

Mission Report, Cabinda April 2005

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of Agriculture, Fisheries and Environments Cabinda

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Quote:

“The approach to dealing with this problem [Human-elephant conflict] needs to be applied at many scales and is as much an art as a science.”

Patrick Omondi, IUCN Human-Elephant Conflict Working Group. Colombo, Sri Lanka. 2004

Cover photo: Steve Blake. Many thanks to him for advice.

Other photos: Joe Heffernan.

Map 1: Elephant listening project (adapted with permission by J.Heffernan).

Map 2: IUCN SSC AfESG African elephant status Report, adapted with permission from Julian Blanc.

Satellite Images: courtesy of NASA. Thanks to Gary Geller for guidance on sourcing and managing these.

1. Mission TOR

Mission objective

- To determine the status of human-elephant conflict in Cabinda, and design a strategy for mitigation of the problem, including establishment of pilot tests of appropriate mitigation techniques.

Consultant Activities

- Record field data on local incidence of human-elephant conflict wherever possible
- Facilitate community meetings to discuss wider incidence of human-elephant conflict, as well as local attitudes and perceived social dynamics of the issue.
- Elicit local knowledge on elephant distribution, movement patterns and behaviour
- Undertake simple GIS analysis of area to prioritise “at risk” villages, as well as suitable locations for field response teams to be based.
- Initiate simple pilot chilli farming exercise to provide materials for future locally based testing of mitigation techniques.
- Train field response teams in data collection of elephant damage, and community engagement with affected farmers.
- Discuss with local farmers and field response staff mitigation methods from other countries, as well as methods already used in the locality.

Outputs

- Practical understanding of HEC situation and its impact in Cabinda
- Pilot tests for possible mitigation techniques
- Outline strategy for mitigation of HEC throughout the Cabinda area
- Training of field-based teams to respond and record incident data and to assist with development of HEC mitigation techniques at a local level

Products

- Report on HEC situation in Cabinda
- Evaluation and initial strategy document for mitigation of HEC in Cabinda at an institutional and local level
- Training Report describing training provided and evaluation of success for follow up staff identified in conjunction with UNDP and local administration

2. Background to Cabinda

2.1 Habitat Description (adapted from Ron, 2004)

The Cabinda is 7,300 Km², and is situated between latitudes 4°23' and 5°46' South and longitudes 12°0' and 13°6' East, bordering the Atlantic Ocean in the West, the Republic of Congo on the North and North-East, and the Democratic Republic of Congo (DRC) on the South and East. There are two major vegetation types in Cabinda: tropical rainforest and wooded savanna.

The climate is hot and humid, with two main seasons, annual mean temperatures of around 25-26°C, relative humidity of roughly 80% throughout the year, mean annual rainfall exceeding 1600mm.

The “Maiombe Forest”, covering around 2,000 km² in the hilly northeast of Cabinda, is part of a larger evergreen tropical rainforest shared by four countries – Gabon (South-West), Cabind.

The Republic of Congo (West, the District of Kouilou and South and West of the District of Niari) and DRC (South-West, north of the Congo River). The canopy is multi-storied, from the dominant layer of tall evergreen trees (30-50m), through layers of smaller trees and shrubs, to a diversified layer of herbaceous and epiphytic plants covering the forest floor. Most of the Maiombe Forest area has been utilized at some stage during the last century, and is therefore comprised of various phases of succession of secondary forest with some climax primary forest remaining in small remnant patches (see satellite image on map 4; p.20).



Picture 1: Maiombe Forest

2.2 Human population status (adapted from Ron, 2004)

The registered population size of Cabinda in 1984 was 116,558 with about 3.3% annual growth. In 2001 it was estimated to be around 250,000, (including around 6,000 internally dislocated people, and an unknown number of refugees from neighboring countries). About 150,00 people live in Cabinda City and less than 40,000 in the area of the Maiombe Forest, though around half of these in the Municipality of Buco-Zau (see map 4, p.20). There are four major urban centers in Cabinda, two of them in the Maiombe Forest area – Buco-Zau and Belize.



Picture 2: Cabinda Market

The main income source of the Province is from petroleum, while in the past people relied more on commercial logging and coffee cultivation. Most of the residents in the forest area rely mainly on subsistence cultivation of peanuts, maize, bananas and cassava (manioc), hunting and participation in logging operations. About 70% of the total

population lives below the poverty line, with higher poverty rates in Cabinda. Life expectancy is 42.4 and about 45% of the population is under 15 years old. Less than half of the population has access to housing, health services, running water or education. In this context, it is obvious that the needs of the local communities residing in the forest must be addressed as a high priority in any conservation initiatives.

2.3 Forest elephants of Cabinda

The African elephants found in Cabinda are most likely of the cyclotis subspecies (S.Wasser, pers.comm.). Scientists are still debating the taxonomic status of elephants. While most biologists have considered there to be two sub-species of elephant in Africa, the forest elephant *Loxodonta africana cyclotis* and the savanna elephant *Loxodonta africana africana* or *Loxodonta africana oxyotis*--there is some evidence suggesting that they are not sub-species but rather two or more separate species: *Loxodonta cyclotis* and *Loxodonta africana* (Frade, 1955; Georgiadis, 1996; Barriel *et al.*, 1999; Roca *et al.*, 2001; Eggert *et al.* 2002). However, at this time the IUCN SSC African elephant Specialist Group (AfESG) is advising that due to the uncertainty over speciation, more research should be completed prior to re-categorising the groups (AfESG 2002).



Presently, the conservation status of elephants in Cabinda is very unclear. Brief surveys by Ron in 2002 have indicated the presence of elephants in the area, whilst the African Elephant Database records the province in the following way:

"Cabinda, bordered with Congo and the DRC, is still reported to harbour elephants in its forests (Ron, cited by J. Hanks, pers. comm. 2003) and part of the territory has been categorized as known range" (from Blanc, *et al.*, 2003). The area indicated (map 2) as known range (shown in dark green) fills the northeastern corner of the province, though information contained in this report extends that area considerably further west, and slightly south (see map 4; p.20).



It is not known if elephants resident in Cabinda represent transboundary populations with either Republic of Congo or DRC. However, with continuous forest cover and relatively few anthropological barriers, it could be assumed that some transboundary migration occurs. According to the information provided by the African Elephant Status Report 2002, transfrontier elephant populations account for more than half the forest elephants and more than two-thirds of the savanna elephants in **West** Africa (Sebogo & Barnes, 2003, after Blanc *et al.*, 2003), giving an indication of the importance of such linkages to regional conservation of the species. Examples of transfrontier elephant conservation corridors also include the Selous-Niassa corridor between Tanzania and Mozambique (Mpanduji *et al.*, 2002) and the Zambezi Valley corridor on the border between Zimbabwe and Mozambique (Osborn & Parker, 2003) (from Sebogo & Barnes,

2003). The concept of transfrontier conservation strategies for Cabinda has also been highlighted by Ron (2004).

The CITES MIKE programme, a global monitoring programme for elephants, has not yet begun in Cabinda, due to ongoing war at the time of initiation. However, there is an intention to begin to engage in Cabinda (N. Hunter, MIKE Director, pers.comm.), and Cabinda would represent a good MIKE site for population monitoring.

2.4 Other wildlife Species

There appears to be a range of wildlife species still remaining in the area. Evidence of gray parrot (*Psittacus erithacus*), forest elephant, dwarf forest buffalo (*Syncerus caffer nanus*), various duikers (*Cephalophus sylvicultor*, *C. dorsalis*, *C. nigrifrons*, *C. monticola*), guenons (*Cercopithecus cephus*, *C. nictitans*), gorilla (*Gorilla gorilla gorilla*), chimpanzee (*Pan troglodytes troglodytes*), dwarf buffalo (*Syncerus caffer*), bush-pig, duikers & squirrels were recorded by one field worker in two days in 2004, indicating a relatively high abundance of wildlife (Ron, 2004).

2.5 Conservation Threats

2.5.1 Habitat loss

Threats to the forested elephant habitat of Cabinda are extensive. Organised local and commercial logging is widespread, often involving clear felling of large areas. Logging has been continuing since colonial times (Ron, 2004), but with larger machinery and transportation vehicles, the rate and yield is likely to be increasing, as elsewhere in the world, especially Africa. In Africa, the forest has reduced by 0.8% between 1990 and 2000, an area of 5,262 km² (FAO, 2003).

Also, encroachment into forest areas for agriculture is common, and appears to form part of the local farming system. Clearing areas of forest for planting crops contributes to human-elephant conflict.



Picture 3: Commercial Logging, Belize.

2.5.2 Illegal killing

According to some reports, elephants are still hunted for ivory in the area. This is a major issue, and links into a high level criminal network of traders and middlemen. Cabinda is certainly well linked to the countries surrounding it, and it would be easy for ivory products to be moved out to DRC or other markets.

There is also a tradition of eating elephants in the locality. One story told is that Buco Zau was named "Place of elephants" by the Portuguese, as upon their arrival, the villagers were holding a feast comprising elephant meat.



Picture 4: Poached elephant (not from Cabinda)

Also, increasing human-elephant conflict can cause people to exact retribution by killing elephants, though often not the elephant which had caused the damage. A main focus of this mission is to find solutions to this issue. In addition to elephants, other species are eaten for bushmeat, with animals often being sold on the side of the road.

2.5.3 Human-elephant conflict

Often people and elephants come into conflict due to the propensity of elephants to eat and destroy agricultural crops located near or within their own home range. This is commonly termed human-elephant conflict (HEC) and is a serious issue for elephant conservation, as it presents major difficulties for the people most directly involved in the continued survival of the species, notably forest dwellers and forest-edge communities. The IUCN SSC African elephant specialist group define HEC as “*Any human-elephant interaction which results in negative effects on human social, economic or cultural life, on elephant conservation or on the environment*” and have established a special taskforce to address the issue. HEC has been identified as one of the five priority issues in the conservation of the African elephant (WWF, 1997).

The factors that drive HEC are complex, and relate to the specific environmental and social variables on each case. Some elephants are very aggressive as a result of some form of post-traumatic stress disorder; some are just adopting an optimal foraging strategy, feeding on resource rich plantations instead of more difficult forest plants.

Also, it has been shown that the forest environment can play a role. If the forest is early succession secondary forest, this can encourage elephants to exploit these areas (as is often the case around human populations and plantations). Once they are near the crop areas, they naturally head to the plantations. It has also been argued conversely that primary forest buffering a plantation means elephants will easily access the area from more secure dense forest patches they may be hiding in (Goldthorpe & Heffernan, in press). These various scenarios highlight the fact that the issue of, and solutions to, HEC are dynamic, but will be found in manipulating the agricultural environment to minimise potential flashpoints.

Fragmentation of habitat is key to increasing levels of human-elephant conflict (Sukumar, 2004). With anarchic farming practises in Cabinda often clearing forest, the reality is that the elephants are not regarding these new plantations as “human areas”, but a part of their normal home range, which has become resource abundant.



Picture 5: Forest Farming

3 Affected Sites – Description and site-specific recommendations

This section provides some details on the extent of conflict at each site visited. We understand these to be all the sites affected in Cabinda, but techniques for data collections were not very robust or replicable. Also, due to the unstable military situation, some areas were necessarily off limits. This mission was amongst the first of its kind, and priority was given to areas of interest to local politicians. This being the case, an objective interview survey should be used to ensure effective capture of data. However, it should be understood that the situation in Cabinda is presently quite volatile and freedom of movement is dictated by military operations.

However, we did compile a useful and most likely representative data set, allowing us to make strong recommendations at a site and regional level, especially with the support of the satellite imagery in section five. The best news from this mission is that the problem is likely to be manageable by a small, well trained **local** team in the medium to long term.

3.1. Caicucongo, Cacongo District (14/4/05)

UTM: (0194181, 9426084)

Site description - Crops are ten minutes walk from the village through secondary scrubland. The crops are interspersed with natural plants, making it difficult to distinguish the crops and the natural foliage. The crops are located in this area as the soil quality is good. Banana is the most popular crop for the elephants, though sweet potatoes had also been uprooted. The damage by elephants is severe, and no doubt costly. The elephants are accessing the crops from all sides, and remaining onsite for prolonged periods, according to the evidence of footprints and damage.

Severity level (7/10)



Recommendations - Crops are extremely exposed, as they blend into the natural environment. Also, they are unable to be protected as nobody is living nearby and there is high foliage blocking any view of the area until you are very close. Organising the crops is essential, as well as clearing sufficient foliage to demarcate a clear planting area. As the elephants are so confident raiding here, the best idea would be to move the crops elsewhere for a number of years. Also, high value crops at high risk of raiding should be moved nearer to the settlements for guarding, especially around harvesting time. Site requires major rezoning of agricultural crops and large scale clearing of foliage. Infeasible during this mission, so no further action at this time.

3.2. Ganda Congo/ Bongo Zimuno, Belize District (27/04/05)

UTM: (0249462, 9468618)

Site Description - Fields inside forest. Large farm with range of crops. Elephant has attacked banana plants and potatoes. Extensive damage. People very angry. Crops far from settlements and surrounded on all sides by forest. From tracks, damage appears



to be from a single small animal (probably sub-adult male). Incidentally, chilli growing locally. Could be cultivated for use in mitigation methods, providing alternate income.
Severity level (7/10)

Recommendations - High vigilance will be required to scare off elephants. A crop-guarding team operating in a rota is probably necessary, though it should be noted that this is not in the local farming culture, and would require further training. Villagers who are stationed in the forest should use scaring tactics such as lighting fires, directing bright lights and making loud noises to keep elephants off crops. Active and careful reporting of damage throughout the commune should be undertaken here to ensure that an objective understanding of the issue is gained, as local tensions are running high, though conflict levels do not seem too high. No further development of agriculture in forested areas should be encouraged, as the problem of conflict is very difficult to manage here. Due to the size of the plantation, some form of conflict mitigation technique should be applied here, probably in the form of chilli ropes and buffer clearing.

3.3. Comboliambo (site I), Cacongo District (15/4/05)
UTM: (0196609, 9436188)

Site description - Crops are sited near to settlements, and damage in some fields has been severe. Local people frustrated by damage but keen to work. Maize and bananas have been targeted by the elephants, as well as some cassava. The area is well managed and organised, and crops are close together.
Severity level (6/10)



Picture 8: Destroyed farmer's crops

Recommendations- Clear a buffer around the fields to demarcate the area. It would be advisable to grow

chilli for use as deterrents, both here and elsewhere. Map site and, for the future, place highest risk crops furthest from the forest edge. Establish lookout post, set up chilli ropes, using locally available palm oil. Use as a pilot site for demonstration and testing of mitigation methods (see section 4).

Selected as Cabinda Pilot HEC Mitigation Site.

3.4. Comboliambo (site II), Cacongo District (16/4/05)
UTM: (0197217; 9437898)

Site Description- Forested site. Variety of crops being grown in forest area, due to good soil. Oil palms and fruit trees seem dominant types. No damage was observed, though farmers assured that regular raids occurred. Fresh elephant sign and scent (c. one day old) were recorded nearby to crops. The "farm" is c. 3km from village into forest. Crops for whole village being grown here by village leaders.
Severity level (5/10)



Picture 9: Deep forest Agriculture

Recommendations - (same as Site 2) High vigilance will be required to scare off elephants. A crop-guarding team operating in a rota is probably necessary, though it should be noted that this is not in the local farming culture, and would require further training; Villagers who are stationed in the forest should use scaring tactics such as lighting fires, directing bright lights and making loud noises to keep elephants off crops. No further development of agriculture in forested areas should be encouraged, as the problem of conflict is very difficult to manage here.

3.5. Ntataba, Buco Zau District (20/04/05)

UTM: (0224081, 9479314)

Site Description: Farm in area of relatively high human density, near road. Damage severe but very localised. From footprints, it appears to be a large solitary elephant. Bananas destroyed. Other animals were recently seen nearby, as well as anecdotal reports of damage. Much confusion over reports. *Severity level (5/10)*



Picture 10: Large male elephant footprint

Recommendations: It would be useful to conduct a detailed interview survey in this locality to establish the severity of HEC, as most information was anecdotal and confusing. As the area is near to Buco Zau and the Project Biodiversidad agro-forestry site, this area is a possible location for a chilli plantation to test yields and strength. If well managed, this could develop into a marketable product line, tied into conservation and human-elephant conflict mitigation objectives.

3.6. Sinde, Buco Zau District (18/4/05)

UTM: (0240539, 9479056)

Site Description- Naturally occurring oil palm plants have been destroyed, as well as fruit trees. These are situated deep in the forest. Villagers have already moved crops to a new location, though they report that the new site is not as productive and plan to return crops next year. Elephant damage did seem to be severe where it occurred. It was not possible to visit agricultural areas for Sinde, making it impossible to assess potential threat from elephants. The villagers have recently been given a high velocity rifle by government officials, though it would be illegal to kill any elephants.

Severity level (3/10)

Recommendations- It is inadvisable for villagers to return their crops to the affected areas as elephants will be very confident and continue to attack crops, despite any mitigation methods that are established. Farmers should be assisted to improve productivity of non-forest (at least safer) farm areas, ideally where they are now. In order to prevent future conflict, chilli ropes could be established around plantations. It may be possible to offer agricultural assistance through "Project Biodiversidad". It should be



Picture 11: Destroyed Oil Palm

emphasised it is illegal to kill elephants through an education programme. A re-evaluation of the provision of a high powered rifle to a frustrated and poorly educated community should be undertaken.

3.7. Balananga, Caongo District (15/4/05)

UTM: (0197217, 9437898)

Site Description- Forested area with small clearings. No crops on-site at present as villagers have moved their fields following previous elephant damage. Elephant signs are extensive and fresh. Villagers indicated plan to return their crops to the area, despite obvious elephant activity. Elephants could be same as the Comboliambo group.

Severity level (2/10)

Recommendations- Farmers should not return their crops to this area, or any other forested area with fresh elephant sign. It is necessary to provide assistance to improve productivity of non-forest farm areas as the soil is not as good outside of the forested areas. Possibly, the agricultural improvement follow-up could be conducted through “Project Biodiversidad”. However, no further action possible during this mission.



Picture 12: Recording field data

3.8. Bongo Zimuno, Buco Zau District (20/4/05)

UTM (0245065, 9475524)

Site Description: Elephants used to raid crops until they were moved nearer to the road. Elephants do not come to these areas, even though the crops still abut the forest edge. Crops now unaffected, nor have been for a number of years, so no action required.

Severity Level (1/10)

Recommendations- The fact that elephants do not seem to raid crops right next to the forest edge and the road in this area is very interesting and should be investigated further, specifically in relation to land use planning.

4. Pilot Field Mitigation Methods- summaries

4.1 Chilli Farming at Ntataba

Rationale- Farming chilli achieves two major purposes related to human elephant conflict mitigation:

- A) Chilli plants contain chemicals repellent to elephants. They do not like it and will try to avoid it. This allows us to use chilli to defend crops, in much the same way a human might use repellent to deter mosquitoes. The most important things to bear in mind are the elephant must be taught that they do not like the substance through physical contact and/or smell. Also, the stimuli that inform the elephant that chilli is nearby must be strong and clear. Chilli delivery devices are detailed separately below and include ropes and burning. Chilli-based repellents are much better than other repellents as elephants cannot habituate to the deterrent, but are also not permanently harmed.
- B) Chilli is a cash crop unpalatable to elephants which can be grown as an alternative product in elephant areas. This helps ensure that farmers can grow crops and generate income, securing their livelihoods and preventing conflicts. With the help of fair trade initiatives, it may be possible to create a wider market within ethical farming shops and suchlike.



Picture 13: Mexican Chilli

Application in Cabinda: The Ntataba agro-forestry site has been identified for testing of different chilli regimes for general use to burn or apply to ropes (see below) to deter elephants. Very strong chilli seeds from Mexico called habaneros are very effective for deterring elephants. These chillies can be used for sale and for mitigating conflict. It is considered that Cabindan people enjoy spicy food, so a local market, especially in Cabinda city should be accessible. Seeds have already been planted in Comboliambo mitigation site, and the products should yield enough seeds to plant in other locations, including Ntataba. Local “birds-eye” chillis are also quite strong (see photo 7). These are in abundance in the market, so these can be cultivated alongside the Mexican varieties, and sold back to a known customer base.

It is important that testing the necessary agricultural conditions for these chillies is conducted scientifically, growing chillies in multiple soil types and shadiness. Also, replication of growth will ensure that results are more robust. The ideal strength for the chilli is very potent but still edible, to facilitate sales. Also, it would be good to identify fast growing chillies in the short term to assist local farmers with developing chilli-based HEC mitigation techniques. These could be sold at a subsidised price to interested villagers.

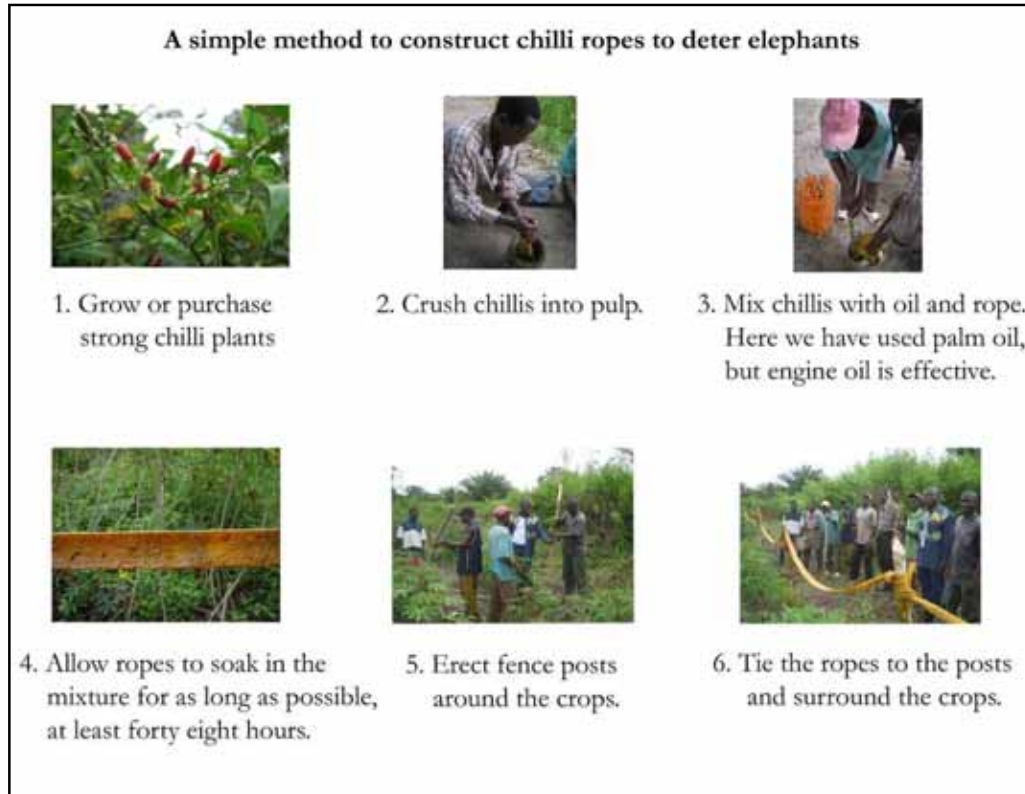
4.2 Chilli Ropes at Comboliambo I

Rationale – Ropes treated with a chilli-based water repellent paste, often using oil, act as an effective and visible delivery device of large amounts of chilli onto the skins of elephants. This causes an irritant effect on the skin of the elephant for a prolonged period, as the elephant cannot easily mechanically rub off the substance. As the paste is oil based, it also takes time to remove in water. However, there is no permanent damage and the elephant does not suffer greatly.



Picture 14: Prepared Ropes

In order to assure the sustainability and low cost of this method, it is important to assess local availability of ropes, chilli and viscous oil. In each area, these are likely to be slightly different products. The cheapest combination found in Cabinda was flat nylon ropes from Cabinda City, with locally produced palm oil and local “birds eye” chilli. Whilst we purchased the ropes on this occasion, it may be possible to create basket weave strips instead in the future. We purchased most of the chilli on this mission, but in future it is expected that the small chilli plantation we established at Comboliabo would supply some of the needs, whilst in the medium term a larger plantation and test site at Ntataba would be a source. We also used engine oil as well as palm oil in the preliminary test phases, but this was decided to be restrictively expensive and equivalent to palm oil. This contrasts with Cambodia in Southeast Asia, where **used** engine oil is readily available and very cheap. The used oil is normally used for greasing motorbike chains or as a wood preservative on houses (H. Sothea, pers. comm.).



Testing of rope combinations- A variety of stages were completed before erecting our full chilli rope array to ensure ratios were correct, and factors such as rain did not have a detrimental effect.

- Initial ratios (test piece)- Stakes were erected at 5m intervals to ensure that when elephants come through the rope, they do not knock down large areas of the perimeter. In this way, the maximum application of chilli paste to the raiding elephants is possible. Initially, 20m of rope was tested to see if it would hold the paste sufficiently well. Also, at this point, the team experimented with different types of rope including a thin natural rope, as well as the wider and preferred nylon matted rope.
- Second ratios (75m for rain test)- For this test, we used 30 cups (one cup approx. 25g) “birds eye” chilli to 3 litres oil (one set palm oil, one set engine oil) to 15m of nylon rope. This resulted in a very strong mixture, which held well to the ropes. It was felt that the quantity of chilli in the mixture could be lower without making the ropes much less effective. Also, the huge quantity of chilli that would be required for larger scale deployment was considered financially and logistically restrictive.
- Final ratios (200m for effectiveness tests)- We used 150 cups to 30 litres of palm oil to coat 200m of nylon rope. These were then established plotwide. Testing of these ropes and their repellent effect will take time, as elephants were not raiding at the time of the mission. Also, it is expected that elephants will travel through the ropes, possibly a number of times, before learning that the ropes are causing the strong irritant effect. The success of these measures **must** be monitored and modifications to the design are likely to be necessary, based upon the responses of the elephants.

4.3 Buffer clearing at Comboliambo I

Rationale – Clearing a buffer around a crop field assists in mitigation of human-elephant conflict in two main ways:

- a) The elephants can perceive a clear demarcation between crop land and scrubby forest areas. This means that *if* other mitigation and elephant repellent techniques are being effective, the elephant will be aware of crossing “the threshold” and be less inclined to damage the crops around the edge of the plantation.
- b) It is surprisingly difficult to detect elephants moving, especially at dusk or night time. The buffers allow spotters to more clearly observe elephants attempting to enter the plantation and can be ready with active mitigation devices.

4.4 Lookout post at Comboliambo I

Rationale- By helping observers view from a distance above the crops, and for similar reasons to the buffer, early warnings of elephant raids are possible, ensuring maximum time to react, and consequently minimum damage by raiders. In this case, a simple ladder up a tree with a cleared path from the houses was constructed. This provides a view of the whole farm area, is relatively simple and very strong and safe.



Picture 15: Ladder for spotting elephants

In this case, the plantation is close enough to the houses (30m) that regular checks can be made using the ladder. In some areas, however, it may be necessary for those guarding the crops to stay overnight. In this case, a small tree house can be constructed, with enough space for one or two people to sleep.

4.5 Noise makers & torches

Rationale- It is clear that elephants are deterred by sounds they perceive to indicate danger. In the past, the presence of a human, often with a gun, would have ensured elephants stay away from people. However, elephants are highly intelligent and habituate to sounds that they know to be non-threatening. So, whilst loud bangs may be used to scare away elephants, this becomes less effective over time. Having said that, very loud and unusual noises (such as fog horns) can scare elephants away if used sparingly. However, noises should signal a number of measures are likely to be used, so that the elephants learn that the noise is relating to negative stimuli, such as burning of chilli or the presence of chilli ropes. Also, a loud blast of a fog horn can awake other villagers to assist in driving away the elephants.

Bright lights also seem to scare elephants, if used sparingly. Powerful torches are cheap and effective mitigation methods, although elephants will also habituate to these if used alone. Elephants usually raid at dusk or in the dark, so creating a well lit scene makes them less confident and easier to drive away.

In this case, a 120db personal foghorn was donated to the Comboliambo test site for use when elephants come. This has been rigged up for use when elephants come. At the time of the mission, no raiding was occurring, so follow up will be required on this method.

4.6 Fires as deterrents

Rationale- Fire has been an age old mitigation technique used throughout the elephants' range. In a similar manner to bright lights and torches, elephants become gradually bolder around fire, as they weigh up the cost-benefit ratio of approaching the fires and attractive crops nearby.

In a recent variation on this theme, tests have been conducted in Africa and Asia to burn hot chilli as well as elephant dung producing an acrid smoke. This has been used quite successfully in Cambodia for small numbers of raiding elephants, though of course its effectiveness is linked to proximity and wind direction. But it certainly makes it more difficult for the elephant to concentrate on eating food. In this case, we cut oil barrels in half to hold the fires and placed them in appropriate locations to maximise the chances of the elephants being affected by the smoke.

4.7 Staying with crops

Rationale- vigilance around crops is deemed to be the most effective method of minimising crop damage by elephants. Guarding crops in-situ is key to using any mitigation method effectively. Some conservation initiatives in Zimbabwe have gone so far as to refuse assistance to farmers who will not sleep in shelters near their crops. In Cabinda, as in much of the equatorial forest belt, it is not in the culture to sleep in isolated crop fields, but rather to return to a central village location at night. Whilst this may be a safer option in terms of wild animals (though this is generally an exaggerated

threat), it does leave crops very vulnerable to the ravages of wild elephants, and in Belize district, wild forest buffalo.

This is a complex cultural issue. Farmers interviewed during this mission indicated a willingness to stay with their crops in some situations, but would need assistance to build comfortable shelters and a suite of effective scaring devices including many of the aforementioned. One way to address this issue is to plant crops nearer to the villages (inevitably on poorer soil), though it should be noted that elephants in close proximity to people increases the risk of personal injury.

Underpinning this need is a culture of forest farming which is arguably the main style of rural agriculture in Cabinda. The good soil of the forest is often targeted for planting crops, but usually due to its fragile nature only capable of a couple of seasons before the nutrients are exhausted and the area becomes useless. In this way, a lot of unnecessary forest degradation occurs which is a major conservation issue. It should be a priority of national and provincial authorities to begin a participatory land-use planning process, as well as to provide technical support to farmers developing crops in non-forest areas. As we can see from the satellite images, the land to the east of the province still has excellent intact forest. This type of farming will degrade and fragment the forested elephant range, ultimately increasing human-elephant conflict.

4.8 Scarecrows – rationale

As with any rural farming scenario, effigies of people can create the illusion that people are in the field. Often spraying the scarecrows with perfume or soap can further confuse the elephants. In Cambodia, hammocks stuffed with pillows and sprayed with perfume are effective barriers at known elephant access points (author's own obs.)!

Scarecrows should be moved around regularly and put on clear display for maximum effect.

In this case, we used old clothes donated from Cabinda city. It was interesting to note that some of the clothes were of such a good quality that the villagers decided to use them for themselves.



Picture 16: Scarecrows at Comboliambo

5. GIS analysis and description

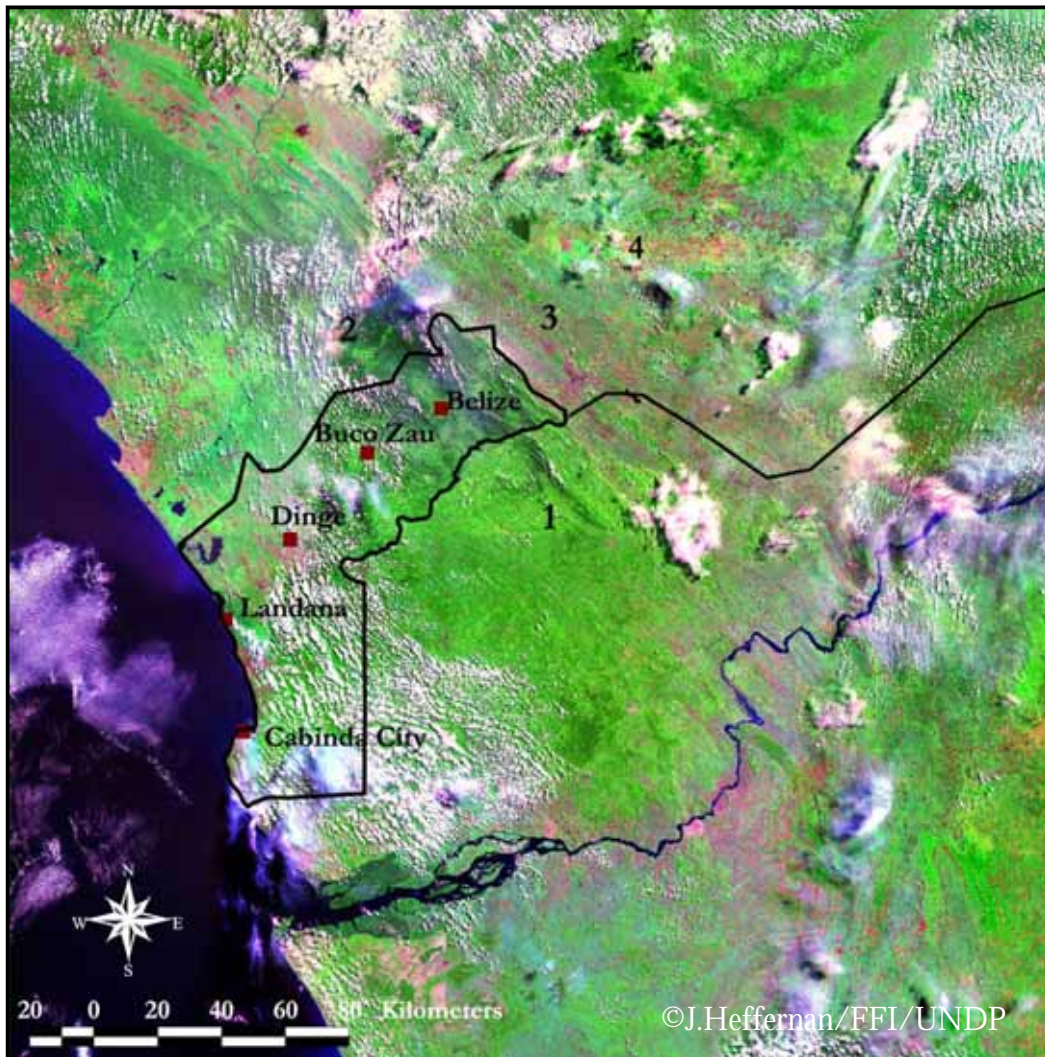
5.1 Background

The following images are taken by the Landsat 7 satellite around May 2000. The following table provides a basic guide to the colour scheme on the maps. Often the location of roads and towns have been a best guess from GPS point data collected on site and features of the satellite imagery indicating the presence of humans. Also, it should be borne in mind that this data is five years old. Whilst much has changed in five years, it is also surprising how much remains unchanged at a broader scale. It would be worth ground truthing a number of areas to check accuracy.

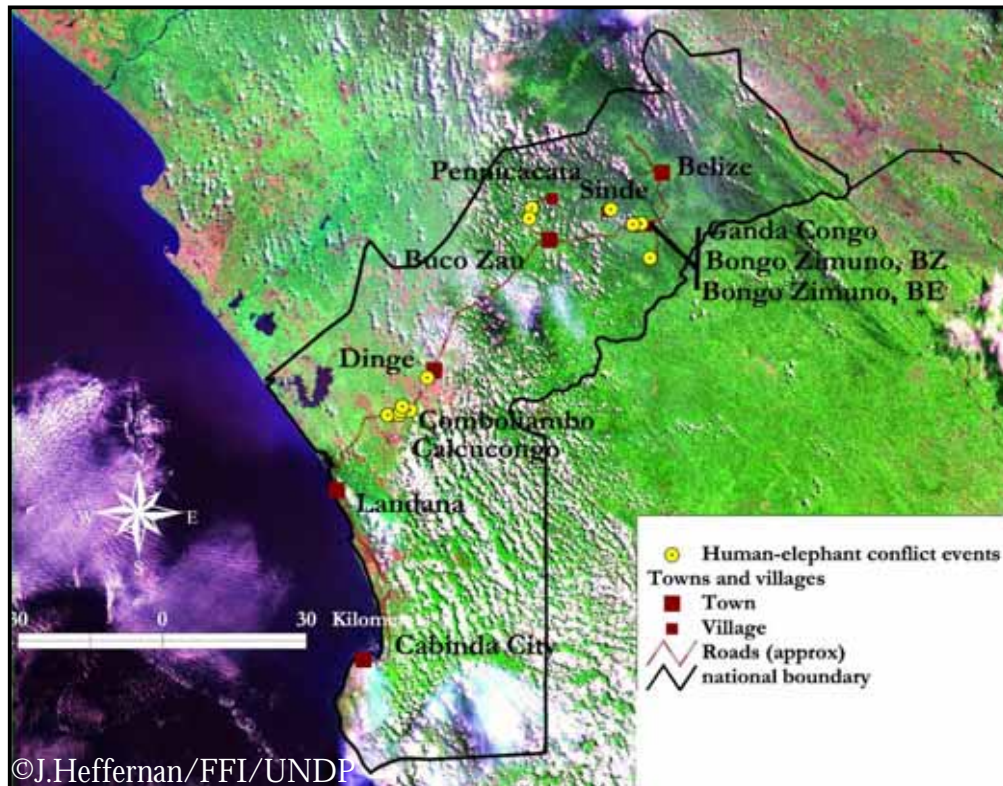
Table 1: The appearance of different surface features for Landsat 7 (*Landsat tutorial, 2005*)

	SWIR (GeoCover) Landsat 7; ETM+
Trees and bushes	Shades of green
Crops	Shades of green
Wetland Vegetation	Shades of green
Water	Black to dark blue
Urban areas	Lavender
Bare soil	Magenta, Lavender, or pale pink

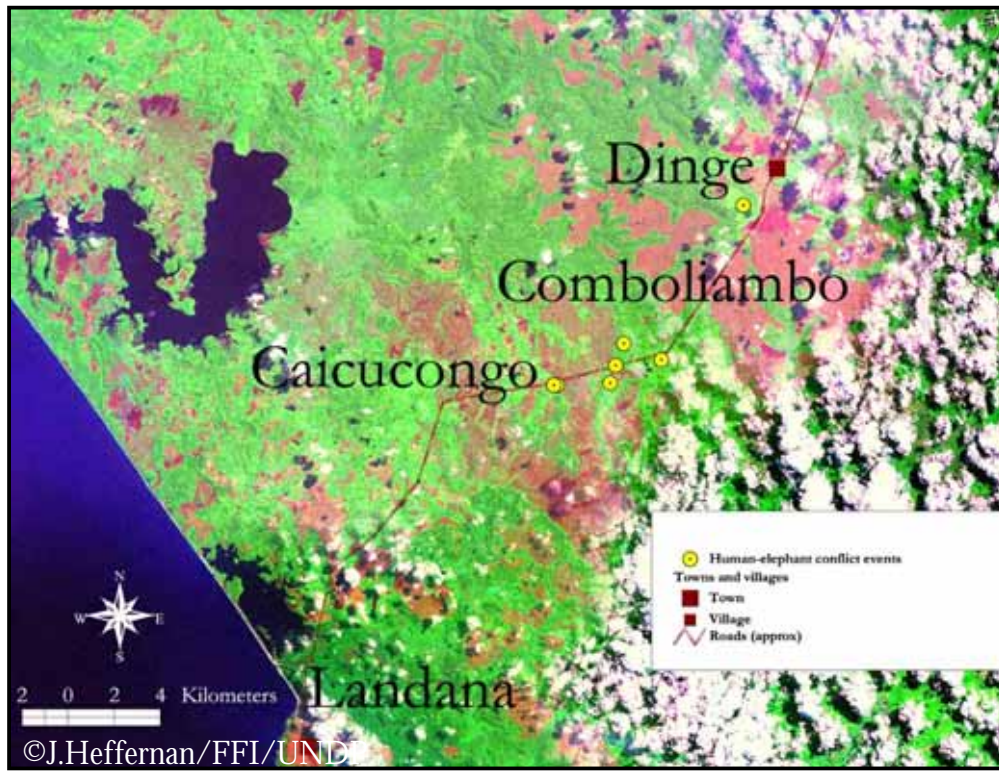
5.2. Map 3: Landsat 7 orthorectified image for Cabinda and surrounding countries



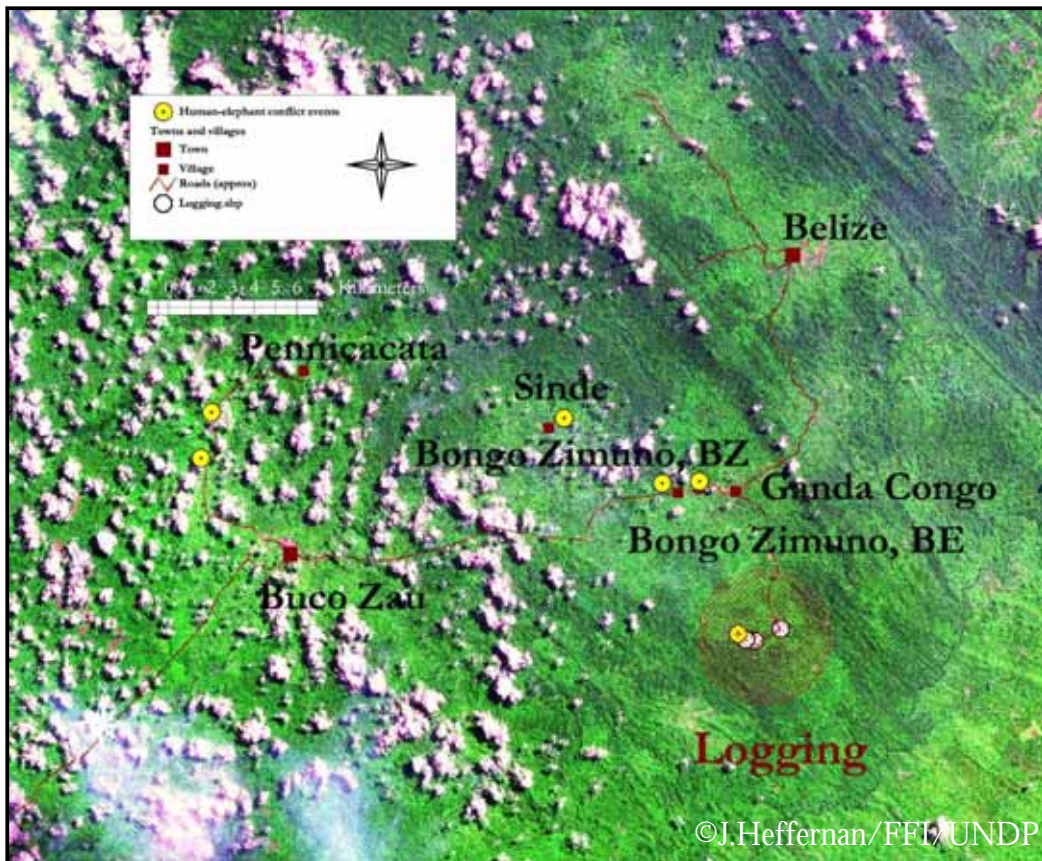
5.3. Map 4: Human-elephant conflict events with forest cover, Cabinda Province.



5.4. Map 5: Priority HEC area 1: Dingé/Comboliambo



5.5. Map 6: Priority HEC area 2: Buco Zau/Gandacongo



5.6 Initial observations from visual study of 2000 Landsat images

- a) Two major concentrations of HEC, c.40km apart. It is likely that separate groups are operating in the two areas, due to the different habitat conditions and distance between the groups (map 4).
 - i) Dingé/Comboliambo in fragmented habitat, isolated from main forest estate (map 4&5). Probably single group, living in isolated forest patches, often a conflict scenario. Long term prospects for these animals are not good, with much clear felling and agricultural development nearby. If they are felt to be of sufficient conservation concern, relocation of these animals further east in to the Maiombe area should be considered. Bearing in mind this image is around five years old, there does appear to be a distinction between areas c.12km northeast of Dingé and those to the west. The eastern areas constitute the intact unfragmented forest area, whilst western areas are fragmented with extensive clear felled land.
 - ii) Buco Zau/Gandacongo in intact secondary forest, centred on main road (map 4 & 6). Logging is occurring in the deep evergreen forest. This may have displaced elephants, which have moved into crops further away from the logging zones. This phenomenon has been described in Malaysia and Indonesia (Sumatra), in light of rapid development (Kinnaird, *et al.*, 2003). HEC events almost all occur in secondary forest areas, though this could well correlate with human presence and therefore crops.

- b) Surrounding countries have less intact forest areas, with a great deal of human pressure, especially in the north and northeast. The forest quality inside Cabinda far exceeds that of the surrounding countries. This has significant implications for any transboundary linkages.
- i) A priority transboundary linkage would be to the south of Belize district, where there is contiguous, relatively unsettled forest areas inside DRC, down to the Zaire River (id 1; map 3).
 - ii) However, the forest areas to the north and northeast inside the Republic of Congo are degraded, and human population pressure is high, with 70% of the population living in Kinshasa and Point and the train track between (CIA factbook, 2005)(id 2; map 3). Whilst the population of the Republic of Congo is only c.3 million people, the implications are that this will be the major development belt for this vast country. The other barrier is the mountain ridges to the northeast of Cabinda (id 3; map 3). These are likely to be barriers to migration, not least because there is little vegetation remaining and huge agro-industrial areas on the plains on the Republic of Congo side (id 4; map 3).

6. Discussion of human-elephant conflict in Cabinda

6.1 Crop raiding and landscape ecology

Conflict between humans and elephants in Cabinda has been occurring for a very long time. However, it does appear that the severity of the issue has increased in recent years, with many people complaining of extensive damage and negative impacts on their lives. As Mr. Omondi, a member of the IUCN's specialist taskforce on this matter recently stated, our approach needs to be applied at many scales (Omondi, 2004). From the province-wide land use planners to the local community associations, all must pitch in to minimize the damage caused by elephants to the local economy.

It should be highlighted that there appears to be two specific "hotspots" in the province; one centred around Comboliambo and one to the east of Buco Zau. These areas (see maps 4 & 5) are suffering considerable losses, and tension amongst local residents is increasing rapidly. It appears that there are multiple groups of elephants involved, probably one main raiding group per site. Elephant numbers always vary widely from eye witness accounts, due in part to the chaotic nature of sightings, with people or elephants often moving away in dense undergrowth. However, according to the interview data collected, the maximum raiding size quoted was thirteen, with the minimum, one. The median group size quoted was three. It has been shown that males are far more likely to raid than females (Hoare, 1999), but that family groups also find benefit from attacking crops. For example, it does appear that in Comboliambo multiple animals come together to raid, (though see below for discussion of fragmentation), whilst according the footprints near to Pennicacatta, only a single large male is causing problems in that area.

Elephants, when raiding, are essentially following an optimal foraging strategy, and trying to maximize the nutrients they ingest for the least work (or risk) possible. By increasing the perceived risk and workload for elephants, we can affect this ratio and prevent damage, at least partly. It has been shown that fragmented forests increase the likelihood of crop raiding, probably due to a greater perimeter of forest to crops, as well as a greater olfactory stimulus for elephants living near to crops (Nath & Sukumar, 1998). In Comboliambo, we can see from the satellite imagery that the forest is extremely degraded, and fragmented. Also, worryingly, some forest areas are entirely isolated from the main Maiombe forest belt, which means that the elephant are geographically isolated from any other herds. This type of landscape is prime for HEC and the only solution available would be to translocate the elephants into a more remote forest area.



Picture 17: Clear felling for agriculture, causing fragmentation

6.2 Crop raiding and communities

It is not clear at the moment the size or trends in the human population in Cabinda. From the available information, the population is growing, though the fluid situation of conflict in the province makes censusing people very difficult. It has been indicated that there is a substantial 3.3% growth rate in the province, though tempered by likely high HIV transmission rates. The forest areas will probably come under increasing pressure in

the future. A typical post conflict scenario, as seen in Liberia or Cambodia, would be the most likely vision for the future. In this scenario, rampant extraction of resources occurs as people seek to secure their livelihoods, and stake a claim to some form of wealth. Also, unemployed soldiers and their families are given land for their service, causing degradation of the forest estate. Rebuilding can strip the forests and lawlessness facilitates poaching and trade in wildlife. It is important that natural resource managers, e.g. government officials and biologists, prepare a clear action plan and implement rulings on protected areas as soon as possible to ensure a legal mandate for important biodiversity areas (Shambaugh, *et al.* 2001).

6.3 Addressing conflict at the site level

Due to the high availability of weapons and low institutional presence in rural areas, it is relatively easy and quite likely that people will shoot elephants, as retribution for damage. In many cases, the elephants that are shot are not the elephants causing the damage. Also, there is discussion that shooting persistent crop raiders just causes another to take up the ecological niche (Hoare, 1999). However, a negative message has been sent by the provincial government, who has furnished the people of Sinda with a high velocity rifle, ostensibly to shoot into the air if elephants come.



Picture 18: Government issued elephant deterrent!

It should be restated that HEC is a long term issue in Cabinda, with communities all stating that the problem has been continuing longer than they can remember. The Portuguese were regular hunters, as were the Belgians in nearby Congo, exporting tonnes of ivory to Europe during the colonial period. Also, elephant was known to be eaten here, as with much bushmeat, providing further incentive to hunt elephants.

The problem is severe in the few communities affected. People are very poor and elephants are having a major impact on their livelihoods. Tolerance to HEC appears to be very low, and something does have to be done. It is the opinion of the author that a coherent package of mitigation measures and strategic landuse and agricultural planning will mitigate the problem greatly (though not prevent it completely). Compensation is being demanded by many communities, especially in GandaCongo. Compensation schemes have regularly turned out as disasters, causing major institutional headaches, whilst have no effect on the crop raiding frequency. In fact, according to some government officials in India, their accounts show raids increasing in frequency and severity (Sukumar, 2004)! It can also be very difficult to verify all claims, especially in a wet forest environment like Cabinda.

6.4 Farmers and their crops

Unfortunately, crop raiding has the greatest negative effect on the poorest farmers (Nath & Sukumar, 1998; Goldthorpe, *et al.*, 2003). The one-off effect of an entire harvest being destroyed for one farmer causes great anxiety to the individual, and often further hardship. In order to manage this problem, it is critical that an intervention by the provincial department continues to provide support and ideas for mitigation of conflict at a site level, as well as in-depth discussions on crop placements and the legally

protected status of elephants. Conflict will always occur, but tolerance to damage can be increased if people have more stable livelihoods and food security.

Many villages have taken a proactive approach to conflict mitigation. Often entire villages have relocated their crops to safer areas, away from elephant signs. However, during meetings, many villagers complained that the areas they have relocated to do not have such good soils and, in some cases, are planning to return to the elephant areas, a move which may not always be advisable. The forces of nature (in this case, elephants) can be extremely strong, and often it is better to be adaptable than try and force your preferred course of action. It does appear that forest farming is the preferred method in



Picture 19: Families preparing chilli ropes

Cabinda. This practice is normal and sustainable for small groups of subsistence farmers, but on a larger scale and with more people, this method of farming is very destructive, and in some cases, exacerbates contact and conflict with wild animals.

The crops being planted in Cabinda are generally similar, banana, maize and cassava (manioc), and some development work to ensure these species can grow in less than optimal soil conditions would ensure food security and reduce local reliance on deep forest farming.

It is of specific interest that chilli is already growing in some areas, specifically around Ganda Congo. The repellent effect of chilli to elephants and the potential market for the product does provide an alternative crop choice for local farmers, especially if assisted. Already, hot Mexican chillies have been planted at Comboliambo as a pilot test, so progress of these should be monitored, as well as their palatability. Local chilli is also relatively strong, and could be grown in areas of severe HEC, e.g. Gandacongo.in Belize. Finally, it is important to emphasise the benefits of improved community organization. Vigilance is the most effective elephant deterrent available and grouping of farms and establishing rotas for crop guarding allow the best quality of life, as well as relative security for crops, especially in the forested areas. Without intensive community involvement and organization, mitigation measures will only be able to improve the situation slightly.

6.5 Crop raiding and wildlife conservation

Populations of elephants in Cabinda are very likely to be depressed due to excessive hunting of tens, probably hundreds of years. This being the case, hunting of the species must stop until the populations recover. Whilst this is not easy, it is critical to the recovery of elephants in the province. It is important to understand the dynamic of the ivory trade in this area, and establish where the key linkages are to major trading centres. This can be done through an undercover trade study, which would be useful for a range of species in the area. However, any activities like this must be carefully discussed with provincial authorities, due to the heightened security situation in the province.



Picture 20: High value carved African ivory, China.

Logging appears to be rampant in Cabinda, with a large amount of timber being seen by the author moving openly on the main roads. It is very unlikely it is occurring under a sustainable forest management plan, which must be in place prior to granting logging concessions. Also, local logging operations appear to be underway, probably for building timber, particularly around Bucu Zau. It is important these are regulated, and a proper example of good conduct set by local officials. According the Convention for Biodiversity which the MPLA signed in 1998, regulation of relevant processes should be established when there is significant adverse effect on biological diversity. All logging should necessarily be put on hold until a full evaluation has occurred. In a post-conflict scenario, as Cabinda is rapidly becoming, private sector exploitation of resources may not represent the best future for the province (Shambaugh et al., 2001)



Picture 21: Mechanised logging, commercial and local.

In looking to recover the elephant population, large areas must be set aside for elephants to live in and complete their normal migratory cycles. It is very likely that most of the elephants living in Cabinda are not crop raiding, as signs showed only small groups to be causing damage. This is very positive as it means the behaviour of raiding crops is not too widespread, and protection of intact forest areas should satisfy the elephant's needs. Most of the areas to the east of Dingo town are covered in forest and are ideal for elephants. Extensive surveys of these forests to pinpoint high elephant density areas would be very useful, leading to effective establishment of protection zones. These could then be managed and funds sought for protection. This type of activity is most likely to be needed due to the broad access for people into the forest from any population centres, even outside of Cabinda.

Importantly, it is not just elephant populations that have come under severe pressure, the bushmeat trade is lively and diverse in Cabinda, judging by the plethora of guenons and duikers, generally being sold by young men on the roadside, province-wide. Other important species known in the province include the great apes, forest dwarf buffalo, as well as an array of smaller mammals and birds. Protected areas would provide a haven

for a wide range of species, though locating and establishing these areas should be carefully managed to ensure a good range of biodiversity, and take account of human needs in this poverty stricken province. This requires an intensive period of biological surveying and social assessments to establish a balanced approach with local buy in.

It does appear that Cabinda is coming to the end of its present period of unrest, as the insurgency is put down province-wide. Whilst a large number of troops are still on the ground, the numbers of opposition forces are said to be few and scattered. It is imperative that conservationists seize the initiative as the province opens up again to secure the important biodiversity areas from the inevitable economic land and resource grab that usually marks the end of hostilities, for example in Liberia and Cambodia.

It has been mooted that a key lever to establishing a higher profile for biodiversity would be through the concepts of transboundary protected areas and co-operation. Whilst this can help to increase the area of land being conserved, it can also become a boondoggle for endless unrelated government liaison meetings, often focused on logging quotas. According to the satellite imagery, Cabinda held some of the best primary forest in the region as of 2000, and so negotiations on transboundary co-operation should reflect that fact. In the opinion of the author, having solely examined the satellite imagery from 2000, the Republic Of Congo, offers little good forest to add to the Cabinda block, especially to the northeast with major human transformation of the landscape. However, the forest south of Belize district in DRC does appear to be in relatively good condition, all the way to the Congo River.

Monitoring activities for elephants could be facilitated by involvement with the CITES MIKE Programme and its director has expressed an interest in getting involved with Cabinda. This would provide a framework for government officers to access the field and assess population status, as well as illegal killings, human-elephant conflict etc. However, it is important to note that MIKE does not pay government salaries under any circumstances, although it can provide equipment and support in other ways.



Picture 22: Selection of bushmeat for sale in Cabinda.

7. Outline Strategy for mitigation of HEC in Cabinda

Proposed Goal

Mitigation of human-elephant conflict at present sites to minimum possible level, and to prevent further conflict events regularly occurring elsewhere.

Proposed Objectives

- Prevent further fragmentation of key elephant areas
- Assist local people to manage conflict locally and successfully
- Engage support from provincial authorities to manage land use effectively and to teach simple conflict mitigation techniques to rural communities

Preferred Options

Institutional (Govt., national & provincial)

1. Need for standardised reporting system & further training
 - a) Proposed reporting team structure:
 - a. Provincial team for reporting & providing mitigation support
 - b. Local representative in each district (comunidad)
 - c. Provincially-based GIS/mapping technician
 - b) Training Requirements:
 - a. Provincial team members need to develop their skills further through reading literature & through visits to other FOREST human-elephant conflict sites, possibly in Kenya or Asia.
 - b. Local representatives can be trained in data collection by provincial team members according the AfESG HETF training protocols, which have just been translated into Portuguese.
 - c. Training of GIS technician should be initiated, either through bringing external technical support or sending him to a training course.
2. Programme to improve productivity of crops on non-forest lands required to prevent forest encroachment for farming, which is causing increased human-elephant conflict
3. Land-use planning process should be initiated (probably requiring interministerial representation and co-operation) to demarcate & manage communities' agricultural land, as well as to identify & gazette important natural areas for protection of biodiversity & environmental services, particularly watershed protection.
4. Initiate programme to bring in technical expertise in managing areas for biodiversity, providing important safe areas for elephants. Specialists in: Protected Areas planning, forest wildlife management. Also, specialists in forest buffalo, great apes and elephants should be contracted to develop species recovery plans. Possible partner agencies could include: IUCN, UNDP, or other international conservation groups. CITES MIKE¹ officers should also be included in any planning process, due to their elephant data requirements.

¹ CITES MIKE is a programme commissioned by the Conference of Parties to CITES (including Cabinda), in accordance with the resolution 10.10. The programme is designed to monitor wild elephant populations

5. Efforts should be made to secure elephant populations, specifically their keystone and flagship importance. Specific threats that need to be addressed include:
 - a. Illegal killings of elephants
 - b. Forest destruction through unsustainable timber extraction & agricultural encroachment
 - c. Lack of wildlife sanctuaries for security of elephants, as well as other wildlife & plant species.
6. It is specifically recommended NOT to give monetary compensation as this tends to cause more problems than it solves. It has no direct effect on lessening the frequency or severity of elephant raids, except for possibly encouraging false claims. This advice is in accordance with the IUCN SSC African elephant specialist group's position.

Local (commune and village)

1. Agricultural crops need to be arranged into fields with clear definition of boundaries to improve effectiveness of any conflict mitigation techniques.
2. Awareness programme on the value of biodiversity with elephants as a local flagship should be implemented, using leaflets & trained staff holding community meetings.
3. Establish conflict resolution committees, which can give guidance and also acknowledge joint responsibility for conflict events. Members of the comunidad, and provincial officials should sit on the committee, as well as farmer's representatives and technical staff.
4. Crops grown entirely in the forest should be guarded, especially when they are ripening. This will involve a significant change to cultural tradition.
5. Further forest farming should be avoided, especially in known areas of elephant presence. It is extremely difficult to avoid conflict in these situations.
6. Efforts should be made (ideally with external assistance) to improve productivity of agriculture in non-forest areas.
7. Affected communities should be assisted to visit the pilot site established in Comboliambo village, CaCongo. This will give ideas of how to manage their areas.
8. The following methods should continue to be field trialled & developed to suit the local situation (Details given in "pilot field mitigation methods") section).

For all areas:

Lookout posts/ ladders; noise making; shining lights; making fires.

Specifically in:

Chilli farming; chilli ropes; clearing buffers.

Specifically in forested areas:

Staying with crops (especially at night); moving crops out of high risk areas.

in Africa & Asia, to determine any effect of changes to the legality of ivory trade, if so agreed by CITES. This programme should have already begun in Cabinda should be included.

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