Chapter 7

Conclusions and recommendations.

This study confirmed the botanical species richness of Gabonese rain forests, and demonstrated the profound influence of past climatic changes on structure and composition of vegetation in Lope (Chapter 2). The model of vegetation change developed for Lope may well apply to other parts of Gabon and central Africa (see de Foresta, 1990), and deserves further investigation. Knowledge of how past climatic change has affected rain forests may enable better predictions of how rain forest vegetation is likely to change in the future (see Schneider, 1991). In addition, studies of the processes of natural savanna colonisation may have applications in reafforestation of degraded areas. Species identified as savanna colonisers in Lope might prove useful in reafforestation projects in Africa in areas outside their natural ranges.

Differences in densities of some large mammals were attributed to natural differences in vegetation structure and composition (Chapter 6). Factors which determine animal densities in tropical rain forests are poorly understood (see Butynski, 1990; Oates *et al.*, 1991), and Lope would be an ideal location for research to investigate this question, since many different vegetation types occur in close proximity, with the same community of animals.

Damage caused by logging was confirmed to be low compared to that in most other countries, and this was due to socioeconomic conditions in Gabon (Chapter 4). Only chimpanzees showed a detectable decline in population density after logging. The reason for this decline was unclear, but similar studies elsewhere have detected the same trend (Skorupa, 1988; Struhsaker, 1975; Tutin & Fernandez, 1983). It shows that even logging at low intensity can have a negative effect on wildlife, and highlights the need for constant monitoring of the ecological effects of forest exploitation. None of the differences detected in abundance of other species between sites could be related to logging, but sampling resolution was low, and unlikely to detect subtle differences. Further studies, monitoring responses of known animals or groups to logging (cf. Johns, 1983), should be undertaken.

In Lope, 75% of plant species produce fruits which show adaptations for dispersal by animals (Chapter 3). This figure is similar in other rain forests

where comparable data have been collected (e.g., Foster, 1982a; Frankie et al., 1974; Gautier-Hion et al., 1985b; Raemaekers et al., 1980) and is one illustration of the vital role played by animals in the dynamics of rainforests. Elephants play an important role in forest ecology, and this study has shown that it is not restricted to that of a mammalian bulldozer. They rarely push over trees, accounting for less than 1% of natural mortality, but are important seed dispersers for many plants, including several commercially valuable timber species. They create clearings at salines, and hence contribute to the structural heterogeneity of the forest, and this may result in increased biomass of other mammalian species (cf. Oates et al., 1991). Gorillas at Lopé are the only important seed dispersers of *Cola lizae,* suggesting a close evolutionary interrelationship (Tutin et al., 1991), and also disperse seeds of many other plant species. Elephants, gorillas and chimpanzees are the major dispersers of 41 out of a sample of 71 fruits which featured in the diet of elephants (Chapter 5). Seed dispersal by other species groups that occur in Lopé has been widely documented (e.g., Charles-Dominique et al., 1981; Dowsett-Lemaire, 1988; Fleming et al., 1987; Gautier-Hion, 1984; Gautier-Hion et al., 1986).

Many studies have found population declines and local extinctions of mammals, in areas whet-e hunting pressure is high (e.g., Glanz, 1991; Lahm, 1992; Mittermeier, 1986, 1991). Lahm (1992) conducted wildlife surveys on line-transects located at different distances from villages in northeast Gabon, and found that all large mammals (pigs, buffalo, elephant, apes and large duikers) and some monkey species, were absent close to villages, due to hunting pressure. However, *Cephalophus monticola, Cercopithecus nictitans, Cercopithecus cephus* and *Cercopithecus pogonias* showed little change between hunted and non-hunted areas. Savanna elephants have been hunted heavily throughout their range and many populations have been decimated (e.g., Douglas-Hamilton, 1987). Initial indications are that forest elephants have suffered a similar fate in parts of their range (Barnes, 1989), although Gabon has not been affected. Lopé is a reserve in' which hunting is not allowed, and none of the study sites had been subject to significant amounts of poaching. In other parts of the country, logging operations open the forest up to commercial hunters, who can devastate primate and ungulate populations in accessible areas to satisfy the demand for "bush-meat" from major towns IR. Fischer, personal communication). In a logging concession in northern Congo hunting practically eliminated all large mammals (D. Wilkie,

personal communication).

Any management system designed to utilise tropical rain forests on a sustained yield basis must consider the maintenance of animal seed dispersers (and pollinators) alongside timber yields. With such low damage levels during each logging cycle, Gabon could argue that its logging industry is likely to be "sustainable". It would have a strong claim to be declared a "sustainable logging country", if it could be shown that hunting was not eliminating vital animal seed dispersers, as is the case in other central African countries (e.g., Dowsett-Lemaire, 1991; D. Wilkie, personal communication). However, the marked decline in numbers of chimpanzees in lightly damaged forest, where there was no hunting pressure, should serve as a warning and emphasise the need fur close, long term ecological monitoring of logging activities in the future.

Some (by no means all) oil companies, operating on-shore in the rain forest of Gabon, routinely commission independent environmental impact assessments when initiating exploitation programmes (J. Bickerton, personal communication). No forestry company has followed this lead (C. Wilks, personal communication), and this is indicative of the industry's general lack of interest in its effects upon the environment. Many foresters operating in Gabon began their careers in Ivory Coast, but were forced to leave when they exhausted the timber resources in that country (T. Levec, personal communication), which does not augur well for the future of Gabonese forests.

Wilks (1990) comprehensively reviewed the conservation status of Gabon. He assessed the current status of reserves, identified priority areas outside reserves, and made recommendations about legislative and research needs, which are necessary if Gabon is to manage it's forests sensibly. Wilks pointed out that the five protected areas in the country accounted for only 6.7% of the surface area, and that their legal status was unclear. All except the small "Réserve naturelle integrale du plateau d'Ipassa", which covers 100 km^2 close to Makokou, northeast Gabon, were being logged, whilst Ipassa has suffered intense poaching,. to the extent that few large mammals survive (S. Lahm, personal communication). He called for a decree clarifying the status of reserves, and proposed 15 new sites worthy of protection, which would increase the protected surface area to 15.8%. In addition, there was a need for more comprehensive legislation to control forest exploitation and hunting, since existing laws were unclear, or incomplete (see also IUCN, in press). These issues have not, as yet, been addressed, and remain a

priority.

Wilks also listed research priorities, with particular reference to logging and hunting. Little was known about levels of damage during logging, effects on the fauna, or regeneration success after exploitation. There was no information an the effects of hunting on mammalian communities, and little basic knowledge of the biology of commercial timber species. What were the pollinators and seed dispersers ? What conditions were best suited for regeneration of selected species ? Aucoumea klaineana which has been exploited in Gabon for over a century, and is still the main timber species, emphasises this lack of basic knowledge: Trees are found in groups, the roots of which are inter-connected, and one trunk is generally larger than the others. It is possible that nutrients are exchanged between individuals, and that the largest (dominant) trunk benefits from the other individuals in the stand (Leroy-Duval, 1974). If that trunk were to be cut, leaving the others intact, it is possible that the next largest individual would assume dominance and rapidly grow to an exploitable size. The need for research into this process seems obvious, but has not been undertaken. This is a familiar scenario. In a World talking about 'sustainable' logging of tropical forests, we should not forget that our knowledge of pattern and process in tropical rain forest environments is in its infancy (see Marshall & Swaine, 1992).

In the light of results of this study, and my own experience on forestry concessions in Gabon, the following recommendations seem sensible, and if carried out, would help to minimise any negative effects on the forest due to selective logging:

1) The system currently used to monitor forestry operations within the country is outdated. Consequently, it is difficult to access information detailing which areas of forest are currently being exploited, and if, when, and at what intensity, any given concession was last worked. This is a basic requirement if concessions are to be granted in a rational manner, ensuring sensible exploitation of Gabon's forest resources on a rotation basis. It would be relatively simple to set up a computer database of all the timber concessions currently operating in Gabon, with their precise locations and duration, and to incorporate existing information on the logging history of the country. In addition, details of forestry inventories, which have been undertaken for 900,000 km^2 of the country (CTFT, 1975) could be incorporated, as could records of extraction rates for different

species in different concessions. This might be best achieved by developing a Geographic information System (GIS) for the country, which would facilitate long-term monitoring of the status of Gabon's forest resources. This could perhaps be developed alongside a programme about to start, which will obtain 'wall-to-wall' LANDSAT TM satellite images for the central African forests, as part of an investigation of current forest status, and deforestation trends within the region, funded by the Global Environment Facility (Wilkie, 1992).

2) By law, each tree felled is given a numerical code which should be marked on the resulting log(s), so that the production of each company can be monitored. In practice, there is little supervision on the part of the Ministry of Water and Forests, and logging companies tend to assign numbers to logs once they reach the point of departure from the 'chantier' - the railway station in the case of companies working in Lopé. In this manner, trees which are cut, but are not extracted, do not have to be accounted for. Forestry companies in Gabon are very wasteful, and many trees cut are overlooked and left *in situ* to rot, or are abandoned at loading areas in the forest, or at railway stations, because they did not conform to export specifications. This is indicative of the disorganised manner in which many companies operate, especially with regards to pre-exploitation inventories, which are rarely undertaken. Logging companies should be required to undertake complete inventories of all commercial species, and to provide records of the number of trees cut on a compartment basis. This information could then be entered into the forestry database or GIS, to provide the government with a cost-free means of monitoring yields of successive cuts in the same area.

3) Logging companies pay no heed to their environmental impact: They clear areas greater than are necessary when locating camps and loading areas; pay no attention to water courses, which are often blocked or deviated; site roads on steep gradients, make them wider than necessary, and clear excessive swathes of forest on either side; pay little attention to the location and extent of skidder trails; and fell trees with no consideration of which direction of fall will do least damage (e.g., will leave other individuals in a stand of inter-connected ***Aucoumea klaineana*** trees intact). Guidelines to minimise damage, such as those presented by Hawthorne (in press) and Poore (1989), should be imposed upon foresters. Studies elsewhere have shown that when measures were taken to minimise the

damage caused by logging, reductions in the cost of logging operations have been achieved (Buenaflor & Tiki, 1989; Marn, 1982, cited in Johns, 1989), and this would doubtless be the case in Gabon.

4) Loggers set snares to trap mammals such as duikers, which are a favoured food item. This has a negative, but localised effect on wildlife, and several species are relatively resilient tu this form of hunting pressure (Lahm, 1992). However, when commercial hunters work alongside loggers, the effects on wildlife can be drastic (Dowsett-Lemaire, 1989; R. Fischer & D. Wilkie, personal communications). Logging companies should ensure that their employees and their families bide by the Gabonese Laws governing hunting, and in cooperation with the Ministry of Water and Forests, should prevent commercial hunters from using their road networks for access into the forest. When logging camps Eire remote, the company should ensure a cheap supply of foodstuffs to employees, to remove the need to hunt. Wilks (1990) further discusses the control of commercial hunting.

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