essence it is now looking at parks management from the outside in rather than from the inside out. In Victoria it is reshaping the role of parks in the community and their value to society.

To achieve this aim new partnerships are required along with the need to dissolve disciplinary barriers and realign common interests with others, such as those within the health and community sectors. Bridging sectoral boundaries is vital to rethinking the role of parks. We require people from a whole host of sectors to imagine the potential of parks from the outside-in. The worlds of sustainability and health have developed almost independently of one another, despite the best intentions of each to address issues of common concern. It is time to reunite them.

However, this kind of collaboration does not just happen; a shift in deep-seated, fragmented ways of understanding parks is required across a whole range of sectors. Political support, champions, leadership, research and public awareness campaigns are all necessary to shift into a new park management paradigm.

Promotion

Beginning as an awareness raising campaign to highlight the connections between a healthy environment and a healthy community, *Healthy Parks Healthy People* has evolved into a new park management paradigm supported by many of Australia's leading park and health organisations.

The key elements of the promotion have been:

- ✓ The first challenge was to develop a genuine and effective positioning in line with Parks Victoria's core values. The positioning needed to trigger a perception in the minds of the public of an organisation that exemplified the qualities and attributes of custodianship, environmental protection, and a contribution to a civil society. The clear and simple slogan *Healthy Parks Healthy People* was used, implying that the environmental health of parks results in a healthy community and that spending active recreation time in a well cared-for park environment can lead to greater health and fitness of both individuals and society.

- ✓ Broad-based awareness was generated through an eight-week radio and print promotion programme, with activities supported by editorials in the national press. A festival showcased state-wide park and recreational opportunities and displays from community and recreational groups celebrating the benefits of outdoor recreation.

- ✓ Parks Victoria *Healthy Parks Healthy People* television advertisements aired for two weeks in April 2006 on metropolitan channels and on regional television. The campaign was very well received by the general community, staff and stakeholders. Enquiries to the Parks Victoria Information Centre and website traffic increased during the period of the campaign.

Ranger Roo (whose adventures can be viewed at: www.rangerroo.com.au/) is a creation of Parks Victoria aimed at inspiring primary school children to learn about and visit Park Victoria's network of parks and protected areas.

- ✓ In line with these broader media and communication strategies, all existing Parks Victoria brochures and promotional programmes are now themed *Healthy Parks Healthy People*, including stands at three major annual exhibitions and major events.

Partnerships and Alliances

Advancing the *Healthy Parks Healthy People* agenda also involved developing partnerships with health and other bodies and with stakeholder groups. These alliances gave extra credibility to the approach by legitimising the links between a healthy park system and a healthy society. Some of those are outlined below.

- ✓ A partnership was established with a national television programme 'Postcards', which featured an actual park ranger as one of the presenters to highlight park venues and visitor opportunities. Each segment was tagged with the *Healthy Parks Healthy People* message. The series was so successful it was placed in the popular time slot of 7.30 p.m. Saturday, and received even higher ratings. Later, this courtship with television evolved into a partnership with a similarly high rating programme.

- ✓ Support was sought and obtained from peak health bodies like the Royal Australian College of General Practitioners, Asthma Victoria, the National Heart Foundation, and Arthritis Victoria. Colourful posters and brochures were distributed to general practitioners' offices state-wide, and more recently (in conjunction with Maternal and Child Health Services and the Australian Breastfeeding Association) a congratulations card is provided to the mother of each new baby. These advise patients and mothers on the benefits of the natural environment and where to get more information about healthy activities in parks.

- ✓ Parks Victoria has continued to work with key partners and stakeholders in the planning and construction of 'bike trails for a liveable city' initiative which promotes the construction of new trails in developing areas, improving the connection between existing trails, and linking communities to places of work, activity centres and Melbourne's park network. In 2007, an impressive 3,160 cyclists cycled through Melbourne's parks and along bike trails as part of our third Bike Path Discovery Day. This free event, now annual, aims to increase awareness, knowledge and use of Victoria's off-road trails and parks and their benefits.

- ✓ Community programmes which support people from culturally and linguistically diverse backgrounds have been developed - these include:

- development of a multilingual Park Note translated into 33 languages, training for Parks Victoria Information Centre staff to increase their capacity to manage callers from non-English speaking backgrounds (including the use of interpreter services); provision of park information to the Welcome to Victoria Kit (distributed annually to every new migrant child entering the education system); and a new Volunteer Bilingual Park Guides programme in partnership with a number of community organisations. The 11 graduating guides conduct tours in a second language including Turkish, Arabic, Spanish, Macedonian, Sudanese and Greek to newly arrived and culturally and linguistically diverse communities to assist them in understanding and appreciating their local open spaces, flora and fauna. It is believed that this course is the first of its kind in Australia and the concept has created interest in other parts of Victoria, as a highly innovative approach to helping settlers gain a sense of belonging in their adopted home. *"I thank Parks Victoria very much. Going out makes me feel very happy after all the difficulties I've been through. Now I'm in a foreign country I forget about what is going on in my home country. The river reminds me of home because my house was near the river and we used to go there to collect water. People would give birth at the river and swim there too."* Adau (Sudanese participant). *"As a teacher and a community project facilitator for the last 27 years, I have not seen another group of people build such a strong and cooperative relationship as with this group"* Dimi Bouzalas, Project Leader, Merri Creek Management Committee

✓ Through partnering with the People & Parks Foundation, and in conjunction with the Variety Club, over 100 disadvantaged young people were supported, to be involved in camps which gave them an experience of nature. Further, over 500 volunteer hours were spent with the Sea Search programme which monitors Victoria's marine national parks and sanctuaries. Data from this programme across 15 marine and coastal parks and reserves helps Parks Victoria to manage these areas whilst providing benefits to the participants.

✓ 'The World's Greatest Pram Stroll' – an annual initiative to encourage young mothers to meet and mix in a pleasant environment, and to establish a great habit and avoid post-natal depression and social isolation. The 'stroll' was first held in 2002 and has grown to an annual event which attracts 5,000 mums, dads and their families simultaneously strolling at one of the 28 local or regional parks for the event in 2008. The event is organised in conjunction with health NGOs and family magazine publishers.

✓ A significant contributor to the success of *Healthy Parks Healthy People* to date has been its endorsement by staff. Across the organisation, there is a growing appreciation of the relationship between a healthy parks system and a healthy society and programmes that demonstrate the broader role parks can play are beginning to grow from the 'grass-roots'.

The great pram stroll, Melbourne, Victoria

The Road Ahead

Parks Victoria will continue to advance the societal value of parks here in Victoria. We will broaden the role parks play and build awareness in Australia that parks are a vital part of a healthy and sustainable future. Parks Victoria has set in motion a process that will help achieve this aim.

- ✓ Whilst recognising that the connection of people to parks and to nature has a long history and is an enduring value we need to ensure we are relevant to today's societal needs and to be planning for the future.
- ✓ Climate change response – we need a plan, action and communication about what it means for parks
- ✓ We need to be better engaged with the community – listening, educating, building support and partnerships and meeting people's needs
- ✓ To be excellent park managers we need an evidence base for decision making. We need knowledge, expertise, data and commitment to performance evaluation
- ✓ We need to expand people's understanding of the benefits of parks and to strengthen the connections between people and parks to achieve mutual benefits
- ✓ We need to be a sustainable organisation; environmentally, socially and financially. We need to operate in an environmentally sustainable way, to foster social cohesion amongst staff and to secure the resources required to manage parks well.

Leading the way: International *Healthy Parks Healthy People* 2010 Congress

To catalyse action and broaden the role of parks, Parks Victoria will host the inaugural *International Healthy Parks Healthy People Congress* in Melbourne during April 2010[5]. It is expected to attract over 1500 delegates from Australia and around the world. Participants will come from many different sectors and provide a diversity of viewpoints. Already IUCN has endorsed the event and *beyondblue* (the national depression initiative) and Deakin University have joined Parks Victoria as partners in the Congress. The internationally renowned scientist, Sir Gustav Nossal AC has agreed to be the Patron.

[5] See www.healthyparkshealthypeoplecongress.org

3.2. The UK *Walking its Way to Health*

by Sue Stolton with the assistance of Natural England staff Dr William Bird, Strategic Health Advisor, Moira Halstead; Lynda Foster, Health and the Natural Environment/WHI; and Joan Pinch of Tiptree Parish Council, Essex

The UK has a publicly funded National Health Service (NHS) – but the costs of keeping the nation healthy are huge and increasing rapidly. Overall, running the NHS cost some £92 billion in 2008 (the budget has risen considerably in recent years; it was for example £52 billion in 2002)[246]. Given that many of the diseases now threatening the UK population are avoidable, the NHS is gradually shifting its emphasis from treatment and cure to prevention. The costs of avoidable physical and mental ill-health are significant, with estimates ranging from £11-50 billion per year in terms of health costs and productive days lost[247]. There is clearly a need urgently to increase the nation's well-being, just as in the past there was a need to fight infectious disease, ensure water purity and improve sanitation.

A long but sedentary life

The population of the UK has greatly benefited from the rapid improvements in medicine and availability of medical care during the last half century. But as lifespan has steadily increased, lifestyles have become less healthy. 70 per cent of the UK population leads sedentary lives creating many major avoidable health problems such as obesity, diabetes, heart disease and some cancers[248].

One move towards preventing ill health has been to link the national health agenda more closely with the government agencies responsible for environmental protection in the different countries that make up the UK (respectively Natural England, Countryside Council for Wales, Scottish Natural Heritage and The Environment and Heritage Service in Northern Ireland). Natural England, for example, has a publicly funded budget of some £2.9 billion to ensure that the country's natural environment, including its land, flora and fauna, freshwater and marine environments, geology and soils, are protected and improved. It also has a responsibility to help people enjoy, understand and access their natural environment. Natural England's recent manifesto recognises that its responsibilities in effect add up to a 'natural health service', which also has the potential to make a major contribution to the health and well-being of the nation[249].

These links between a publicly funded health service and publicly funded bodies managing the natural environment are slowly being developed through more binding policies and objectives. In 2008, Natural England published a Policy Position Statement on *Health and Wellbeing* which includes three major 'well-being' policy positions relating to different stages of life plus one overarching position on the rationale of linking our environment to our health. The policy statements states:

"We believe that:

- ✓ Better health and wellbeing are two of the major social and economic benefits we can secure through good management of the natural environment in both rural and urban settings.
- ✓ Specifically:
  - Children should experience and familiarise themselves with their local environment to benefit their mental and physical health and further their development.
  - Adults should be offered increased contact with the natural environment resulting in reduced stress and more fulfilling lives.
  - Healthy Ageing is enhanced by close and frequent contact with the natural environment leading to greater independence and dignity.
- ✓ Connections between people and the natural environment should go beyond the lives of individuals to create a lasting legacy of strong and healthy communities for future generations"[250].

North Yorkshire Moors National Park, England

© Nigel Dudley

Activities and programmes

Against a background where public use of the natural environment has been declining over the last decade, some new programmes are demonstrating how contact with the natural environment can make a measurable impact on people's health and well-being. Three leading programme initiatives in England are:

- ✓ The *Green Gym* which offers individuals an outdoor alternative to conventional gyms. Green gyms allow people to increase their physical activity levels through direct involvement in practical conservation activities[6].

- ✓ *Active Woods* is a national drive by the Forestry Commission to promote the range of health and fitness opportunities offered by Britain's woodlands. Hundreds of events are being organised across England such as activity days, den-building competitions and dog walks, reflecting the campaign's three themes of *naturally active, naturally stimulating and naturally relaxing*[7].

- ✓ *Walking for Health* (WfH) is a joint initiative between Natural England and the British Heart Foundation. WfH aims to encourage people, particularly those who take little exercise, to do regular short walks in their communities. There are currently over 500 local health walk schemes across England[8].

All these schemes take place in a range of areas throughout England, including National Parks, National Nature Reserves and many local and private reserves, as illustrated by the example below. There are also similar initiatives developing in other parts of the UK. Although the overall effectiveness of individual programmes' contribution to improved health may be hard to assess the overall role of green spaces in the health of the English is clear. A major research project reviewed the records of more than 360,000 pre-retirement age deaths from all causes in England for links between mortality and income and access to green space. Green spaces were found to benefit health by encouraging people to take exercise and reduce deaths from circulatory diseases. Indeed the researchers concluded that in the 20 per cent of the population of England with the greatest exposure to green space, an estimated 1,328 lives are saved each year[251].

Tiptree Heath, Essex, England

Tiptree Heath is a 25 ha (61 acre) Site of Special Scientific Interest. It is the largest remaining significant fragment of heathland in Essex which in past centuries covered thousands of acres. The heath is privately owned common land and is managed as a protected area by the Friends of Tiptree Heath and the Essex Wildlife Trust. The heath has a variety of habitats, with pockets of woodland, a stream, two ponds and open areas which are in the process of being restored to heathland in favourable condition. It is home to many locally and nationally important plants and invertebrates.

[6] http://www.cvni.org/greengym/
[7] http://www.forestry.gov.uk/forestry/INFD-6ACE8M
[8] http://www.whi.org.uk/

Public access to the heath is an important management objective following the recent introduction of grazing cattle as an effective management strategy. Gates, allowing pushchair and disabled access, have been placed on the most frequently-used paths, and there is also a full perimeter path outside the grazed area. These networks allow for a well supported WHI initiative. Walks take place weekly and eight walk leaders have been trained to lead activities at the site. Walkers take part for a variety of reasons including health related issues such as heart disease and diabetes, and for mental health issues, general improvement of well-being and for social reasons. Buggy (i.e. pushchair) walks are in the process of being trialled and there are also walks of special interest, e.g. history/art trail/bat walks/flora and fauna species walks and a dawn chorus walk. One of the warden/walk co-ordinators also jointly runs with volunteer leaders regular work parties which constitute a Green Gym[252] involving volunteers of ages from 12 to over 70 including a good number of teenagers and younger adults.

Tiptree Heath, Essex: An Art walk as part of the summer 'Going Ratty' day about small mammals for younger generation (left © Cheryl Pinch) and health walks for the more mature (right © Jenni Jordan)

3.3. Protecting medicinal resources in Colombia

by Sue Stolton with assistance from María Ximena Barrera Rey and Luis German Naranjo, WWF Colombia

Conservation can be driven by a range of incentives based on the values associated with a specific environment. In parts of the Colombian Amazon, conservation strategies focus on preserving the shamanic tradition of local peoples and on the protection of the associated medicinal plants.

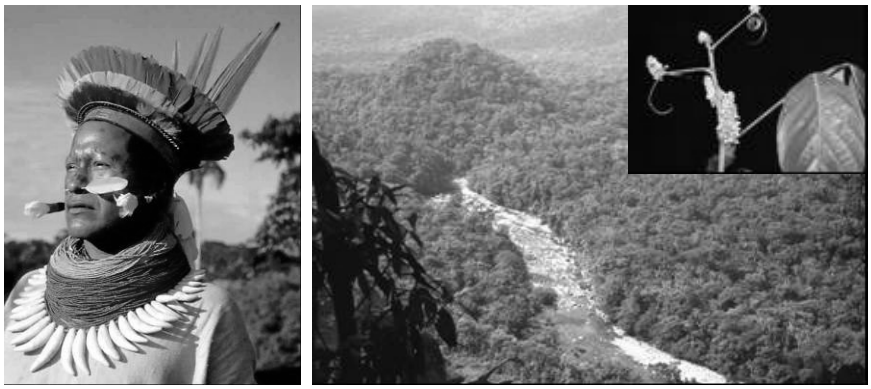
A new protected area

"In this world, God has left us everything surrounding us, the lands, waters, remedies for health. Now we have to look after them, if they finish, we will be finished as well."[9]

In 2008, the Colombian Ministry for the Environment, Housing and Territorial Development and the Head Office of National Natural Parks of Colombia, announced the creation of the 54th protected area for the country. The establishment of the Alto Orito Indi-Ande Medicinal Plants Sanctuary was proposed by the indigenous Kofán communities, who live along the margins of the Putumayo, San Miguel and Guamués Rivers, and by the traditional medicine-men of the Putumayo foothills. The protected area was planned as part of their strategy to strengthen and restore their traditional culture and the associated landscapes. The Sanctuary is regarded as an area of special concern, and jointly protected by indigenous communities, traditional authorities and governmental conservation institutions.

Two species in particular are inextricably linked with the local culture: the yoco (*Paullinia yoco*) and yagé (*Banisteriopsis caapi*). The yoco liana is one of the most highly regarded medicinal plants in northwestern Amazon. According to Jose Pablo Jaramillo, Programme Director of the NGO Amazon Conservation Team (ACT), Colombia[253] "Yoco can be considered a 'keystone' species in terms of conservation, necessitating the protection of the surrounding ecosystem". The whole culture and way of life of the various indigenous groups of the area are based on the ritual and sacred consumption of yagé. In consequence, anthropologists have named this region and its inhabitants the 'culture of yagé', which is regarded as one of the most purely preserved shamanic traditions in the world.

This part of the Amazon has been greatly affected by colonization. The indigenous peoples of the region have lost the majority of their territories, and deforestation has resulted in the loss of medicinal plants and the consequent impoverishment of their culture and traditional medical system[254]. The traditional healers, or Taitas, have however long fought for the preservation of their culture.



The people and landscapes of the Colombian Amazon and the yoco plant (insert right)

[9] These references have been taken from various memoirs and plans collected by Correa in 2004, as part of the process of discussion between Natural National Parks and indigenous communities of the lower Cauca River, relating to the conservation of the Churumbelos mountainous region.

At a 'Gathering of Taitas' in Yurayaco, in the foothills of the Colombian Amazon in 1999, 40 of the most prominent indigenous healers from seven tribes met for the first time to discuss the future of their forests, their medicine and their people. The result was the Union of Traditional Yagé Healers of the Colombian Amazon (UMIYAC after its Spanish name) whose jointly signed declaration became the basis of this new alliance[255]. They stated that: "*We consider yagé, our medicinal plants and our wisdom to be gifts from God and of great benefit for the health of humanity. This Gathering may be our last opportunity to unite and defend our rights. Our motivation is not economic or political. We are seriously determined to demonstrate to the world the importance of our values*"; and they noted that: "*We must regain possession of our territories and sacred sites. The forest is for us the fountain of our resources. If the forests disappear so will medicine and life*"[256]. The declaration of a floristic sanctuary, focusing on medicinal plants, is an initiative from this alliance, and is seen as a means of combining the protection of the habitat and the biological resources with that of the traditional medicine systems, thus contributing to recovery of the area's natural, cultural and intangible heritage.

One strategy to protect the forests, their resources and the associated culture is through training and education for the followers of traditional medicine – to ensure that traditions are kept alive. This educational need was summarised by one member of the local community: "*To lead a respectable life, children used to be taken to the 'taitas' to receive advice from them and for them to cure them drinking 'yagé'. It is necessary to guide young people and children not to lose the habits and for them to grow up and be educated with the ancestral values. Young people today don't care about earth, nature nor family, everything is getting lost.*" [257].

Such traditions will certainly be lost if the natural resources they depend on are under threat. Julia Miranda, Director of National Natural Parks of Colombia, believes that "*The risk of extinction of yoco and other medicinal plants, and the decreasing possibility of counting on natural areas that allow the indigenous peoples to develop their traditions, bear an impact on the conservation of medicinal biodiversity, and favour cultural erosion of these communities. In most cases, the effectiveness of the medicinal plants depends on their collection from natural environments because it is only there that they are charged with the vital energy of nature*". The protection of the area through its declaration as a protected area within the National Natural Parks System is seen by the UMIYAC as an alliance to guarantee the perpetuity of the area and its values. Due to the absence of natural spaces inside their territory the sanctuary is an ideal place for the 'taitas' and traditional doctors of the yagé and yoco culture to develop their medicinal system and their culture.[258].

In terms of developing conservation targets and strategies, such conservation of traditions may be hard to measure or manage, but they are still of vital importance when trying to deliver long term conservation for cultures and habitats. As the former Colombian Minister for Environment, Housing and Territorial Development noted, the declaration of a sanctuary of flora medicinal plants is "*an important step towards the conservation of the intangible heritage of the Colombian people, which will benefit future generations*"[259].

The local community provided the knowledge base behind the declaration of the Orito Ingi-Ande Sanctuary, whose name means 'our territory' in the Kofán language. They were supported by the Etno-biology Institute, Rosario University and the UMIYAC. Funding was provided by the Dutch Embassy in Colombia, the Gordon and Betty Moore Foundation and ACT.

Orito Ingi-Ande is in the Colombian Amazon Piedmont, the transition zone between Andean ecosystems and the lowlands. The Sanctuary is located in part of an ancestral territory of the Kofán people, but the Piedmont has been, for centuries, a space of commercial exchange and socio-cultural relationships with other indigenous communities such as the Inganos, Secoya, Coreguaje and Kofán ethnic groups, among others[260]. The area is in Southwestern Colombia, in the Departments of

Putumayo (Municipality of Orito) and Nariño (Municipalities of Funes and Pasto), on the eastern slope of Patascoy hill. It covers 10,200 ha of tropical rainforests and Andean forests ranging from between 700 and 3,300 metres above sea level. The Sanctuary is bordered by rivers Orito and Guamués, which are part of the fluvial star of Patascoy hill that flows into the Amazon basin.

The area is biologically rich. It contains an estimated 400 bird species and includes many species of amphibians, reptiles and mammals, such as the spectacled bear (*Tremarctos ornatus*) and the jaguar (*Panthera onca*), both endangered species listed in the Red Book of Mammals of Colombia[261]. The area is also, of course, rich in medicinal plants. According to Julia Miranda "*Over a hundred plants from the medicinal gardens of the area have been characterized jointly with Kofán grandmothers and youngsters. Such gardens are regarded by the community as pharmacies where they find the plants required in their medicinal practices*"[262].

Conclusions

Orito Ingi-Ande is the only protected area in Colombia primarily dedicated to the conservation of medicinal flora. But it is much more than just an area set aside to conserve plant species. In the words of Juan Lozano, former Minister of the Environment: "*The declaration of the Sanctuary Orito Ingi Ande is an important landmark in the history of the National Natural Parks of Colombia. The category of Sanctuary of Flora of Medicinal Plants harmonizes the western point of view of the conservation of biodiversity with the traditional integrated management of the Cosmovision of the Kofán People. The preservation and survival of their customs and traditions in the use and management of medicinal plants depends on the conservation of these territories*". [263].

3.4. Medicinal plants and panda landscapes in China

by Anthony B Cunningham for WWF China

The ecosystem services, such as health benefits from clean water, that are provided by China's nature reserves within mountain catchments are well known. What is less well known are the health benefits of medicinal plants, many of which have their last stronghold within these reserves. This case study focuses on the interface between nature reserves, health care and local communities in the Upper Yangtze ecoregion, a globally outstanding area for biodiversity conservation.

Across all cultures, for most of human history, doctors were effectively botanists, using medicinal plants as the primary source of medicines to treat disease. Of the 12,807 species used in traditional Chinese medicine, for example, 11,146 are plant species[264]. Evidence that these plants are the roots of medical practice is clearer today in China than almost anywhere else in the world. Parallel systems of health care, one using modern pharmaceuticals and the other using Traditional Chinese Medicine (TCM) are found in many major hospitals. An important reason for this is that China's long and well-documented history of medicine linked with significant policy support has resulted in public health programmes that use TCM to treat many common illnesses[265].

TCM reserves

The great importance placed on TCM in China poses a major challenge for landscape-level conservation. Many high value TCM plant species have been subject to unmanaged harvest for decades. As a result, demand exceeds depleted supplies outside of nature reserves. This has lead to conservation challenges within nature reserves, which have become the last strongholds of significant wild populations of the most effective and economically valuable medicinal plant species.

This conservation challenge is exemplified in China's Upper Yangtze ecoregion, whose landscapes are a global conservation priority. Spanning a large area of Shaanxi, Gansu and Sichuan, this ecoregion is best known for the 18 conservation areas where the giant panda (*Ailuropoda melanoleuca*) still occurs in the wild. What is less well known is that about 75 per cent of commercially harvested Chinese medicinal plant species occur in the mountains of the Upper Yangtze ecoregion, many of which are endangered due to over-harvesting. Commercial harvest of remaining populations of slow growing and often habitat specific medicinal plants within nature reserves is not just a plant conservation issue. With limited staff, strict controls are difficult in these remote, rugged mountains. As a result, commercial collectors camp within nature reserves during the TCM harvest season, in some cases for two months or more, harvesting TCM species and hunting wildlife as a source of food. When hunting of protected wildlife such as takin (*Budorcas taxicolor)* occurs, then conflicts between conservation authorities and TCM collector's increases, often with negative outcomes for both people and nature.

The landscapes of Wanglang Nature Reserve not only contain giant pandas and other rare wildlife, but are also important for conserving many endemic medicinal plant species © WWF

Millions of *Fritillaria cirrhosa* (*beimu*) bulbs, all wild collected, including from within nature reserves, are sold for industrial production of cough remedies (*left*). Frame constructed within a nature reserve by commercial medicinal plant harvesters for drying rhizomes of *Notopterygium* (*qianghou*) an endemic genus only found in China (*right*). © WWF China

Trade and conservation

The medicinal plants trade is also not just a national issue. At a global scale, China is the largest exporter of medicinal and aromatic plants, mainly to Hong Kong and is also a significant importer. In 2002, the total global sales of TCM were US$23.2 billion. In the UK alone, there are more than 3,000 clinics now offering TCM.

In many ways, TCM species are the forgotten flagship species of the Upper Yangtze ecoregion. Five TCM species are prominent: 1) the beautiful *Fritillaria* (beimu); 2) the slow growing snow lotus (*Saussurea*), which is found on the highest peaks; 3) the caterpillar fungus (*Cordyceps sinensis*), which at prices of up to US$12,000 per kg is the most expensive fungus in the world; 4) *Paris polyphylla* (chong lou), which has been an ingredient of a commercial TCM Chinese army first-aid kits used to stop bleeding; and 5) qianghou (*Notopterygium*) from a small genus only found in China and nowhere else in the world.

In common with many species worldwide, the conservation status of these and other TCMs is being affected by multiple factors simultaneously, at different spatial and time scales. The most serious of these are habitat loss and fragmentation, global climate change, species-specific over-exploitation and invasive species.

Illegal exploitation

Declining TCMs in the mountains accessible from villages means that more and more people now enter nature reserves to illegally exploit high value medicinal species. Species-specific, illegal over-harvesting in what appears to be intact habitat is affecting *Fritillaria, Paris* and *Notoptergium* populations and causing conflict with conservation areas in the Upper Yangtze ecoregion.

Over 100 tons of delicate, tiny white *Fritillaria* bulbs are used annually by over 400 commercial companies for 200 TCM preparations, with an unsatisfied market demand estimated at 2000 tons/year[266]. China has 22 of the world's 24 *Paris* species; and two species, *P. undulata* (endemic to China) and *P. birmanica* (endemic to Burma) may be extinct. Whether this is due to habitat loss or overharvest is unknown. What is known is that vast quantities of *P. polyphylla* have been used since the 1940s. As scarcity of the focal species, *P. polyphylla,* has increased it is likely that other *Paris* species are being exploited. This may include *P. daliensis, P. delavayi, P. mairei* and *P. thibetica*: a 'cascade effect' from the most favoured species to others in the genus. As for snow lotus and caterpillar fungus, they are not only affected by harvesting, but by climate change, as warmer temperatures literally 'squeeze' their alpine habitats higher and higher, with complex affects on their population biology.

EU-China Biodiversity Programme

Local livelihoods have to be taken into account if these conflicts are to be reduced. This is the goal of an innovative EU-China Biodiversity Programme (ECBP) project between WWF-China, TRAFFIC and IUCN. This project is being managed by WWF-China in partnership with TCM Bureau, Provincial Forest departments and local people in four pilot-study villages. The project is developing and building capacity to implement a strategic model for biodiversity conservation and sustainable development in China. The main activities are to:

- Establish effective resource assessment, management and monitoring systems in pilot areas for sustainable harvest of wild medicinal plants. Completed base-line surveys confirm local harvesters' views that populations of the main harvested species (such as *Gastrodia elata* (tianma) and *P. polyphylla* (chong lou)) are in decline. However, managed harvest of fruits outside nature reserves from common species such as *Schisandra sphenanthera* (nan wuwiezi) for a higher value international market occurring offers an alternative and sustainable source of income.

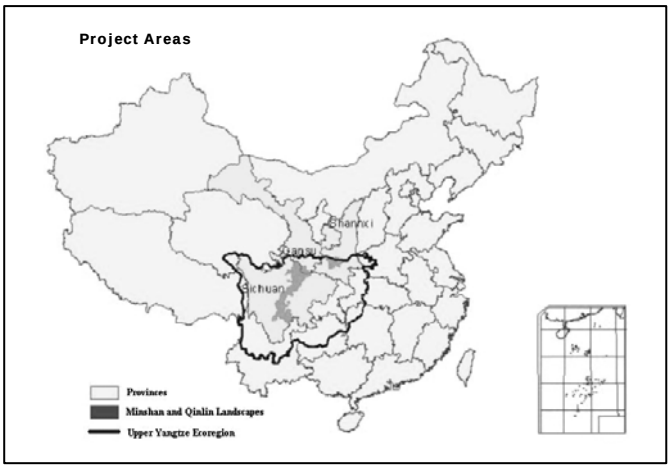
- Increase community income in pilot areas, through integrated strategies for poverty alleviation and sustainable use of wild medicinal plants. This is about to start on a pilot-scale with a US-company committed to conservation, which has a long-term relationship with a herbal products extraction company in Shanghai.

- Establish incentive-based mechanisms through private-public partnerships that are transparent and supportive of sustainable use. For example, between the large-scale private sector selling herbal medicines and the public sector (wild harvesters and village level farmers), linked to certification mechanisms for selected cultivated and wild medicinal plants. Cultivation of *Magnolia officinalis* (houpo) and *Eucommia ulmoides* (dhuzong) has significantly reduced pressure on wild stocks. Cultivation of *Notopterygium* (qianghou) species could do the same.

- Increase awareness among key stakeholders of the positive outcomes of sustainable harvest of wild medicinal plants in attaining the Millennium Development Goals (MDGs) and meeting the goals of the CBD, including the Global Strategy for Plant Conservation (GSPC).

- Review, analyse and enhance policies and regulatory frameworks relevant to the management and market linkages in medicinal plants and support processes to attain the MDGs and CBD targets.

- Establish a learning and exchange network across landscapes, as well as nationally and internationally, that promotes best practices, builds capacity and replicates results from medicinal plant pilot programmes.



EU-China Biodiversity Programme project area (*left*). Xian market (*right*) © WWF China

Livelihood options

Four recent baseline surveys of medicinal plant populations and their importance to local livelihoods in landscapes of the Upper Yangtze eco-region recorded local people's observations. In Meigu, 58 per cent of the 90 households were involved in medicinal plant collection, with 36 per cent of households collecting chong lou (*P. polyphylla).* In villages surveyed in both Pingwu county and in Wenxian, medicinal plant collecting was also important, providing 30 per cent of cash income to households. The remainder of cash income comes mainly from livestock sales, to a lesser extent, crop sales and in Pingwu county, from mining. In each case, declines in numbers of the most valuable species contributing the most to local livelihoods, including chong lou (*P. polyphylla*), beimu (*Fritiliiaria*) and tianma (*G. elata*) were recognised by local people. The challenge is to find solutions. These have to include alternative species and alternative livelihoods.

At this stage, after conducting detailed baseline ecological surveys in all four sites, the project has identified alternative species whose harvest can be sustainably managed. One of the project goals is to develop commercial partnerships with partners who will buy certified 'Panda friendly' products that bring higher incomes to local villages through managed harvest rather than 'resource mining'. One of those species is nan wuweizi (*Schisandra sphenanthera*), for which participatory management plans are being developed for fruit harvest.

Through these partnerships, we aim not only save the plants that save lives, but contribute to saving pandas too!

3.5. The relationship between wild honey and the Tualang Tree in Malaysia

by Siti Zuraidah Abidin, WWF-Malaysia

In Malaysia, the Tualang honey is one of the prized possessions of the rainforest; in particular for its medicinal properties. The honey is named after the Tualang tree (*Koompassia excelsa*) in which the bees (*Apis dorsata*) make nests. There is a wealth of tradition associated with the honey collection and nowhere is it more studied and written about as than in the Ulu Muda area in the Malaysia state of Kedah. Research conducted by entomologist Stephen Buchmann showed that the Tualang honey collected in Ulu Muda is among the best in the world as the bees gathered nectar from 180 species of flowers[267].

Found in north and central Peninsular Malaysia, Borneo and Sumatra, this tree belongs to the Leguminosae family. The Tualang tree has tall buttresses and its bole can reach up to 290cm in diameter[268]. The Tualang tree is the tallest recorded rainforest tree in the world (83.8m) and is the third tallest of all trees after the giant redwood (*Sequoia sempervirens*) of California at 101.5m and the blue gum (*Eucalyptus regnans*) of Victoria, Australia at 97.8m[269].

Being a great forest emergent with tall straight boles and wide-spreading crown, the Tualang tree makes a good honey tree[270]. It has hard and heavy wood that can support the weight of the large bee comb in which a single comb may weight 40kg or more. Being an emergent (i.e. the tallest trees in the forest canopy), the Tualang tree provides a clear area below the comb and in some situations, an even larger space around the comb. This is important to the bees because any close vegetation could provide access to its open nest and food store for any climbing mammals or insects (especially ants)[271]. Other trees that are also a nesting place for bees include the binuang (*Octomeles sumatrana*), *Ficus albipila* and mangrove trees such as *Avicennia* spp. and *Ceriops* spp.[272, 273, 274].

Ulu Muda Forest

The Ulu Muda Forest Complex (Ulu Muda) consists of eight forest reserves (FR); namely the Ulu Muda FR, Pedu FR, Padang Terap FR, proposed Bukit Keramat FR, Chabar Besar FR, proposed Bukit Saiong FR, Chabar Kecil FR and proposed Ulu Muda FR. Despite its size and significance, Ulu Muda remains a hidden realm. It is unknown to most Malaysians and the outside world in general. Listed as one of the ten special places for ecotourism by the National Ecotourism Plan and identified as an Environmentally-Sensitive Area Rank I by the National Physical Plan, Ulu Muda is of outstanding value for its wildlife conservation and nature tourism. Unlike other rainforests in Malaysia such as Endau-Rompin and Taman Negara, Ulu Muda area contains forests with Thai-Burmese characteristics due to its proximity to southern Thailand[275]. Covering an area approximately 160,000ha, Ulu Muda is located within the district of Baling, Padang Terap and Sik in the north-eastern corner of Kedah (a northern state in Peninsular Malaysia).

Ulu Muda boasts a high concentration of saltlicks and hot springs that are important to the health and well-being of wild animals. Studies conducted during a scientific expedition to Ulu Muda provide an indication of the abundance and diversity of the wildlife species as follows (as percentage of the total in Malaysia): 55 per cent of mammals (including six out of 10 primates, 78 per cent of squirrel species and 53 per cent of bat species), 175 of bird species (including seven out of 10 hornbill species) and 42 out of 54 reptile species[276]. Aside from that Ulu Muda area also functions as a water-catchment forest.

Ulu Muda supports life beyond the flora and fauna that inhabits its forest. It sustains the water needs for agricultural, domestic and industrial uses for the northern region of Peninsular Malaysia. Irrigation schemes supported by the catchment forest supply water to the 'rice-bowl' of Malaysia (Kedah is the

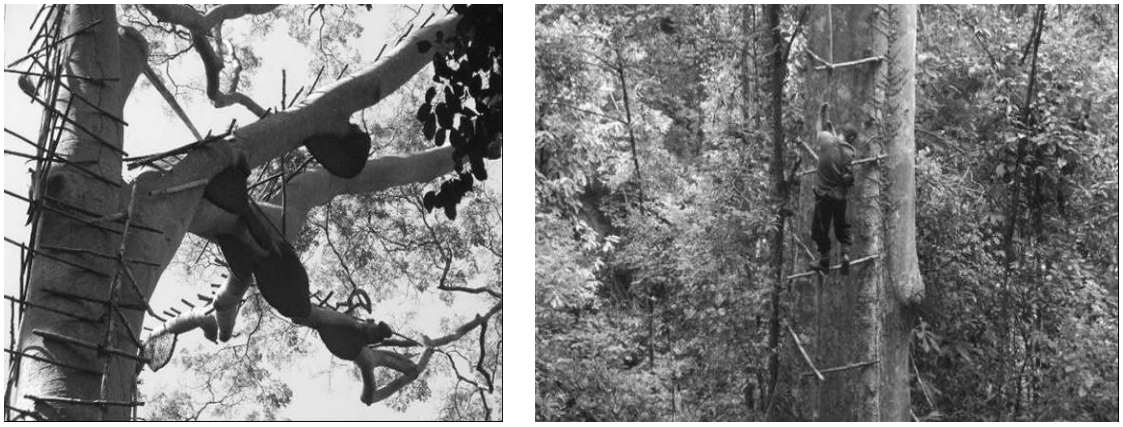
largest rice-growing state in Malaysia) and to the electronics and heavy industries sector centred at Penang and Kulim (southern Kedah)[277].

Honey Gathering Tradition

Beyond these apparent contributions, there is another facet of Ulu Muda's intricate ties with the locals – the honey gathering tradition. This tradition is one of the cultural highlights in the Ulu Muda area that is unique to the Malay villages, and is quite different from commercialised honey gathering activities and from honey farming. Aside from making livelihood from the wild honey which is bottled and sold, traditional honey gathering is associated with rural culture. Practices and knowledge are passed from one generation to the next and is followed with eager anticipation. The honey collecting season (each season lasts about two or three months) creates an opportunity for the gatherers to be away from the city (where they usually work/stay during the rest of the year) and to spend time in the forest. A leader of one of the honey gathering clans remarked that when the bees arrive, he completely forgets about home[278].

In the Ulu Muda area, there are approximately 70 bands of honey gatherers operating and they must obtain special permission from the Sultan of Kedah as the honey belongs to the ruler[279]. A Tualang tree can harbour more than 80 combs, each housing between 30,000 and 70,000 bees. Each band of honey gatherers has specific Tualang trees that they can collect honey from. Honey gatherers start by constructing a makeshift ladder from the ground level up to the combs. Traditional honey collection occurs during moonless nights as any source of light would help the bees to know where to sting[280]. The honey gatherers also use traditional torches to produce glowing embers that distract the bees from attacking them. Collectively, the honey gatherers harvested as much as 150,000 pounds of honey each season[281]. Tualang honey gathering allows each man in the band to make as much as US$150 more per month than he would make as a rubber taper or farm labourer[282].

The Tualang honey that is collected is also marketed by the Federal Agriculture Marketing Authority (FAMA) that was established under the Ministry of Agriculture and Agro-based Industry. FAMA's involvement has not only broadened the marketing scope of the honey but it has also put in place a framework for generating income for the locals through agro-tourism activities (such as following the honey gatherers when they are collecting the honey) and in maintaining the credibility as well as the quality of the honey sold. In 2007, FAMA and Hospital Universiti Sains Malaysia signed a memorandum of understanding to further enhance efforts in researching the medicinal properties of honey[283].



Bee nest in Tualang tree at Ulu Muda (left) © Rohani Rahmani. Honey gatherer climbing the Tualang tree at Ulu Muda (right) © Surin Suksuwan

The medical values of honey

Honey is acknowledged in numerous religions, cultures and civilisations as a natural and healthy food containing many medicinal properties. Honey is mentioned in religious books such as the Torah, the Bible and the Qur'an and it properties have been well known throughout history by, for example, the Malay, Chinese and Indian cultures. The Qur'an, for instance, refers to honey as a healer of disease while in the Bible, honey is referred to as a wholesome food among other things[284, 285]. Easily digestible and palatable, honey also contains minerals (such as magnesium, potassium, calcium, sodium chlorine, sulphur, iron and phosphate), vitamins (such as B1, B2, C, B6, B5 and B3) and is a rich source of carbohydrates[286].

However, it is the medicinal properties of honey that is the subject of numerous research and written articles. From folk-medicine to modern professional medicine, honey is regarded as being a natural cure. An international conference on the medicinal uses of honey in 2006 saw numerous papers presented including about the use of honey to treat infectious diseases (infections from both gram-positive and gram-negative bacteria) and autoimmune disorders (such as multiple sclerosis, systemic lupus erythematous, rheumatoid arthritis, etc.)[287].

The applications of honey in treating traumatic and surgical wounds for present and future treatment are also increasing with the advent of antibiotic resistance in bacteria. As such, honey bioactivities that are gaining wide acceptance in modern medicine include[288]:

- ✓ Antibacterial action
- ✓ Rapid debriding action
- ✓ Stimulatory effect on growth of tissues for wound repair
- ✓ Anti-oxidant and anti-inflammatory action (minimises scarring)

The threat to Ulu Muda

Presently, logging is the main threat facing the Tualang tree and Ulu Muda. Deep axe incision of about 15cm has been found in one of the century old Tualang tree at Ulu Muda[289]. As a result, the tree became withered, the branches brittle and the number of combs in the tree declined as compared to previous years. Not only that, logging in Ulu Muda is depleting the floral resources in the rainforest and has resulted in the decreasing yield of the Tualang honey[290]. However, the bigger threat is the unprotected status of Ulu Muda (much of which is within production forest reserves). To date, there have been two proposals by the state government to log Ulu Muda to generate revenue[291]. The Federal Cabinet banned the first logging proposal (in 2003) stating that Ulu Muda is an important water catchment area and should remain undisturbed following protests by local NGOs that formed the Friends of Ulu Muda coalition, including WWF-Malaysia[292]. In 2008, the state government again proposed to log Ulu Muda, prompting local NGOs to protest again against the logging proposal[293, 294].

There are now strong calls for the protection of the Ulu Muda forest by establishing a state or national park covering the entire forest complex and preparing a management plan for the area. This would be of utmost importance in safeguarding the honey gathering tradition, the Tualang tree and the rich biodiversity of Ulu Muda.

3.6. Population-health-environment approaches in Kiunga Marine National Reserve, Kenya

by Judy Oglethorpe, Ali Mwachui, Sam Weru and Cara Honzak, WWF

PHE: what is its rationale?

Population-health-environment (PHE) projects integrate health and/or family planning with conservation activities, seeking synergies to produce greater conservation and human wellbeing results than if they were implemented in isolated single-sector approaches. Conservation projects working in remote areas of outstanding biodiversity in developing countries often partner with local communities, key guardians of this biodiversity. Yet these people may suffer from ill health because they have poor access to modern health services, poor nutrition and little or no access to improved water supplies and sanitation. In addition, growing populations often put increasing pressure on land and resources. By adopting a PHE approach, conservation projects can: improve the health and well-being of communities, particularly women and children; build trust in communities and buy-in to conservation activities; decrease the unmet need for family planning and slow population growth of remote, underserved communities; reduce pressure on natural resources; empower women; and reduce operational costs[295].

Kiunga Marine National Reserve – the issues

The Kiunga Marine National Reserve lies in the northern part of the Lamu Archipelago on the north Kenya coast, on the international border with Somalia. It hosts a number of endangered marine species, including dugong and five species of sea turtle. The archipelago in turn is part of Coastal East Africa, a global priority for marine conservation. It stretches for 4,600 km along the east coast of Kenya, Tanzania and Mozambique, with the longest fringing coral reef in the world, extensive mangrove forests and sea grass beds, spectacular sand dunes and a large number of ecologically critical lagoons and estuaries. Biodiversity, endemism and species abundance in the ecoregion is high, including 1,500 species of fish. The Lamu Seascape's relatively undisturbed reefs, mangroves and sea grass beds support the richest marine fishery in Kenya and important turtle nesting sites. However, increasing population pressure and demand for fish are threatening the integrity of the archipelago's vital marine ecosystems.

When the Kiunga Marine National Reserve was created in 1979, there was little local consultation and for several years local communities resented the reserve. WWF, starting to work in Kiunga over a decade ago with the communities as well as the Kenya Wildlife Service and Fisheries Department, found it very difficult to make headway with community conservation.

The area provides few opportunities for permanent employment, resulting in high direct dependence on natural resources. The local coastal communities are predominantly Bajuni of Arab and Bantu ancestry who number about 15,000 people and whose traditional livelihoods include fishing, mangrove harvesting, subsistence farming and animal husbandry. Inland, around 4,200 Boni people rely on small-scale agriculture and honey-harvesting; former hunter-gatherers, they still collect edible and medicinal plants from the Dodori and Boni Reserves.

Mkokoni village, Kiunga Marine National Reserve, Kenya


People rely on dhows (boats) for their livelihood and transport in Kiunga (left: © Meg Gawler / WWF-Canon) and on the mangrove forests (*Rizophora maculata*) for resources (right: © Martin Nicoll / WWF-Canon).

The main health issues in remote Lamu District before the PHE project started were maternal and child health problems, malaria and HIV/AIDS, exacerbated by illiteracy, taboos and lack of information. Nationally, Kenya's population is growing at 2.8 per cent per year; it has a total fertility rate of 4.9 births per woman[296], and an unmet need for family planning of 24 per cent[297]. This case study describes how WWF's Kiunga programme has undertaken PHE work to improve the health of people and the environment. The project received funding from Johnson & Johnson for health and environment activities, and from USAID for family planning/reproductive health activities linked with environmental education.

How has PHE improved human health in Kiunga?

In Kiunga, WWF started population-health-environment work in 2003, collaborating with the Ministry of Health (MoH), African Medical and Research Foundation, and later Family Health International. In its work on marine conservation, WWF collaborates with Kenya Wildlife Service and the Department of Fisheries. PHE work has included building MoH and community capacity; improving access to health services; improving water supplies and sanitation; and conducting outreach with integrated messaging about health, family planning and natural resources. Recently the project has supported implementation of Kenya's second National Health Sector Strategic Plan, which at the local level aims to improve health services by establishing community units of twenty households, with a volunteer community health worker (CHW) serving each unit. The CHWs are supported by government-employed Community Health Extension Workers (CHEWs). CHWs provide services such as awareness raising, training and supporting home care givers, reporting on health status and promoting dialogue.

Improved water supplies, hygiene and sanitation. In Kiunga there is a shortage of good drinking water. Ground water is often saline; in addition, at the start of the project existing wells and rain water catchment tanks were poorly managed, often lacking covers and resulting in diarrheal infections, especially after heavy rain. The project helped to improve water supplies by building covers for wells, installing pumps and improving or building new rain water catchment tanks. CHWs were trained to chlorinate water sources. Public health officers ensure that general hygiene standards are maintained to avoid the spread of water-borne infections, and check that latrines are located so as to avoid contamination of wells. Women are trained to treat water for children under five since they are most vulnerable. To date, there has been a recorded 13 per cent decline of waterborne illness in villages which treat their water sources.

Beaches are another area of activity. WWF provides separate capacity building support to the fishermen's beach management units (BMUs) that are actively involved in resource use management and conflict resolution between fishermen from different fishing villages. Health care officials have worked with BMUs to maintain clean and healthy fish landing sites by securing clean watering points for migrant fishermen and controlling waste disposal. BMUs maintain latrines in landing sites. Kiunga beaches have another problem: at certain times of the year Indian Ocean currents deposit large amounts of garbage from Asia. It builds up, inconveniencing local communities, creating an eyesore for tourism, and causing a hazard for turtle nestlings (which have to navigate garbage to reach the sea). The Kiunga project organizes beach clean ups involving BMUs, schools and other youth groups. A women's project turns trash to cash: women make handicrafts from washed up flip-flops, helping to generate income for household and school expenses.

Health services and information. The project works to improve access to health services and information, focusing on maternal and child health, malaria and infectious diseases. It established monthly mobile clinics by boat and vehicle to remote villages on the mainland and islands; health partners staff the clinics, WWF provides transport and logistics, and clinics are preceded by outreach sessions on specific topics such as hygiene, family planning and HIV/AIDS. The mobile clinic runs under-fives clinics, provides general consultation, provides voluntary counselling and testing for HIV and refers cases for treatment to medical facilities. In addition, the project constructed a dispensary in Mkokoni village; it provides services to the village and nearby communities. Immunization coverage has greatly improved due to increased awareness amongst village residents about the importance of children's vaccination, and improved access through the mobile clinics; in the whole of Lamu district (of which the project area is a part) immunizations rates rose from 60 to 80 per cent.

The project has been able to tap into a large national malaria programme distributing free insecticide-impregnated bed nets to mothers of children under five years of age. It has directly distributed several thousand bed nets and facilitated delivery of many more though dispensaries and health posts. It also facilitates treatment of malaria through the dispensaries and mobile clinics. The District Health Office reported an 8 per cent decline in cases of malaria districtwide in 2007 after the introduction of the programme (note that the project does not cover the whole district).

Family planning and reproductive health. Before the project started, a health needs assessment found that in remote villages, women's top priority was better access to family planning. Many Muslim women do not travel far from the home, making it very difficult for them to access contraceptives to space their children and have the size of family they want. The project established a system of community based distributors (CBDs), volunteers who distribute pills and condoms and provide family planning advice within their communities. Traditional birth attendants have been integrated into community health units as referral agents for reproductive health care with support from community health workers. The mobile clinics and dispensaries also provide outreach sessions and advice on family planning and reproductive health, and distribute a wider range of family planning methods. Permanent methods are available by referral to Lamu. The project taps into the national supply chain for contraceptive commodities, but when occasional stock-outs occur, it purchases stock privately to ensure commodities are always available.

Family planning and reproductive health discussion sessions are conducted for men, women and youth to reduce barriers and beliefs that discourage people from seeking relevant health care services. Campaigns focus on HIV/AIDS and other sexually transmitted infections as well as family planning. Integrated messages that discuss trends in fish stocks, livelihoods and desired family size make it easier to broach the subject of family planning among men who have very traditional attitudes in this Muslim society. The contraceptive prevalence rate increased by 10 per cent between 2003 and 2008 in the Kiunga area.


Pictures left to right: Consultation at Mkokoni clinic © Cara Honzak/WWF-US; New well, Kiunga © WWF Kiunga Project; Baby weighing during a mobile clinic © Cara Honzak/WWF-US

In order to reduce maternal mortality the project has encouraged women to deliver their babies at health care facilities rather than at home. Health facilities were equipped with delivery kits and the referral system by traditional birth attendants was strengthened. Deliveries at facilities have increased in Lamu East from 29 to 35 per cent.

Nutrition and food security. The PHE project monitors weights of babies and young children, and provides advice on nutrition. In Kiunga WWF has also worked to improve fishery management and hence livelihoods by promoting fishing gear exchange, whereby fishermen exchange their illegal, small-mesh fishing nets for legal larger-mesh nets, avoiding bycatch of young fish. Although there was resistance to this initially (see below), fishermen now like the new nets because without the bycatch, less work is needed to pull them in. Through the BMUs, fishermen have also recently started setting aside no-take sanctuaries within the reserve where fish can breed and grow, and prevented fishing within them. This work will make the fishery more sustainable.

How has PHE improved conservation success in Kiunga?

Community attitudes to conservation. Community buy-in to conservation has been greatly catalyzed by provision of health care, along with separately funded high school scholarships to needy families, and women's income generating activities through flip-flop crafts. Before these projects, communities were very suspicious of conservation activities, fearing their access to the fishery would be restricted. It was only when they saw that conservationists cared about their wellbeing as well as biodiversity that they started exchanging fishing gear and setting up no-take zones. BMUs have now taken charge of their fishery and have begun to establish fishermen saving and credit cooperative schemes, and communities are participating in ecological monitoring of the reserve.

Changing attitudes extend to turtle conservation. Previously, the community harvested turtles for meat and eggs. As part of the education programme, students with scholarships attend environmental camps where they learn about conservation and help to tag hatchling turtles; they take environmental messages home to their families. Since 2006, 65 per cent of all monitored turtle nests have been reported by community members, compared to less than 30 per cent previously.

Community capacity for sound natural resource management. It is likely that by improving the health of the people of the Kiunga area, the PHE work has reduced demands that people make on the environment because of ill health: for example, going fishing an extra time to pay for treatment of a sick child. And since people can only participate in natural resource management and governance if they are healthy and they are not spending all their time caring for sick family members, it is likely that

PHE has improved and/or maintained local people's capacity for work with the BMUs and other groups. The project's work on HIV/AIDS awareness, prevention and testing is particularly relevant here. It is well recognised that fishing communities in Africa are particularly vulnerable to HIV because of movements of fishermen[298]. Kiunga is relatively remote, but migrant fishermen come into the area from further south where HIV prevalence rates are higher, and its own fishermen sometimes travel south to Lamu to sell their catch. Many Kiunga men are polygamous, marrying wives on fishing trips as well as in Kiunga, and risk spreading the disease. In 2007 the national HIV prevalence rate in Kenya in adults aged 15-49 was estimated at between 7.1 and 8.5 per cent[299].

Slowing natural population growth. Meeting the unmet need for family planning should slow the population growth rate in Kiunga, so helping to reduce the growth of pressure on the fishery, mangroves and agricultural land. This will have long-term effects for conservation and sustainable development in the area.

Cost efficiencies. Finally, there have been cost efficiencies through partnership with health organizations, which have been able to use WWF's facilities and transport to support the health work in Kiunga. And conservation staff based in Kiunga have had access to improved health facilities, without having to travel to Lamu.

Further expansion: Building on the successes of the first five years, WWF and health partners are now expanding the PHE work by replicating successful approaches farther south to reach more people and benefit a larger part of the Lamu seascape.

3.7. Bioprospecting in Yellowstone National Park, USA

by Sue Stolton with the assistance of Kathy Sheehan, Molecular, Cellular and Developmental Biology Dept., University of Colorado-Boulder, Tom Oliff, Chief of Yellowstone's Center for Resources, Lindsay Mclelland, National Park Service Geologist and Jonathan Putnam, Office of International Affairs, National Park Service

In the United States most of the potential bioprospecting in national parks is related to the study of microorganisms[300], a research partnership which is almost as old as national parks themselves. Yellowstone was America's first national park; it was established in 1872 and the first research permit for the collection of microbial specimens from its hot springs was issued in 1898[301].

Yellowstone National Park is owned by the American public and managed by one of the US Federal Land Management agencies, the National Park Service (NPS), which in turn falls under the jurisdiction of the US Department of the Interior. Yellowstone is unique because it has half of the earth's geothermal features in the only essentially undisturbed geyser basins left worldwide. With some 300 geysers, two thirds of all those found on earth, and more than 10,000 thermal features such as hot springs, bubbling mudpots, and steaming fumaroles,[302] it is not surprising that the park is a hotspot for microbial research – and in particular research into extremophilic organisms, i.e. those that thrive in conditions that are physically impossible for a majority of life on Earth.

Thermus aquaticus

In 1966, Thomas Brock conducted ground-breaking field studies of microorganisms in hot springs in Yellowstone. He cultured *Thermus aquaticus* from near boiling water in Mushroom Pool in the Lower Geyser Basin. A living sample was deposited in the American Type Culture Collection (ATCC) for safekeeping[303]. *T. aquaticus* is an extremophilic bacterium known as a thermophile, a 'heat-loving' organism that is adapted to life at high temperatures, similar to some of the most ancient microorganisms on the planet that thrive under conditions that were typical of Earth's early environments[5].

In 1985, a biotechnology company, Cetus Corporation, was looking for a way to duplicate genetic material to aid DNA research. Since the amount of DNA present in a cell sample is too small to study easily, Kary Mullis, a biochemist at Cetus, devised a method of amplification that utilized heating and cooling cycles to break open a strand of DNA during a chemical reaction. He then added a DNA polymerase enzyme to the reaction to 'read' the strand of DNA and replicate a new strand. The high temperature required to break open the DNA inactivated the polymerase after the heating cycle and required adding more polymerase after each cycle, making the process laborious. Furthermore, at the time, DNA polymerase was difficult and expensive to isolate. Mullis found a solution to this problem by adding a heat stable enzyme named *Taq polymerase*, which was purified from a culture of *T. aquaticus,* obtained for US$35 from the ATCC. The enzyme allowed the process to work effectively at high temperatures[304]. As a result DNA could be amplified billions of times in a few hours[305].The process was called the Polymerase Chain Reaction or PCR.

By allowing scientists to study DNA more effectively, the PCR technique using *Taq polymerase* led to many new research applications in the biological sciences. Since the early 1990s the PCR technique has been used in many research areas, including basic molecular biology research, clinical testing, forensics, cancer research and in helping to detect the HIV virus in AIDS[306]. The development of PCR was also financially successful, resulting in a multi-million dollar business (Hoffmann-La Roche eventually bought the PCR and *Taq polymerase* patents from Cetus for US$330 million[307]).

The geothermal features at Yellowstone National Park, USA © Roger Crofts

The isolation of *Taq polymerase* from the Yellowstone culture of *Thermus aquaticus* for use in PCR did not however result in any direct benefits for the National Park Service, the US Federal Government or the US public[308]. Not surprisingly this situation brought the issue of benefits-sharing agreements for future bioprospecting in Yellowstone to the forefront. Policies and legislation were developed and finally the National Parks Omnibus Management Act of 1998 (NPOMA) was passed, which authorises '*negotiations with the research community and private industry for equitable, efficient benefits-sharing arrangements*' in connection with research conducted in national parks. NPOMA provides guidance to national parks on developing benefits-sharing agreements with the research community and mandates increased scientific research in protected areas. The legislation specifically authorises the US National Park Service to negotiate agreements for profit-sharing when park-based research results in a product with commercial value[309].

Access to biological resources in US parks for research purposes is governed by National Park Service (NPS) regulations. Permits are issued only when "*public health and safety, environmental or scenic values, natural or cultural resources, scientific research, implementation of management responsibilities, proper allocation and use of facilities, or visitor use activities will not be adversely impacted*"[310].

Benefit-sharing arrangements

In 1996, Yellowstone, in keeping with its pioneering role in bioprospecting, was asked to develop a framework for negotiating benefit-sharing arrangements with researchers wanting to access biological resources from the park that would: a) strengthen resource conservation activities and b) be a pilot for other national parks developing bioprospecting agreements[311]. After a period of consultation and research (including a thorough review of the experience of the National Biodiversity Institute from Costa Rica (INBio) where there is many years' experience of access and benefit-sharing arrangements with companies, including agreements with Merck & Co. in 1991 and 1994, as well as an agreement with Diversa), Yellowstone became the first US national park to enter a Cooperative Research and Development Agreement (CRADA) with a private company in 1997[312]. The agreement was with Diversa Corporation (now part of Verenium Corporation), which specialises in collecting DNA from hydrothermal habitats and screening genes for their ability to produce useful compounds[313].

The CRADA, which initially ran for five years, stipulated that Diversa pay Yellowstone a sum totalling US$100,000. The fees were paid into a special government account used to fund the Yellowstone Thermophiles Conservation Project. The company also provided equipment such as DNA extraction kits and DNA 'primers' and trained Yellowstone staff in molecular biology techniques. The annual benefit of this technology transfer was valued at US$75,000 per year[314]. As part of the agreement, in

1999 Diversa staff used their expertise to carry out DNA profiling of Yellowstone's endangered wolves (*Canis lupus lupus*). This profiling was the first ever established for a wild wolf population and the results are aiding park personnel in understanding the dynamics of the wolf population, by for instance, allowing biologists to assess accurately the genetic health of Yellowstone's wolves and helping identification of wolves killed illegally. The DNA profiling was carried out free of charge by Diversa, and was a study that would otherwise have been beyond the reach of the park service[315]. Diversa also helped with the detection of *Brucellosis* in Yellowstone bison (*Bison bison*) using PCR technology[316].

All specimens collected under Scientific Research and Collecting Permits from US National Parks remain Federal property and thus the CRADA does not transfer ownership of the specimens sampled in Yellowstone. However, the CRADA allows Diversa to develop valuable products from research specimens lawfully collected from Yellowstone National Park. Diversa therefore could, as long as the relevant US intellectual property legislation is adhered to, patent any innovations based on the specimens sampled and sell any resulting products, but would be required under the terms of the CRADA to provide royalties to the park based on sales of successful products[317].

In order to be granted a research permit within Yellowstone, an applicant must demonstrate that the research activities will have no serious impact on the ecosystem. This stipulation is particularly important because areas where microbes are found can be particularly fragile – and even a single human footprint could damage the area. Park scientists closely monitor research activities and advise visiting scientists on appropriate collection techniques[318].

The agreement between Yellowstone and Diversa did not go unopposed. Some NGOs (specifically the Edmonds Institute and the International Center for Technology Assessment) opposed the partnership believing that the CRADA involved "*selling off public resources*" [319]. This led to a lawsuit being filed in 1998 challenging the CRADA, claiming that it violated the Federal Technology Transfer Act, the NPS Organic Act, the Yellowstone National Park Organic Act, and the National Environmental Policy Act, among other things. The case was however dismissed in 2000 when it was ruled that the benefits-sharing agreement was consistent with US legislation[320]. The CRADA has remained suspended pending completion of environmental analysis required by the court.

Conclusion

Equitable deals between protected area managers, biotechnology companies and local stakeholders as relevant present a clear opportunity for sourcing conservation funds. However, the often long timescale between the collection of raw material from a protected area and the development of a commercial product (as this case study clearly shows this time period can be as much as 20 or 30 years), means that bioprospecting in national parks may not be a particularly profitable exercise. Indeed, it is perhaps instructive that a restructuring at Diversa in 2006 was stated as being necessary to improve the companies product sales and to "*conserve its dwindling cash pile*" by reducing research including bioprospecting partnerships[321].

Chapter 4
What role can protected areas play in reducing the risks to human health?

Well-managed protected areas can provide a wide range of health and well-being benefits as shown by the survey of the links between protected areas and health in chapter 2 and the more detailed reviews summarised in the case studies in chapter 3. But how relevant are these to the health threats facing us today? This chapter is based around an analysis of the major risks to human health at a global scale and looks at the practical ways in which protected areas might contribute to reducing these risks, by providing guidance for both health practitioners and protected area professionals.

In developing this chapter, we reviewed a range of research carried out by the World Health Organisation (WHO), the United Nations body which works primarily on global health issues. Rather than looking at the direct causes of mortality, we focused our analysis on **risks to our health**; these were selected as the best analytical tool because in many cases the immediate causes of death are not recorded in detail and, in addition, any particular incidence of illness or death may arise as a result of several different risk factors. Risk factors form the basis of many national and international health policy agendas, making them a convenient focus for any policy setting initiative such as the *Arguments for Protection* series.

We also need to be aware of important regional differences. Poverty, resulting in malnutrition, lack of clean water, lack of protection from disease vectors and lack of access to modern health services, tends to be the factor linking the diseases affecting inhabitants of the poorer countries. Inhabitants of industrialised countries, suffer from chronic diseases, i.e. diseases of long duration and generally slow progression such as heart disease, stroke, cancer, chronic respiratory diseases and diabetes, which have increasingly replaced acute infectious disease as the major cause of disability and death. In both cases the problems are often long-term and are potentially very expensive in terms of health care requirements and cost to the community[322]. On the other hand they are also often preventable, provided that policies can be shifted to focus on promotion of good health.

This chapter and the assessment of risk would not have been possible without the publication in 2002 of the World Health Report '*Reducing Risks, Promoting Healthy Life*'[10]. The publication details one of the largest research projects ever undertaken by the WHO to understand the most important risks to human health. By quantifying the health impacts of various risk factors, the report describes the amount of disease, disability and death in the world today that can be attributed to a selected number of the most important risks to human health. The research concentrates on a selection of risk factors which represent real risks to health, often the actual causes of major diseases, and concludes that had these risks not existed, then healthy life expectancy in 2000 might have been, on average, almost a decade greater globally[323].

Risk factors discussed

The WHO report calculates risk by studying a range of major health risk factors categorised under seven headings (see table 2): (1) childhood and maternal under-nutrition; (2) other diet-related risk factors and physical inactivity; (3) sexual and reproductive health; (4) addictive substances; (5) environmental risks; (6) occupational risks; and (7) other selected risks to health (including unsafe

[10] Risk is defined in this context as *'a probability of an adverse outcome, or a factor that raises this probability'*

health care practices, and abuse and violence). The risk factors assessed were chosen with the following considerations in mind:

- ✓ Potential global impact: likely to be among leading causes of disease burden as a result of high prevalence and/or large increases in risk for major types of death and disability.
- ✓ High likelihood of causality.
- ✓ Potential modifiability.
- ✓ Neither too specific nor too broad (for example, environmental hazards as a whole).
- ✓ Availability of reasonably complete data on risk factor distributions and risk factor–disease relationships[324].

In relation to the choice of risks the report also notes "*There is unavoidably an arbitrary component to any choice of risk factors for assessment, as time and resource constraints will always operate and trade-offs will be required. For example, some factors like global warming where data are substantially incomplete may nonetheless be of such potential importance that they should be included and their impact estimated based on possible scenarios and theoretical models. These trade-offs should be made clear when the data sources, methods and results are reported in detail, including estimation of uncertainty*" [325]. The data used here should thus be seen as indicative of some of the major health problems we face and inevitably some issues may not be covered; but the data remain the best source of information regarding risks to health and thus for developing well-being strategies.

Table 2: **Worldwide attributable mortality by risk factor in 2000**[11]

Risk Factor	Deaths
1. **Diet-related risks and physical inactivity** (blood pressure; cholesterol; overweight; low fruit and vegetable intake; and physical inactivity)	18,795,000
2. **Addictive substances** (tobacco; alcohol and illicit drugs)	6,915,000
3. **Childhood and maternal under-nutrition** (underweight; iron deficiency; vitamin A deficiency and zinc deficiency)	6,156,000
4. **Environmental risks** (unsafe water, sanitation and hygiene; urban air pollution; indoor smoke from solid fuels; lead exposure and climate change)	4,536,000
5. **Sexual and reproductive health risks** (unsafe sex and lack of contraception)	3,035,000
6. **Occupational risks** (risk factors for injury; carcinogens and airborne particulates)	699,000
7. **Other selected risks to health** (unsafe health care injections and childhood sexual abuse)	580,000

Linking health risks with protected area management

If protected area managers wish to promote the benefits of the areas/systems that they manage in terms of health, then the findings of the WHO risk report are a good place to start. In chapters 2 and 3 we reviewed many of the ways in which protected areas are contributing to health and well-being. But what can we learn from this overview?

In the following section we review the WHO risk factors detailed in the table above and then look at these issues in relation to protected areas, both from the perspective of health professionals and protected areas managers, looking at how protected areas can contribute to reducing health risks and

[11] This table is based on Annex Table 11 of the *Reducing Risks, Promoting Healthy Life* report

thus promoting good health. We hope that this information will help health care professionals and policy makers to identify the full range of contributions that protected areas can make to health and will also allow protected area professionals and policy makers to gain a little inspiration about how the area that they protect for the conservation of nature can also contribute to the goals of reducing the risks to health.

We look in more detail at each of the major risk factors in turn, providing an overview of the risk and its impact on health based on the WHO research. This risk is measured both in terms of both mortality and burden of disease. The figures given below are for the number of deaths in the year 2000, and burden of disease, measured using the WHO concept of disability-adjusted life year (DALY), which combines years of life lost due to premature mortality and years of life lost due to time lived in states of less than full health; thus one DALY is equal to the loss of one healthy life year.

Diet-related risk factors and physical inactivity

Although lack of adequate nutrition remains the major problem for much of the world's population, with about one-sixth of the entire disease burden in developing countries being attributed to underweight, the risk factors that could be attributed most often to mortality (see table 2) are actually associated with the over-consumption of certain foods or food components. Indeed WHO report that whilst there are some 170 million children in poor countries who are underweight – and over three million of them die each year as a result – there are more than one billion adults worldwide who are overweight and at least 300 million who are clinically obese[326]. In assessing the risks relating to diet-related and physical inactivity factors, the WHO research concentrated on five key areas: blood pressure; cholesterol; overweight; low fruit and vegetable intake; and physical inactivity. Their findings for each of these areas are summarised below.

High blood pressure is often related to diet, especially salt intake; levels of exercise; obesity; and excessive alcohol intake. Worldwide, high blood pressure is estimated to cause 7.1 million deaths, about 13 per cent of the total. Cholesterol is a fat-like substance, made primarily by the liver from a wide variety of foods, especially from saturated fats such as those found in animal products. Cholesterol increases the risks of heart disease, stroke and other vascular diseases. In North America and Europe high cholesterol accounts for between 5 and 12 per cent of DALYs[327]. Being overweight is commonly assessed using the body mass index (BMI), a height/weight formula with a strong correlation to body fat content. WHO criteria define overweight as a BMI of at least 25 kg/m^2 and obesity as a BMI of at least 30 kg/m^2. The mean BMI level in adults in Africa and Asia is 20–23 kg/m^2 compared with levels of between 25–27 kg/m^2 in North America and Europe. Weight problems are linked to poor diet and lack of exercise and can lead to high blood pressure, cholesterol and insulin resistance, thus increasing the risk of heart disease, stroke and type 2 diabetes. WHO reports that 58 per cent of type 2 diabetes globally, 21 per cent of ischaemic heart disease (i.e. heart disease characterised by reduced blood supply to the heart muscle) and between 8 and 42 per cent of certain cancers were attributable to BMI above 21 kg/m^2 [328].

Fruit and vegetables can help prevent major diseases such as cardiovascular diseases and certain cancers principally of the digestive system. Low intake of fruit and vegetables is estimated to cause about 19 per cent of digestive tract cancer, about 31 per cent of ischaemic heart disease and 11 per cent of stroke worldwide. Physical activity can also reduce the risk of cardiovascular disease, some cancers and type 2 diabetes[12]. Overall physical inactivity was estimated to cause 1.9 million deaths and 19 million DALYs globally; more specifically lack of exercise is estimated to cause between 10 and 16 per cent of cases each of breast cancer, colon and rectal cancers and diabetes, and about 22 per cent of ischaemic heart disease globally[329].

[12] There is no internationally agreed definition or measure of physical activity

✓ Health practitioners

The links between physical activity and protected areas represent perhaps one of the clearest strategies for further developing the contribution of protected areas to a country's or state's health agendas particularly in the developed world. As the case study from the UK in the previous chapter shows there is a strong economic argument for making this link. In Scotland, for instance, the health benefits of woodlands have been estimated at between £14.1 million to £18.9 million per year (at 2006 prices) by helping to avoid premature deaths and morbidity through increased physical exercise, reduced air pollution, savings in mental health treatment costs and reduced absence from employment[330]. And as was noted above, it has been calculated that in America every US$1 invested in physical activity leads to a saving in medical cost of US$3.2[331]. Protected areas such as nature reserves and national parks can help to facilitate exercise by providing safe, well-marked paths, guided walks and additional incentives in terms of pleasant scenery and wildlife. Most will have managers, rangers or wardens who can assist in developing health-related activities: there are guides and case studies available[332].

✓ Protected areas

The role that protected areas can play in providing safe places to exercise is increasingly recognised. In this report we have seen examples from Australia, India and Europe. Such initiatives do not necessarily have to be the sole responsibility of the protected area manager but can be developed in association with other organisations working in the protected area.

The common features of these initiatives include:

- ✓ Providing a safe and secure place to exercise and enjoy being out in the fresh air.
- ✓ Developing specific walking and or exercise initiatives where people are encouraged to come together to enjoy the protected area (these initiatives are generally supported by specific publicity drives and can involve training park staff to lead the walks).
- ✓ Ensuring easy access to protected area facilities (this can range from waiving entrance fees, as in Keoladeo National Park in India and in the example from the US below, to ensuring that park infrastructure, e.g. paths, gates etc, are accessible to people with different physical abilities).

Protected area managers throughout the world are increasingly being encouraged to see the areas they manage enjoyed as 'outdoor gyms'. Although this is clearly not a strategy for all protected areas, in particular those with fragile environments or where animal populations include species which represent a danger to human life, for many managers and policy makers the need to link protected areas and health is becoming clear. In the 2002 fitness initiative in the US, for example, President George Bush signed two Executive Orders designed to promote national fitness. The second of these orders, '*Activities to Promote Personal Fitness*', encourages federal agencies, including the Department of the Interior which is responsible for national parks in the US, to take steps to promote exercise and fitness among the American people. In response all entrance fees were waived for a weekend to the national parks, forests, and other lands, and the Parks Service organised a series of special events. Praising these initiatives, the President said: "*Regular hiking through a park can add years to a person's life ... If you're interested in doing something about your health, go to one of our parks--and take a hike*"[333]. Some protected area systems now include exercise circuits and equipment on public trails, as is the case in many Swiss reserves, or provide information on exercise, for example Singapore reserves have a website listing exercise options[334].

The Mawddach Estuary, Snowdonia National Park, Wales, runs voice trails for blind and visually impaired people. The trails are led by trained volunteers from the National Park Authority or the Countryside Council for Wales, who use radio mikes to provide a commentary of the walk so participants can 'listen' to the view, hear about the local flora and wildlife and learn about local history
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Addictive substances

The WHO research on addictive substances concentrated on tobacco, alcohol and illicit drugs. Smoking causes substantially increased risk of mortality from cancer, heart disease, stroke, chronic respiratory disease and a range of other medical causes. Among industrialized countries smoking is estimated to cause over 90 per cent of lung cancer in men and about 70 per cent of lung cancer among women. Worldwide, it is estimated that tobacco causes about 8.8 per cent of deaths (4.9 million) and 4.1 per cent of DALYs (59.1 million). There are causal relationships between average volume of alcohol consumption and more than 60 types of disease and injury, with most of these relationships being detrimental. Worldwide, alcohol causes 3.2 per cent of deaths (1.8 million) and 4.0 per cent of DALYs (58.3 million). Because the use of illicit drugs is often hidden, it is difficult to estimate their prevalence and therefore the occurrence of adverse health consequences. However globally the WHO estimates that 0.4 per cent of deaths (0.2 million) and 0.8 per cent of DALYs (11.2 million) are attributed to overall illicit drug use[335].

✓ Health practitioners

It has been suggested that alcohol, food and drug addiction helps in part to fill the spiritual emptiness that has arisen from loss of contact with nature[336]. So can returning to nature help people recover from the impacts of addictive substances use? In chapter two, we included a description of a project in England where rehabilitation activities based in nature reserves were attributed to helping to ensure that people stayed in substance abuse rehabilitation programmes. The conservation therapy programme developed with the nature reserves is based on improving self-realisation through participation in conservation activities. The programme aims to build self-esteem and confidence through three interlinked factors: 1) the activity, which aims can provide gratification through 'ownership' of the activity and tangible positive results; 2) the environment, through the being in, and producing something with, the natural environment; and 3) relationships/communication, thanks to bonding and team working with peers in real life work settings[337].

✓ Protected areas

Projects which link therapeutic activities with conservation work can have major benefits for protected areas in helping carry out management activities such as boundary repairs (e.g. fencing and walling), infrastructure work (e.g. road and path building or maintenance) and habitat management (e.g. invasive species removal, woodland and freshwater management and habitat restoration). Although such work will require careful supervision by trained staff there are clearly major benefits in having committed volunteers to carry out vital tasks. As the organisers of the Phoenix Futures Conservation Therapy Programme in the UK point out: "*Large constructive tasks are always the most popular as they enable our partners to complete tasks they would otherwise be unable to attempt without our help*" [338]. The organisation of projects does require some funding, but again to quote from the UK example. "*Local authorities value the programme as it works towards their regional objectives. They are prepared to support the programme financially as they see it benefiting the local community as a conservation project, making an area more accessible for example, and at the same time reducing incidences of perceived crime in the local area*" [339].

Childhood and maternal under-nutrition

Malnutrition is a major problem in developing countries due primarily to poverty. Being underweight was estimated to cause 3.7 million deaths in 2000 (about 1 in 15 deaths globally), with 1.8 million of these deaths occurring in Africa. All ages are at risk, but the problem is most acute among children under five years and women of child bearing age. WHO estimates that approximately 27 per cent (168 million) of children under five years are underweight and are at increased risk of mortality from infectious illnesses[340].

Under-nutrition is not only caused by poor diet; it also results from lack of nutrition and healthcare knowledge; poor sanitation and hygiene (which often lead to diarrhoeal diseases and intestinal parasites); other diseases such as malaria; and poor access to health services and a healthy environment.

✓ Health practitioners

Although nutrition has not been the major focus of this report, there is a growing body of evidence that protected areas in some places and in some circumstances contribute to better nutrition. The links between protected areas and our food and nutrition were examined in some detail in two previous reports in the Arguments for Protection series: *Safety Net: Protected areas and poverty reduction*[341] and *Food Stores: Using Protected Areas to Secure Crop Genetic Diversity*[342]. The study of nutrition, and particularly childhood nutrition, in protected areas has not been particularly comprehensive; with the majority of research looking at marine protected areas in relation to availability of fish stocks for local consumption. For instance, a research project funded by The Nature Conservancy, the Australian Government Department of the Environment and Water Resources and the Poverty Reduction and Environment Management Program at Vrije Universiteit in Amsterdam, looked at marine protected areas (MPAs) in the Pacific and found that greater fish catches led to increased protein intake in Navakavu in Fiji and Apo Island in the Philippines with a perceived improvement in children's health in particular (see box overleaf)[343]. Another comparative study in the Roviana Lagoon of the Solomon Islands, also found that residents of villages with effective MPAs had higher energy and protein intake than those who had no MPA or an ineffective MPA[344]. In Quirimbas National Park in Mozambique, a recovery in fish populations following the establishment of community-run sanctuaries has resulted in the improvement of the economy of coastal communities, people have moved back to islands they previously had to abandon due to exhaustion of the fish stocks; and with recovery of fish populations, tourism is flourishing and many people are now getting employment through tourism. In addition local women report greater child survival[345].

In terrestrial protected areas the relationship is not always so positive. Research in Thailand found that closing off forests to local people, who eat about a hundred plant species, led to reduced food supply[346]. However, in cases where protected areas incorporate a sustainable harvest of food products for local communities, conservation strategies can ensure that natural resources are not depleted, while simultaneously protecting biodiversity. Such a balance is not necessarily easy to achieve and can lead to tensions, disputes and protracted negotiations. Also, interventions in terrestrial areas often take longer to bear results than in marine areas. There are nonetheless many working examples of such systems including for example the conservancies of Namibia and the many Indigenous and Community Conserved Areas that exist around the world. Such opportunities often provide a safety net for some of the most remote, poor and food insecure people when crops and livestock fail. For example, in April 2005, local communities in parts of the Spiny Forest, Madagascar, had lost their crops in a cyclone and were surviving on tubers and other foods collected daily from their local forest. The communities greatly valued the forest for food security and also as a source of medicines. Even in normal times wild foods from protected areas can ensure a more balanced diet, supplementing staples such as maize and cassava.

Preparing forest tubers to eat in the Spiny Forest area, Madagascar

In addition, conservation projects sometimes work with local communities living in and around protected areas to improve their agriculture, increasing crop production per hectare and diversifying production by bringing in new cultivation techniques such as soil water conservation and fish farming, and new crops, crop strains and livestock breeds. This can often work as a win-win situation, improving food security and reducing pressure on protected areas.

Building nutrition from marine protected areas

Over-fishing and a decline in fish stocks can be disastrous for human communities relying on fish as a major source of food. Carefully designed marine protected areas (MPAs) can boost fish stocks, in some cases very quickly, by providing a safe place for fish to spawn and grow. The restrictions on the area open to fishing are often more than compensated for by the increased fish available[347].

The case in Fiji noted above is indicative of a successful MPA approach to nutrition. Approximately 75 per cent of the people in the MPA area eat *more* fish now than before the MPA was established five years ago. Conversely, outside the MPA area, 76 per cent eat *less* fish than five years ago. *"Before, a pot of fish was not enough to cater for a family's nutritional needs but at present after the establishment of the MPA, a catch of only 3 fish is enough to feed a nuclear family,"* notes a village leader. There is a general perception that residents and children in particular are now able to get a more nutritious meal from fish and shellfish that spill over from the MPA. Local health has also improved from increased protein in diets and a perceived drop in colds.

The MPA has also brought in projects that have stimulated more vegetable farming, and fishing is starting to improve after a long decline. *"Generally the Arnavons…have contributed a lot towards restocking our surrounding reef areas. This is clear in that a lot of fish are around especially on trolling gear. Thus, it helps us to be more secure in terms of availability of enough fish for family needs,"* notes a local fisher. *"Children have more variety of food now which is good for their health,"* says a local mother.

✓ Protected areas

The issue of access to food from protected areas is complex. Illegal collection of food is the most frequent problem cited by protected area managers – poaching was identified as the number one threat in around a third of protected areas assessed in a global study[348]. The bushmeat trade is affecting many protected areas[349] and clashes between encroaching farmers or mobile pastoralists and protected area managers also remain a major issue[350]. Sometimes these conflicts arise because people are desperate for food while in other cases the poaching is part of a lucrative business, as is now the case with much bushmeat hunting. With these caveats in mind, an increasing number of protected area managers regard maintaining food supplies as a significant objective of management. Some protected areas have even been established specifically because of their value to food production, this is particularly the case in MPAs but there are terrestrial examples as well. Many others modify their management systems to allow local communities to maintain or regain benefits in terms of food production. Table 3 below summarises the main types of interactions.

Table 3: **Main ways in which protected areas support provision of food**

Link with food production	Examples
Protected areas established to maintain stocks of wild food (typically breeding areas or seed stocks) which are often harvested beyond the protected area boundaries.	Typical of many no-take zones in marine protected areas such as the Nabq Managed Resource Protected Area, Egypt[351] and various approaches to maintaining freshwater fish stocks as in the Lower Mekong[352]
Protected areas that include within management plans permission for local people or others to	Agreements for collection of non-timber forest products are in place in Mount Elgon National

Link with food production	Examples
collect food, often with restrictions on timing, collection areas etc, which may or may not be worked out cooperatively with the local community.	Park, Uganda[353] or hunting of game only by the Penan indigenous people in Mulu National Park, Sarawak[354]
Protected areas established specifically to protect agrobiodiversity such as crop wild relatives and land-races, which also encourage or are based around the maintenance of traditional agricultural practices[355].	Often micro-reserves or parts of larger reserves, such as the Potato Park in the Peruvian Andes[356], which protects unique potato diversity[357] and Erebuni State Reserve in Armenia, which protects important crop wild relatives of wheat[358].
Protected areas where food production is carried out in traditional ways, integrated with conservation inside protected areas or in their buffer zones, often in protected landscapes[359].	Varied examples: New Forest National Park, UK where woodland grazing maintains rich plant communities[360], Hohe Tauern National Park, Austria, where sheep grazing conserves alpine flora[361] and Chartang-Kushkizar community conserved wetland, Iran that combines grazing and conservation[362].
Protected areas where part of the area is set aside for very specific extractive activities – usually known as extractive reserves – and the collection of a particular species or resource[363].	Many Amazonian protected areas such as Reserva de Desenvolvimento Sustentable Mamirauá, Brazil[364].
Protected areas where food production is carried out in non-traditional ways that are compatible with biodiversity protection.	Examples include organic agriculture encouraged within and around category V protected areas in Italy[365] and forms of wild game farming in conservancies in Namibia[366] .
Sustainable production systems at the edge of protected areas to provide buffer zones and / or corridors.	In Mexico[367] and Costa Rica[368], shade-grown coffee creates corridor habitat for birds and commands a price premium. The role of sustainable production is a major component of the seven-country Meso-American Biological Corridor[369].
Protected areas can be important for providing pollination services which are vital for many crops[370]	Pollination services of protected areas in Cape Town in South Africa are worth US$400 million annually[371].

Under nutrition is a complex issue that is not only caused by poor food insecurity. It can also be caused by poor sanitation and hygiene, other diseases, and poor access to health services and a healthy environment[372]. Inappropriate feeding and care practices can also contribute, if mothers lack knowledge, or time and energy to care properly for themselves and their infants as they are faced with household demands including fetching fuelwood and water. Frequent pregnancy can also contribute to under nutrition. Protected areas may play several roles in helping avoid under nutrition or improving the situation. This includes the role they can play in reducing infectious diseases and parasites that contribute to under nutrition (e.g. the role of protected areas in providing safe and reliable water, and keeping the incidence of malaria low by maintaining forest cover, compared to deforested areas). Protected area programmes that promote fuel efficiencies and improved village water supplies (e.g. gravity feed or wells) for neighbouring communities can improve maternal health by saving women time and labour, and also children's health because women have more time for childcare. Alternative energy and fuel efficiency programmes that reduce pressure on protected areas and also reduce indoor air pollution can reduce acute respiratory infections such as pneumonia in children and bronchitis in women. If health and family planning activities are incorporated in protected area community programmes, this helps to reduce under nutrition by improving access to health knowledge and bringing in health services including family planning so that women can space births.

Stieng mother and her children in Cat Tien National Park, Vietnam

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Protected area programmes that focus on women's empowerment, for example by promoting women's participation in natural resource management, improving women's access to credit, and explaining the links between health and environment, can also help by empowering women to take action to improve maternal and child health[373].

Environmental risks

Environmental risks, as defined by the WHO for the purpose of mortality statistics, include the hazards in the household, workplace, outdoor and transportation environments, and as a result of climate change. The environmental risks which were assessed by WHO in the '*Reducing Risks, Promoting Healthy Life'* report are: unsafe water, sanitation and hygiene; urban air pollution; indoor smoke from solid fuels; lead exposure and climate change.

Infectious diarrhoea makes the largest single contribution to the burden of disease associated with unsafe water, sanitation and hygiene. Approximately 3.1 per cent of deaths (1.7 million) and 3.7 per cent of DALYs (54.2 million) worldwide are attributable to unsafe water, sanitation and hygiene. Of this burden, about one-third occur in Africa and one-third in parts of South East Asia (Bangladesh, Bhutan, Democratic People's Republic of Korea, India, Maldives, Myanmar, Nepal) [374]. The environmental burden per capita of diarrhoeal diseases is 120-times greater in some developing countries as compared to developed countries[375].

Urban air pollution is largely and increasingly the result of the combustion of fossil fuels for transport, power generation and other human activities. WHO estimate that ambient air pollution causes about 5 per cent of trachea, bronchus and lung cancer, 2 per cent of cardiorespiratory mortality and about 1 per cent of respiratory infections mortality globally. Although air pollutant emissions are dominated by outdoor sources, human exposure to air pollution is mainly from the indoor environment. Nearly half the world cooks and heats their homes with solid fuels such as dung, wood, agricultural residues or coal. WHO estimate that indoor smoke from solid fuels causes about 35.7 per cent of lower respiratory infections, 22.0 per cent of chronic obstructive pulmonary disease and 1.5 per cent of trachea, bronchus and lung cancer[376].

Potential risks to human health from climate change arise from increased exposures to thermal extremes (cardiovascular and respiratory mortality) and from increases in weather disasters (including deaths and injuries associated with floods and drought) [377]. Other risks may arise because of the changing dynamics of disease vectors (such as malaria and dengue fever), the seasonality and incidence of various food-related and waterborne infections, etc. Climate change was estimated to be responsible in 2000 for approximately 2.4 per cent of worldwide diarrhoea, six per cent of malaria in some middle income countries and seven per cent of dengue fever in some industrialized countries[378].

✓ Health practitioners

Unfortunately in many countries government departments tend to work quite separately, with little communication between them and little effort in finding synergistic policies. The various issues related to water, be it too little, too dirty, or too much, or at the wrong time, offer a perfect example of where cooperation between environmental and health management would clearly be beneficial. Protected areas can play a major role in the management of water resources; they can help protect watersheds which in turn can help regulate flow and more especially water purity and they can provide barriers, by protecting forests or watershed against extreme weather events, which can otherwise cause flooding and loss of life or livelihood.

People have settled historically in areas rich with natural resources and today most of the world's population live downstream of forested watersheds[379]. In the Arguments for Protection study *Running Pure* we carried out a meta-study on the role of forests in providing drinking water, including a survey of the worlds largest cities (broken down regionally by population) to assess whether forest protection – through official protected areas or other forms of protective forest management – played a significant role in water supply. We found what appears to be a clear link between forests and the quality of water coming out of a catchment, a much more sporadic link between forests and the quantity of water available and a variable link between forests and the constancy of flow. Around a third (33 out of 105) of the world's largest cities obtain a significant proportion of their drinking water directly from forest protected areas and thus obtain direct benefits from cleaner water supplies. Examples of major cities drawing drinking water from protected areas include Mumbai, Jakarta, Karachi, Singapore, Bogata, Rio de Janeiro, Caracas, Madrid, Sofja, Abijan, Cape Town and Harare. In addition at least five other of the hundred largest cities obtain water from sources that originate in distant protected forested watersheds and eight more obtain water from forests that are managed in a way that gives priority to their functions in providing water[380].

Some municipalities around the world cite maintenance of a pure water supply as a reason for introducing forest protection or reforestation. For example reforestation of the Pyrenees in Spain is being promoted by the government to improve downstream water resources[381]. In the USA, all states are required under federal law to have a Source Water Assessment, which promotes the idea that protecting drinking water at the source is the most effective way of preventing drinking water contamination[382]. Similar examples can be found in many tropical and subtropical regions. The Mount Makiling Forest Reserve south of Manila in the Philippines is a 4,244 ha area of forest administered and managed by the University of the Philippines. More than 50 per cent of the reserve is forested and its watershed ecosystem supplies water to five water districts and several water cooperatives that provide water for domestic, institutional and commercial water users. In the Dominican Republic the Madre de las Aguas (Mother of the Waters) Conservation Area, protects the headwaters of 17 rivers that provide energy, irrigation and drinkable water for more than 50 per cent of the country's population[383].

✓ Protected areas

The links between protected areas and clean water represent perhaps one of the best 'win-win' opportunities for joint efforts to protect human health and biodiversity[384]. The economic case is quite convincing in many cases. A team of researchers from the United States, Argentina and the Netherlands in the late 1990s put an average price tag of US$33 trillion a year on fundamental ecosystem services, which are usually taken for granted because they are free[385]. Water regulation and supply was estimated to be worth US$2.3 trillion. At the national level, the economic value of the water storage function of China's forests is estimated as 7.5 trillion yuan (approximately a trillion US dollars), three times the value of the wood in those forests. Similarly, recent studies calculated that the presence of forest on Mount Kenya saved Kenya's economy more than US$20 million a year through protecting the catchment for two of the country's main river systems, the Tana and the Ewaso Ngiro[386].

The issue for protected area managers and policy makers is how to translate these values to help support particular types of land management. One reason why it has proved so difficult to halt and reverse global forest loss is that those who manage forests typically receive little or no compensation for the services that forests generate for others and hence have little incentive to conserve them. Recognition of this problem has encouraged the development of systems in which land users are paid for the environmental services that they generate through management. The central principles of the 'payment for environmental services' (PES) approach are that those who provide environmental services should be compensated for doing so from those who receive the services. Projects using water resources as a springboard for PES schemes have been most developed in Latin America, but interest is quickening throughout the world. In Costa Rica, the government has been involved in a scheme to help users such as hydropower companies to pay farmers to maintain forest cover in watersheds, while in Quito, Ecuador, water companies are helping to pay for the management of protected areas that are the source for much of the capital's drinking water[387]. Such approaches probably offer one of the best mechanisms for protected areas to be recognised for the value they provide as suppliers of water – however few of the related studies mention how the clean water can also contribute directly to human health.

Sexual and reproductive health

The largest risk by far in this category is that posed by unsafe sex leading to infection with HIV. HIV/AIDS is the fourth biggest cause of mortality in the world. Currently, 28 million (70 per cent) of the 40 million people with HIV infection are concentrated in Africa. Life expectancy at birth in sub-Saharan Africa is currently estimated at 47 years; without AIDS it is estimated that it would be around 62 years[388].

✓ Health practitioners

Natural systems are increasingly being seen as a possible source of materials which can be used in HIV/AIDS treatments. As was noted in Chapter 2, protected areas such as Cuc-Phuong National Park in Vietnam[389] are being actively investigated for compounds which may be effective in treating AIDS. In Africa, a forest liana from Korup National Park in Cameroon has been found to contain a possible anti–HIV compound[390] as has a plant collected from Manovo-Gounda-St. Floris National Park in the Central African Republic[391]. The research techniques made possible by the discovering a compound in Yellowstone National Park in the US (see case study) are also helping to detect the HIV virus in AIDS. Although positive results have yet to come from any of these research projects the role of protected areas in providing compounds for the pharmaceuticals industry remains important.

✓ Protected areas

HIV/AIDS is also having a direct detrimental impact on protected areas in Africa. In many Eastern, Southern and Central African countries, AIDS impacts include significant staff losses (for example, the Wildlife and Environmental Society in Malawi has lost 14 per cent of its 60 staff; a national fire awareness programme in southern Africa lost 10 of its 12 extension workers)[392].

Protected area staff can be infected or spread infection in a number of ways, including:

- Protected area staff may be particularly at risk when working in remote areas where there is often no access to HIV/AIDS advice or protection, where they may be away from their families for many months at a time and where they are more likely to engage in risky behaviour due to lack of entertainment, boredom or loneliness.
- Staff who travel, such as drivers, community conservation personnel and people attending training programmes and workshops away from home, may spread or contract HIV.
- In particular for staff working in rural communities, there is a risk of HIV, and other disease, transmission between staff and community members[393].

HIV/AIDS information corner at the office of the WWF-funded Integrated Rural Development and Nature Conservation (IRNDC) in Katima Mulilo, East Caprivi, Namibia. The Caprivi strip has the highest AIDS rate of all Namibia. About one pregnant woman out of four is HIV infected and more than a third of the whole Caprivi population is reported to be HIV positive. But there are only two hospitals with a little over 200 beds in the area.

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Although protected areas can contribute to the HIV/AIDS problem through the results of choices made about staff deployment, conservation organisations may also be in a position to make a positive contribution as well. Specifically:

- International conservation organisations and their local partners often work to improve communication and transportation infrastructures and resources in areas where they work. This can also help the work of local health and development organisations working on HIV/AIDS issues, and can be particularly significant in remote areas, where services are limited.
- NGOs and protected area staff often have well-established contacts with local communities and organisations that can facilitate the work of health initiatives[394]. Protected area agencies and others are increasingly running staff training programmes and extension work teaching about the dangers of AIDS and about preventative measures.

In areas where HIV/AIDS is a substantial risk it is important for conservation organizations to assess organisational vulnerability in terms of staff, financial resources and management systems and to develop and implement workplace policies. Some guidance exists, for example the *Guidelines for Mitigating the Impacts of HIV/AIDS on Coastal Biodiversity and Natural Resource Management* developed by the Population Reference Bureau[395]; Kenya Wildlife Service, Tanzania National Parks and the African Wildlife Foundation, for example, have HIV/AIDS workplace policies; and WWF is also developing policies for its whole network. At park level, a vulnerability assessment carried out in Ankarafantsika National Park in Madagascar has been incorporated into the management strategy. The park also has a trained officer as the HIV/AIDS Focal Point, who implements and co-ordinates activities related to HIV/AIDS including: informing staff on HIV/AIDS in an awareness raising session; distributing free condoms to staff members, in the visitors' centre and in each field station; and holding HIV/AIDS information events in villages and hamlets in the park's peripheral zone[396]. Such strategies should: note an organisation's commitment to take action against the impacts and spread of HIV/AIDS; lay down a standard of behaviour for all employees; give guidance to supervisors and managers on disseminating information about HIV transmission and prevention; provide support for employees living with HIV/AIDS where possible; and extend this to local communities within and bordering the protected area[397].

Occupational risks

Examples of work-related risk factors include exposure to pesticides, heavy metals, infectious organisms and agents causing occupational asthma and chronic obstructive lung disease. In industrialized nations psychological stress at work has been associated with cardiovascular disease. An extensive literature survey carried out for the WHO report found that approximately 310,000 workers lose their lives each year as a result of occupational injuries that are unintentional. Globally about 20–30 per cent of the male and 5–20 per cent of the female working-age population may have been exposed during their working lives to lung carcinogens, including asbestos, arsenic, beryllium, cadmium, chromium, diesel exhaust, nickel and silica. Deaths from pulmonary disease, which can be

caused by airborne particles such as silica, asbestos and coal dust, accounts for 0.4 per cent of deaths globally and 3.0 million (0.2 per cent) DALYs[398].

Although none of these issues are likely to be a major risk for protected area staff, protected area managers do have to ensure that work-related safety is a major consideration in management practices and processes. Many protected areas employ chemical pesticides in control of invasive species for example, and full application of safety procedures is needed[399].

Other selected risks to health

As the WHO report acknowledges clearly, many thousands of other threats to health exist within and outside these categories. As examples, the WHO report looks at just two issue – unsafe health care injections and childhood sexual abuse[400].

Although there are not really any direct connections between these risks and protected areas, there are many projects associated with protected areas which aim to help develop better community infrastructure and healthcare in particular. Many of these come under the umbrella of the PHE (population-health-environment) approach which was discussed in the case study from Kenya. These projects aim to integrate health and/or family planning with conservation activities, seeking synergies to produce greater conservation and human wellbeing results[401].

Designating a protected area in a remote area can provide the first real development opportunities for the communities living there and protected area managers and associated project executants are increasingly aware of their wider responsibilities. For example, a local association was created around the Lossi Gorilla Sanctuary in Congo Brazzaville, which, amongst other objectives, aims to promote tourism and community development. In 2001, AATL had total savings of US$6,000 obtained mainly from ecotourism revenue. Thanks to financing from the association and material support from ECOFAC (Programme for the conservation and rational use of forest ecosystems in Central Africa) a local health centre was built and a health advisor recruited[402].

Chapter 5
Recommendations
Furthering the benefits that protected areas provide to human health

Linking environment and health at the policy level

Making the link between our environment and our health has not happened overnight. In 1986, an international conference sponsored by the WHO highlighted the need to bring the health and environment agendas together in a more comprehensive approach to health that went far beyond the normal responsibilities of countries' traditional health sectors. The 'Ottawa Charter for Health Promotion' stated that health had to be on the agenda of all sectors and at all levels. The charter noted that: "*The inextricable links between people and their environment constitutes the basis for a socioecological approach to health*" and that "*The conservation of natural resources throughout the world should be emphasized as a global responsibility*"[403].

But such changes take time. So perhaps it is not surprising that twenty years after the 1986 conference a WHO and UNEP Inter-ministerial Conference for Health and Environment in Africa pointed out: "*Whereas health is generally among the top 4 priority areas in national development strategies, environment remains much lower*"[404]. The conference recommended that governments, amongst other things:

- ✓ Establish and strengthen national institutes or centres for health and environment, to *inter alia* assess the risks entailed by economic and development processes and provide advice on the management of such risks.
- ✓ Encourage the integration of health and environment objectives with poverty reduction strategies and development plans, including investments related to sectoral economic activities.

The role of protected areas

This report has highlighted that there are many and varied links between human health and protected areas; and that protected areas can play a significant role in improving human health, and can, for example, help nations achieve the Millennium Development Goals[13] amongst others. And we have reviewed in detail the four main areas where protected areas can contribute to human health:

1. **Environmental benefits:** which can be divided into two: the direct benefits that come from the conscious management of ecosystems to reduce the risk of disease and the indirect benefits related to management activities within protected area that contribute to better health.
2. **Sources of local medicines:** drawing primarily on ethnobotanical studies carried out in protected areas, to show the wide range of values that these areas contain.
3. **Sources of global medicines:** looking firstly at plants which are used raw or in only lightly processed form (i.e. the growing use of, and trade in, complementary and alternative medicine); and secondly as sources for materials that are components of pharmaceuticals.
4. **Provision of direct health benefits:** looking at the role of protected areas in providing opportunities for a wide range of physical exercise, issues related to mental health and a range of other well-being benefits linked to therapeutic activities; these three issues also make important contributions to overall well-being.

[13] Millennium development goals directly related to health are Goal 1: Eradicate extreme poverty and hunger; Goal 4: Reduce child mortality; Goal 5: Improve maternal health; Goal 6: Combat HIV/AIDS, malaria, and other diseases,

However it remains the case that although many protected areas across the world have been set up with the dual aims of conservation and recreation, few have had specific health mandates. There are some exceptions: the case studies from the UK and Australia given above show that policy agendas linking health and conservation can provide real benefits for both sectors and hopefully these case studies will provide an inspiration for more countries to follow suit. The case study from Colombia provides an excellent example of how protected areas and indigenous people's medicinal traditions can have a common vision and objectives.

There is also a growing recognition of the need to link health and conservation initiatives by some conservation NGOs. Conservation projects often partner with communities living in remote areas with high biodiversity in the developing world (see China and Kenya case study). Although conservation is the primary aim of these projects, it clearly makes sense to link with, and sometimes work directly on, other development issues such as healthcare. These PHE (population-health-environment) projects recognise that: "*Partnerships between healthcare providers and nature organisations to share and exchange expertise could create new policies that recognise the interdependence between healthy people and healthy ecosystems*"[405]. Protected area authorities and NGOs such as WWF are also developing policies on poverty and conservation[406]. As health is intricately related to this agenda, conservation projects are increasingly seeking to understand and address the links between human health and the environment in their work.

But these positive links, which are beginning once again to be recognised in the scientific literature and environmental and health policy around the world, continue to be undermined by habitat destruction and loss. Protected areas can offer one of the most permanent and effective strategies to ensure that at least some of our natural world is conserved. We thus conclude this report with a series of recommendations to further the understanding and promotion of the role of protected areas in contributing to human health. The underlying recommendation, however, remains the need for the vision of protected areas defined in the CBD's *Programme of Work on Protected Areas* of a comprehensive, effectively managed, and ecologically representative national and regional systems of protected areas[407].

Aerial shot of deforestation in the Amazon, Loreto region, Peru

Recommendations

Although research demonstrates that access to nature helps us stay psychologically, emotionally and spiritually healthy the role that protected areas can play in human health, well-being and development has in general "*not been fully recognised*"[408]. As in other reports for the *Arguments for Protection* series, the guidance and recommendations provided here are very specific to protected areas. Clearly there are many other responses that health professionals can take to reduce disease burdens and increase health and life expectancy. The WHO in its 2002 report *Reducing Risks, Promoting Healthy Life*, for example, suggests a whole range of responses and policies[409].

The recommendations are divided into several sections, aimed at specific user groups:

Policy makers should be encouraged to:

1. Note the WHO definition of health that embraces overall well-being
2. Link national health and environmental policies to protected areas as a delivery mechanism for health services where appropriate
3. Develop and promote benefit-sharing mechanisms for relevant health resources (particularly genetic material)
4. Ensure values are conserved within and outside protected areas that already or might in the future provide health benefits
5. Promote compatible and equitable policies and legislation regarding access to materials and health benefits of medicinal resources from protected areas
6. Consider the implications for existing and emerging infectious diseases when making planning decisions that relate to natural or semi-natural habitats
7. Develop and/or support initiatives such as the payment for environmental services schemes which ensure essential services for health and well-being, such as water

Social and health professionals should be encouraged to:

8. Develop awareness of the various roles that protected areas can play in health promotion
9. Further research links between emerging infectious disease and habitat management
10. Continue to carry out ethnobotanical studies in protected areas to increase understanding of resource use and to identify potentially useful medicinal material
11. Ensure equitable benefit-sharing options from positive research outcomes from protected areas
12. Ensure that ingredients in medicinal resources are sourced sustainably and where appropriate benefits from the resource used are equitably shared
13. Develop partnerships with protected area managers to implement health-related activities.

Protected areas professionals should be encouraged to:

14. Develop health arguments and communication strategies and promote these with health professionals
15. Develop – with partners where possible – health activities and ensure access to these by the public
16. Ensure sustainable use of resources including those related to health (e.g. collection of medicinal herbs in protected areas)
17. Minimise risk of adverse health impacts to protected area staff and local communities through sound management decisions
18. Practice benefit-sharing mechanisms relating to health benefits
19. Consider specific habitat management for health impacts
20. Consider the values of medicinal knowledge (e.g. sustainable harvesting, cultural traditions, etc) as objectives of protected area management

Conservation professionals should be encouraged to:

21. Raise awareness of health issues across all projects and activities
22. Integrate health more fully into visitor programmes in protected areas
23. Raise awareness of the risks of emerging diseases from wildlife, due to increased contact between people and wildlife, with national policy makers, the health sector and the public, and collaborate on research and control measures
24. Develop and scale up PHE (population-health-environment) approaches in close collaboration with the health and development sectors
25. Help develop monitoring and harvesting protocols for medicinal plant resources

Researchers and academics should be encouraged to:

26. Incorporate integrated health-environment teachings in health and in environment courses at all levels including technical training and university courses

Appendix 1: International Standard for Sustainable Wild Collection of Medicinal and Aromatic Plants (ISSC-MAP) Principles and Criteria[14]

SECTION 1: WILD COLLECTION AND CONSERVATION REQUIREMENTS

Principle 1. Maintaining Wild Medicinal and Aromatic Plants (MAP) Resources

Wild collection of MAP resources shall be conducted at a scale and rate and in a manner that maintains populations and species over the long term.

Criteria 1.1 Conservation status of target MAP species

The conservation status of target MAP species and populations is assessed and regularly reviewed.

Criteria 1.2 Knowledge-based collection practices

MAP collection and management practices are based on adequate identification, inventory, assessment, and monitoring of the target species and collection impacts.

Criteria 1.3 Collection intensity and species regeneration

The rate (intensity and frequency) of MAP collection does not exceed the target species' ability to regenerate over the long term.

Principle 2. Preventing Negative Environmental Impacts

Negative impacts caused by MAP collection activities on other wild species, the collection area, and neighbouring areas shall be prevented.

Criteria 2.1 Sensitive taxa and habitats

Rare, threatened, and endangered species and habitats that are likely to be affected by MAP collection and management are identified and protected.

Criteria 2.2 Habitat (landscape level) management

Management activities supporting wild MAP collection do not adversely affect ecosystem diversity, processes, and functions.

SECTION II: LEGAL AND ETHICAL REQUIREMENTS

Principle 3. Complying with Laws, Regulations, and Agreements

MAP collection and management activities shall be carried out under legitimate tenure arrangements, and comply with relevant laws, regulations, and agreements.

Criteria 3.1 Tenure, management authority, and use rights

Collectors and managers have a clear and recognized right and authority to use and manage the target MAP resources.

Criteria 3.2 Laws, regulations, and administrative requirements

Collection and management of MAP resources complies with all international agreements and with national, and local laws, regulations, and administrative requirements, including those related to protected species and areas.

Principle 4. Respecting Customary Rights

Local communities' and indigenous peoples' customary rights to use and manage collection areas and wild collected MAP resources shall be recognized and respected.

Criteria 4.1 Traditional use, access rights, and cultural heritage

Local communities and indigenous people with legal or customary tenure or use rights maintain control, to the extent necessary to protect their rights or resources, over MAP collection operations.

Criteria 4.2 Benefit sharing

Agreements with local communities and indigenous people are based on appropriate and adequate knowledge of MAP resource tenure, management requirements, and resource value.

[14] For more information on the ISSC-MAP see: data.iucn.org/themes/ssc/sgs/mpsg/main/issc_map.html

SECTION III: MANAGEMENT AND BUSINESS REQUIREMENTS

Principle 5. Applying Responsible Management Practices

Wild collection of MAP species shall be based on adaptive, practical, participatory, and transparent management practices.

Criteria 5.1 Species / area management plan

A species / area management plan defines adaptive, practical management processes and good collection practices.

Criteria 5.2 Inventory, assessment, and monitoring

Management of MAP wild collection is supported by adequate and practical resource inventory, assessment, and monitoring of collection impacts.

Criteria 5.3 Transparency and participation

MAP collection activities are carried out in a transparent manner with respect to management planning and implementation, recording and sharing information, and involving stakeholders.

Criteria 5.4 Documentation

Procedures for collecting, managing, and sharing information required for effective collection management are established and carried out.

Principle 6. Applying Responsible Business Practices

Wild collection of wild MAP resources shall be undertaken to support quality, financial, and labour requirements of the market without sacrificing sustainability of the resource.

Criteria 6.1 Market / buyer specifications

The sustainable collection and handling of MAP resources is managed and planned according to market requirements in order to prevent or minimise the collection of products unlikely to be sold.

Criteria 6.2 Traceability

Storage and handling of MAP resources is managed to support traceability to collection area.

Criteria 6.3 Financial viability

Mechanisms are encouraged to ensure the financial viability of systems of sustainable wild collection of MAP resources.

Criteria 6.4 Training and capacity building

Resource managers and collectors have adequate skills (training, supervision, experience) to implement the provisions of the management plan, and to comply with the requirements of this standard.

Criteria 6.5 Worker safety and compensation

MAP collection management provides adequate work-related health, safety, and financial compensation to collectors and other workers

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