Improving the conservation of Cross River gorillas with mobile device-based law enforcement monitoring
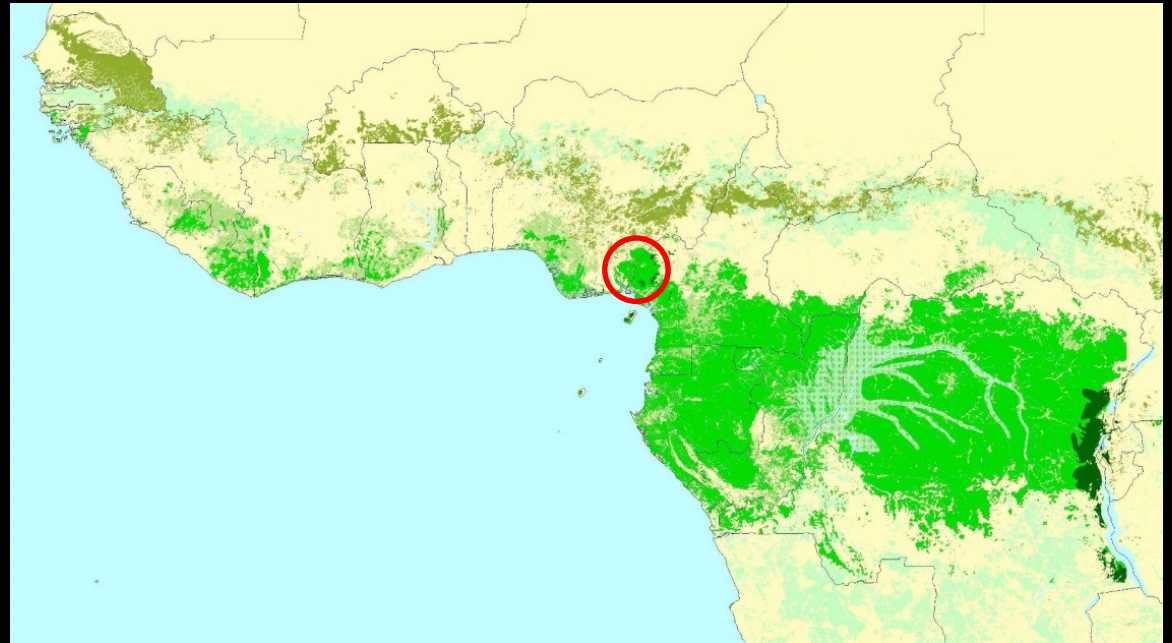
Richard Bergl, North Carolina Zoo
Andrew Dunn, WCS Nigeria
Inaoyom Imong, WCS Nigeria
Francis Okeke, WCS Nigeria

The Gulf of Guinea Forests

- Largest block of continuous tropical forest in west Africa

- Relatively poorly studied

- Concerted conservation action somewhat recent
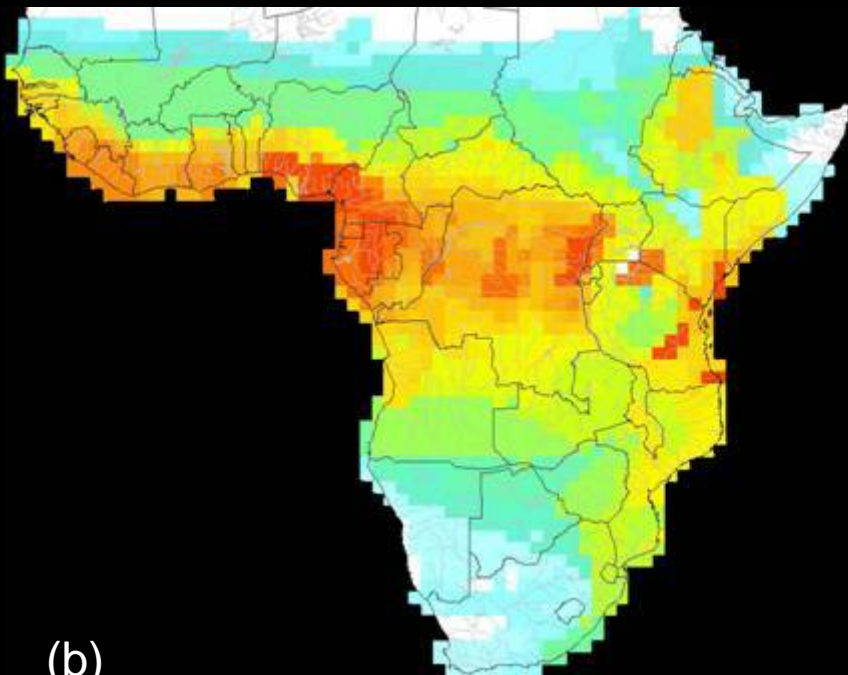
- High species richness and endemism

Primate Biodiversity Hotspot

-Extremely high primate species richness
-Africa's largest number of endemic taxa

Primate species (a) richness and (b) endemism in sub-Saharan Africa. Species richness and level of endemism increase with increasing warmth of color.
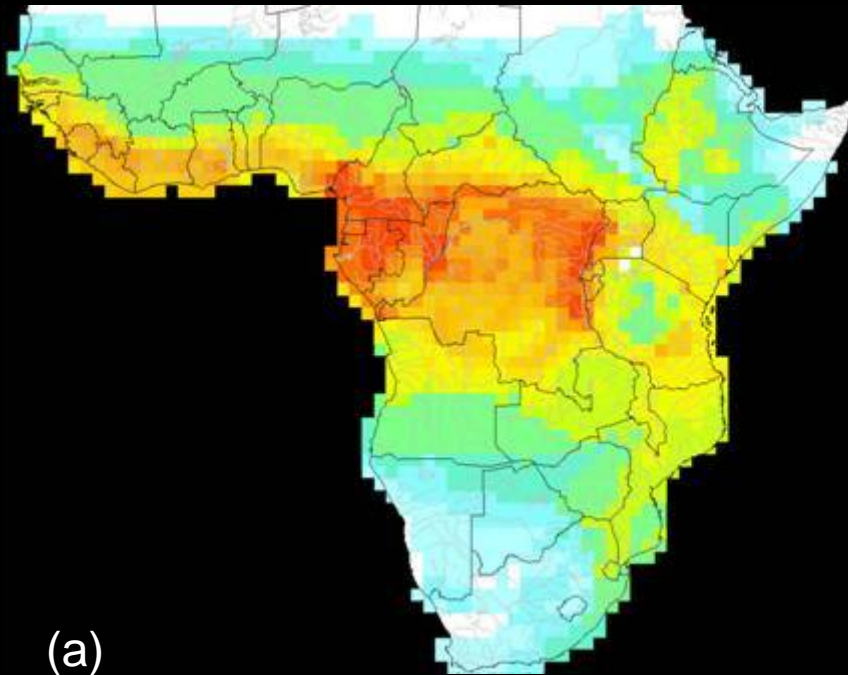
Drill (*Mandrillus leucophaeus*)

Nigeria-Cameroon chimpanzee (*Pan troglodytes ellioti*)

Preuss' guenon (*Cercopithecus preussi*)

Cross River gorilla (*Gorilla gorilla diehli*)

Birds

This region has the highest bird species richness and endemism of all Central and West Africa .
-26 endemic species
-2 monotypic endemic genera
-3 species each known only from a single locality

Bird species (a) richness and (b) endemism in sub-Saharan Africa. Species richness and level of endemism increase with increasing warmth of color.

(a)
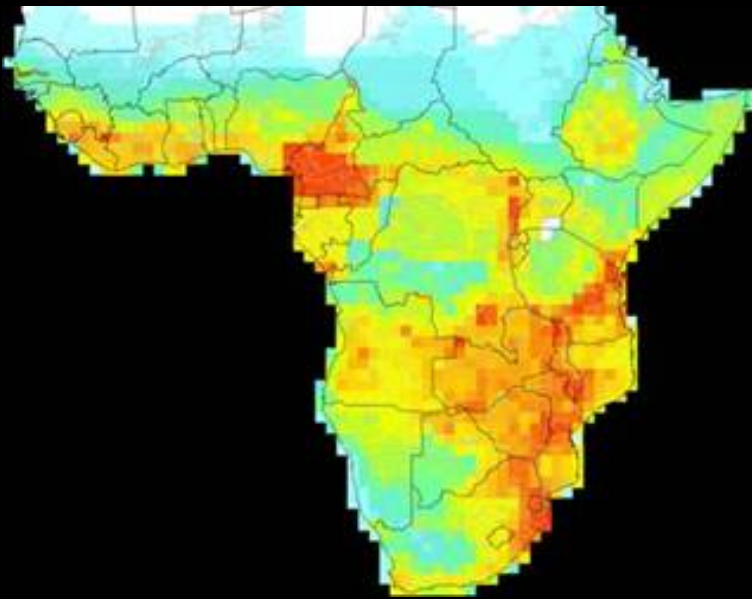
(b)
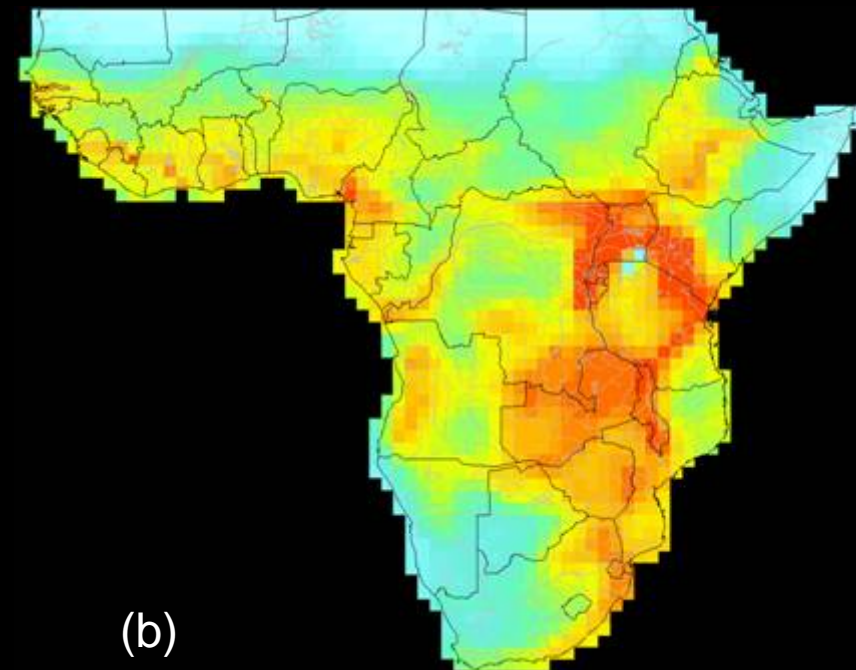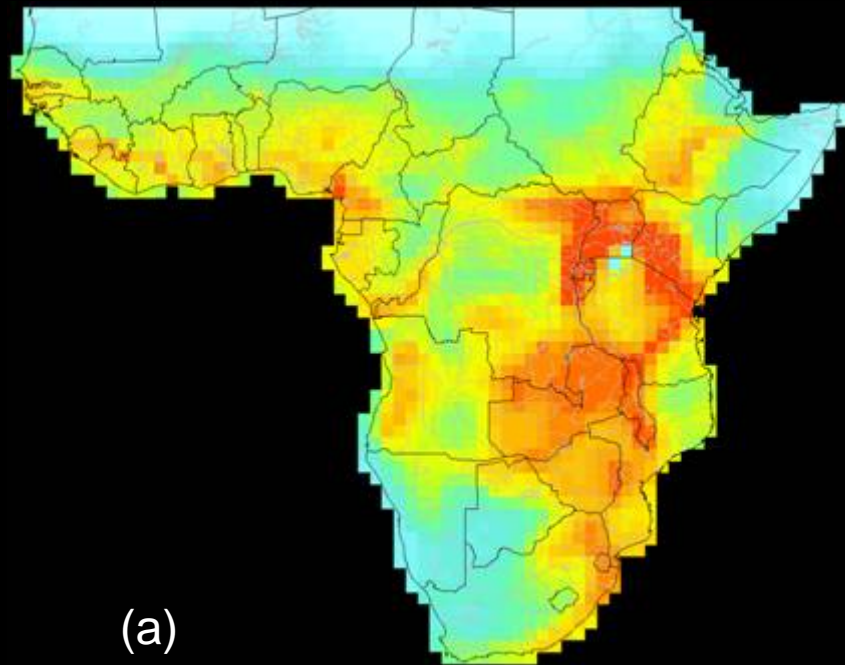
Ursula's mouse-colored
sunbird
(Nectarinia ursulae)

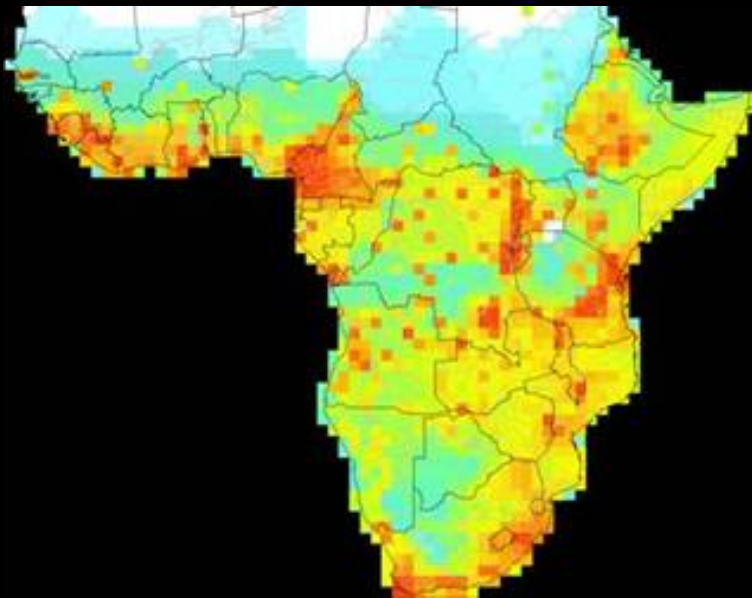Bannerman's tauraco
(Tauraco bannermani)

Amphibians

Possibly the highest amphibian species richness in Africa
-52 endemic species

(a)

(b)

Amphibian species (a) richness and (b) endemism in sub-Saharan Africa. Species richness and level of endemism increase with increasing warmth of color.

Black long-fingered Frog *(Cardioglossa pulchra)*

Cameroon slippery frog
(*Hyperolius riggenbachi*)

Challenging environment for conservation

High rates of forest loss and fragmentation
-Plantations
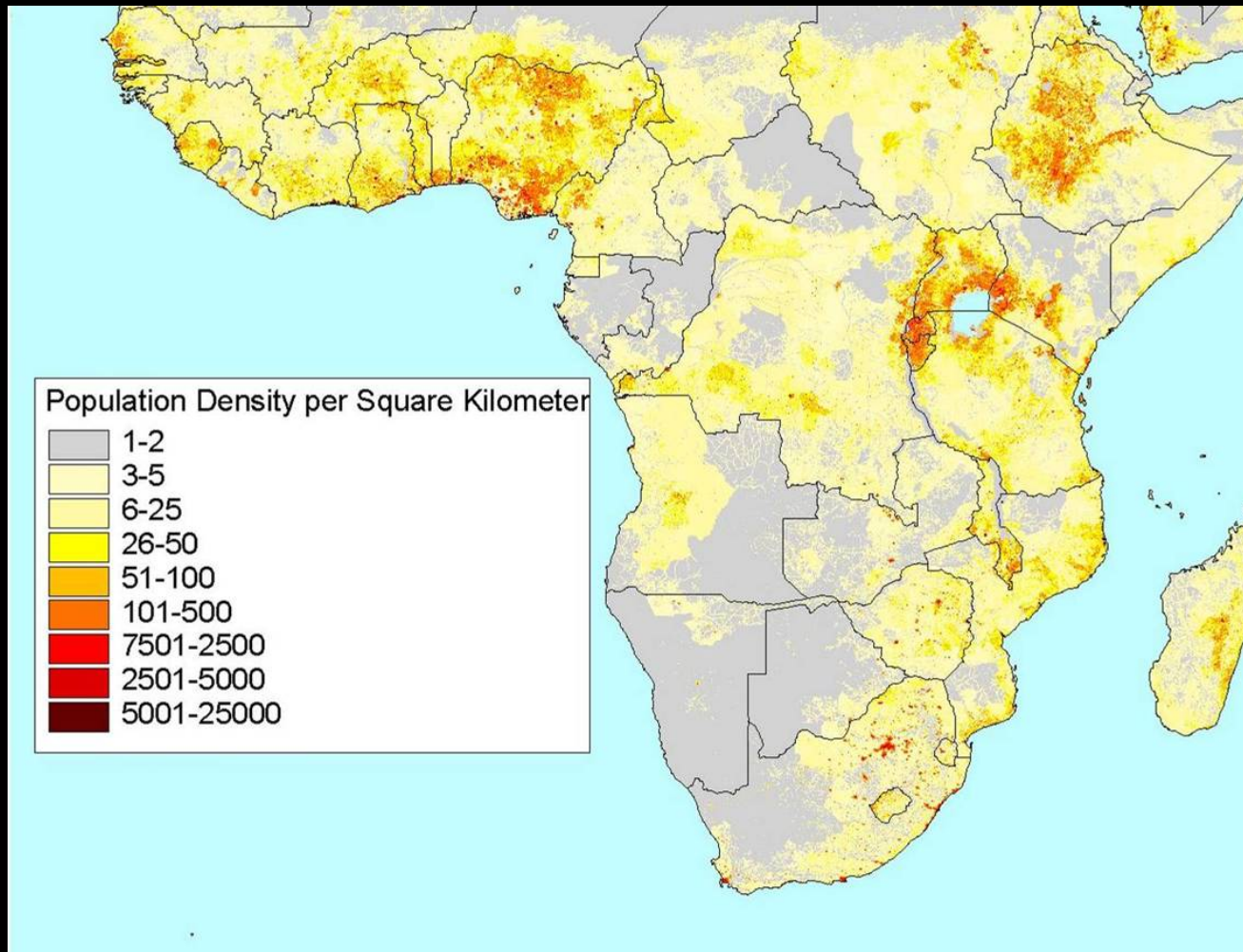-Small scale agriculture
-NTFP collection
-Limited logging for timber

Challenging environment for conservation

Bushmeat a significant source of food

Challenging environment for conservation

Population Density per Square Kilometer
- 1-2
- 3-5
- 6-25
- 26-50
- 51-100
- 101-500
- 7501-2500
- 2501-5000
- 5001-25000

One of Africa's highest human population densities

The Cross River Gorilla (*Gorilla gorilla diehli*): endemic to the forests of Nigeria-Cameroon border.

- Critically Endangered
- Only about 300 individuals, spread across multiple remote highland sites
- Long history of hunting
- Poorly studied
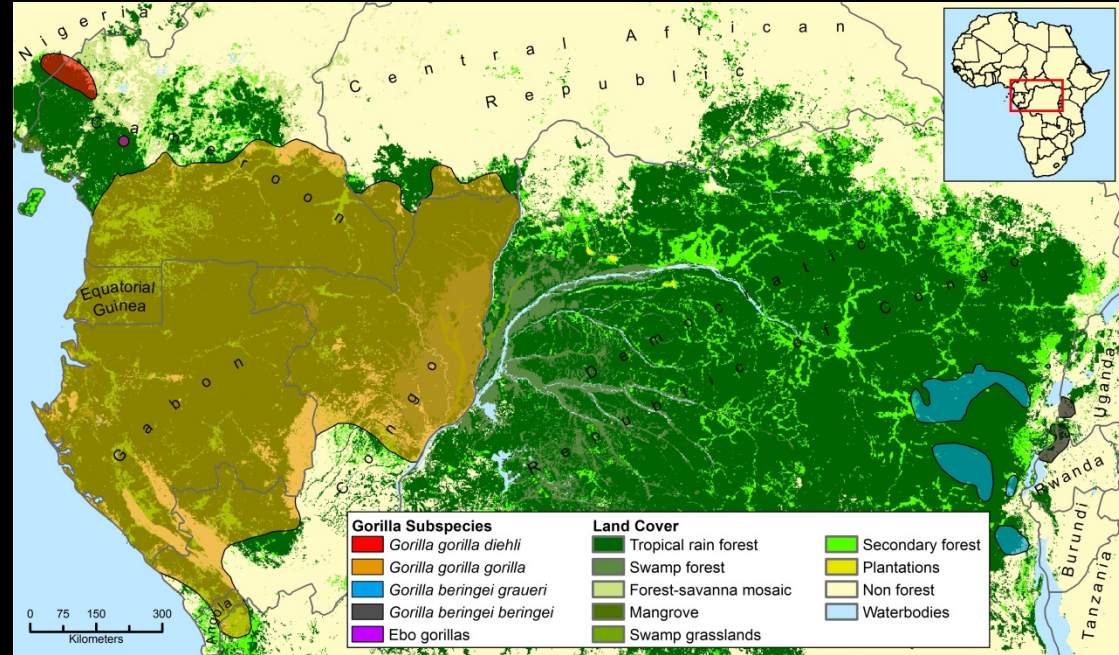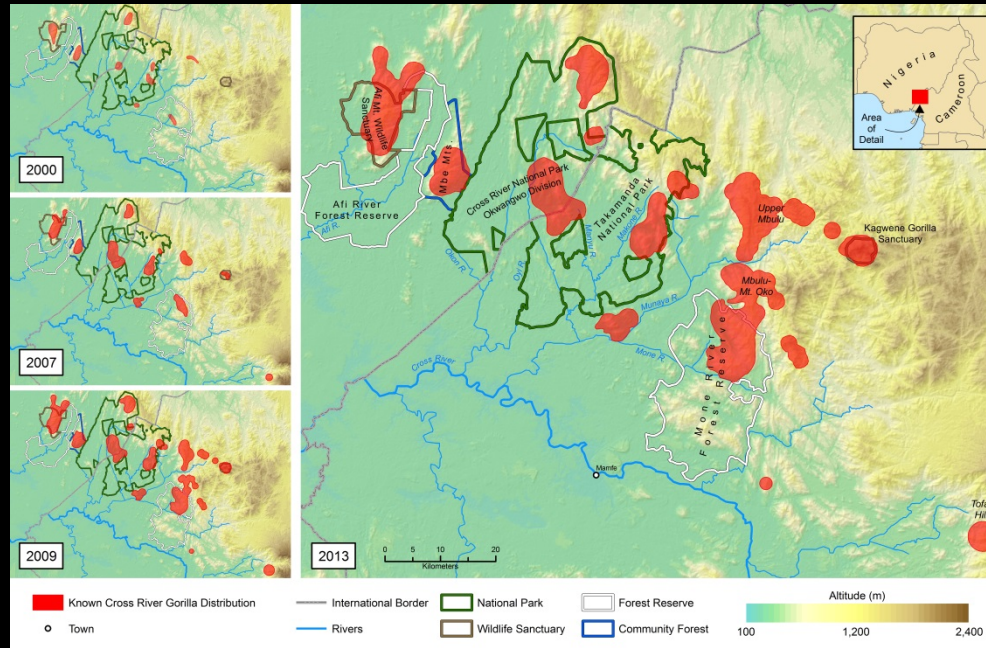
Distribution and numbers

TABLE 1. KEY SITES AND ABUNDANCE ESTIMATES FOR CROSS RIVER GORILLAS				
Country / Site	Status	Gorilla range (km²)	Altitude (m)	Estimated gorilla numbers
Nigeria				
Afi Mountain Wildlife Sanctuary	Wildlife Sanctuary	105	130–1,300	25–30
Mbe Mountains	Community Reserve	45	110–900	25–30
Cross River National Park–Boshi Extension	National Park	55	300–1,700	20–25
Cross River National Park–Okwa Hills (Nigeria) + Central Takamanda National Park (Cameroon)	Transboundary; two National Parks	80	150–800	15–30
			Subtotal Nigeria:	**85–115**
Cameroon				
Takamanda National Park–East (Kekpane area)	National Park	50	175–900	8–12
Takamanda National Park–North (Atolo area)	National Park	20	300–1,500	10–15
Mawambi Hills	Unprotected forest	25	125–550	20–30
Mone Forest Reserve (northern half)	Forest Reserve	100	150–1,200	20–30
Mount Oko Area	Unprotected forest	60	250–1,700	6–15
Eastern Mone Forest Reserve	Unprotected forest	20	250–1,600	9–12
Upper Mbulu	Unprotected forest	100	500–2,000	20–25
Kagwene Gorilla Sanctuary	Wildlife Sanctuary	25	1,700–2,000	20–25
Tofala Hills	Unprotected forest	25	500–1,200	20–30
			Subtotal Cameroon:	**132–194**
TOTAL				**218–309**

Revised IUCN/SSC conservation action plan

Today, the total population of Cross River gorillas may number fewer than 300 individuals

Revised Regional Action Plan for the Conservation of the Cross River Gorilla (*Gorilla gorilla diehli*) 2014–2019

Understanding the status of the changing threats across the Cross River gorilla landscape will provide key information for guiding our collective conservation activities

# Accomplishments of the previous plan

- Creation of three new protected areas

- Better understanding of gorillas' range

- Enhanced wildlife and law enforcement monitoring

- Greater trans-boundary collaboration

- Increased community involvement

Today, the total population of Cross River gorillas may number fewer than 300 individuals.

Regional Action Plan for the Conservation of the Cross River Gorilla (*Gorilla gorilla diehli*)

Implementation of the recommendations in this plan will make a significant difference to the survival of the Cross River gorilla.

The Mbe Mountains Community Wildlife Sanctuary

- Approximately 100 km² protected area in Nigeria

- Managed by a community conservation association

- An important site for CR gorillas and for linking Afi Mountain Wildlife Sanctuary to the Okwangwo Division of Cross River National Park

- 13 Eco-guards employed and managed by the Wildlife Conservation Society

- Other conservation initiatives include alternative livelihoods for hunters and conservation education

Afi Mt. Wildlife Sanctuary

Cross River National Park

Mbe Mountains
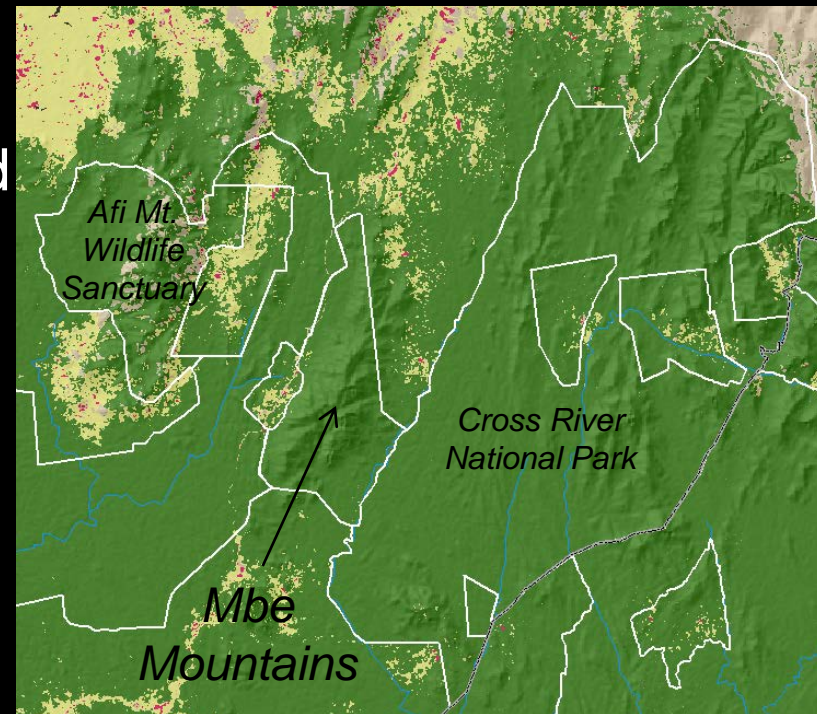
Questions

- Have ranger patrols been successful in reducing threats to wildlife?

- How have wildlife populations responded?

Cybertracker-based monitoring

- Touch-screen data collection, automated track log

- Automatically integrates observational and spatial data

- Desktop database that allows for rapid and straightforward data analysis

- System set up to monitor wildlife, threats and ranger performance

| Observation |
|---|
| Animal |
| Human Activity |
| Human Settlement |
| Road or Trail |
| Protected Area Boundary |
| Landmark |
| Begin Field Work |
| End Field Work |

Ranger-based data collection

- Data collected by community rangers over five years (2009-2013) during the course of anti-poaching patrols.

- All evidence of wildlife and human activity recorded on mobile devices, as are automated track points (5 mins).

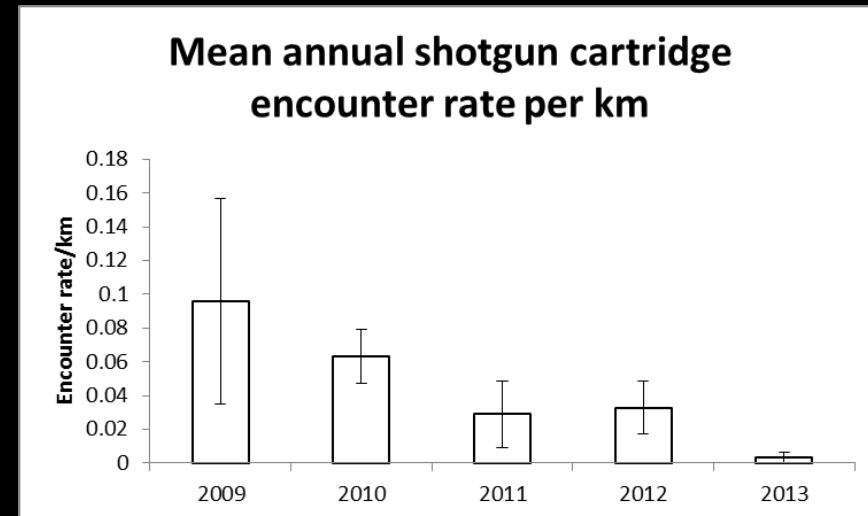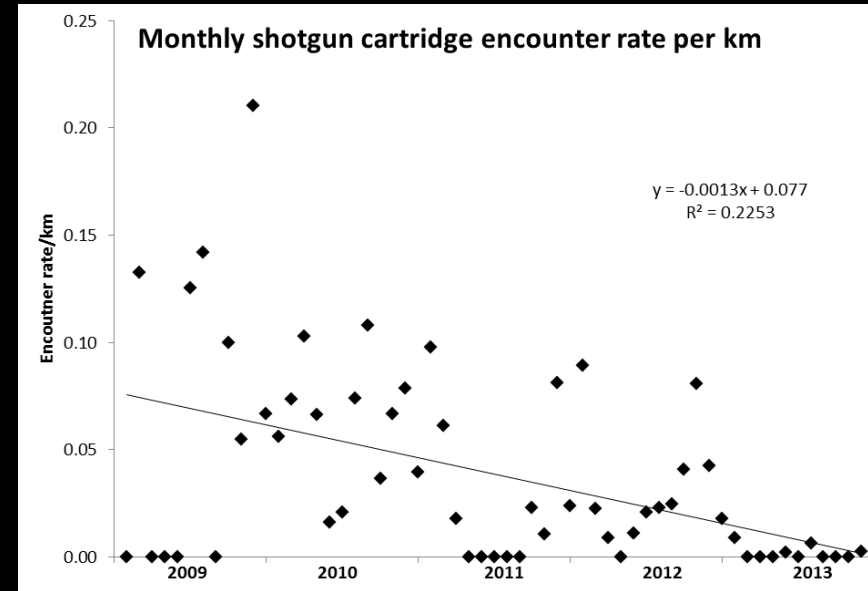- Almost 15,000 km of patrols walked

Results: Patrol effort

- 100% increase in number of patrol days
- 200% increase in patrol effort (km walked)

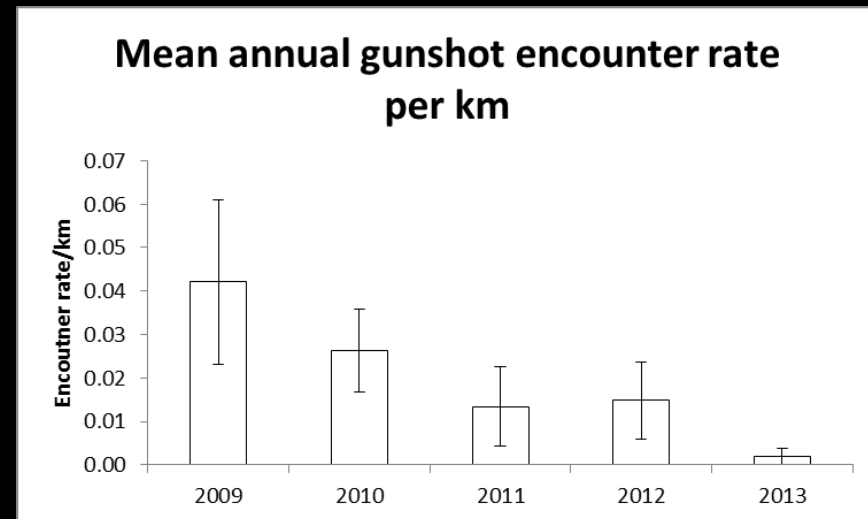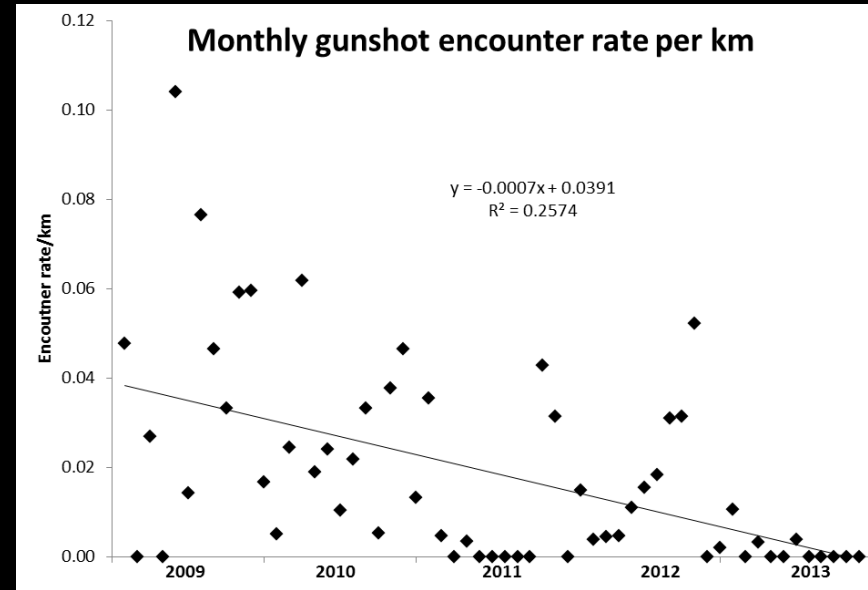**Number of patrols per year**

Patrol distance per year
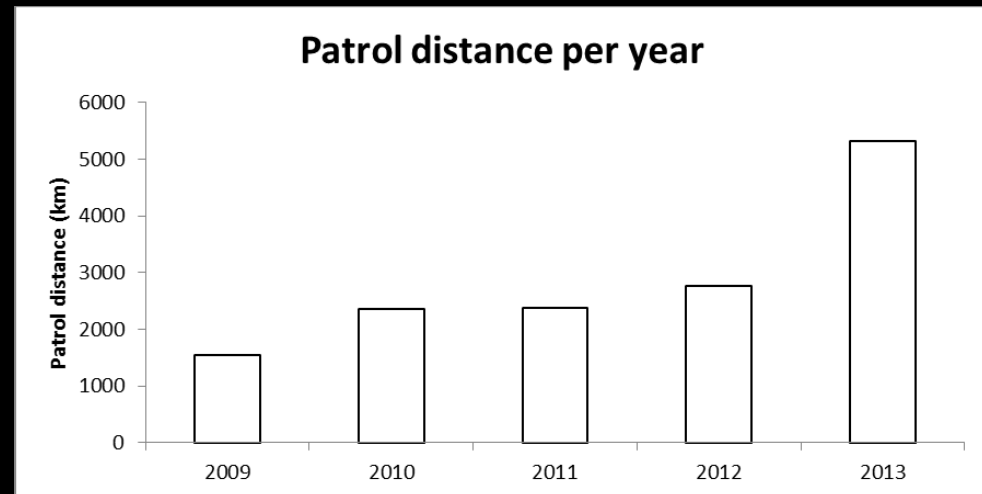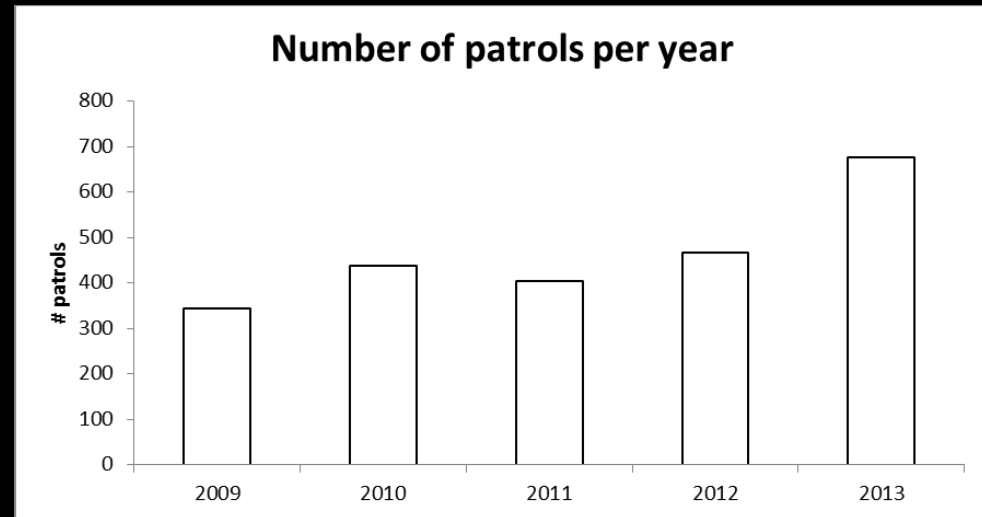
Results: Indices of hunting

- Significant reduction in encounter rate of expended shotgun cartridges ($t=-4.419$, $p<.05$)

Monthly shotgun cartridge encounter rate per km

$y = -0.0013x + 0.077$
$R^2 = 0.2253$
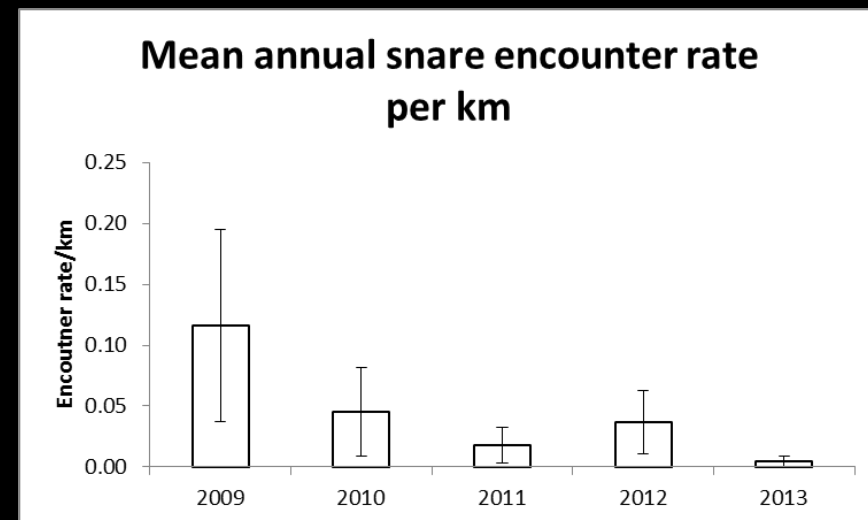

Mean annual shotgun cartridge encounter rate per km

Results: Indices of hunting

- Significant reduction in gunshots heard
(t=-5.127, p<.05)

Monthly gunshot encounter rate per km

$y = -0.0007x + 0.0391$
$R^2 = 0.2574$

Mean annual gunshot encounter rate per km

Results: Indices of hunting

- Significant reduction in encounter rate of wire snares

  (t=-3.105, p<.05)

Monthly snare encounter rate per km

$y = -0.0015x + 0.0849$
$R^2 = 0.1113$

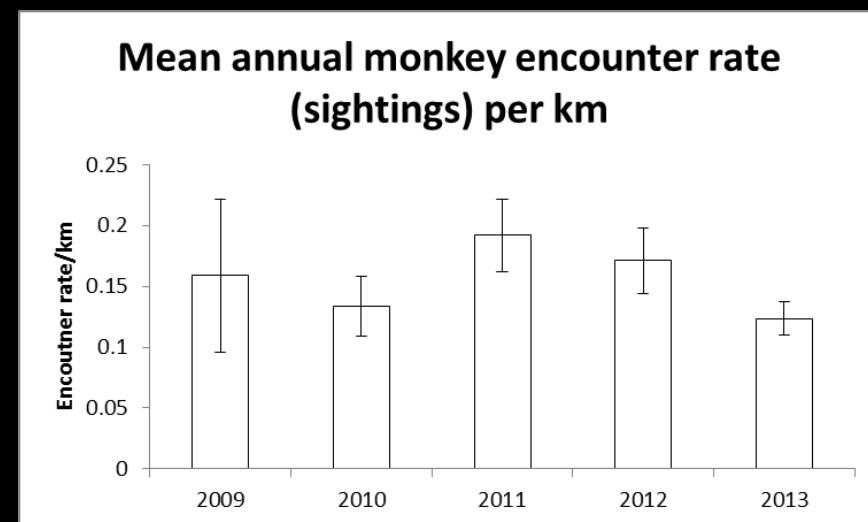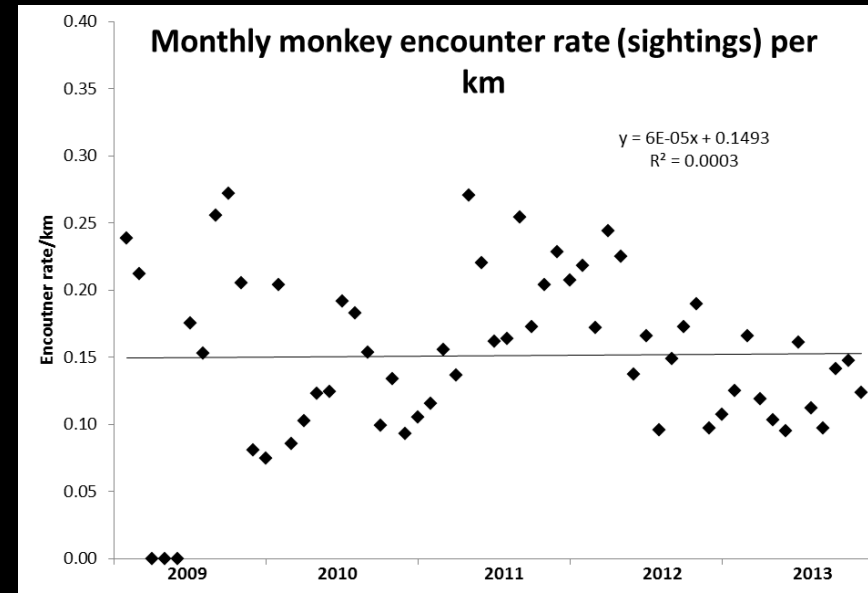Mean annual snare encounter rate per km
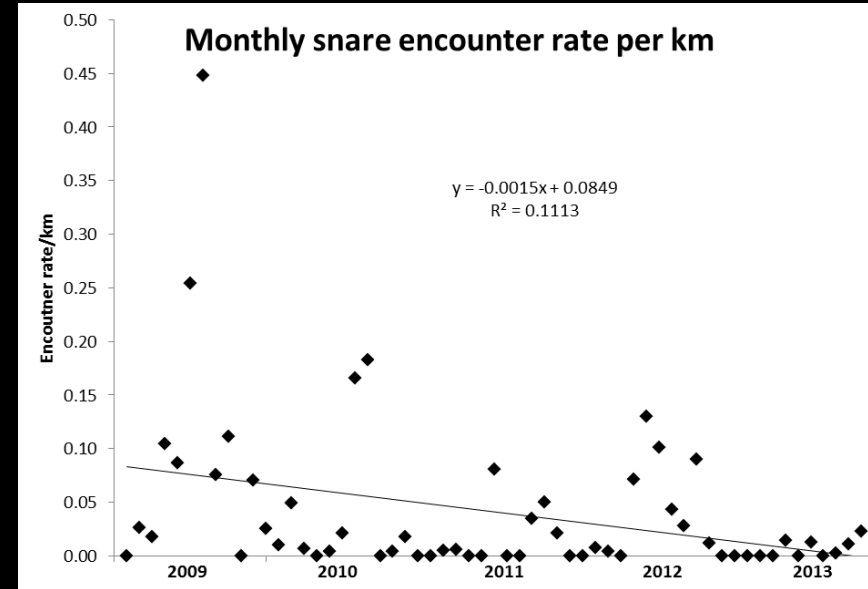
Results: Duiker encounter rates

- No change in duiker encounter rate (all species; t=0.97, p=0.33)

Monthly duiker encounter rate (all species) per km

$y = 0.0004x + 0.1311$
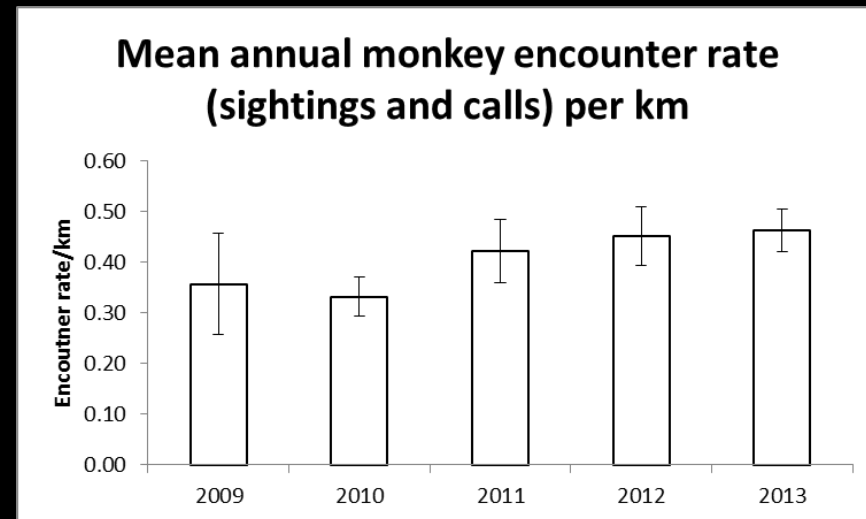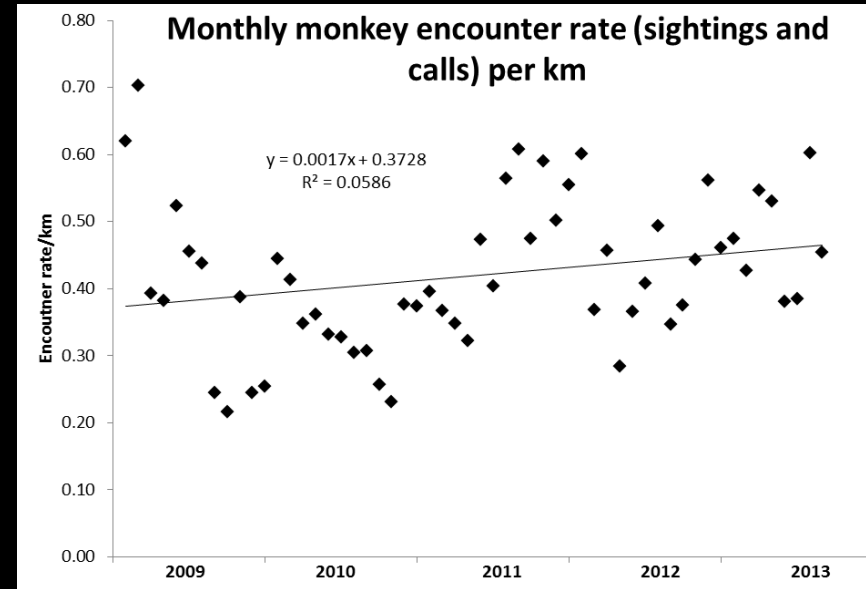$R^2 = 0.013$

Mean annual duiker encounter rate per km
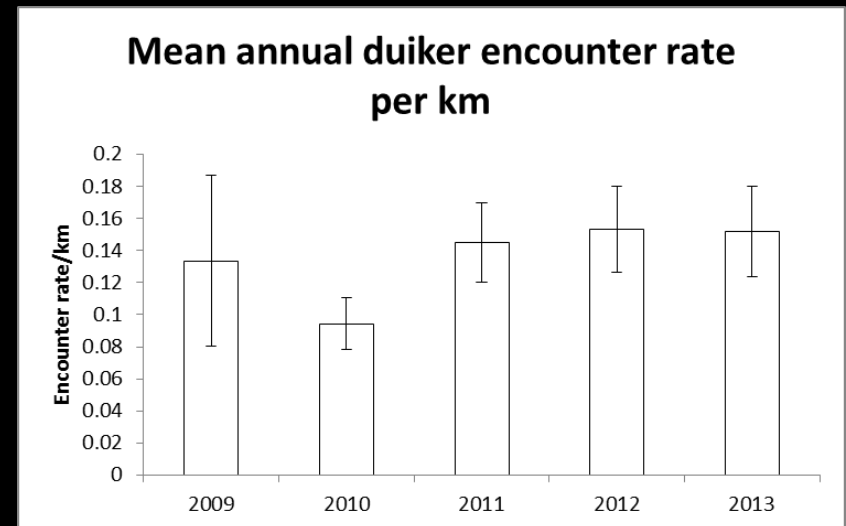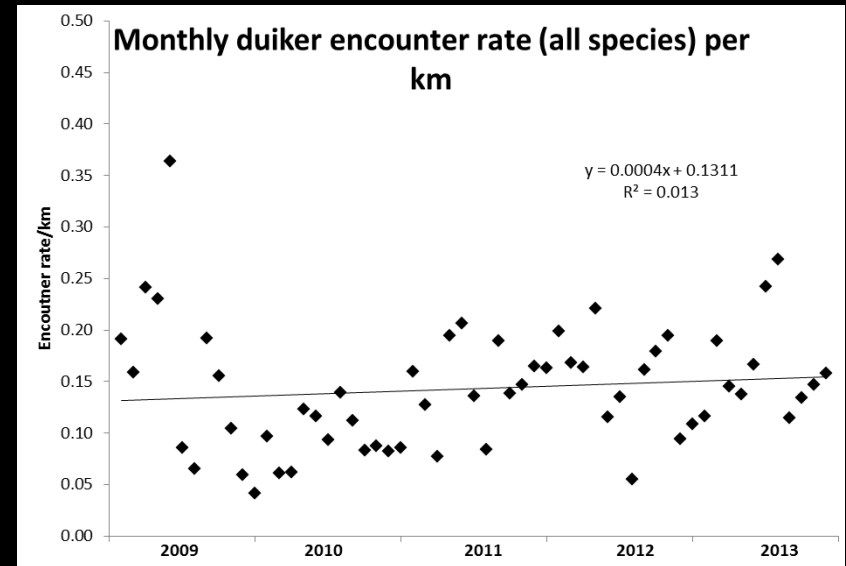
Results: Monkey encounter rates

- No change in overall monkey encounter rate based on sightings (t=-.024, p=0.98)

Monthly monkey encounter rate (sightings) per km

$y = 6E\text{-}05x + 0.1493$
$R^2 = 0.0003$

Mean annual monkey encounter rate (sightings) per km

Results: Monkey encounter rates

- Monkey encounter rate (all species) based on sightings and calls increased (t=2.081, p<.05)

Monthly monkey encounter rate (sightings and calls) per km

$y = 0.0017x + 0.3728$
$R^2 = 0.0586$

Mean annual monkey encounter rate (sightings and calls) per km

Results: Primate encounter rates by species
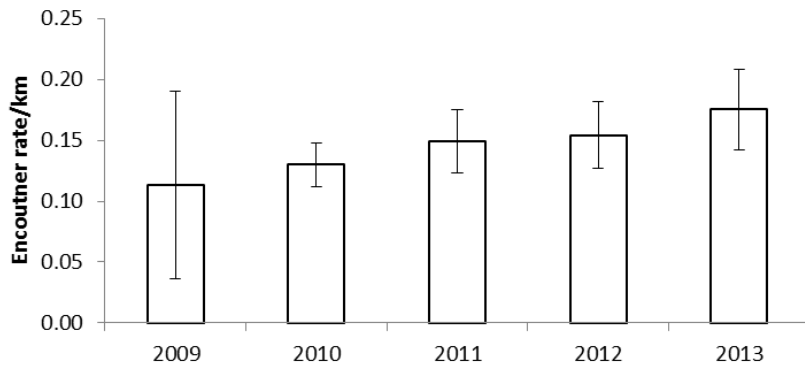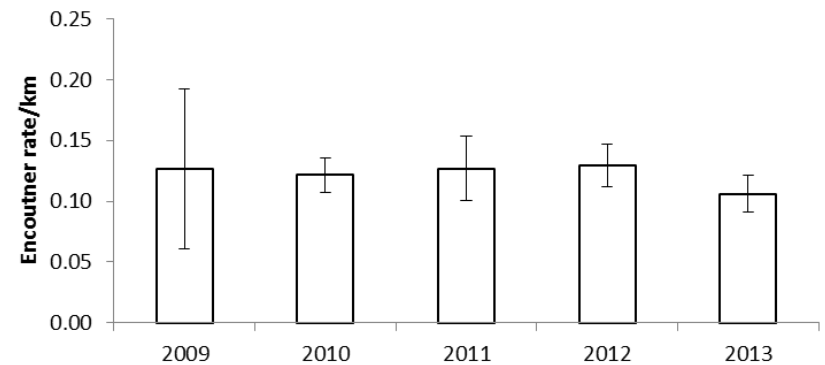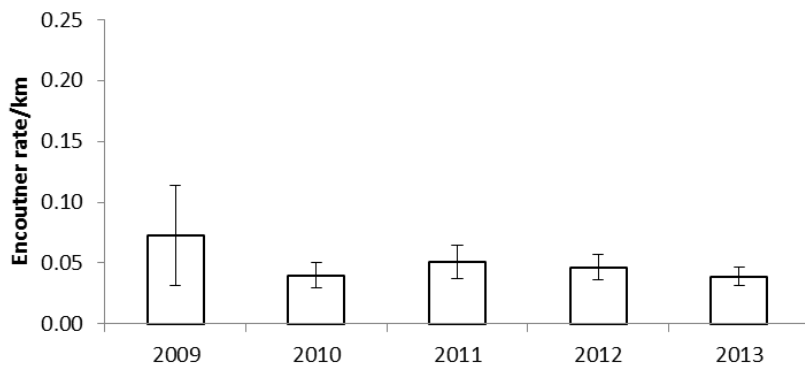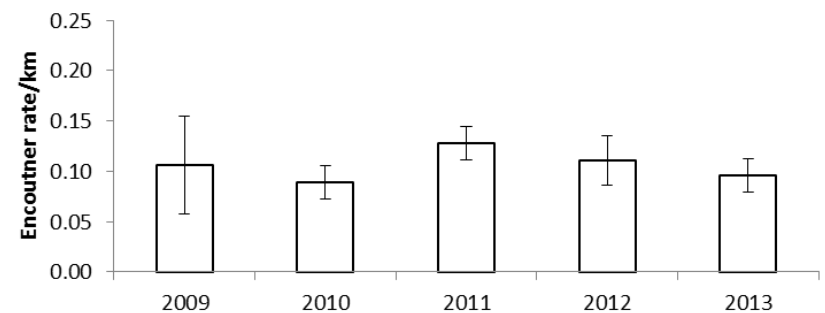
Other factors

- Community participation
- Conservation education
- Alternative livelihoods

Challenges

- Funding

- Hardware

- Software analysis limitations

- Capacity and technical support

- No direct measure of impact on gorillas!

Discussion

- Increase or stability of primate encounter rates, with simultaneous decrease in indicators of human activity and increase in patrol effort, suggests that changes are due to a reduction in threat, rather than "empty forest syndrome"

- Some species appear to rebound faster than others

- Primate encounter rates are still very low, relative to other similar sites

- Seasonality of hunting may have impacted strength of trends over time

- Data collected by ranger patrols likely not as precise as survey data-considerable monthly variation in encounter rates

Conclusions

- A comprehensive, well-monitored conservation program can reduce threats to primate (and other wildlife) populations

- Community participation important

- Demonstrating reduction in threats easier than increase in wildlife

- Ranger-based data collection should be supplemented with more systematic surveys

- One of very few sites in Africa where at least some threats to wildlife populations have been reduced

Contributors to success

- Trends we observed would not have been documented using more traditional approaches (e.g., paper and pencil)
- Data collection designed in consultation with all levels of users (field staff, managers, project directors)
- Extensive field testing of data collection interface and hardware prior to deployment
- Investment in appropriate hardware
- Ongoing commitment to technical support
- Focus on applied management

Current NC Zoo Cybertracker projects

- Rangers at Nigeria's Yankari Game Reserve (with WCS)

- Survey teams and wildlife monitors in Equatorial Guinea (with Bioko Biodiversity Preservation Program).

- Anti-poaching teams and park-wide mountain gorilla census in Rwanda' s Volcanoes National Park (with Diane Fossey Gorilla Fund International and International Gorilla Conservation Programme).

- Lion surveys at multiple sites (with Panthera)

- Carnivore in Ruaha National Park, Tanzania (with Ruaha Carnivore Project and WCS)

Limitations of Cybertracker

- No manual and few supporting materials
- No formal training available
- Limited query and analysis capability (e.g., month to month comparisons)
- Basic database structure
- Limited mapping functionality
- Single user

SMART

- Spatial Monitoring and Reporting Tool: a purpose built law enforcement monitoring and protected area management tool
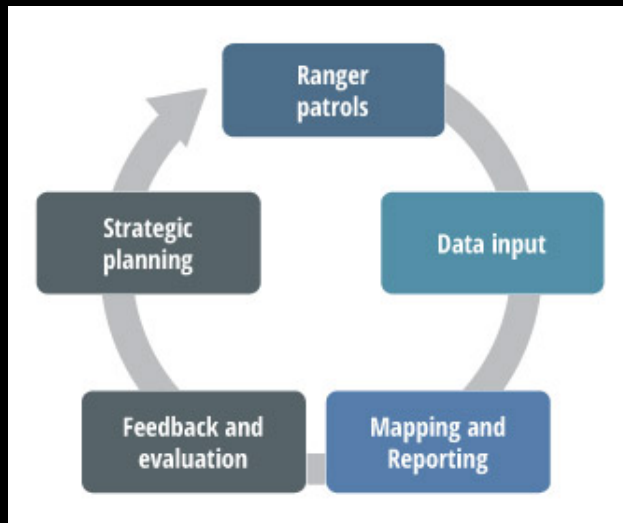
What makes SMART different

- More powerful analysis

- Automated report generation

- Multiple users

- Improved data security and controls

- Plugin framework (e.g., Cybertracker, ecological monitoring, entity tracker)

- Open source

- Easy to use, semi-automated analysis and reporting functions

What makes SMART different

- Incorporates intelligence and patrol planning information

- Available in multiple languages

- Simultaneous analysis for multiple protected areas

- Well-developed support materials

- Importation of existing data

Moving forward

- Transition to SMART at all sites for LEM

- Building SMART capacity and implementing at PAs across Africa

- Possible assessment of ranger-based monitoring data vs more independent data from acoustic monitors

- Continue with Cybertracker for some purely research-focused projects

Acknowledgements

- US Fish and Wildlife Service
- AZA Conservation Endowment Fund
- IUCN Save our Species Fund
- North Carolina Zoological Society
- Cleveland Metroparks Zoo
- Berggorilla & Regenwald Direkthilfe
- Community Conservation Association of the Mbe Mountains