PROTECTED AREAS AS REFUGES FOR ELEFHANTS

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collected by Iain Douglas-Hamilton

In the course of the present review, emphasis has been placed on
determining whether the different vegetation types of Africa are adequately
covered in the existing protected areas system. This approach is based on the
expectation that if the habitat is intact the constituent species of that
habitat will be protected. This expectation is particularly weak for those
species which are threatened by direct human pressures such as hunting,
poaching, overharvesting or persecution rather than habitat loss or habitat
degradation. As a check, the distribution patterns of various selected groups
of species have been examined to see if the system of protected areas does
indeed provide sanctuary for the full range of species and in particular those
species known to be rare or threatened. Lists of species records for chosen
protected areas have been examined to evaluate the degree of such protection
coverage (section IV.6).

Whether the protected areas will be able to maintain their present species
composition over time can be only roughly predicted given the current state of
understanding of local extinction phenomena. The fate of individual species of
concern must be monitored by long-term sampling and re-inventory. Such data are
not available for most species but we do have continent-wide information on
the status of elephants, collected by Iain Douglas-Hamilton (1979) as part of
the African Elephant Survey and Conservation Programme, funded by WWF-US and
New York Zoological Society. In this section we therefore intend to analyse
the long-term and current trends in elephant populations to throw further light
on the effectiveness of the existing protected area system of the realm.

The elephant makes a particularly suitable indicator species because it is
large and conspicuous, and data on its distribution can be easily collected
from both ground and aerial surveys. Long-term data are available from some
areas in the form of registered kills, tusk exports etc. Both living and dead
elephants can be counted with fair reliability from aerial survey
(Douglas-Hamilton, 1984). The health of an elephant population reflects both
the adequacy of habitat and the adequacy of anti-poaching measures. In addition
to these advantages, the elephant is the mammal species with the broadest
habitat range in the realm. Elephants can live in all types of vegetation from
sea level to high mountain slopes, from the wettest rain-forests to some of the
most arid semi-deserts. It was only in the extremely arid regions of North
Africa and the Namib/Kalahari deserts that elephants were not seen and reported
by the earliest European explorers to the continent.

Today, however, the elephant's range has been drastically reduced, to about one
third of its former extent. There are now large parts of Africa where
elephants have not been seen for decades. The elephant's range declines as the
natural ecosystems of which it is a part also decline. We have used elephant
range as an indicator of conservation condition by measuring the percentage of
each sub-Saharan vegetation zone and biogeographic unit which is still elephant
range.

In 1979, the African Elephant Survey and Conservation Programme collected a
large volume of data concerning the status and distribution of the African
elephant. A map of elephant range (Fig. 1) was made from this data and
overlaid on the UNESCO vegetation map of Africa (White, 1983). The amount of

FIGURE ONE   DISTRIBUTION OF ELEPHANTS IN 1979
(Source - Douglas Hamilton, 1979)

Key:

Known Elephant
Distribution

0 250 500   1000 km
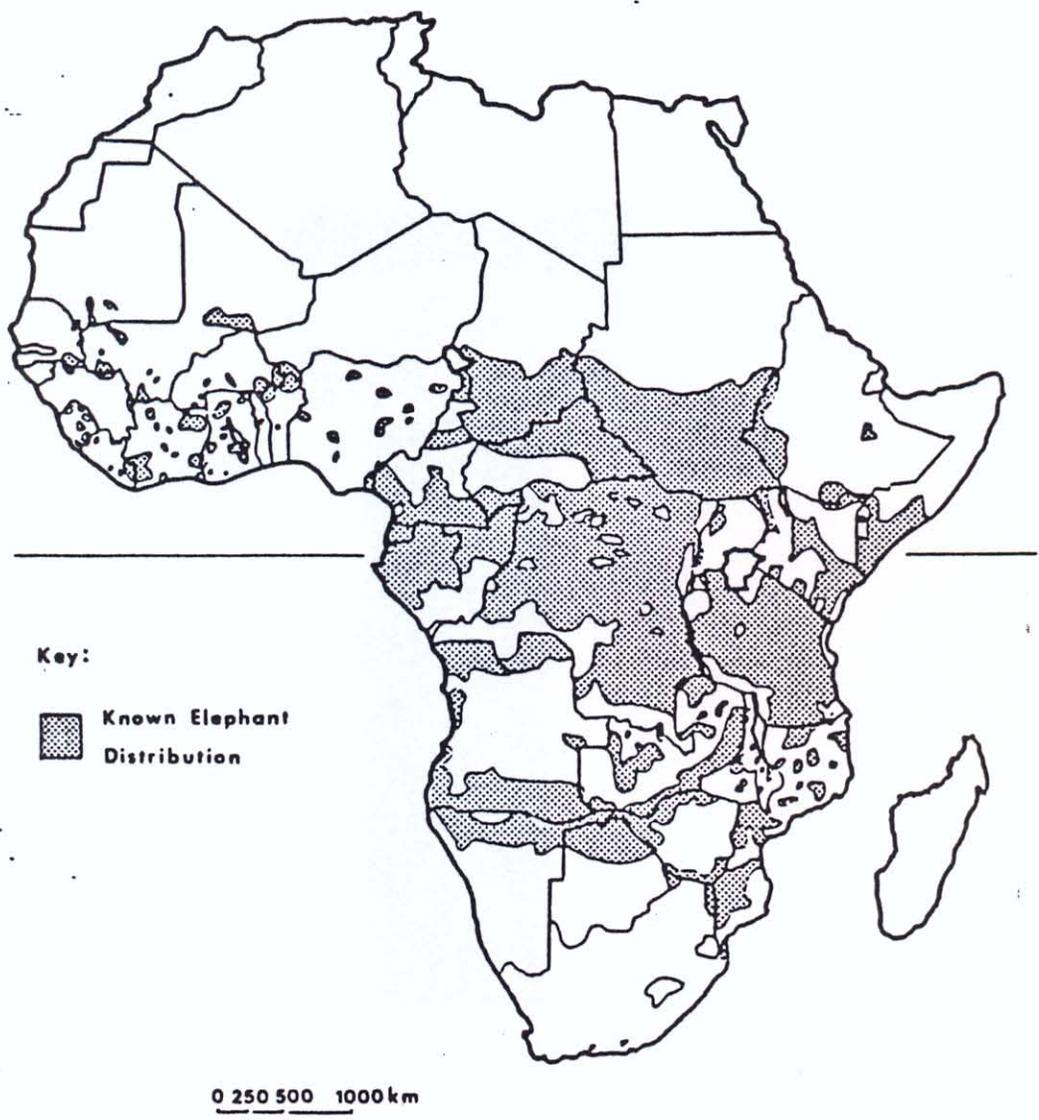
current elephant range and the total area were measured for each vegetation zone within each biogeographic unit (botanical phytochoria), excluding the parts of the Kalahari and Namib deserts where elephant are believed to have never occurred. These vegetation areas, equivalent to present and original elephant range, were then scored for each region. Protected areas were also plotted on the overlaid maps to determine the percentage of remaining elephant range which is protected in each region.

The status of the African elephant was first considered on a continental scale by biogeographic phytochoria (Fig. 2). Only two of the 14 units (I - Guinea-Congolian and X - Guinea-Congolia/Zambesian transition) showed 50% or more elephant range remaining. Of the remaining units, seven had less than 20% elephant range. Some of these areas of low remaining elephant range have already been the target of conservation measures. The Tongaland-Pondoland region (XV), for example has 38% of its remaining elephant range protected. However, other areas with low amounts of remaining elephant range have very little protected and require further conservation action to protect elephants. Units most underprotected include: VI (Karoo-Namib), XI (Guinea-Congolia/ Sudania Transition), and XIV (Kalahari Highveld). Each of these biogeographic units has less than 25% of its original elephant range remaining and less than 10% of that is protected. Other units with limited elephant range and limited protection in these areas are VIII (Afromontane) and XVI (Sahel). All of these units are in danger of losing their elephant populations.

Next in priority for additional protection are those units which still have large areas of elephant range, but where very little is protected. Without adequate protection, the natural habitat in these units may diminish until they too become threatened or their elephant populations are eliminated by uncontrolled poaching. Biogeographic units falling into this category include I (Guinea-Congolian), X (Guinea-Congolia - Zambezian transition), and XIII (Zanzibar Inhambane).

The units with relatively high percentages of elephant range remaining and much of this range protected, such as phytochoria II (Zambesian) and IV (Somalia-Masai), clearly have the lowest priority for additional protected areas, though protective measures or management in protected areas may need improvement.

The same data were also analysed to evaluate the status of elephants on the basis of vegetation (Figure 3). Vegetation types were grouped into biome classes such as forest, woodland, bushland etc., but could also be considered individually. The priorities for increased protection within vegetation zones, as for biogeographic units, are here based on the amount of natural elephant range remaining and the extent of its protection.

Vegetation types with less than 20% elephant range remaining are montane and arid areas. Both of these types also have only small amounts of their original elephant range protected. Thus remaining elephant range in these types should be a high priority for additional protection.

Secondary priority for additional protection is accorded to those vegetation types with higher percentages of remaining elephant range but low proportional protection. The most critical regions in this category are forests and mangroves (probably not essential for elephants), each of which have less than 5% of their remaining elephant habitat protected. Also somewhat underprotected

FIGURE TWO

Biogeographic Realm		Area ('00 km sq)	Natural Habitat (% elephant range)	% of Natural Habitat Protect
I	Guinea – Congolian	28155	70	A
II	Zambezian	39236	41	D
III	Sudanian	35671	48	C
IV	Somalia – Masai	19899	24	D
V	Cape	752	0	–
VI	Karoo – Namib	4739	14	A
VIII	Afromontane	6453	16	C
X	Guinea – Congolia / Zambezian transition	7362	62	B
XI	Guinea – Congolian / Sudania transition	12479	20	B
XII	Lake Victoria	2074	21	D
XIII	Zanzibar Inhambane	3799	32	A
XIV	Kalahari – Highveld	9525	13	B
XV	Tongaland – Pondoland	1474	12	E
XVI	Sahel	24368	6	C

Percent Protected:
A less than 5%
B 5 – 10 %
C 11 – 20 %
D 21 – 30 %
E 31 – 40 %

FIGURE THREE

Vegetation Zone	Area ('00 km sq)	Natural Habitat (% elephant range)	% of Natural Habitat Protected
Forest	26512	72	A
Forest/Grassland transition	27726	35	B
Woodland	62672	38	D
Woodland/Grassland transition	8161	62	B
Bushland	29447	21	D
Bushland/Grassland transition	4126	29	E
Grassland	5219	44	B
Montane	6086	14	C
Arid and semi-arid	22584	4	A
Aquatic	2396	54	C
Halophytic	501	74	C
Mangrove Swamps	855	20	A

Percent Protected:

- A less than 5%
- B 5 - 10 %
- C 11 - 20 %
- D 21 - 30 %
- E 31 - 40 %

Vegetation Types in each Vegetation Class:

Forest: 1 - 10
Forest/Grassland transition: 11 - 16, 22
Woodland: 21, 25 - 30
Woodland/Grassland transition: 31 - 35, 62 - 63
Bushland: 36, 39 - 44, 49 - 50
Bushland/Grassland transition: 45 - 47, 57
Grassland: 17 - 18, 37, 58 - 61
Montane: 19 - 20, 23 - 24, 65 - 66
Arid and Semi-Arid: 51 - 56, 67 - 74
Aquatic: 64, 75
Halophytic: 76 (and unlabelled pan within 76)
Mangrove Swamps: 77

Biogeographic Realm	Vegetation Zone	Area ('00 km sq)	Natural Habitat (% elephant range)	% of Natural Habitat Protec
XI	F	523	52	C
	F/G	11735	19	B
	Mn	153	0	—
	W/G	68	0	—
XII	F	114	16	A
	F/G	1097	24	A
	W	121	39	G
	B	33	0	—
	B/G	709	15	F
XIII	F/G	3647	32	A
	Mn	151	36	B
XIV	M	692	0	—
	W/G	3091	25	A
	B	2951	17	C
	D	388	0	—
	B/G	998	0	—
	G	1405	0	—
XV	F/G	687	7	B
	W	424	29	F
	B	334	1	G
	Mn	9	39	4
XVI	B	10379	12	D
	D	13355	0	—
	W/G	198	40	A
	Aq	436	13	E

Percent Protected:

A   less than 5%
B   5 - 10 %
C   11 - 20 %
D   21 - 30 %
E   31 - 40 %
F   41 - 50 %
G   over 50%

Vegetation Zones:

F - Forest
F/G - Forest/Grassland transition
W - Woodland
W/G - Woodland/Grassland transition
B - Bushland
B/G - Bushland/Grassland transition
G - Grassland
M - Montane
D - Arid and Semi-Arid
H - Halophytic
Aq - Aquatic
Mn - Mangrove Swamps

FIGURE FIVE

Amount of Remaining Natural Habitat (Elephant Range) Protected

Information Missing — Uganda

Not applicable (no range left) — Burundi
Lesotho
Gambia
Swaziland
Djibouti
Guinea - Bissau

None — Guinea
Equatorial Guinea
Mauritania
Somalia
Congo

Less than 10 % — Zaire
Mozambique
Gabon
Cameroon
Sudan
Ethiopia

10 % to 29 % — Botswana
Chad
Namibia
Zambia
Central African Republic
Liberia
Kenya
Angola
Ivory Coast
Benin

30 % to 49 % — Zimbabwe
Niger
Nigeria
Senegal
Ghana

50 % and over — Tanzania
Togo
Sierra Leone
Burkina Faso
Mali
Malawi
South Africa
Rwanda

are remaining elephant ranges in the woodland/grassland transition zones and grassland biomes.

Woodlands, bushland and bushland/grassland transition zones are the vegetation types in least need of additional protection on the continental scale. Each of these has over 20% of their area still inhabited by elephants and a relatively large amount of this habitat protected.

Priorities can also be established by vegetation type within biogeographic unit by reference to Figure 4. Region XII (Lake Victoria Regional Mosaic), for instance, is not a priority biogeographic unit on the continental scale. However, within the region, there are clear priorities. Woodland is already well protected, but the natural areas in the forest zone and the forest/grassland transition zone are both very underprotected and would be priorities within the region.

Phytochorion XIV (Kalahari-Highveld) is, in contrast, a priority biogeographic unit, but within it there is a relatively large amount of protected natural bushland, so efforts to increase protection in this region should be focussed on the woodland/grassland transition zone.

When countries are considering priorities for additional protected areas, it is preferable to ensure that the chosen area will have regional as well as national significance. Priorities like this can be established for all countries by examining the uncompressed data included in Appendix I. (Figure 5 shows a ranking of how much of the remaining natural area, as indicated by elephant range, is already protected overall in each country.) The data in Appendix I can also be used to consider priorities based on individual vegetation categories rather than classes of vegetation types.

Declaring an area protected is the first step in maintaining the natural ecosystem. It has been shown (Douglas-Hamilton, in prep.) that in a sample of protected areas examined, large mammal densities were consistently higher within park boundaries than immediately outside. Moreover the national figures collected in 1979 by the ID-H indicate that mean densities of elephants inside protected areas were on average X.X times greater than in remaining elephant habitat outside of protected areas. It was thus estimated that XX % of the total remaining elephant population in Africa lived in protected areas although these areas account for only YY % of it total reamining range. However, protected areas vary considerably in the actual degree of protection afforded to the natural ecosystems they include and some protected areas have failed to protect their elephant populations.

We have used elephant data to evaluate the characteristics of a sample of 20 protected areas in an effort to determine how various factors affect their conservation success. These 20 areas (Ruaha, Luangwa, Manyara, Queen Elizabeth, Tsavo, Murchison Falls, Bamingui, Wankie, Kruger, Niokola-Koba, Addo, Garamba, Yankari, Chobe, N.E.Selous, Serengeti, Monovo-Gounda-St.Floris, Kasungu, Virunga and Shambe) were chosen to give a sample from across the continent and also on the availability of data indicating the change in elephant densities over a three or four year period ending about 1980. The change in densities (trend) was used as a basis for comparison rather than absolute densities which might reflect differences based strictly on habitat. The average annual change was correlated with each of several factors which we thought might have an impact on the wildlife numbers in the park. These factors

FIGURE FOUR

Biogeographic Realm	Vegetation Zone	Area ('00 km sq)	Natural Habitat (% elephant range)	% of Natural Habitat Protected
I	F	24313	76	A
	F/G	3367	30	B
	Mn	474	18	A
II	H	461	80	C
	F	387	37	A
	F/G	2723	70	E
	G	1125	11	D
	W	31000	37	D
	W/G	516	72	B
	B	193	35	E
	B/G	1559	59	E
	Aq	1272	51	C
III	F/G	15	93	D
	M	17	100	A
	W	29801	39	C
	W/G	3722	29	B
	G	1498	100	A
	Aq	618	37	B
IV	F/G	3	33	A
	B	14563	29	D
	B/G	731	24	D
	D	4294	7	B
	G	177	64	F
	Aq	70	91	A
	H	40	5	A
	Mn	21	0	-
V	F	752	0	-
VI	B	63	0	-
	D	4547	15	A
	B/G	129	0	-
VIII	G	127	100	C
	M	5377	15	C
	W	38	0	-
	B	911	7	B
X	F	422	47	A
	F/G	4452	71	A
	W	1298	29	C
	G	387	51	B
	Mn	47	53	A
	W/G	566	92	B

(Cont...)

included scores for: administrative and law enforcement capacity, political
climate, land pressures, poaching threat, economic conflict in land use,
conservation importance and investment, economic potential of wildlife,
scientific facilities and touristic facilities.

Of these, the most significant factor affecting the trend in elephant numbers
was the poaching threat (Figure 6). Only one protected area with a moderate
or high poaching threat (Chobe) showed an increase in elephant numbers. In
contrast, over half of those with little or no poaching showed an increase or
no change. All but one of the protected areas with poaching problems were
ranked as having limitations in either manpower and/or equipment provided to
combat poaching. The protected areas which were ranked as being fully equipped
and appropriately staffed to perform anti-poaching operations showed an average
increase in elephant numbers of 9% per annum, compared to a decrease of 7% per
annum for the other protected areas.

Since all of the protected areas in this study had some form of anti-poaching
unit, it is clearly indicated that the mere presence of an anti-poaching unit
is not enough to guarantee its effectiveness. In order to have results, the
anti-poaching unit must be adequately funded to hire a motivated staff and
purchase adequate equipment. An effective anti-poaching unit appears to be the
single most important factor influencing the trend in elephant numbers in the
protected areas examined.

The presence of highly developed tourist facilities also corresponded with good
conservation although the trend was not statistically significant from this
small sample. The protected areas with highly developed tourist facilities
showed an overall drop of 0.7% in elephant population compared to a drop of
4.6% for the other protected areas. This trend may simply reflect the fact
that tourists are more likely to visit protected areas in which the wildlife is
thriving but knowledge of some case histories suggests that tourism does help
conservation. Elephants and other wildlife respond quickly to the increased
security and vigilance that come with tourist developments and significant game
populations have now built up around new tourist complexes in the Mara, Tsavo
and other parks in sites that were formerly not exceptional for wildlife.

The presence of scientific research facilities in the protected areas also
corresponds with improved elephant trend (Fig. 7). Possibly for the same
reasons as above, that wildlife learns it is safe in areas where research is
going on. But there is also a good correlation with the development of tourist
and research facilities and overall good management of protected areas. Both
research and tourism development indicate that the administration takes
conservation seriously and is prepared to invest money in wildlife
conservation.

Land pressure from the surrounding rural population did not appear to have a
significant impact on elephant numbers. In fact, contrary to expectations,
protected areas with dense and expanding populations nearby had a slightly
lower decline in elephant numbers than did areas surrounded by few settlements.
(-2.7% for areas with dense and expanding human populations vs. -3.6% for
sparse human populations.) There are possibly two reasons for this. Firstly
there may be a time lag in that elephants are still being driven out of
surrounding lands and finding refuge in protected areas thus boosting park
numbers in areas of high land pressure. Secondly, poachers prefer to operate

$(R^2 = 0.0, N = 20)$

% Change in Elephant Nos

+50

+25

0

-25

10   30   50

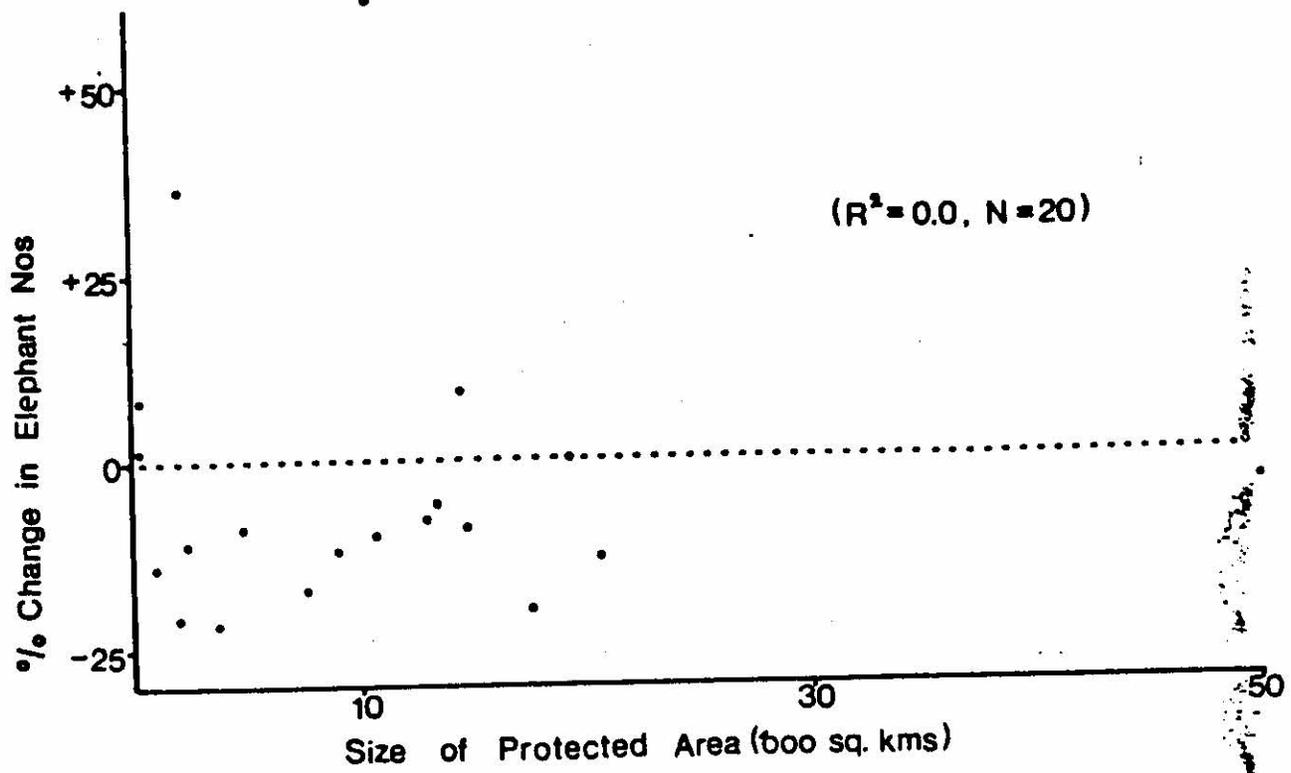Size   of   Protected   Area (boo sq. kms)

Figure Eight   Relationship between Protected Area size and change
in elephant numbers.
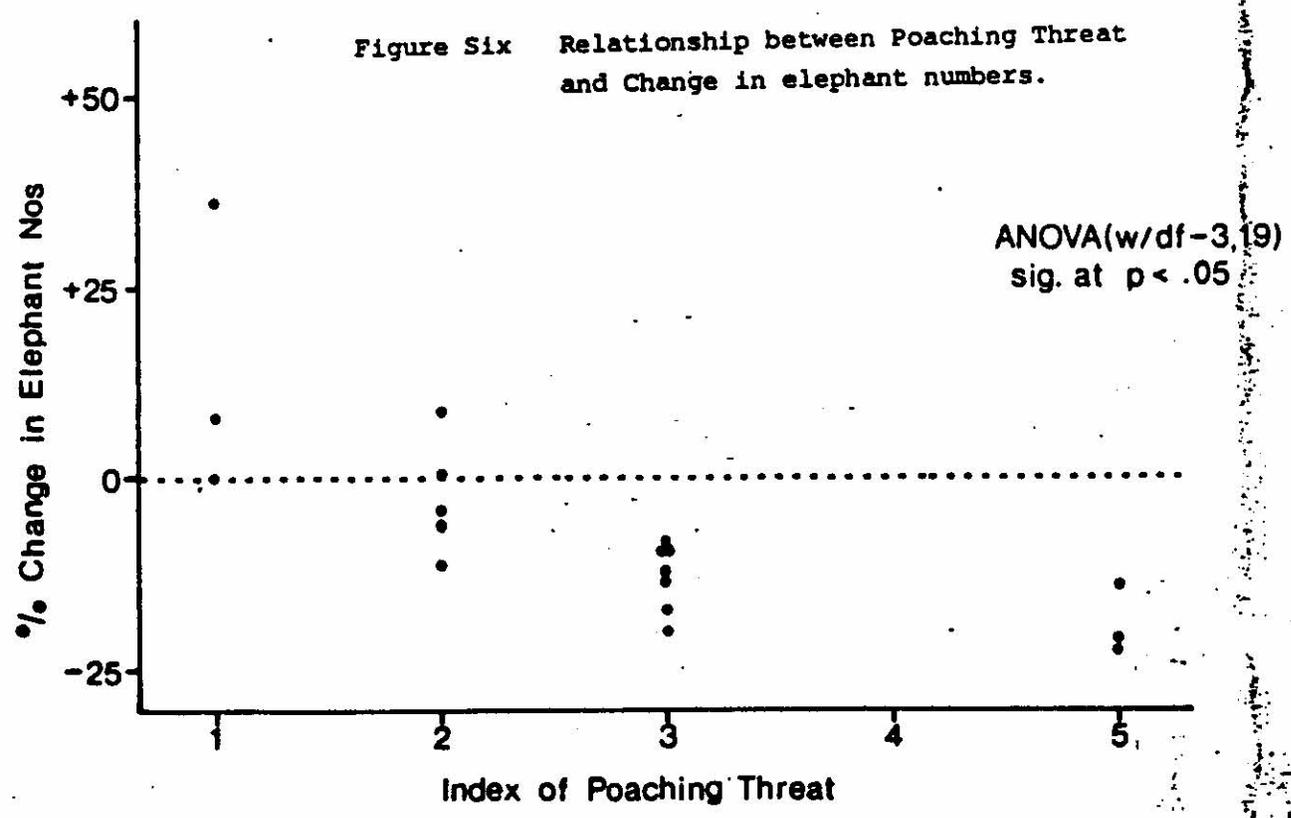
Figure Six   Relationship between Poaching Threat
and Change in elephant numbers.

% Change in Elephant Nos

+50

+25

0

-25

ANOVA(w/df−3,19)
sig. at p < .05

1   2   3   4   5

Index of Poaching Threat

in very remote areas, not in places where too many people will notice their
activities.

We were interested to see what the relationship would be between protected area
size and elephant population trend. Island biogeography theory has shown that
the number of species which can survive in an area is related to the size of
that area. Small areas are unable to sustain as wide a diversity of species as
larger areas. Theory has also shown that it is the larger species which are
most likely to be lost from small isolated ecosystems. This would lead one to
predict that the smaller protected areas are most likely to show declining
elephant numbers. This study, however, found no significant relationship
between size of the protected area and elephant trends (Figure 8). It would
seem that any effect of size of the reserve is entirely masked by the effect of
poaching threats on the population and the ability of the park's anti-poaching
forces to repel the threat. The immediate advantages of large size of parks are
discounted by the increasing difficulty of patrolling and protecting them
effectively.

The trend in conservation effectiveness in an established protected area will
be largely determined by the factors directly affecting the area, notably the
poaching threat. However, national factors must also be considered in
evaluating the status of conservation. Some African countries still have large
areas of natural habitat while other have almost none. In some countries,
wildlife is disappearing rapidly; in others animal numbers are stable or
increasing. The final part of this study considered a variety of national
factors in relation to the amount of remaining elephant range in each country
and their respective trends in elephant numbers. .

The national trends in elephant numbers, as derived from the AERSG Elephant
Action Plan, were taken as a score of the general short-term trend in elephant
conservation and the amount of elephant range remaining in each country was
used as a score of long-term historical conservation success. It has already
been seen that the percentage of elephant range varies considerably among
different biogeographic and vegetation areas. Since this part of the analysis
sought only to evaluate human factors affecting conservation, it was desirable
to remove these physical components. The percentage of elephant range
remaining in each country was therefore corrected so that it reflected the loss
of range in relation to the continental means for those biogeographic units and
vegetation types. Biogeographic units are mostly continuous and include
sections of about 10 countries each on average; vegetation zones are more
scattered and include parts of 17 countries each on average. For this reason,
in order to minimize problems of spatial autocorrelation, similar physical
areas were defined by vegetation zone rather than by biogeographic realm. Each
country was divided into sections based on vegetation type and each of these
sections was given a score based on its deviation in percentage of elephant
range from the mean percentage elephant range for its vegetation type. The
weighted averages of these sections were then calculated for each country.
(Fig. 9).

Both sets of national scores were then regressed against a variety of social,
political and economic variables thought to be potentially relevant. These
variables included scores for country size, population density, population
growth, proportion of closed forest remaining, proportion of land under
permanent agriculture or pasture, debt per capita, rate of forest clearance,
political stability (an index scored from 1 - 5 on the basis of the number of

Fig. 9   Ranking of Countries by Trend (a) and %age Remaining
          Elephant range / Vegetation type mean (b)

a)

Trend	Condition	Country
-9		Lesotho
-9		Swaziland
-9		Gambia
-9	N/A	Burundi
-9		Djibouti
-9		Guinea-Bissau
-2		Somalia
-2		Sudan
-2		Mali
-2		Liberia
-2	Very Bad	Uganda
-2		C.A.R.
-2		Chad
-2		Angola
-1		Ethiopia
-1		Cameroon
-1		Congo
-1		Benin
-1		Mozambique
-1		Guinea
-1		Sierra Leone
-1	Bad	Mauritania
-1		Kenya
-1		Chana
-1		Niger
-1		Nigeria
-1		Namibia
-1		Senegal
-1		Zambia
-1		Zaire
-1		Ivory Coast
-1		Tanzania
0		Equatorial Guinea
0		Rwanda
0	Stable	Burkina Faso
0		Togo
0		Gabon
1	Impr.	Botswana
1		Malawi
2	Very Good	South Africa
2		Zimbabwe

b)

RG/VG	Country
-0.47	Liberia
-0.36	Nigeria
-0.35	Gambia
-0.34	Guinea
-0.33	Ghana
-0.33	Swaziland
-0.32	Ivory Coast
-0.31	Guinea-Bissau
-0.30	Sierra Leone
-0.26	Burkina Faso
-0.25	Burundi
-0.24	Togo
-0.24	Senegal
-0.21	South Africa
-0.19	Uganda
-0.19	Mali
-0.19	Lesotho
-0.18	Benin
-0.16	Niger
-0.14	Malawi
-0.11	Zimbabwe
-0.09	Zambia
-0.08	Botswana
-0.07	Ethiopia
-0.04	Djibouti
-0.02	Mozambique
0.01	Angola
0.01	Mauritania
0.02	Rwanda
0.03	Somalia
0.05	Tanzania
0.07	Namibia
0.09	Cameroon
0.10	Congo
0.12	Chad
0.19	C.A.R.
0.20	Kenya
0.21	Gabon
0.26	Zaire
0.27	Sudan
0.29	Equatorial Africa

Figure Ten   Relationship between Civil Disruption Index and Current Trend in Elephant Conservation.
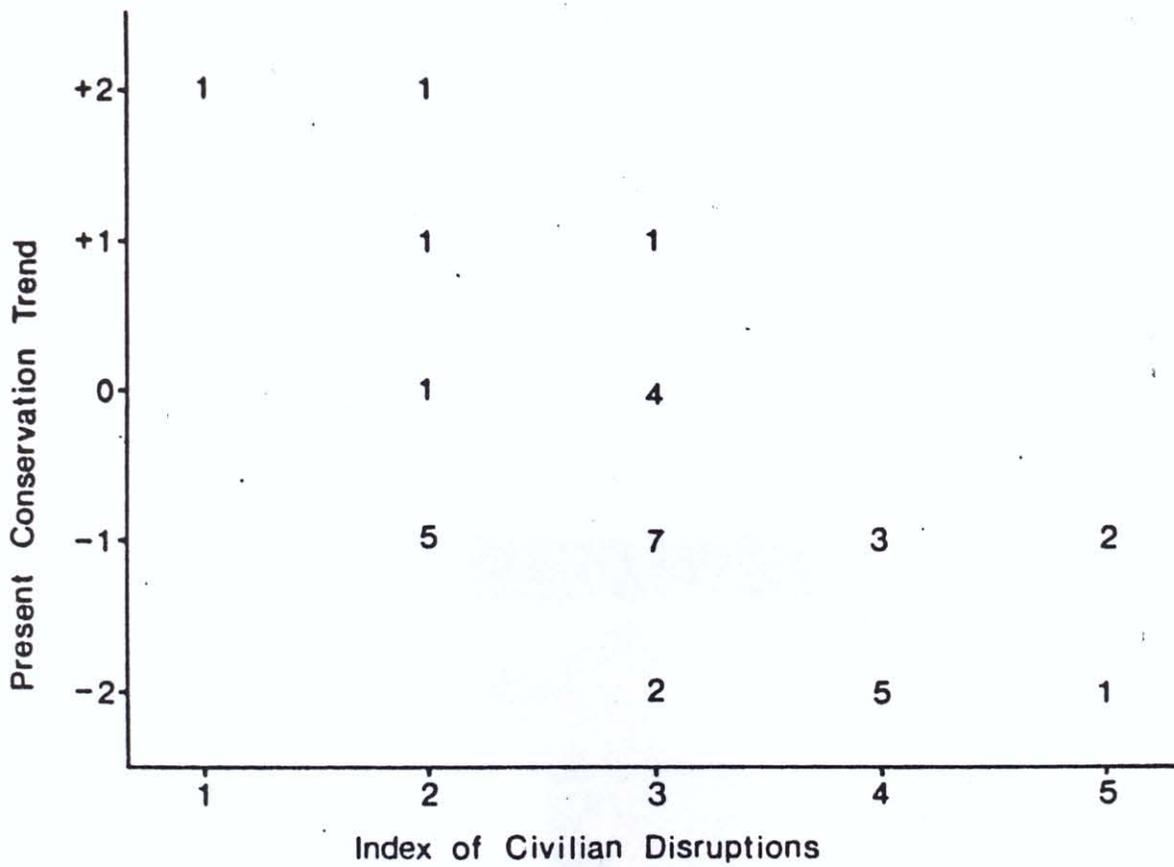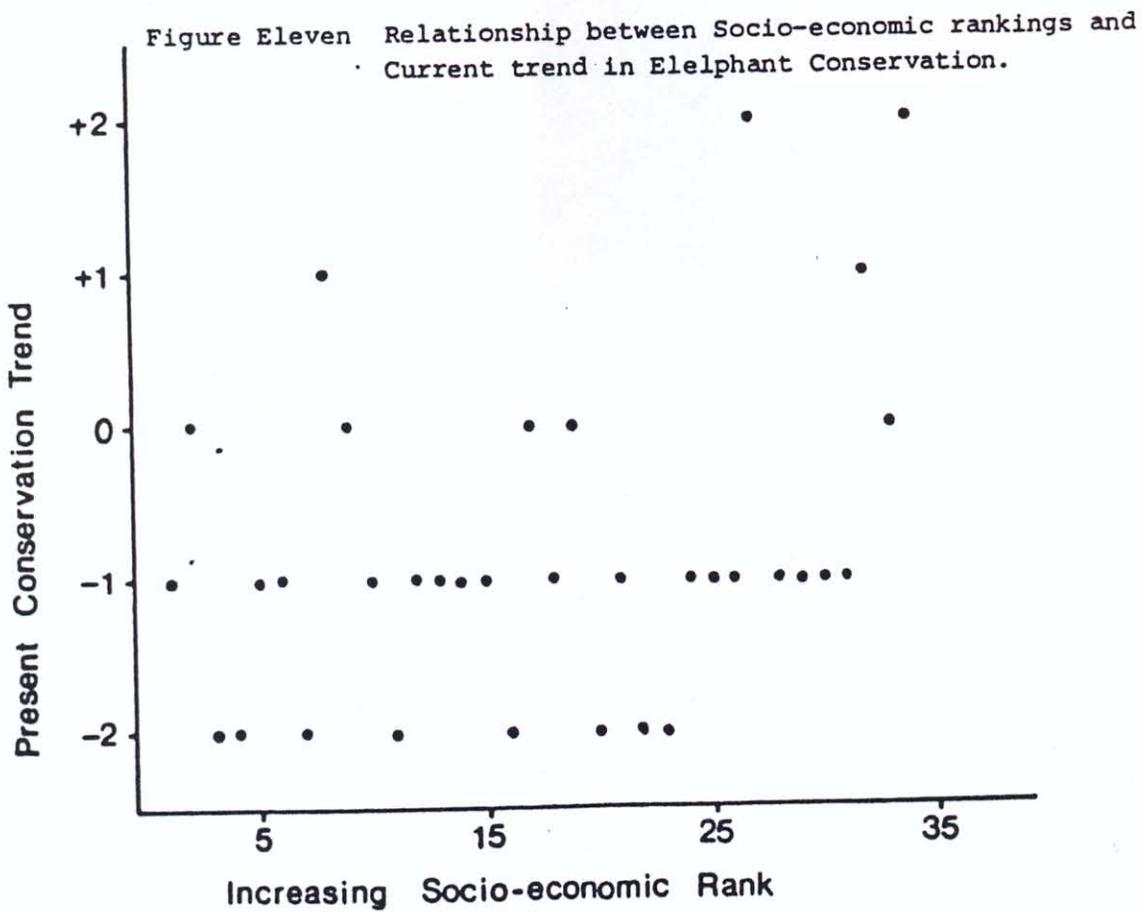

Figure Eleven   Relationship between Socio-economic rankings and Current trend in Elelphant Conservation.

political changes and coups in the country), civil order (an index scored from 1 - 5 on the basis of the level of civil disorder, guerrilla activity, lack of communications etc), proportion of land protected, size of UNDP aid programme, armament expenditures, rates of change in armament expenditure, GNP per capita, literacy rate, medical expenditure per capita, infant mortality, life expectancy, scientific investment in conservation and other social factors.

The trend scores correlated most closely to an index of civilian disruptions in the country (Fig. 10). The countries with high indices of political instability similarly showed low trend scores. This result parallels the results reported above for protected areas. Conditions present in countries with frequent civilian disruptions and severe political instability would be likely to foster increases in poaching. Civilian and political disturbances increase the general state of lawlessness in a country, which would encourage poaching; under such conditions the government's priorities would naturally focus on securing its power base, not on protecting the nation's natural heritage. Disruptions most often also involve an increased distribution of arms among the population, providing means of intensified poaching, both within and outside protected areas. This correlation is further supported by the protected areas' data. The protected areas in countries with stable political conditions showed an average increase in elephant population of 2.5% per annum; in the other protected areas, there was an average decrease of 16% per annum.

The short-term trend in conservation also correlated with a variety of socio-economic indicators. Countries with better socio-economic conditions tended to score better on conservation trend. (Fig. 11). The trend showed a positive correlation to the percent of children in school, the literacy rate and the average calorific intake. Conversely, it showed a negative correlation with infant mortality. Since these socio-economic conditions often affect the stability of a country, it is clear how they could affect the trend in conservation. Countries with depressed socio-economic conditions are likely to be the scene of frequent civilian disturbances by a disgruntled populace. They are also more likely to experience political turmoil. Also if countries do not have the resources for improving socio-economic conditions they will not be bothering much with conservation. Efforts to improve socio-economic conditions often take years to show results, however, these efforts should not be seen as entirely unrelated to the goals of improving conservation.

The long-term scores in conservation were most closely related (negatively) to the percentage of land under permanent agriculture or pasture (Fig. 12). Countries with large amounts of land under permanent agricultural or pastural use are those least likely to have large areas of remaining natural habitat. Similarly, the population density and population growth rate showed a significant negative correlation with the amount of natural habitat. None of these indicators showed a correlation with the short-term trend. Short-term trend did, however, correlate with the crudely scored ratings for scientific investment.

In an effort to clarify some of these inter-related effects 17 variables (elephant trend, elephant range corrected for vegetation, area of country, population density, proportion of land under permanent use, proportion of closed forest, rate of forest clearance, debt per capita, civil stability index (a combination of civil order and political stability), UNDP budget, % of land protected, military expenditure per capita, rate of population growth, % of children schooled, life expectancy, % of population urban and scientific

Figure Seven
Relationship between Scientific Facilities and Elephant Numbers

	Av.% change in El. Nos	N
No scientific facilities	-12.4	5
Limited Scientific facilities	- 3.0	6
Good scientific facilities	- 1.8	6

Remaining Elephant Habitat
(relative to vegatation type mean)

$(R^2 = .31, \text{ sig at } p < 001)$

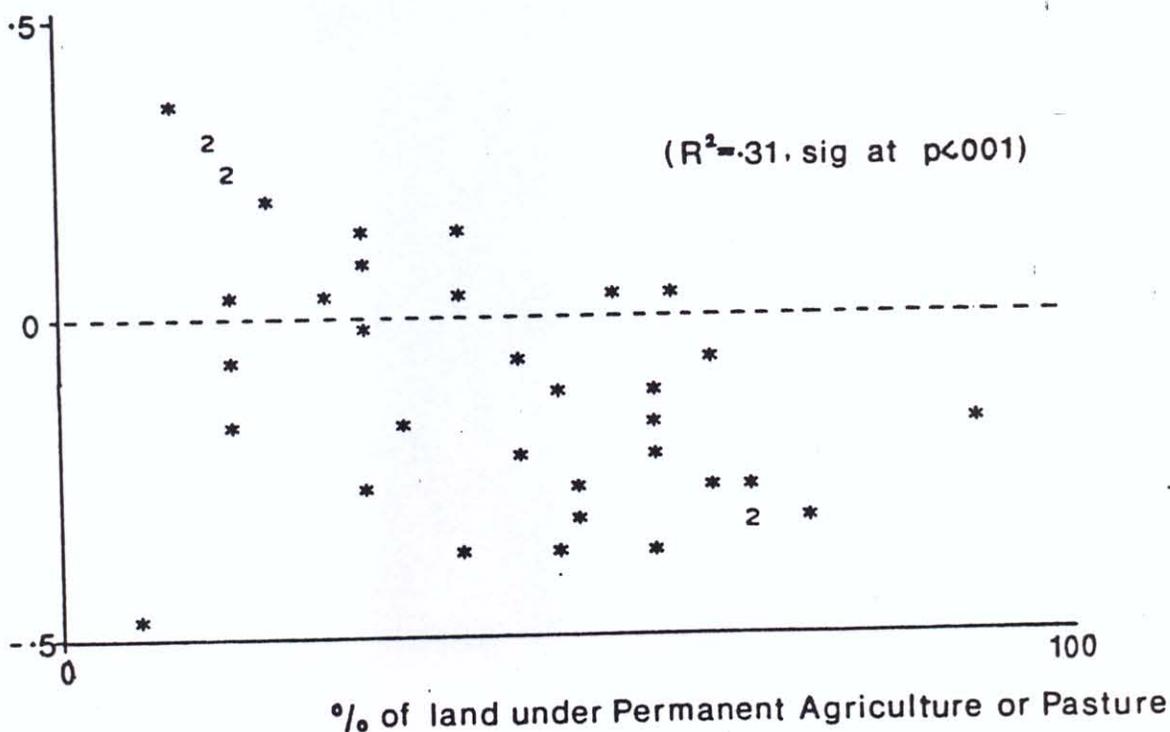% of land under Permanent Agriculture or Pasture

Figure Twelve
Relationship between the amount of elephant habitat remaining
(in relation to the mean for that vegetation type) and the
percentage of land under agriculture or permanent pasture.

investment) were used in a stepwise multiple regression analysis (Microstat 2.0). From this regression the three factors most predictive of the trend of elephant populations were the index of civil stability (regression coefficient = -0.2443), armament expenditure per capita (regression coefficient = 0.0226) and the proportion of land under permanent use (regression coefficient = 0.0140) in total explaining 72% of the observed variation. The three factors most predictive of the amount of elephant range remaining in relation to vegetation means were the rate of forest clearance (regression coefficient = -0.0562), the proportion of land under permanent use (regression coefficient = -0.0031) and the area of the country (which was non-directional or irrelevant factor with a regression coefficient of 0.0000) in total explaining 71% of the observed variation.

Thus, not surprisingly, the data show that the most developed countries tended to have lost the highest proportion of their original wildlife resources but were on average doing a better job now of preserving what little wildlife is left.

The negative correlation between the amount of UNDP aid received by countries and their current trend in elephant conservation need not be interpreted as further evidence of the deleterious effects well-meaning aid programmes have had on the African environment (cf. introduction of rinderpest, tsetse eradication programmes, veterinary fencing for cattle disrupting animal migration routes, opening of waterholes in arid regions, medical assistance without birth control etc.). UNDP inputs correlate with resource loss because it is the poorer countries that are losing their resources fastest and the UNDP budget is determined by a formula that combines population size of a country with its standard of living.

The positive correlation between armament expenditure and trend figures per country is surprising. In an earlier paper Douglas Hamilton (1984) has shown that the continental collapse of elephant populations correlates closely in time with the continental expenditure on armaments. Our figures would indicate that armaments listed in national purchase statistics are primarily used for law enforcement within those countries and/or that the arms doing the poaching damage are either unrecorded or cross national frontiers. Despite the negative correlation we feel that the overall increase in firearms in Africa has greatly increased the poaching threat for elephants and other game.

Overall, the results indicate that, in the long-term, population growth will be a major factor in reduction of natural lands. Countries with large and increasing populations need to pay particular attention to incorporating protected areas into national land-use plans now, and to implementing appropriate conservation and land-use measures (eg. establishment and protection of reserves). They also need to come to grips with the politically difficult problem of containing population growth. Long-term measures, however, will be in vain if the short-term trend in conservation remains negative. On a national scale, stability seems to be the key to positive conervation trends. At the park level this corresponds to the ability to enforce anti-poaching regulations.

4.8   Summary of Species Coverage

Evaluation of the species records of individual protected areas across the
Realm for selected animal groups indicates that most species are protected in
the existing protected area network and that most species are present in
several to many protected areas. There are, however, some species that are
inadequately protected or not protected at all. Proposals to include these
species have been made.

The number of species inadequately covered by protected areas is quite small.
Identification of these under-protected species and subsequent monitoring of
their status should be quite feasible for most conspicuous animal groups and
should be part of the monitoring role of CMC.

The findings of this part of the review mirror closely the findings from
evaluation of vegetation type coverage and from species conservation priorities
of section 4.5. Again, the areas where protection is weakest are the western
rainforests, Madagascar, and isolated mountain and island communities. These
are the areas where priority for further protected area development and other
conseravtion action must be focussed.