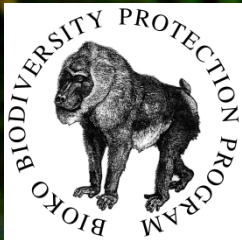


Bioko Island Where the Wild Things are...for now.



Shaya Honarvar

Department of Biology
Drexel University
Bioko Biodiversity Protection Program



ACKNOWLEDGEMENTS

- Professors and students at UNGE
- BBPP employees
- American undergraduates & and visiting instructors from the Study Abroad on Bioko Island
- Students & volunteers on the Annual Expedition to Bioko's Gran Caldera (1996 through 2011)
- Recent funding: **ExxonMobil Foundation (Moka Wildlife Center)**

National Geographic Conservation Trust
Margot Marsh Biodiversity Foundation
Tombros Foundation
Phoebe Haas Charitable Trust
Rotko Family Foundation
Primate Conservation, Inc.
International Primate Protection League
HESS Corporation
US Embassy



BBPP's mission is the conservation of Bioko Island's biodiversity, especially its threatened primates and marine turtles, through the development of economically sustainable educational programs, research programs and conservation activities that demonstrate the value of wildlife.



Christian Zeigler, ILCP RAVE



Bioko Island, Equatorial Guinea:

32 km offshore from Cameroon; separated from the African mainland ~12,000 yrs; area = ~2,000 km²

- 3 volcanic peaks (~3000m asl) with steep terrain (no logging)
- Tropical climate (4° N latitude) with > 10 m rain/year in south
- Capital city (Malabo) and most people (~100,000) in north
- Politically isolated, Spanish-speaking, no other students or tourists
- 2 protected areas making up ~ 40 % , but no guards
- Southern 1/3 is very remote



Why is Bioko important to biodiversity conservation?



Monkeys: Seven species of monkeys live in Bioko's forests, including Pennant's red colobus and the Bioko drill.

"Bioko Island is the single most important place in Africa for primate conservation action."

---IUCN/SSC Primate Specialist Group



Nesting sea turtles: Four species of sea turtles nest on the ~12 miles of Bioko's southern beaches, including many leatherbacks and green turtles.



Frogs: Bioko's deep mountain valleys and high rainfall may be conducive to frog speciation. Frogs are also very sensitive to changes in climate, habitat loss and pollution.

Conservation status of marine turtles on Bioko Island

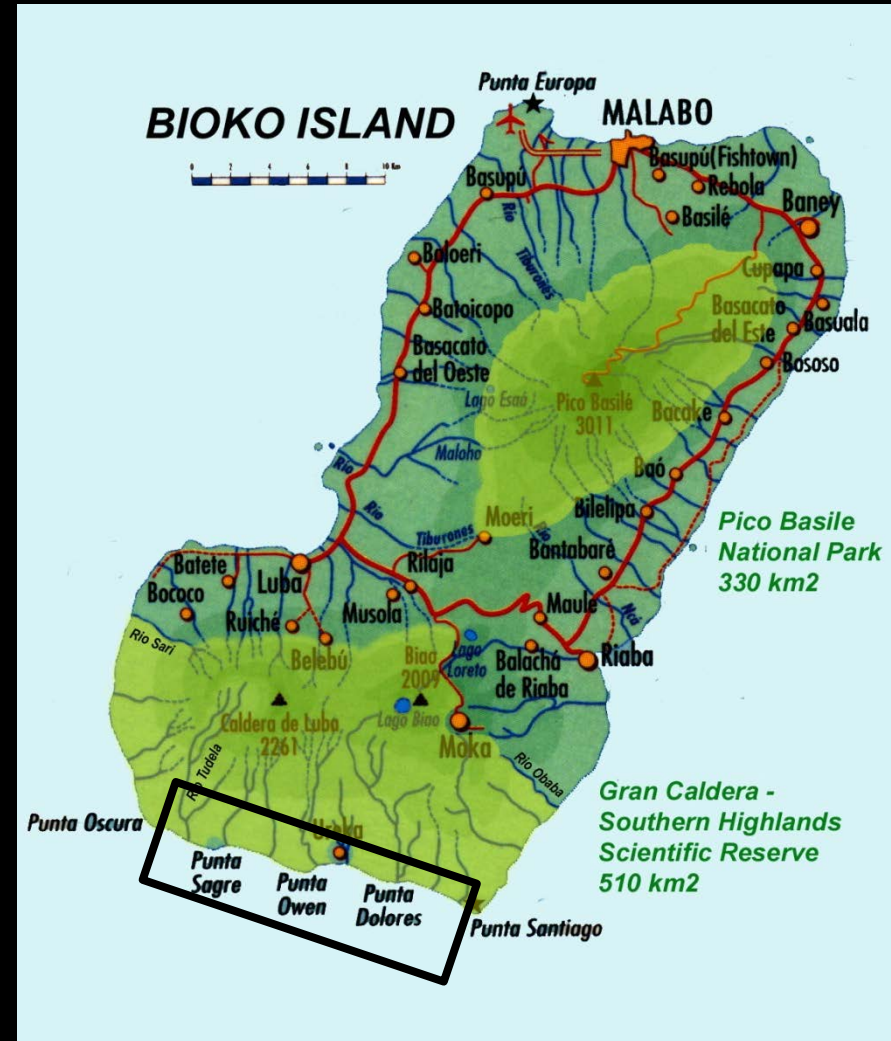


Sea Turtles of Bioko Island

Sea turtle species	IUCN
<i>Leatherback turtle</i> <i>Dermochelys coriacea</i>	CR
<i>Hawksbill turtle</i> <i>Eretmochelys imbricata</i>	CR
<i>Green turtle</i> <i>Chelonia mydas</i>	END
<i>Olive ridley turtle</i> <i>Lepidochelys olivacea</i>	VUL



Justin Jay



Threats to sea turtles

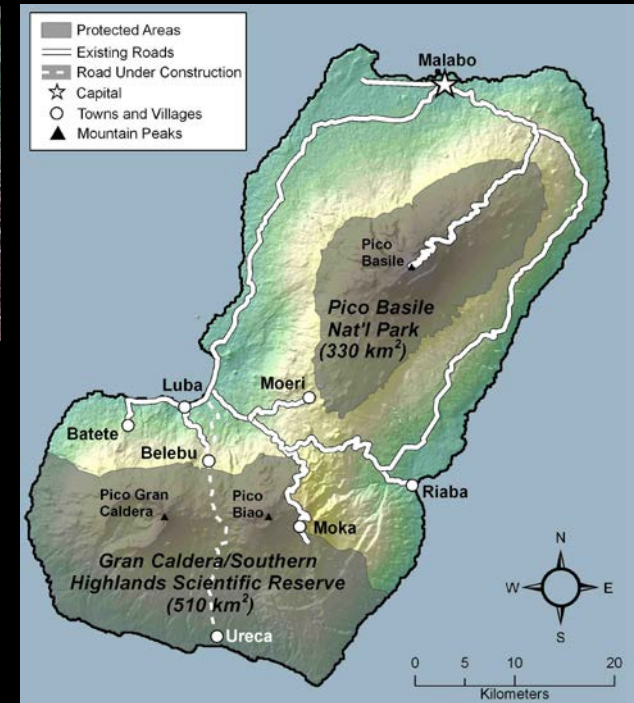
The Gulf of Guinea contains one of the world's largest nesting populations of the critically endangered leatherback turtle.

- Adult turtle (green turtles) take and occasional egg poaching



Petroleum exploration and development has led to rapid economic expansion.

- Belebu to Ureca road construction



Sea turtle conservation efforts on Bioko Island

- Conservation efforts started by the Asociación Amigos de Doñana (1996)
- Bioko Biodiversity Protection Program (1998)
- Data collection by community members (18 men and 16 women) was resumed under the direction of the BBPP (2000).
- Initiation of a PIT tagging program of the leatherbacks on the eastern-most beaches along with a flipper tagging program (2007).





Tim Laman, ILCP RAVE

Moaba Playa Camp: Site of leatherback turtle research camp.

Long term collection of nesting ecology data



1) PIT tag leatherback turtles



6) Nest temperatures



2) Count number of eggs



7) Count number of hatchlings

3) Body measurements; SCCL & SCCW

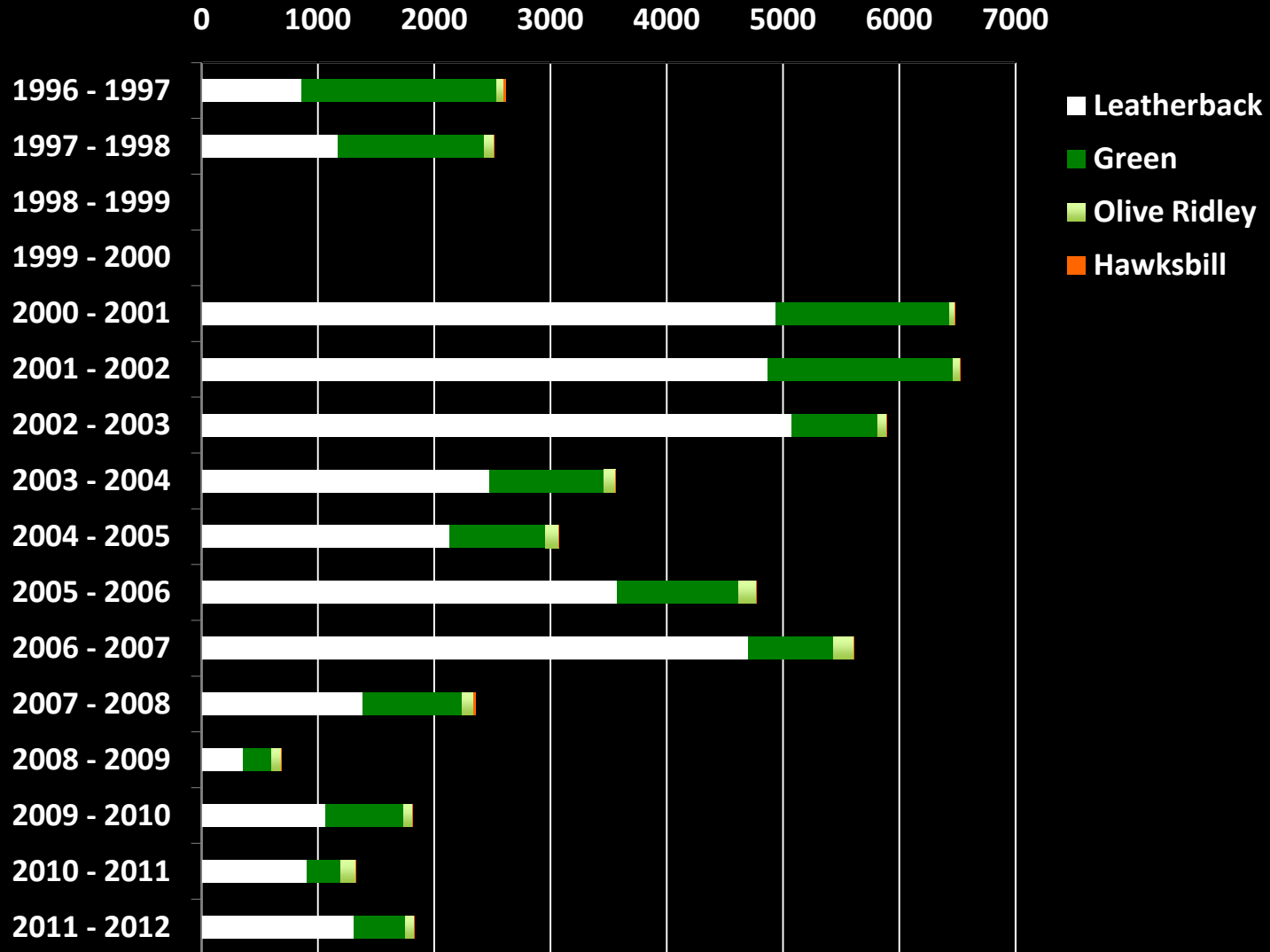
8) SCL, SCW and mass of hatchlings

4) Nest location on the beach

9) Post-hatching excavation

5) Time of specific nesting activities

Number of sea turtle encounters on the southern beaches of Bioko Island



350 Leatherback turtles have been PIT tagged in the past 5 nesting season on Playa Moaba!



Two studies

➤ Due to the importance of this region for the future survival of leatherbacks, and the potential threat of an environmental disaster from increasing oil production, it is important to obtain adequate baseline data on these populations.

Study #1: Changes in plasma chemistry and reproductive output of nesting leatherbacks.

➤ To understand how global climate change affects the biology of sea turtles it will be important to understand mechanisms that determine quality of beaches for water, gas and heat exchange in sea turtle eggs in order to predict which beaches will be suitable for nesting in future.

Study #2: Tidal ventilation of sea turtle nests.

Changes in plasma chemistry and reproductive output of nesting leatherbacks.

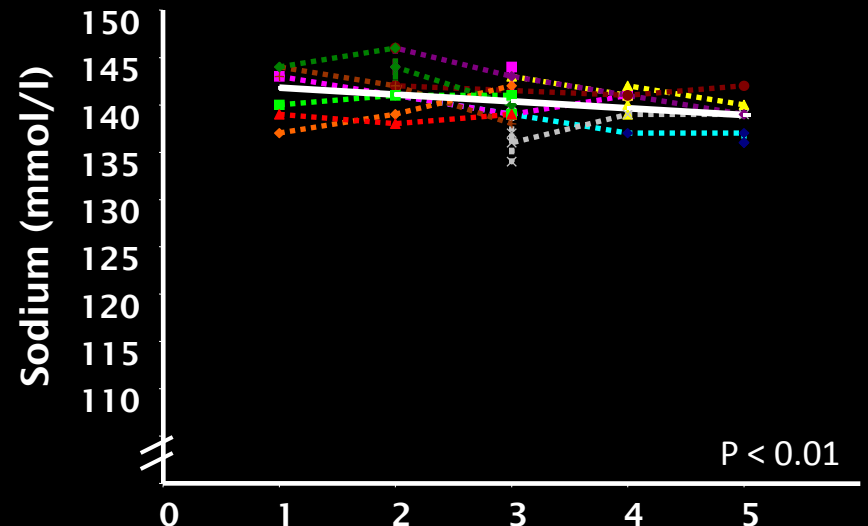
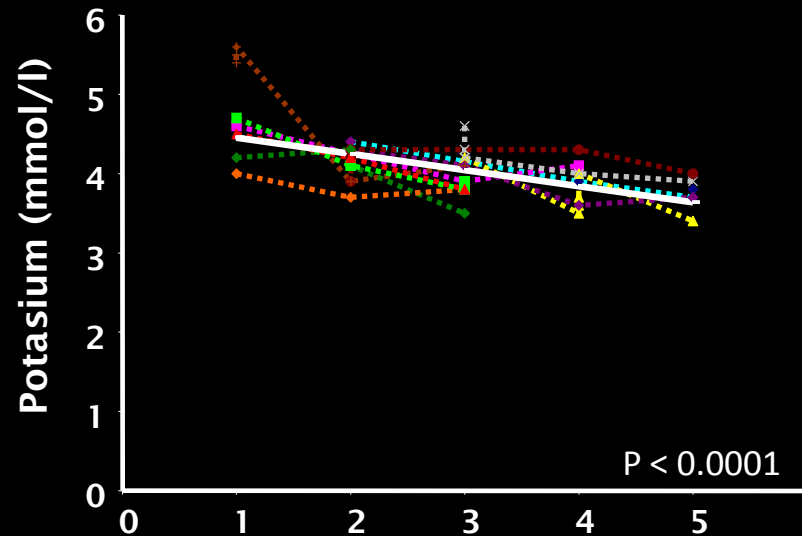
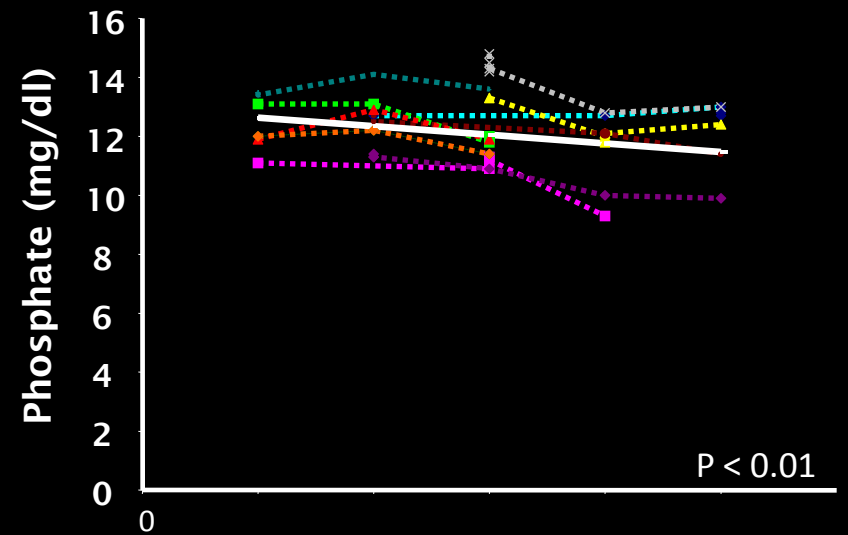
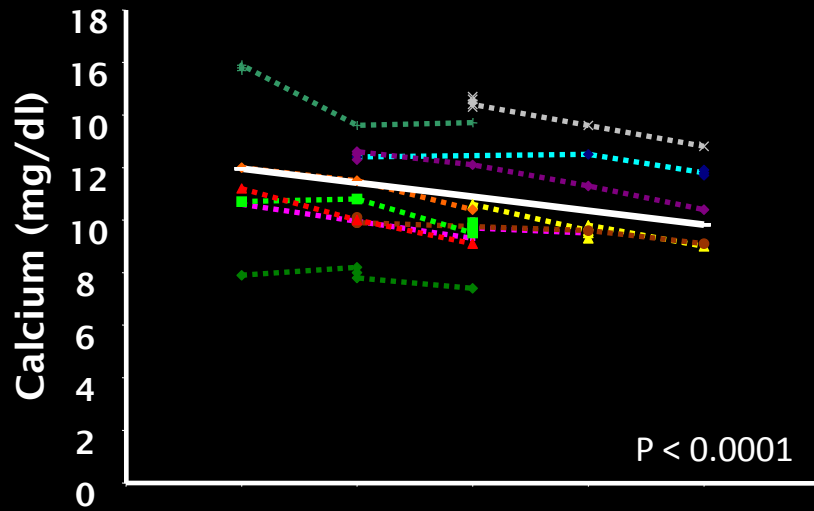


- 1) Body Condition Score was assessed.
- 2) Blood was collected in Lithium Heparin tubes 23 turtles (55 samples).
- 3) Packed Cell Volume and Total Protein were measured.
- 4) Blood Plasma was processed for Complete Blood Chemistry by VetScan VS2.

Plasma biochemical concentrations analyzed by VetScan VS2 (ABAXIS)

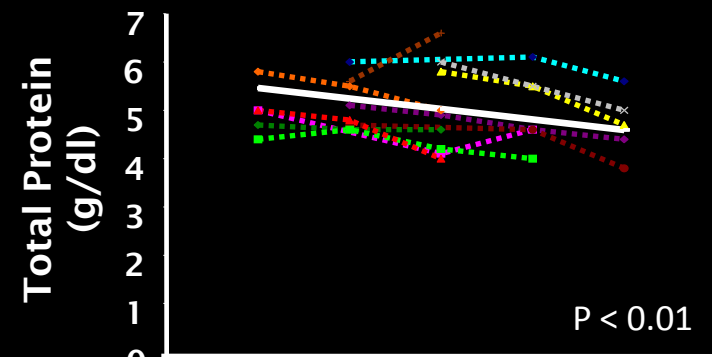
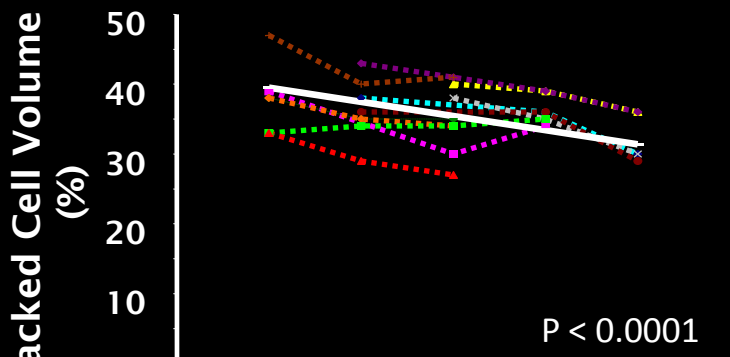
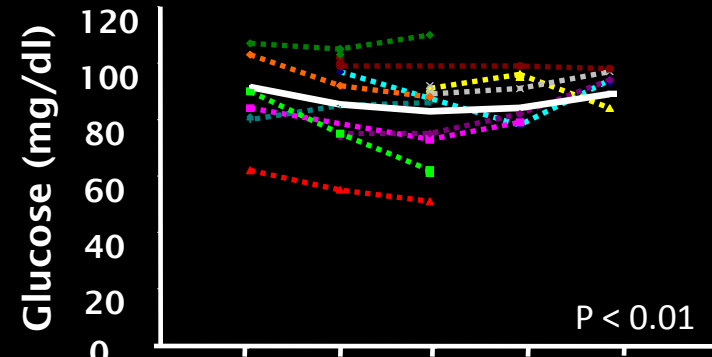
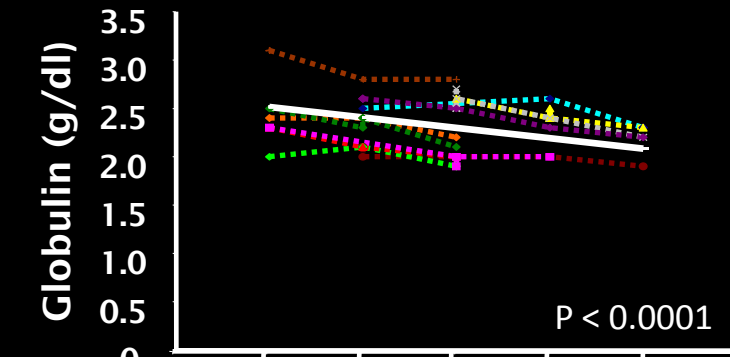
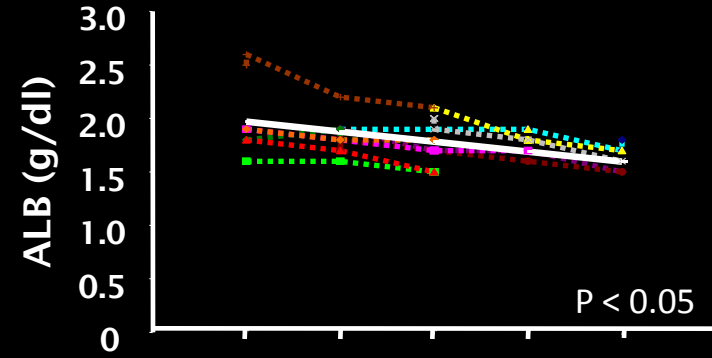
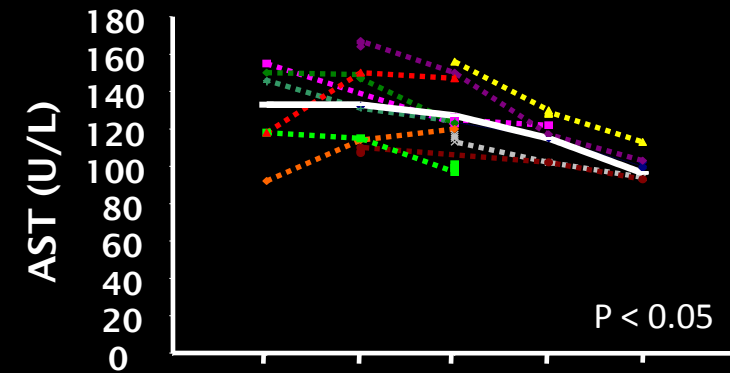
Parameters ^a	<i>All sampled leatherback turtles</i>			<i>First time nesters</i>	
	n	Mean ± SE	Reference Interval	n	Mean ± SE
Albumin (g/dL)	55	1.77 ± 0.03	1.30–2.24	16	1.82 ± 0.08
ALP (U/L)	20	52.35 ± 1.53	30.10–74.60	3	38.33 ± 2.19
ALT (U/L)	18	8.83 ± 0.39	3.20–14.46	2	9.00
Amylase (U/L)	20	345.85 ± 8.99	215.13 –476.57	3	291.33 ± 11.70
AST (U/L)	55	125.9 ± 3.27	78.28–173.48	16	128.77 ± 6.60
BUN (mg/L)	6	2.33 ± 0.07	1.32–3.34	1	2.00
Calcium (mg/dL)	55	11.16 ± 0.25	7.50–14.83	16	11.35 ± 0.55
Creatine kinase (U/L)	52	146.87 ± 21.08	N/A–453.31	16	151.43 ± 34.64
Globulin (g/dL)	55	2.40 ± 0.04	1.8–2.99	16	2.40 ± 0.09
Glucose (mg/dL)	55	86.34 ± 1.83	59.77–112.91	16	86.44 ± 3.28
Phosphorous (mg/dL)	55	12.19 ± 0.16	9.85–14.52	16	12.03 ± 0.27
Potassium (mmol/L)	55	4.07 ± 0.05	3.30–4.85	16	4.38 ± 0.11
Sodium (mmol/L)	55	140.27 ± 0.37	134.83–145.704	16	140.31 ± 0.54
TBIL (mg/dL)	20	0.21 ± 0.003	0.16–0.25	3	0.20
Uric acid (mg/dL)	45	0.39 ± 0.01	0.23–0.55	16	0.40 ± 0.02
TP (g/dL)	54	5.08 ± 0.10	3.60–6.56	16	5.01 ± 0.23
PCV (%)	55	36.4 ± 0.59	27.83–44.97	16	37.63 ± 0.91

Plasma biochemical concentrations during the nesting season (n = 11)



Nesting Event (#)

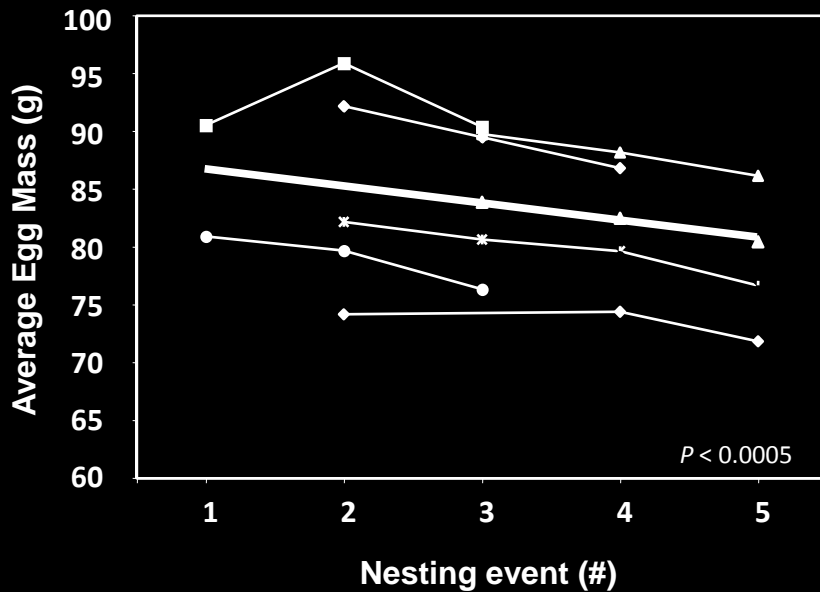
Plasma biochemical concentrations and PCV values during the nesting season (n = 11)



Nesting Event (#)

Changes in plasma chemistry and reproductive output of nesting leatherbacks.

The decreasing trends in plasma biochemical concentrations and PCV values found in this study can probably be attributed to the physiological stress of folliculogenesis and nesting, which is further compounded by a possible period of fasting during the nesting season.



A decreasing trend in egg mass further supports this assumption.



Such data can be used in future conservation and management practices, such as comparative studies of clinically normal and diseased turtles, or as indicators of exposure to contaminants.



Two studies

➤ Due to the importance of this region for the future survival of leatherbacks, and the potential threat of an environmental disaster from increasing oil production, it is important to obtain adequate baseline data on these populations.

Study #1: Changes in plasma chemistry and reproductive output of nesting leatherbacks.

➤ To understand how global climate change affects the biology of sea turtles it will be important to understand mechanisms that determine quality of beaches for water, gas and heat exchange in sea turtle eggs in order to predict which beaches will be suitable for nesting in future.

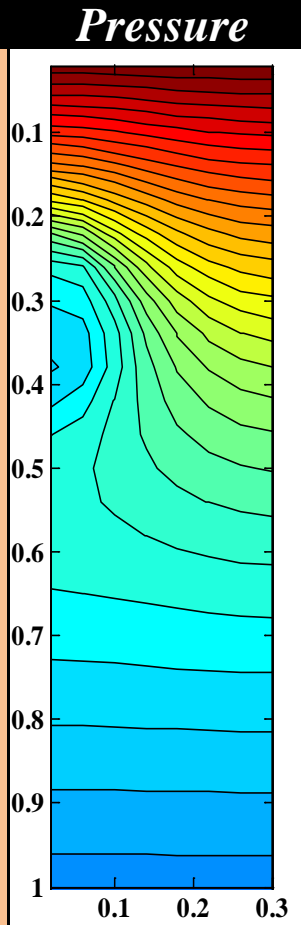
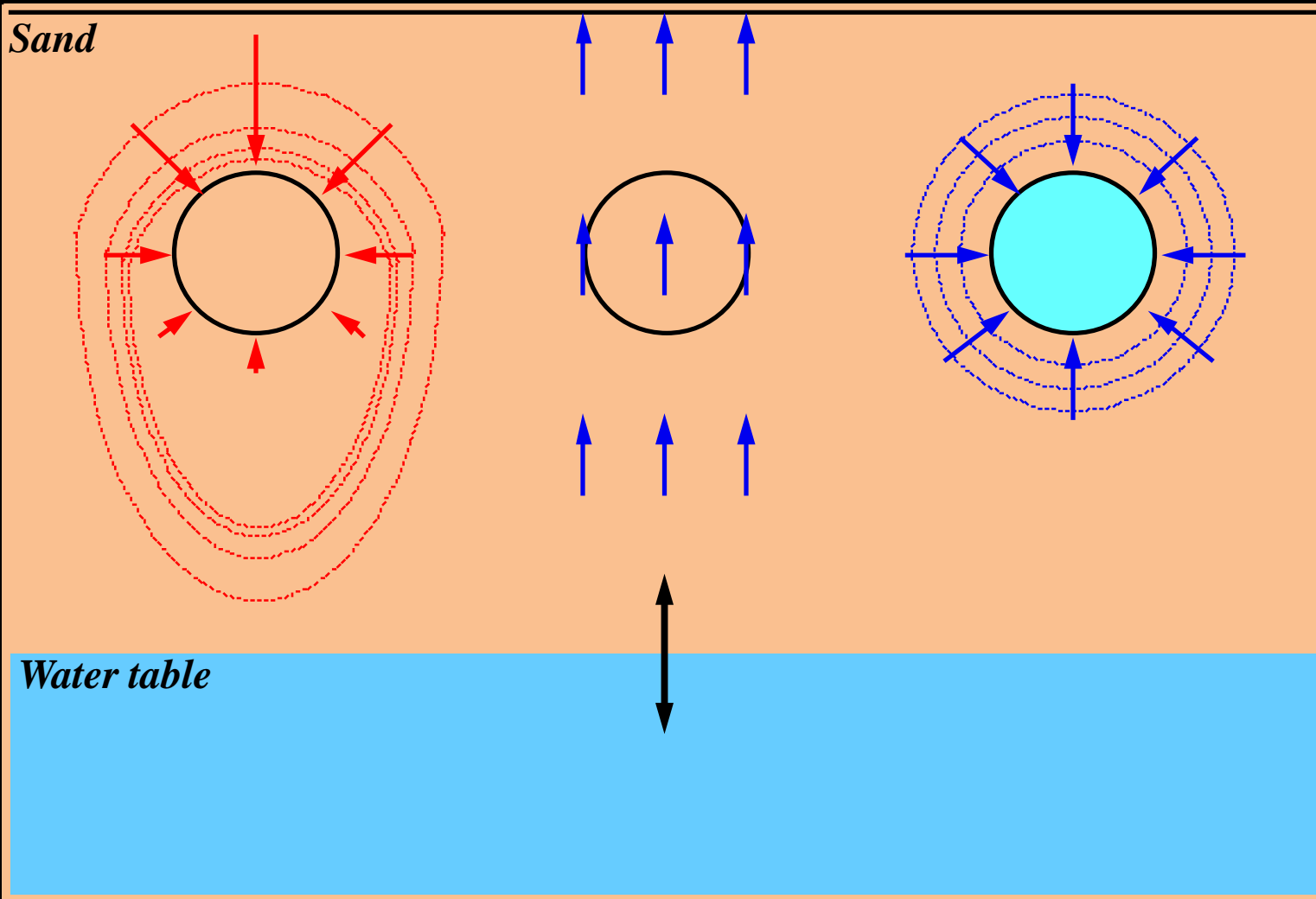
Study #2: Tidal ventilation of sea turtle nests.

Tidal ventilation of sea turtle nests

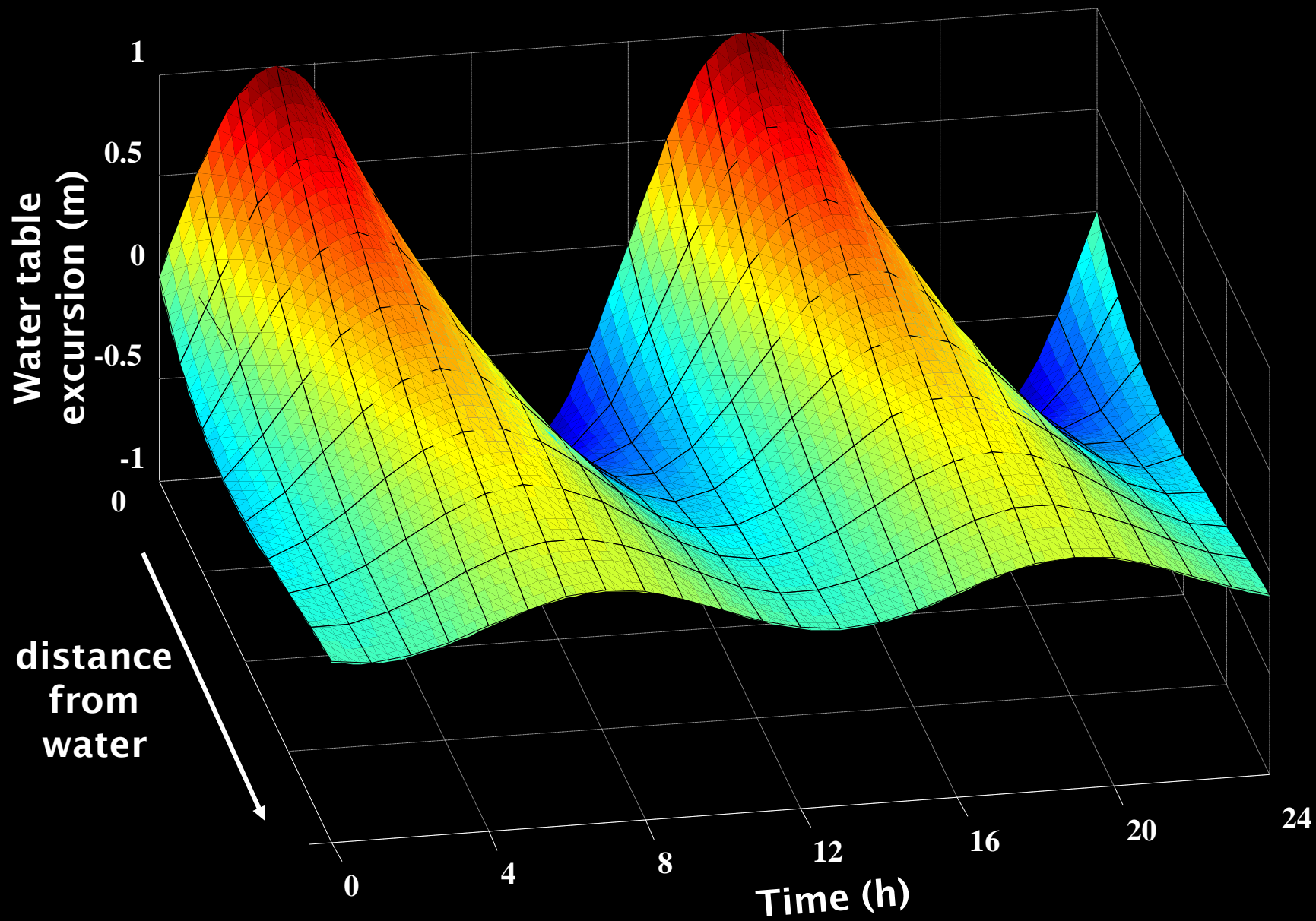
- Eggs are laid in the ground as deep as 70-80 cm
 - This changes the dynamics of the biophysical exchanges such as heat, water vapor and respiratory gases between the egg and the environment.
- Turtle eggs are leathery or parchment-like
 - Smaller shell resistance to gas and heat exchange than bird eggs. Therefore, the conditions of the medium (soil type, temperature and moisture content) dominate the biophysical exchanges.

Gas exchange modes

Air *diffusion* *tidal convection* *gas sink convection*

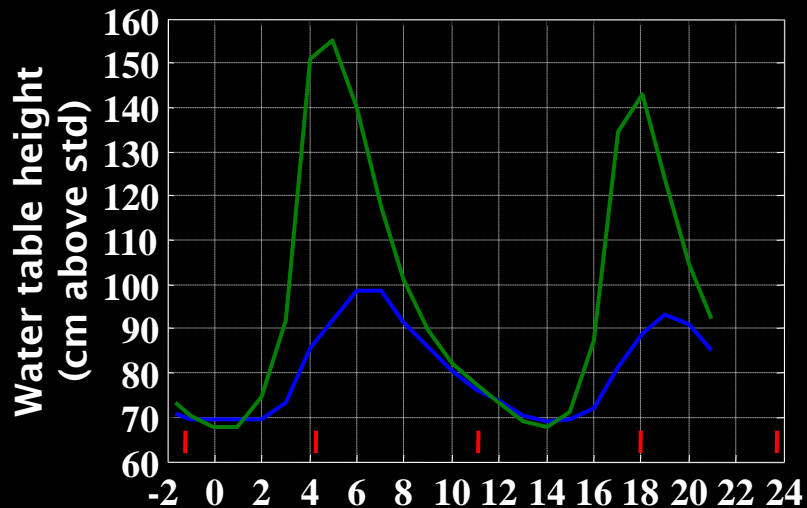


Tidal water table movements



Water table heights and gas concentrations

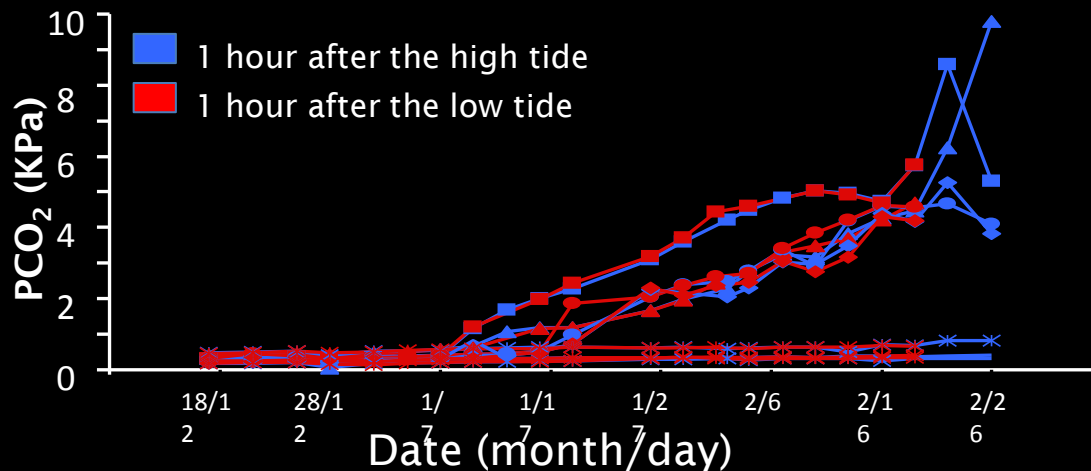
Full moon



Measuring the tide gauge day and night !



Measuring CO₂ and O₂ levels.



Convective ventilation of sea turtle nests by tidal pumping may significantly mitigate metabolic hypoxia and hypercapnia.

As global climate continues to change It is important to be able to predict which beaches will be suitable for nesting in future and what are the mechanisms that determine the quality of nesting beaches.



Conservation status of the critically endangered Bioko Pennant's red colobus



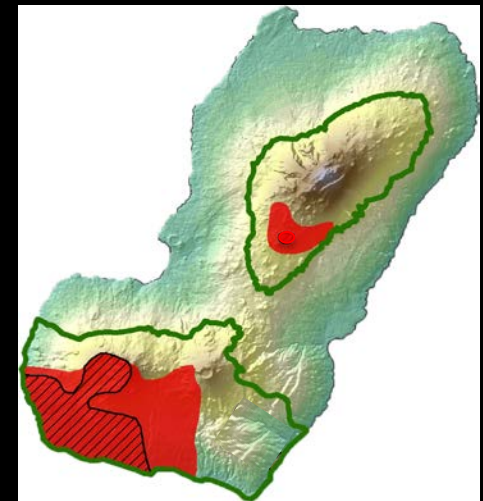
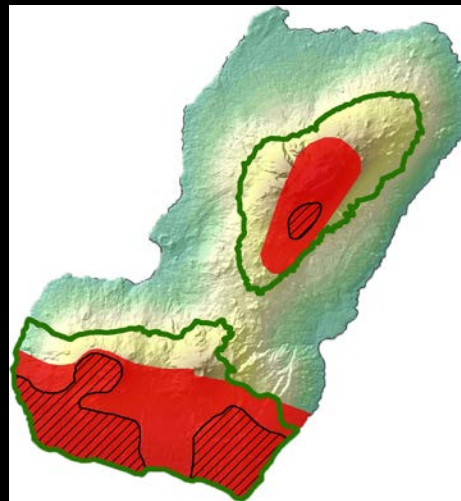
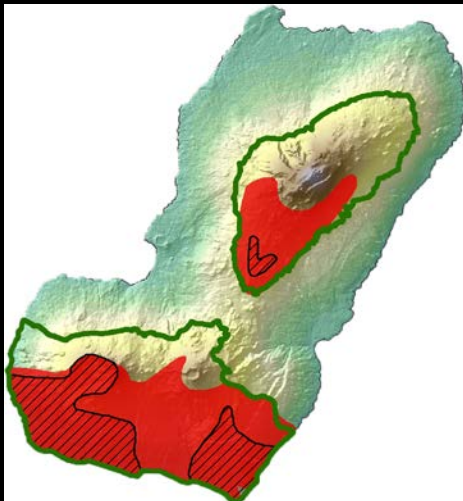
Estimated ranges for Bioko Island monkeys in 2010



Bioko Drill (EN)
Mandrillus leucophaeus poensis

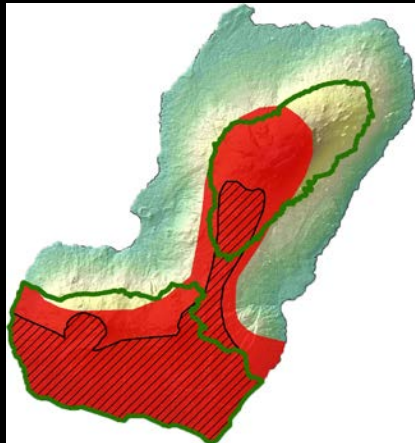
Black colobus (EN)
Colobus satanas satanas

Pennant's red colobus (CR)
Procolobus pennanti pennanti

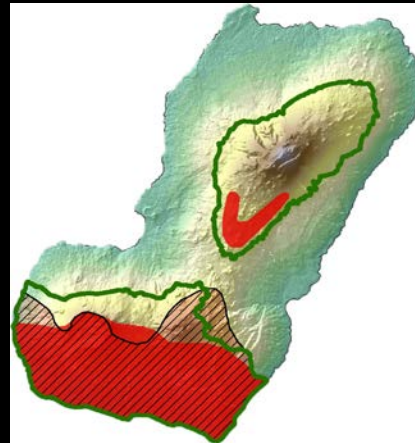
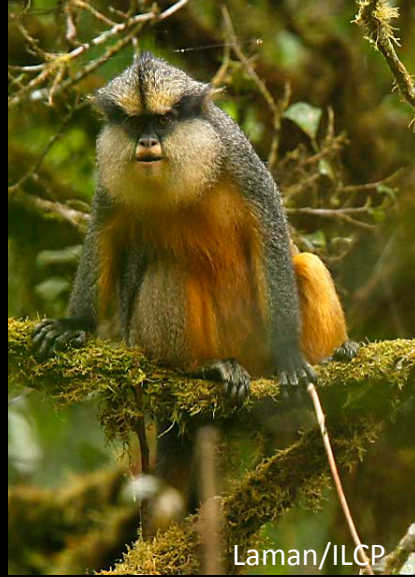


Estimated ranges for Bioko Island monkeys in 2010

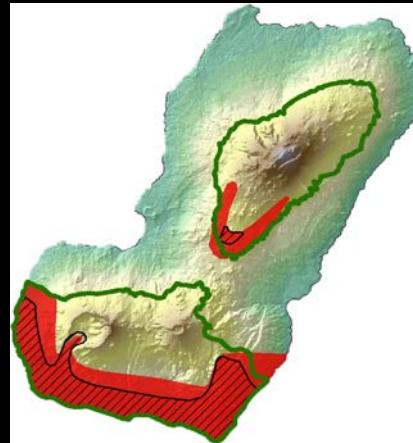
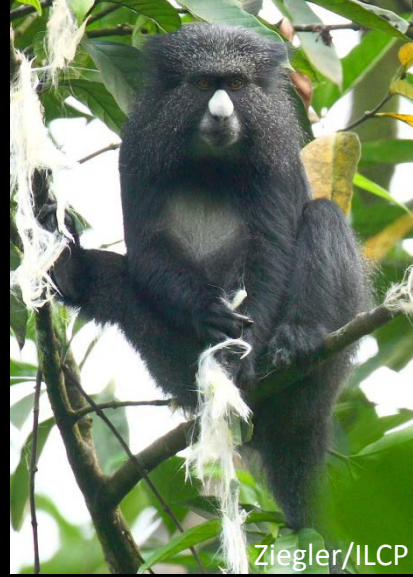
Red-eared monkey
Cercopithecus erythrotis erythrotis (VUL)



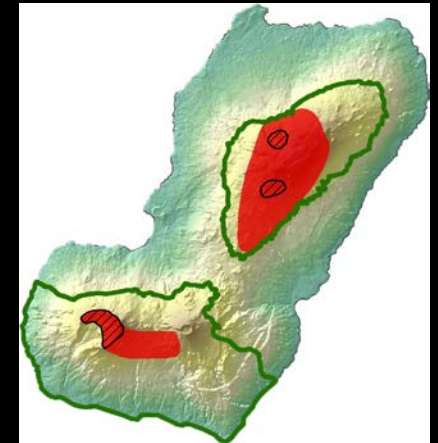
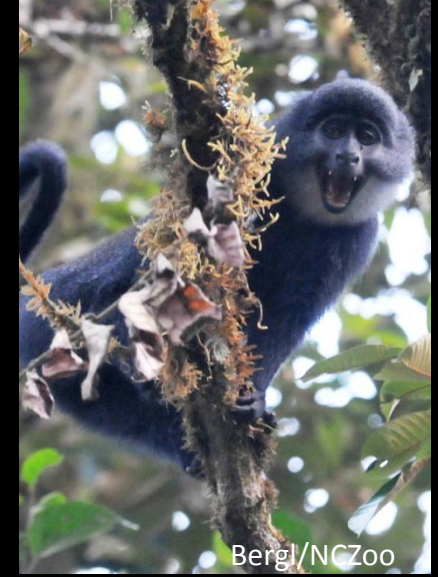
Crowned monkey
Cercopithecus pogonias pogonias (VUL)



Putty-nosed monkey
Cercopithecus nictitans martini (VUL)



Preuss's monkey
Allochrocebus/Cercopithecus preussi insularis (END)



Threat to monkeys



- The only threat to monkeys, on Bioko Island is commercial hunting for a bushmeat market in Malabo
 - Bushmeat is a luxury item.
 - Local supermarkets sell fresh domestic meat at lower prices.
 - Local people are increasingly prosperous because of offshore oil.

Primate conservation efforts on Bioko Island

➤ For almost 15 years we (= Bioko Biodiversity Protection Program, an academic partnership between the National University of Equatorial Guinea & Drexel University) have monitored the status of Bioko Island's forest wildlife (including monkeys) both in the market and in the forest:

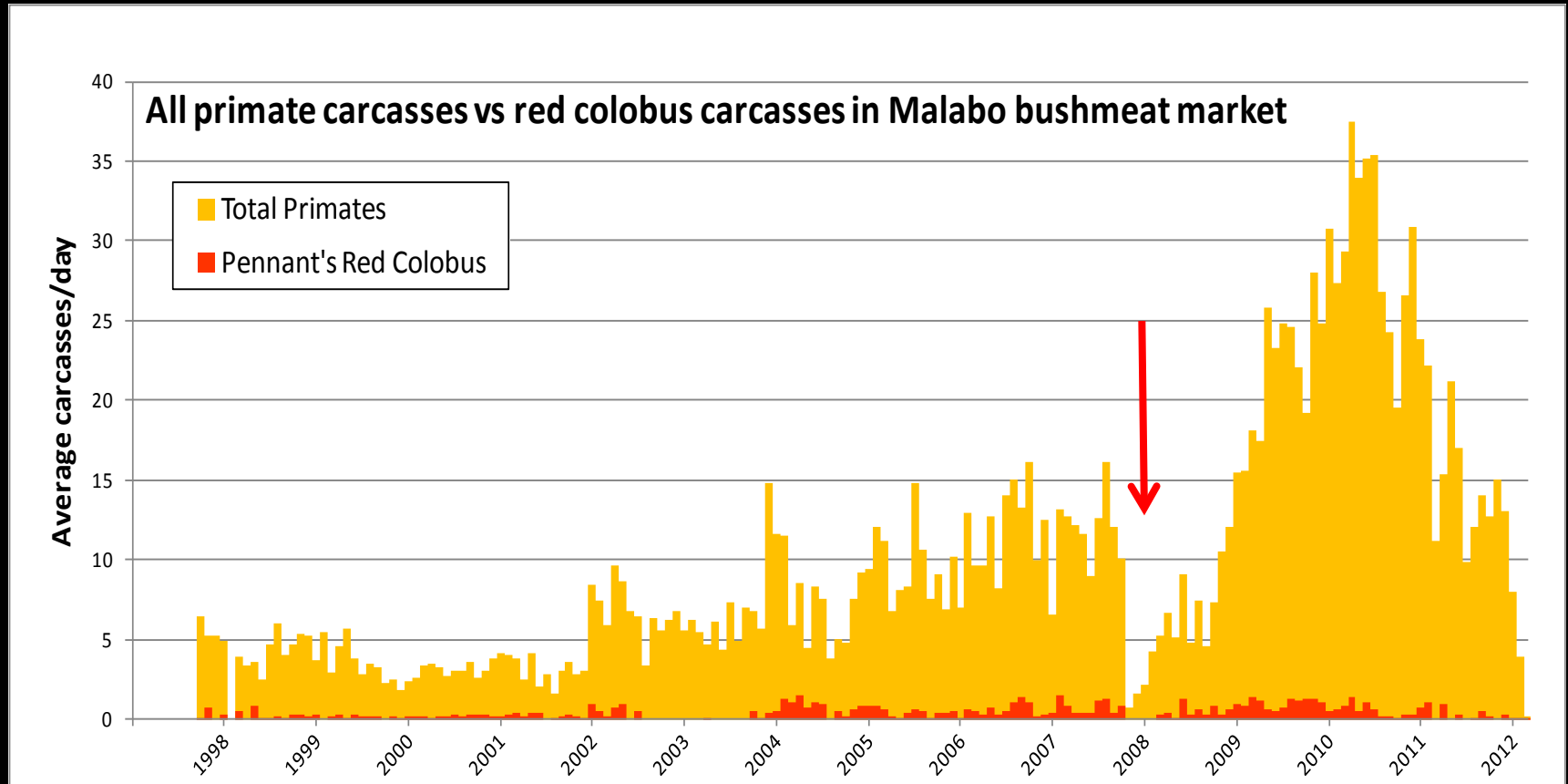
MARKET CENSUS

In the Malabo Market, we record each carcass brought to the market each day (6/7) since October 1997.

- Information includes date, species, approximate age, method of capture, selling price & origin.
- More than 220,000 carcasses
- Approximately 18% monkeys
- Red colobus make up < 1% of total carcasses.



Red colobus carcasses in the bushmeat market over time (14+ yrs)



- Total monkey carcasses = 40,640; total red colobus carcasses = 1,856 (4.6%)
- Red colobus carcasses reflect low hunting intensity in SW corner & Gran Caldera

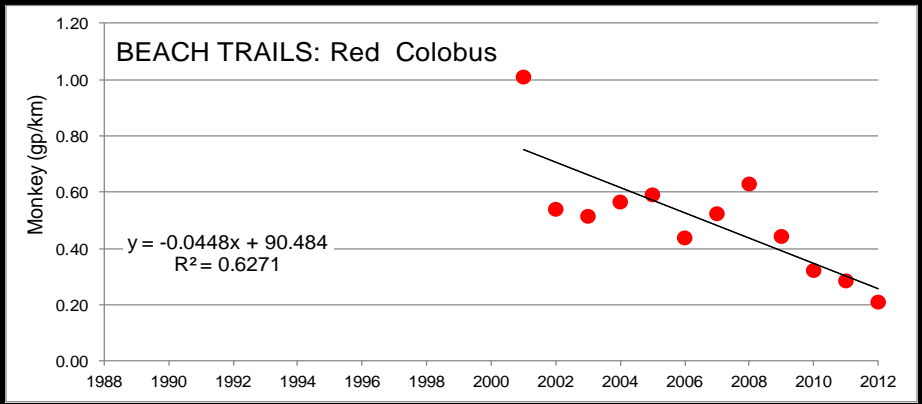
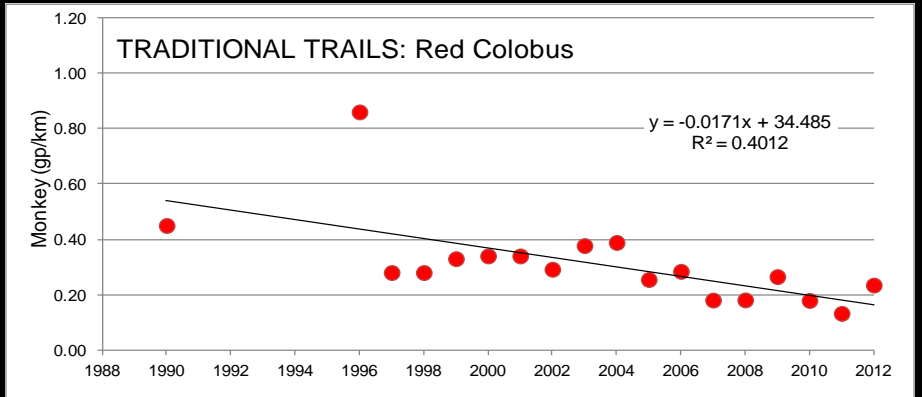
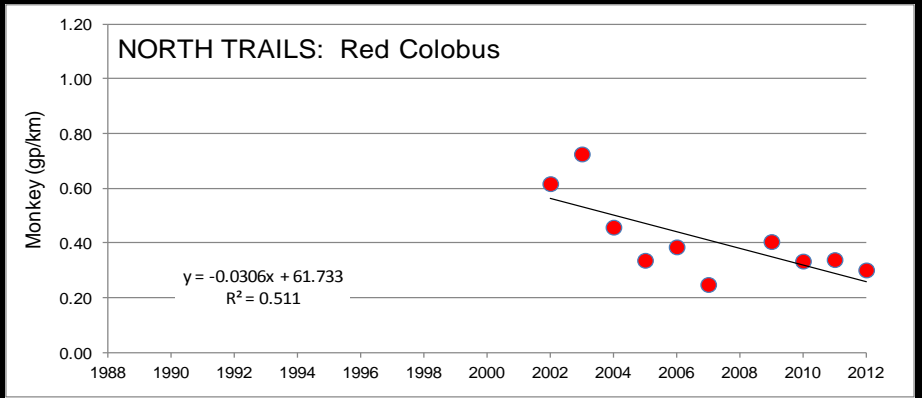
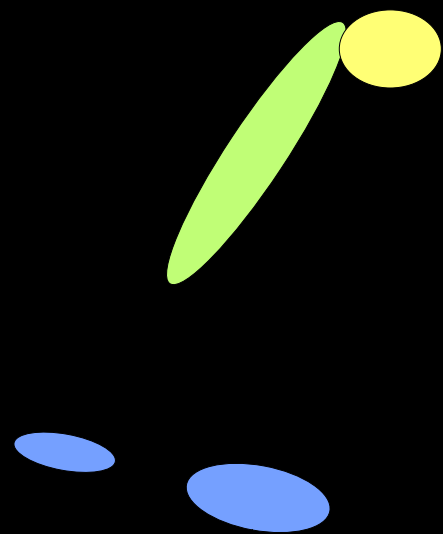
Primate conservation efforts on Bioko Island



- Forest census during the Grand Caldera Expedition was initiated in 1996.
- Forest census by local team was initiated in 1998.
- Since 2010, forest census has been done using Cybertrackers which was implemented as part of a collaboration with the North Carolina zoo.



Tim Laman: ILCP RAVE



Impact factors

Negative factors:

- The Pennant's red colobus population is confined to 259 km² area
- Shotgun hunting expected to increase dramatically & Red Colobus are very susceptible to shotgun hunting
- No governmental protection from hunting
- New roads into GC&SH Reserve increase hunter access

Positive factors:

- Area is remote and difficult to hunt
- Hunters are deterred by passive protection (BBPP patrols)
- EG government is increasingly interested in biodiversity conservation to improve its international image
- EG government has money & can curtail the bushmeat market
- Pennant's Red Colobus is gaining recognition: EG endemic; Cinderella species; 25 Most Endangered Species



Christian Zeigler, ILCP RAVE

Bioko Island's amphibians are increasingly threatened by habitat destruction, especially road-building in protected areas.

1996



Hearn

Pico Basilé Development

2007



Cronin

2009



Hearn



Conservation of Bioko's Endangered Amphibians

- Surveys sought to confirm the presence of both endangered species, and document their range in Pico Basile.
- Initiate a multi-faceted campaign to prevent the destruction of this vital habitat.



Didynamipus sjostedti
(IUCN Endangered)



Arlequinus krebsi
(IUCN Endangered)

We don't just study biodiversity conservation, we do biodiversity conservation!

- Bioko Biodiversity Protection Program (1999), a partnership between Drexel University & the National University of Equatorial Guinea (not an NGO) www.bioko.org
- Direct conservation:
 - Wildlife census by local patrols (Caldera, Southern Beaches & Roving Patrols)
 - • Public & government relations: Reports & other publicity for wildlife
- Education
 - UNGE faculty workshops & paid post-graduate training
 - Drexel Study Abroad on Bioko Island with UNGE
 - Training patrols and outreach to schools
- Research
 - Field Research Station at Moka
 - Hosting guest scientists
 - Baseline data in anticipation of climate change
 - • Intensified field presence providing indirect protection

CONSERVATION STRATEGY #1: Convince the Government of Equatorial Guinea that protecting Bioko Island's monkeys (and other wildlife) is important to their international image and that the hunting ban must be enforced.

- Validation from independent sources:
NATIONAL GEOGRAPHIC MAGAZINE (August 2008)
- Reports written in conjunction with UNGE faculty
- Outreach materials

CONSERVATION STRATEGY #2: Intensified field research presence in the protected areas, based out of the new Moka Wildlife Center.

- Annual expedition to the Gran Caldera for forest wildlife census
- Monthly census by a local team using the Cybertrackers
- Drexel Study Abroad on Bioko Island: Fall and Winter Terms
- Hearn Lab research volunteers



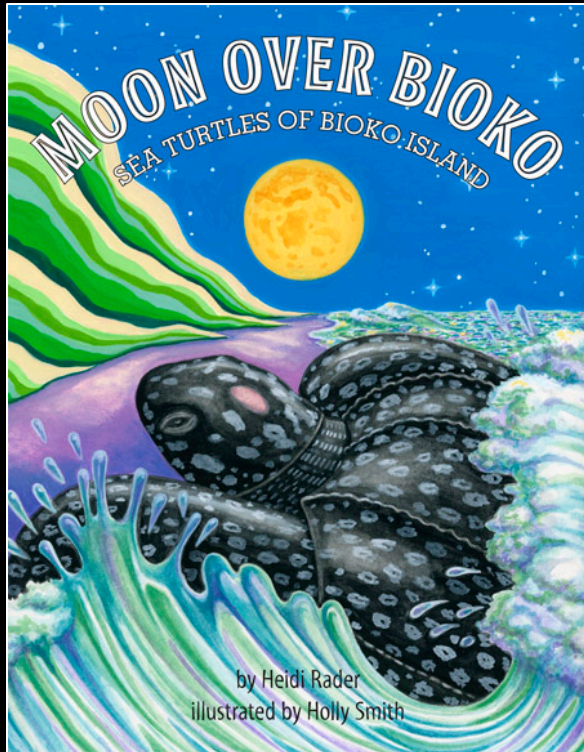
Chiu/BBPP



Chiu/BBPP

Two outreach projects currently underway:

- “Moon Over Bioko,” an award-winning children's book about the BBPP turtle patrols, also in a Spanish edition.
- A documentary film featuring extensive footage of wild drills on Bioko Island.



We believe Bioko Island continues to be a particularly promising location for conservation success

- Low human population
- Land is unsuitable for other functions (logging & farming) because of steep terrain and high rainfall
- Government of Equatorial Guinea already has the money (from oil) and increasingly has the desire (future ecotourism) to protect wildlife.
- Long term educational collaboration has made the message (conserve biodiversity) acceptable.
- Bioko Island still has a wildlife.



Thank you