The University of Texas at Austin
Environmental Science Institute

Hot Science - Cool Talk # 90

Primate Social Behavior

Dr. Anthony Di Fiore
April 4, 2014

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Photo: Federico Pardo, National Geographic

HOT SCIENCE – COOL TALKS

THE SOCIAL LIVES OF MONKEYS

LONG-TERM RESEARCH ON SPIDER MONKEYS IN AMAZONIAN ECUADOR

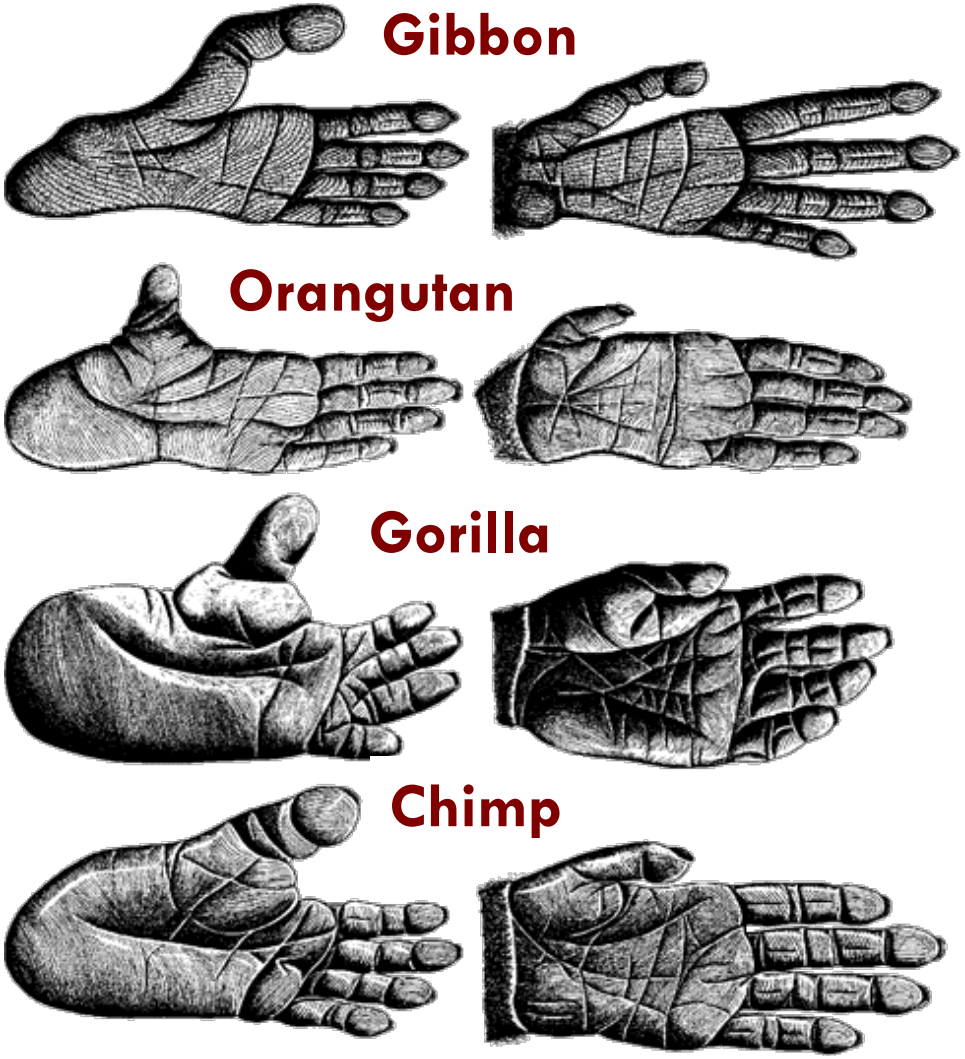
Dr. Anthony Di Fiore
University of Texas at Austin

Where we're going…

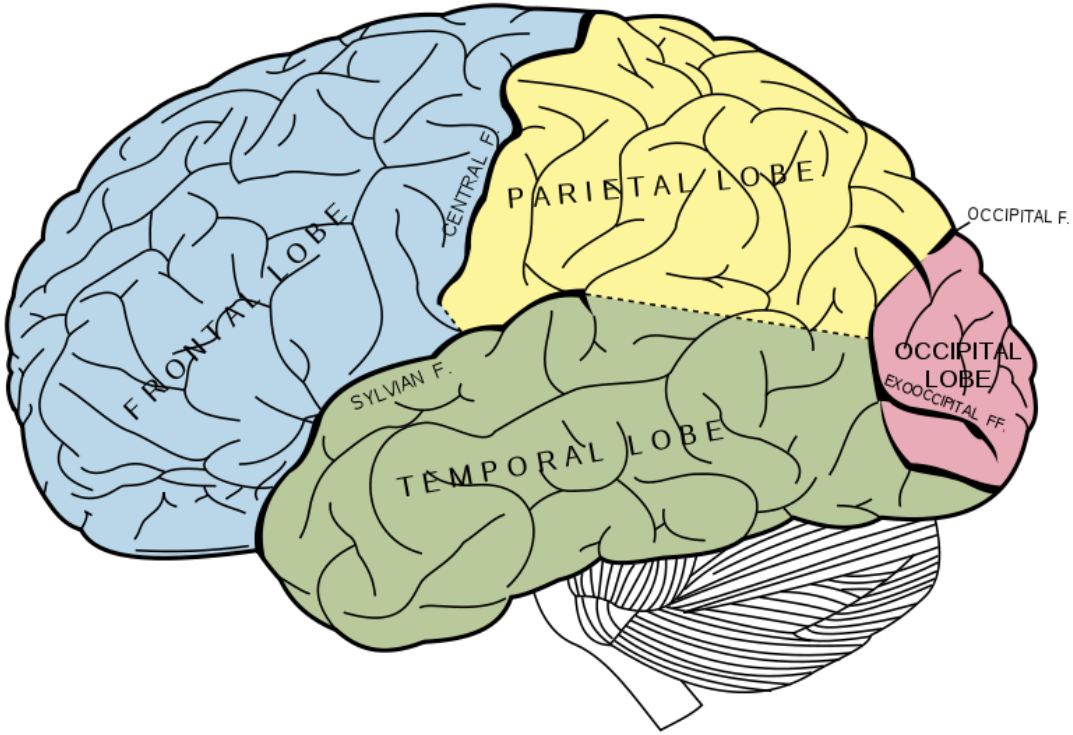
- An introduction to primates…
  - … *especially spider monkeys!*
- A taste of primatology fieldwork
  - *How the heck do you study arboreal rainforest primates?*
- Four vignettes…
  - *Social media for spider monkeys*
  - *Mineral licks, predation risk, and safety in numbers*
  - *Patrols, raids, and warfare*
  - *Sex and the single monkey*

Tarsier

http://biologypop.com/tarsier/



http://www.gibbons.de/



http://en.wikipedia.org/wiki/File:Gray728.svg

<u>Neocortex</u>

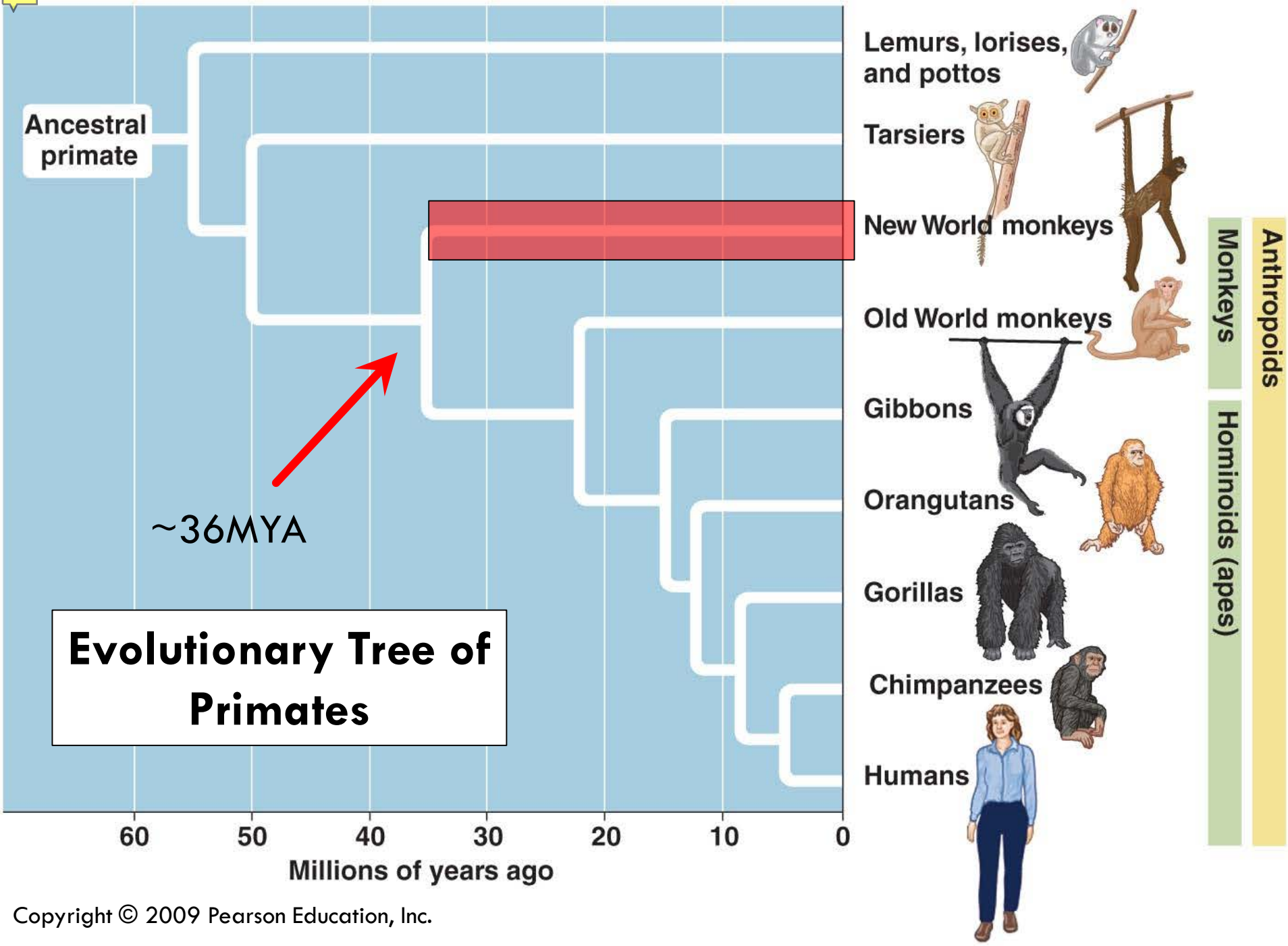
Self control

Abstract thought

Perspective taking

Geladas in the Ethiopian Highlands

http://focusingonwildlife.com/news/wp-content/uploads/2012/02/Gelada-Simien-Mountains-NP-Ethiopia-AR-682.jpg



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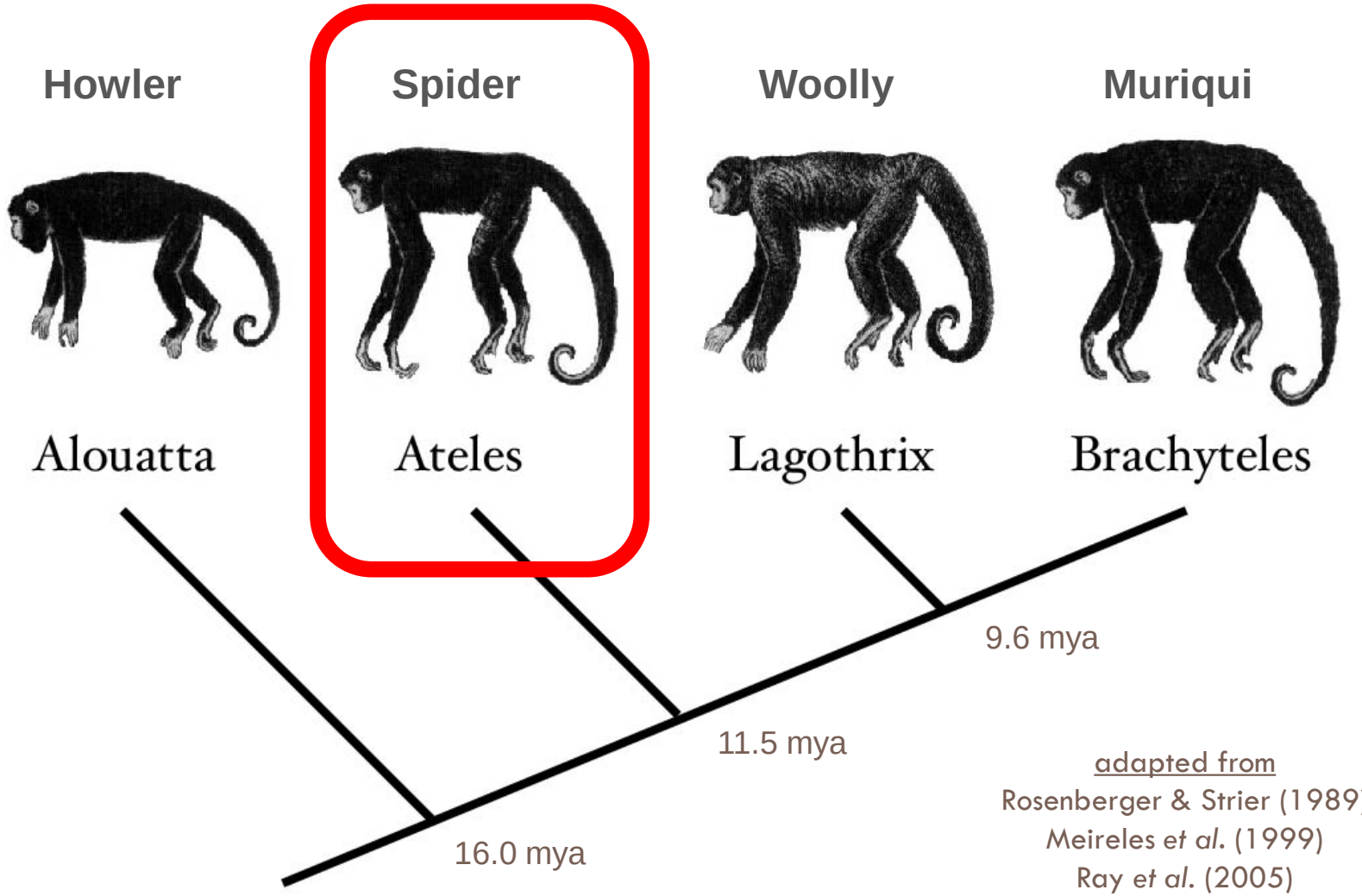
Howler Monkey

http://commons.wikimedia.org/

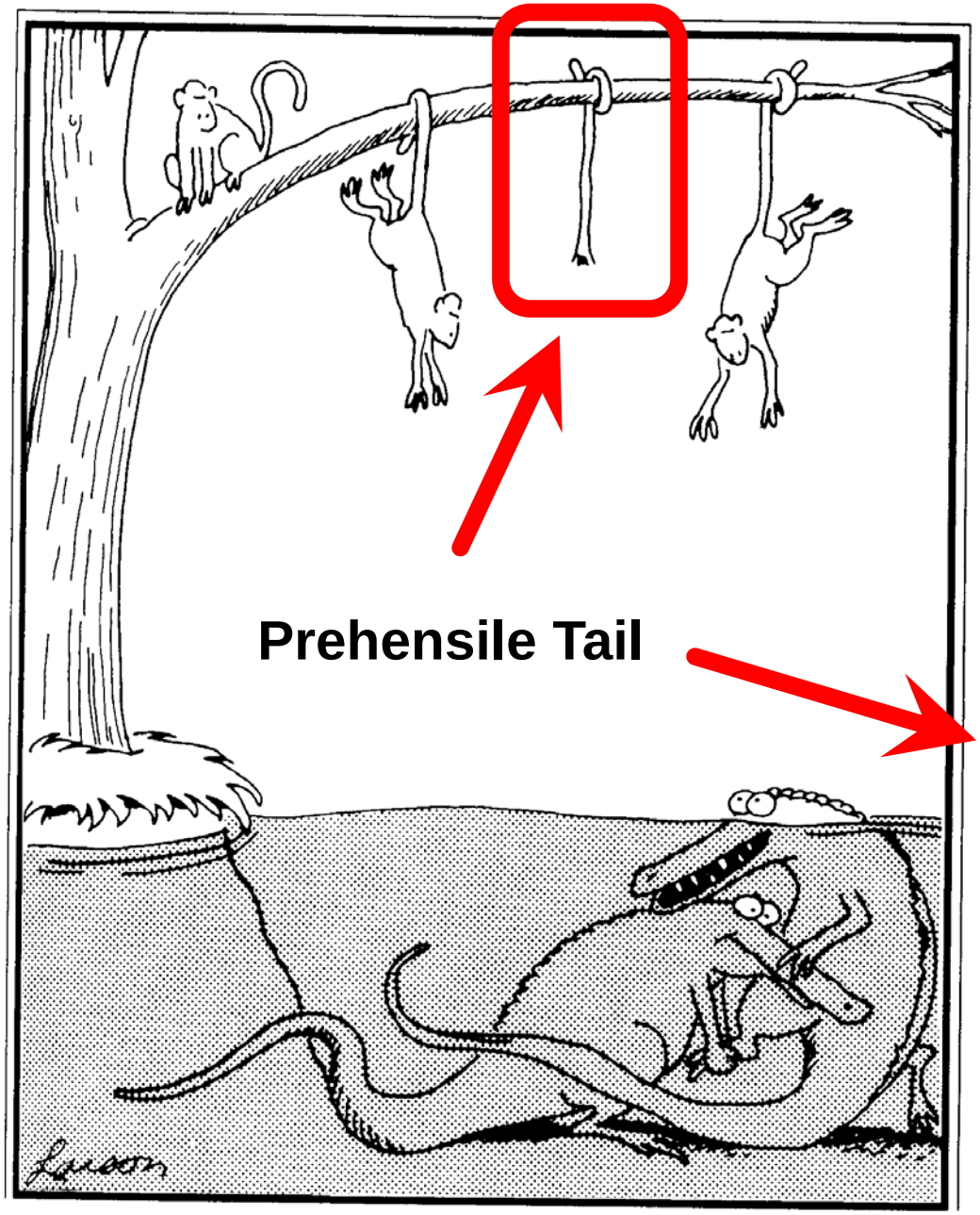
Muriqui

Woolly Monkey

Family: Atelidae



adapted from
Rosenberger & Strier (1989)
Meireles *et al.* (1999)
Ray *et al.* (2005)
Herke *et al.* (2007)



"Okay, here we go again . . . one . . . two . . ."

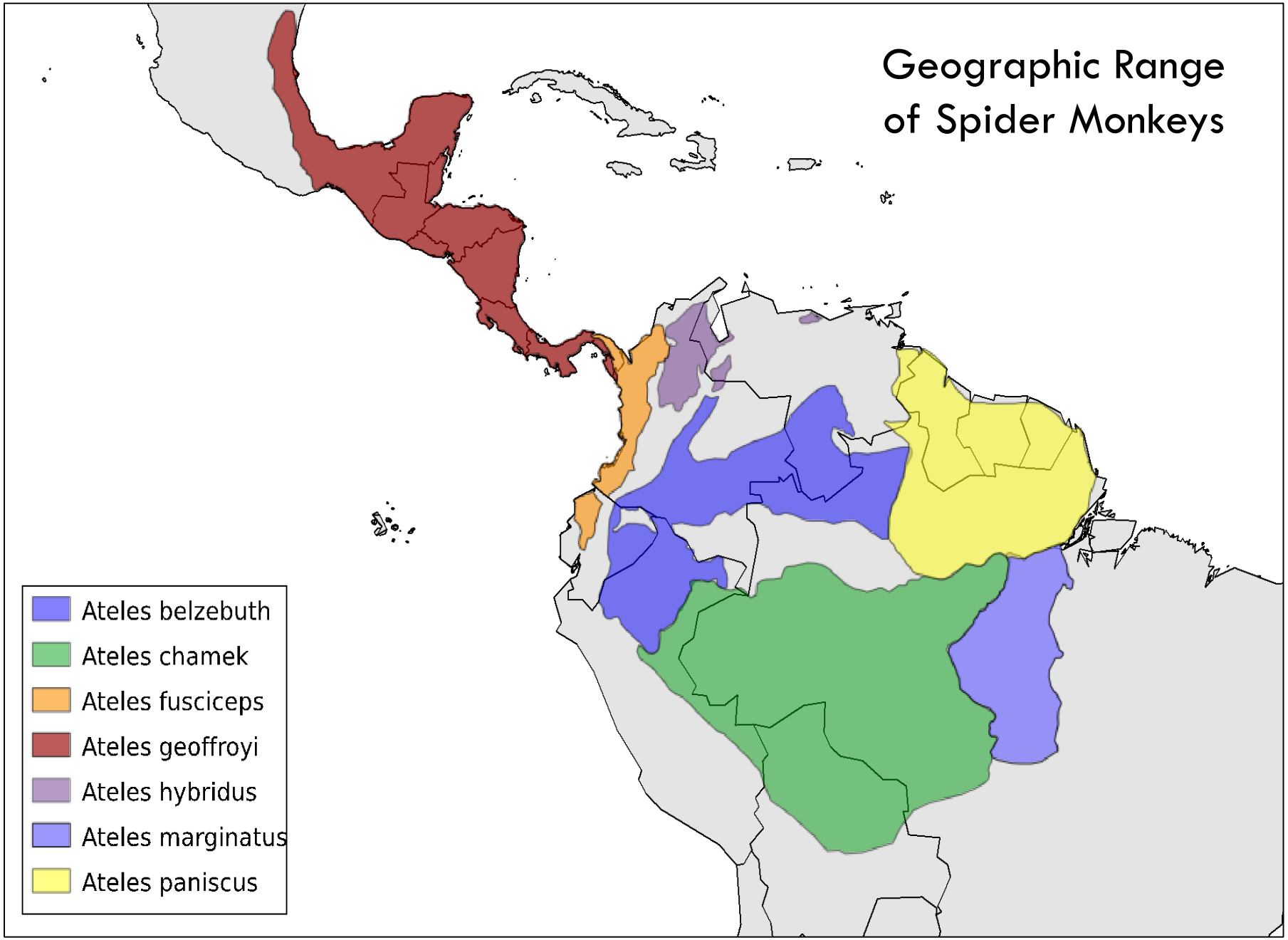
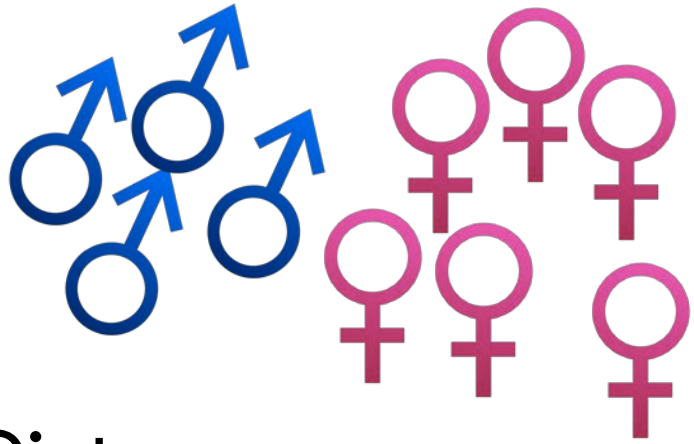

Geographic Range
of Spider Monkeys
Ateles belzebuth
Ateles chamek
Ateles fusciceps
Ateles geoffroyi
Ateles hybridus
Ateles marginatus
Ateles paniscus

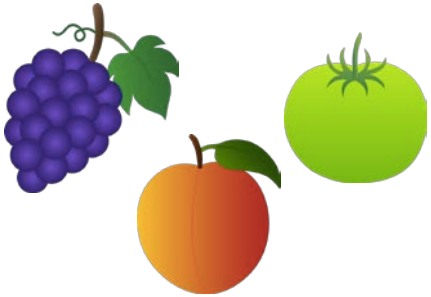
Photo: Dylan Schwindt, Proyecto Primates

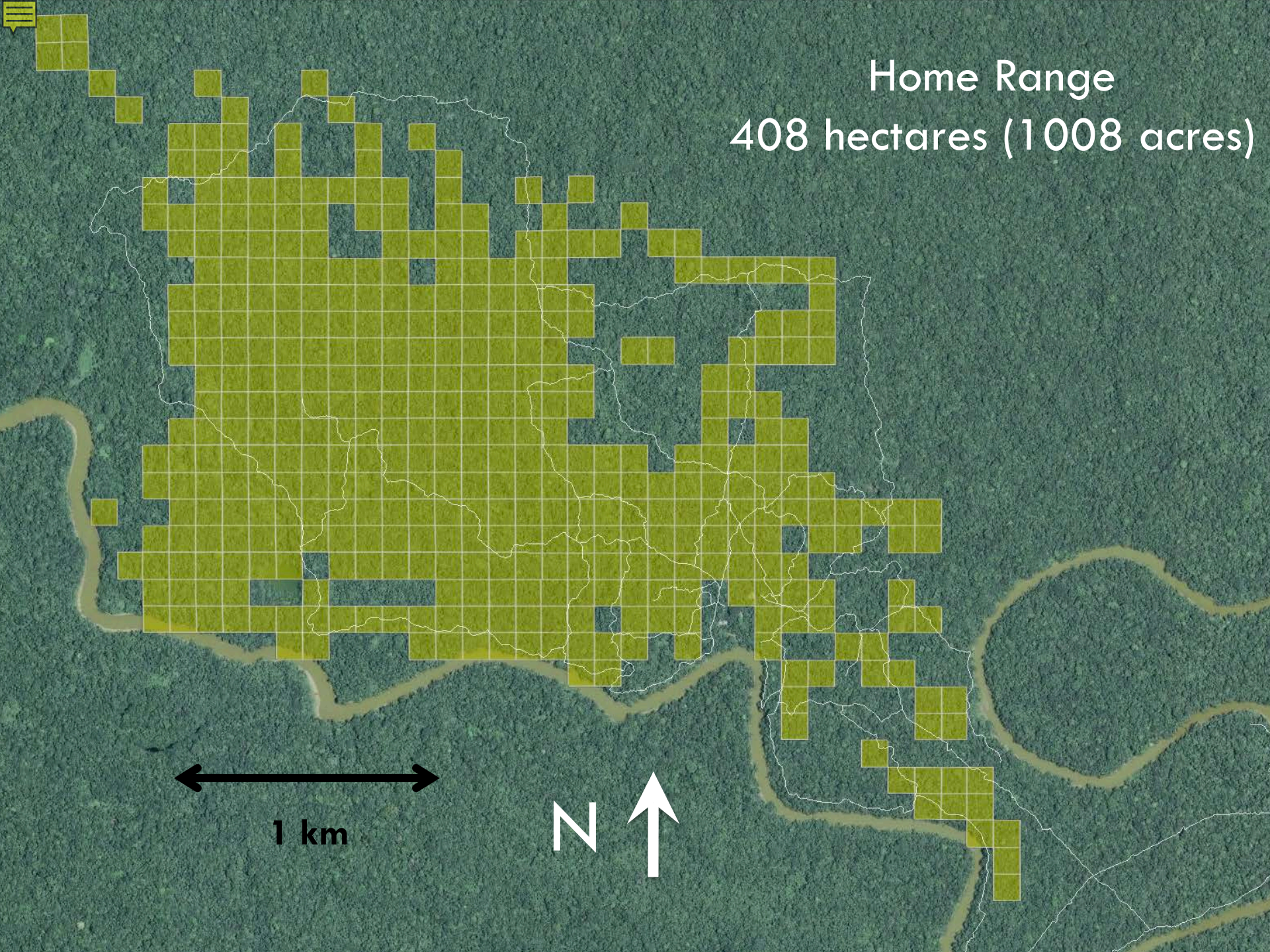
Natural History

- Group Composition

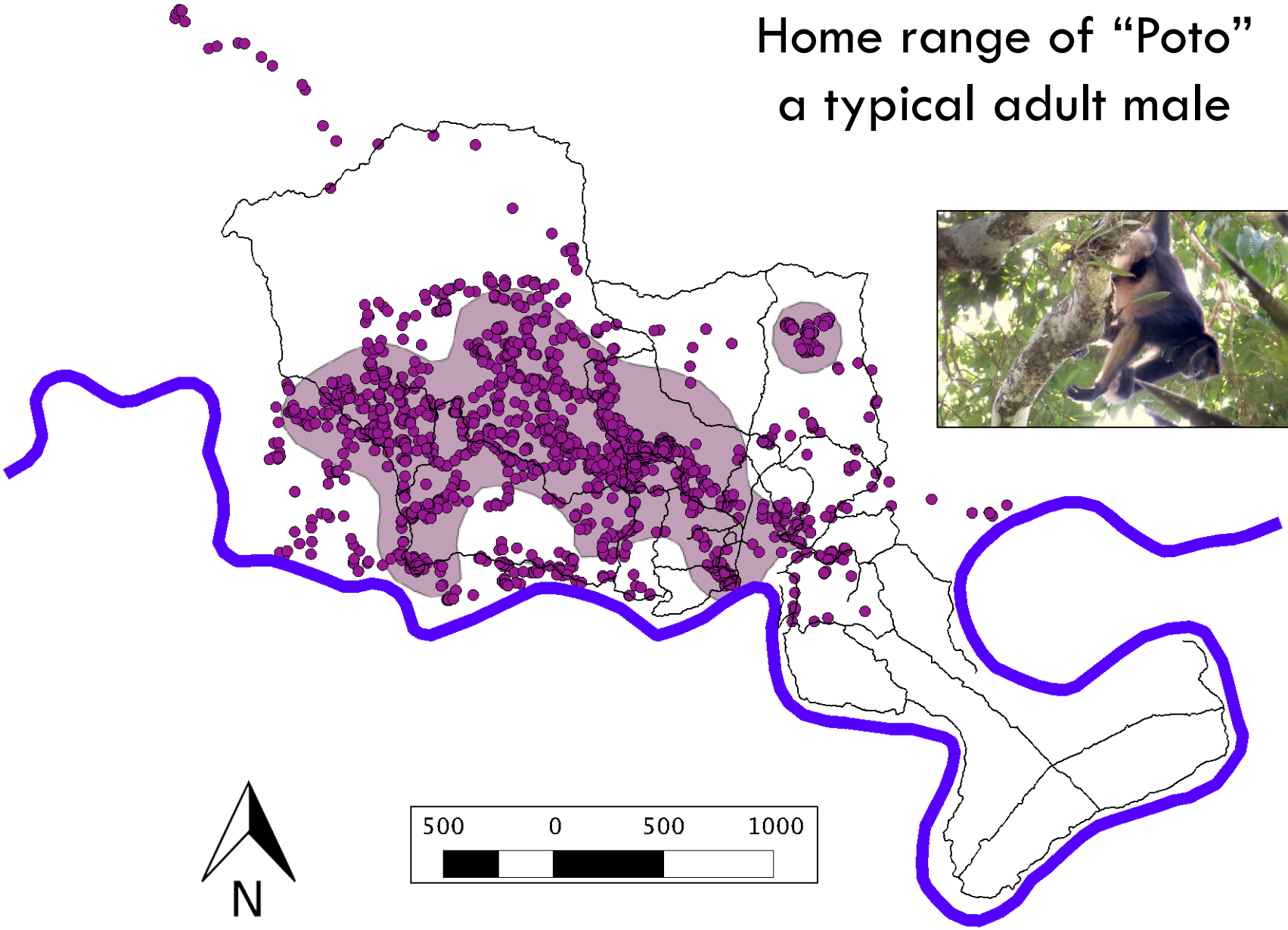


- Diet

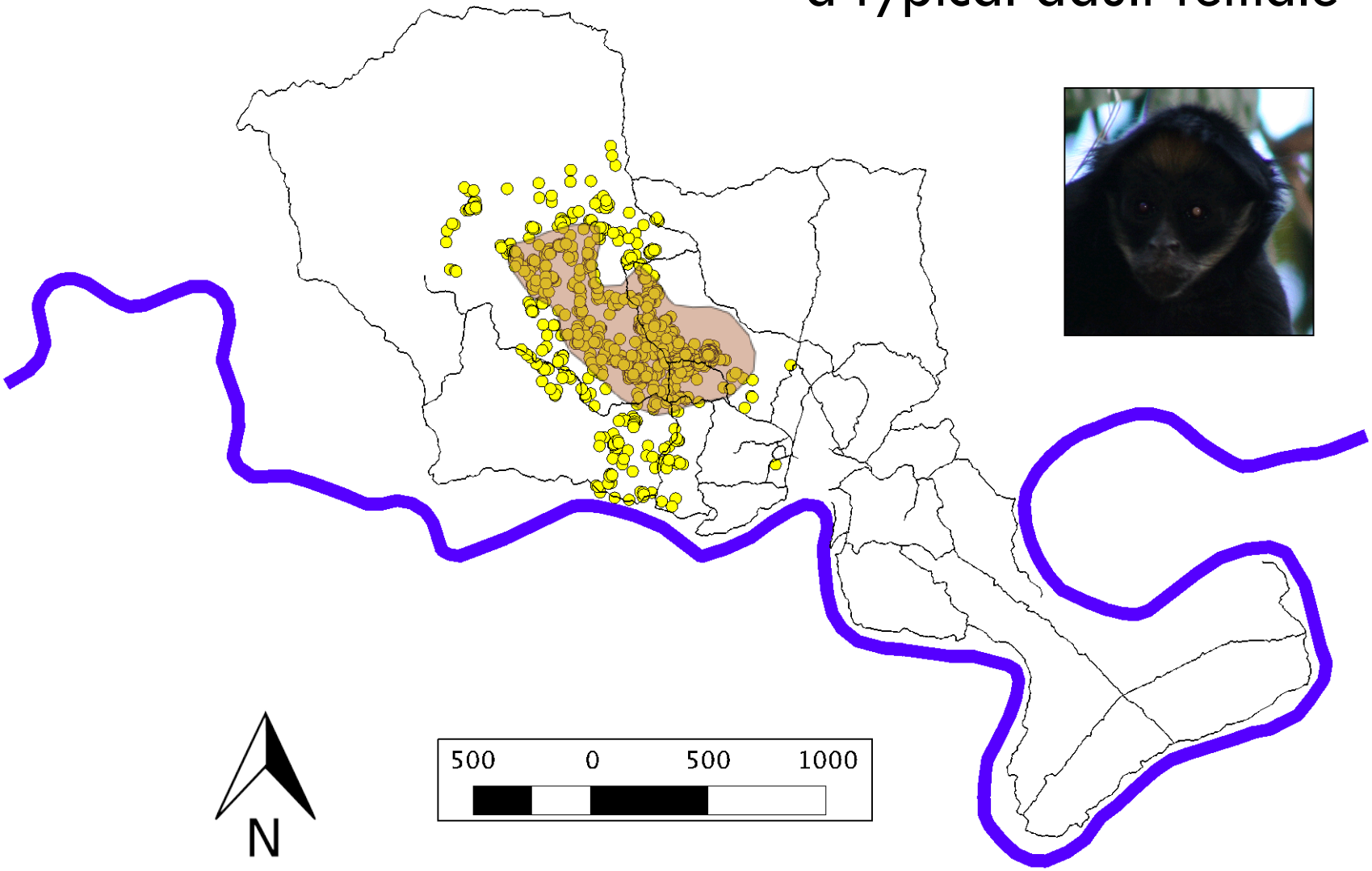



Home Range
408 hectares (1008 acres)
1 km
N

Home range of “Poto” a typical adult male



Home range of “Ana”
a typical adult female



Sex Differences in Range Size

** P < 0.001, 12 females, 7 males

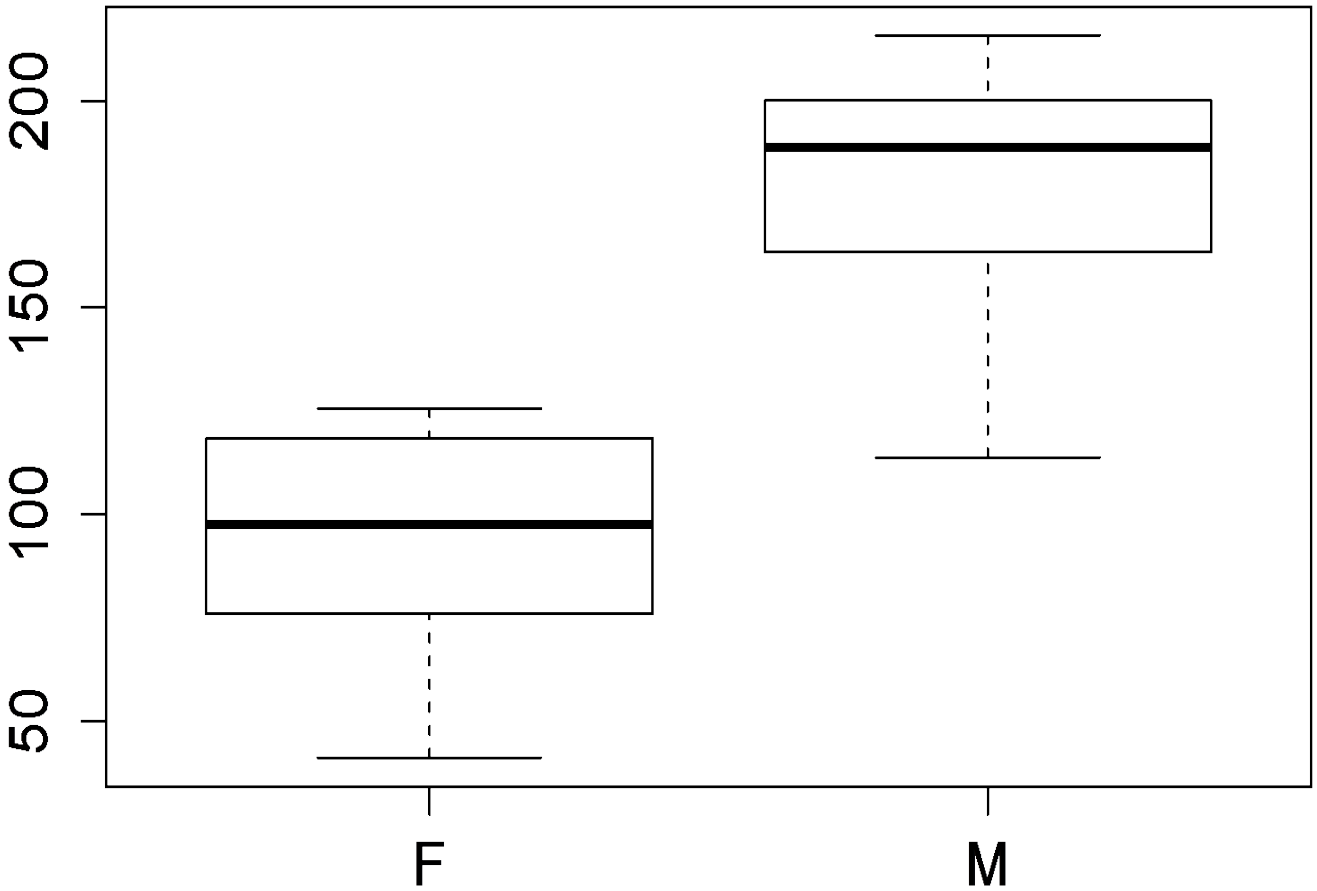


Photo: Dylan Schwindt, Proyecto Primates

Natural History

- Female dispersal and immigrations
  - *REALLY RARE IN MAMMALS!*
- "Fission-fusion" social associations
  - *ALSO REALLY RARE IN MAMMALS!*

http:/

http://w

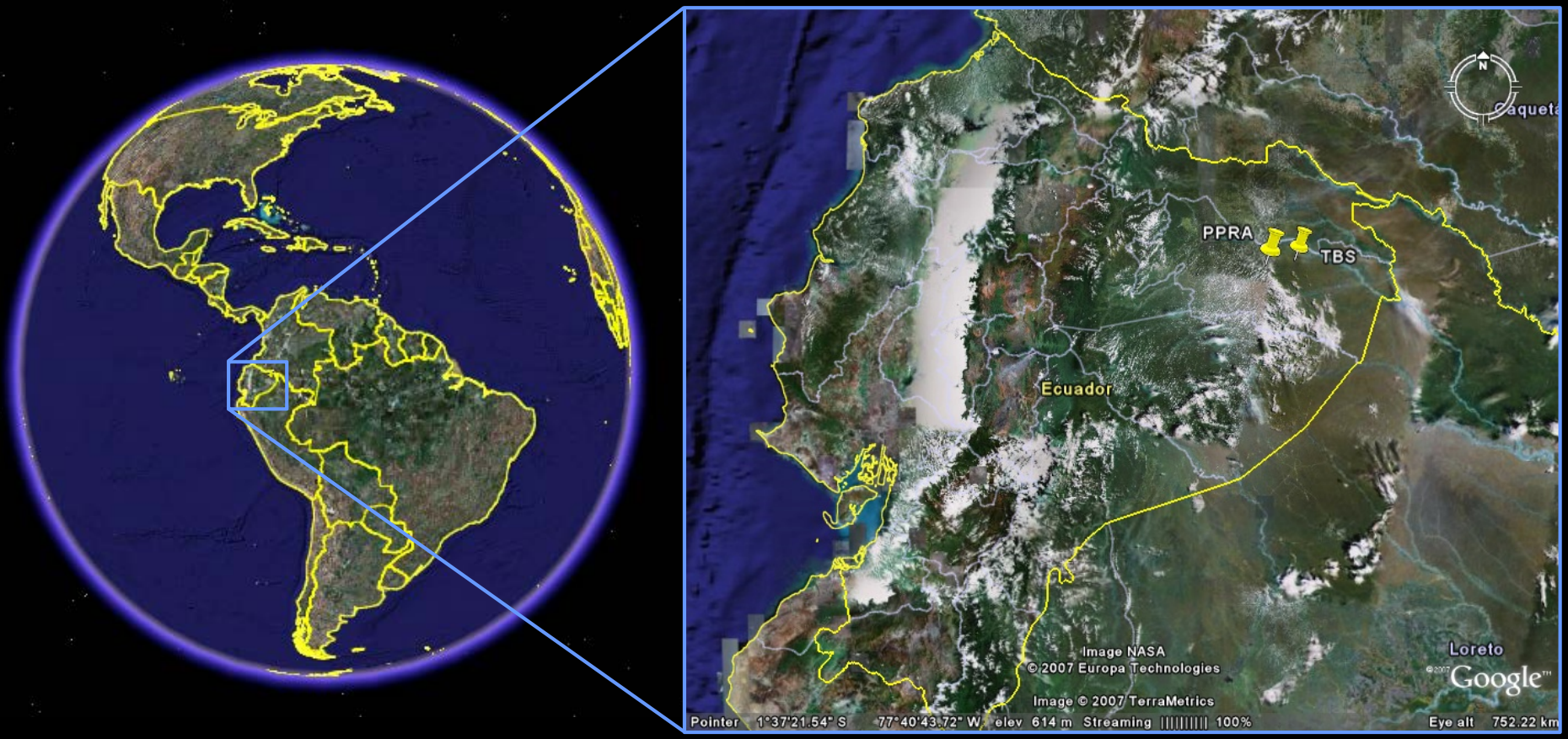
http://www.hyaenidae.org/the-hyaenidae/spotted-hyena-crocuta-crocuta/crocuta-social-behavior.html

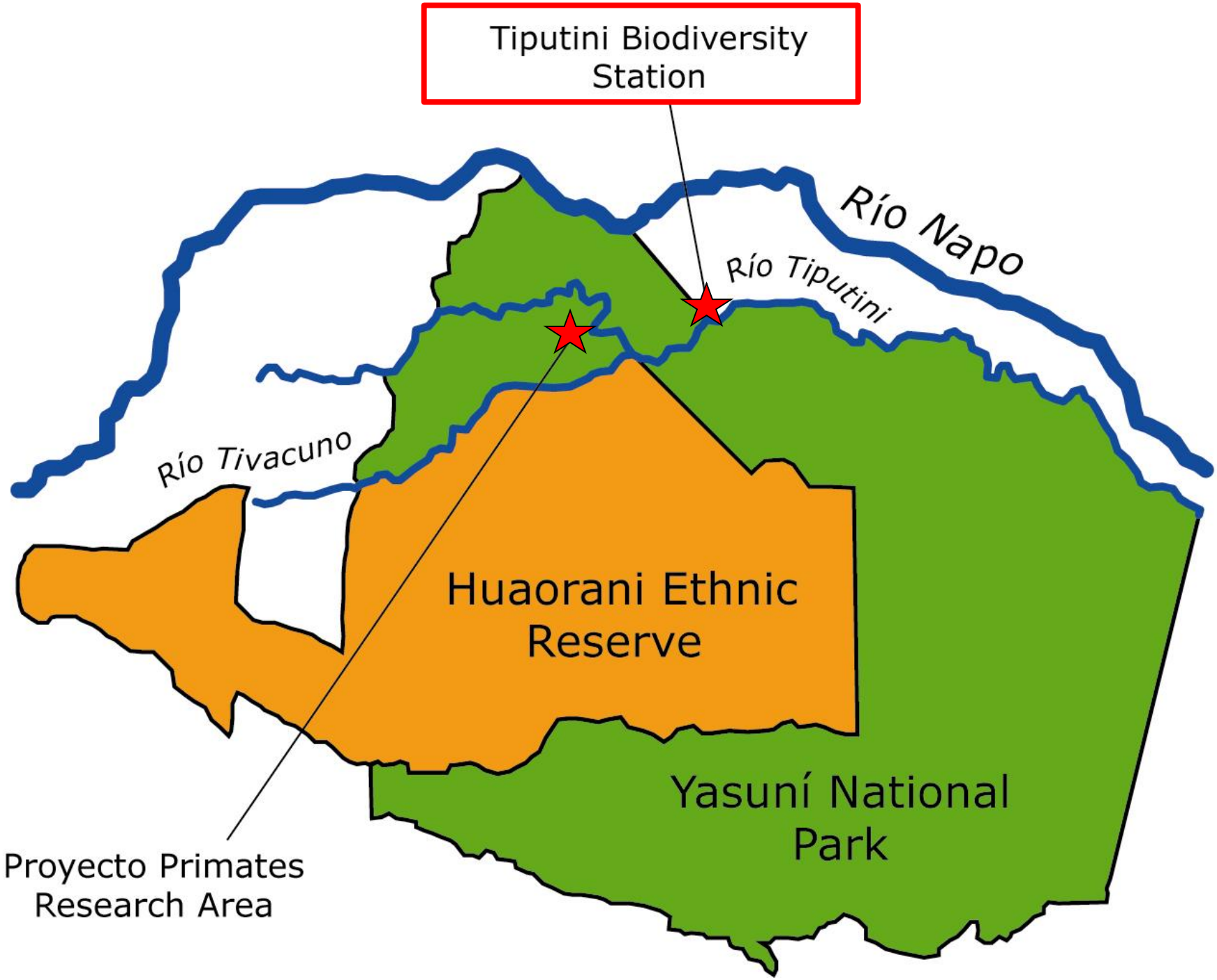
http://www.nature.com/nature/journal/v479/n7372/fig_tab/479182a_F1.html

http://connecticut.cbslocal.com/2014/02/10/weather-related-conditions-slow-commuter-rail/

A Taste of Primatology Fieldwork

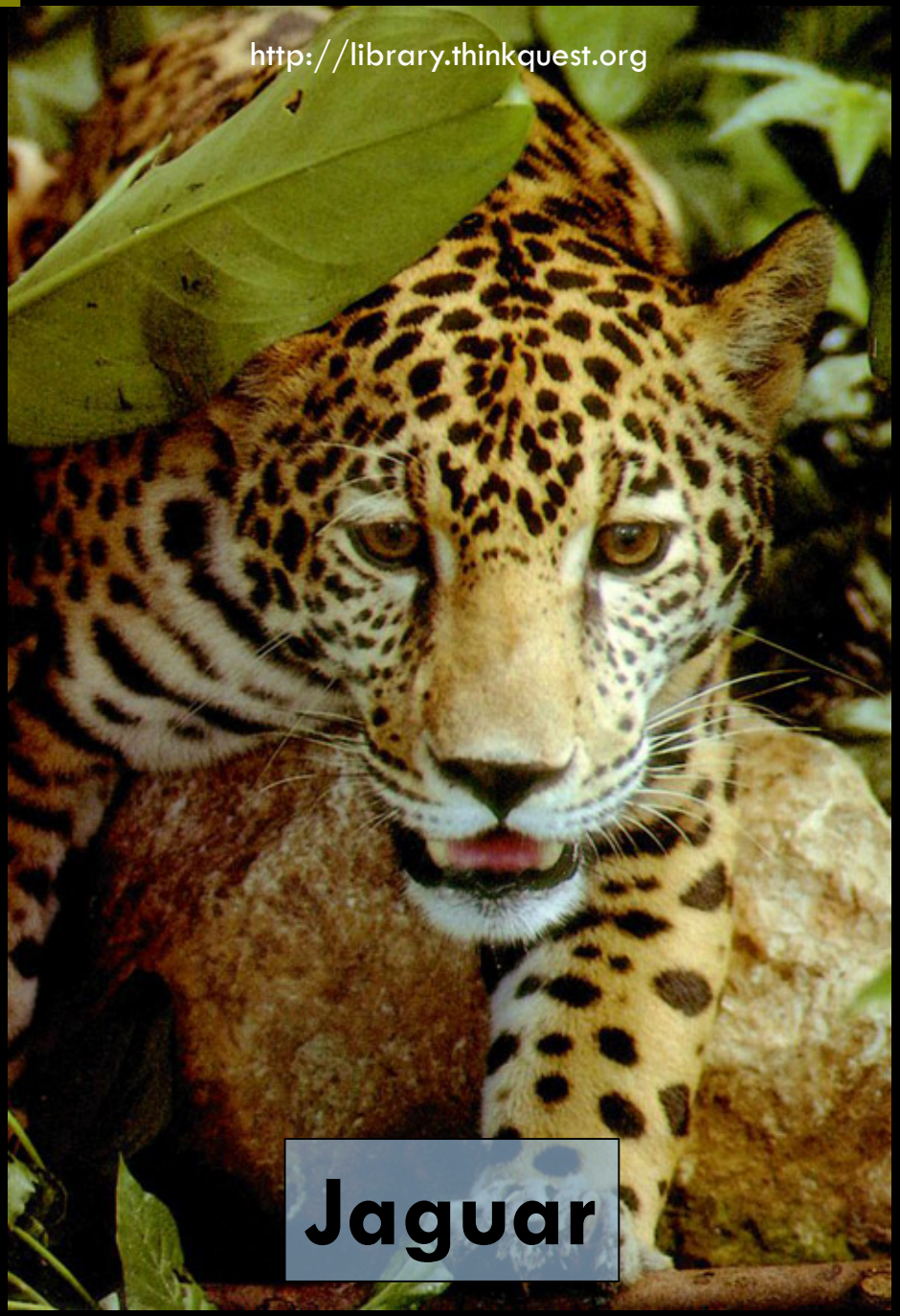
Tiputini Biodiversity Station
Yasuní Biosphere Reserve, Ecuador




Tiputini Biodiversity Station
Río Napo
Río Tiputini
Río Tivacuno
Huaorani Ethnic Reserve
Yasuní National Park
Proyecto Primates Research Area

Ateles belzebuth
(white-bellied spider monkey)

Photos: Viveca Persson; Dylan Schwindt; Delanie Hurst; Tim Laman, National Geographic


http://library.thinkquest.org
Jaguar

http://www.forwallpaper.com/wallpaper/puma-the-jungle-spy-563493.html
Puma

Video Clip: Untamed Americas: Forests, National Geographic

Basic Methods:

- Capture animals to measure and affix collars

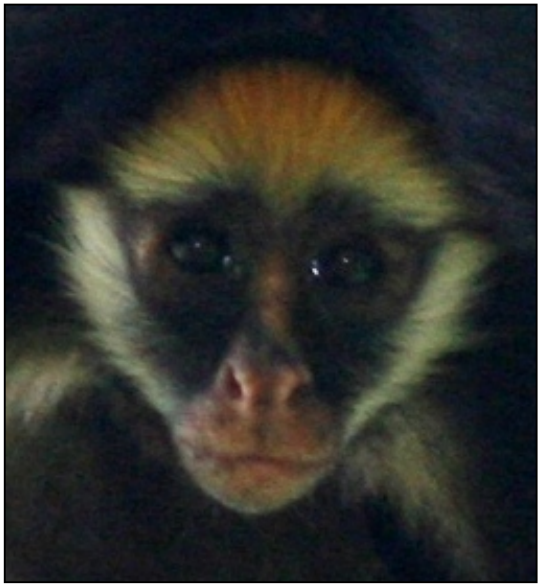
Basic Methods:

- Follow animals to map their travel routes and use of space

Behavioral Observations

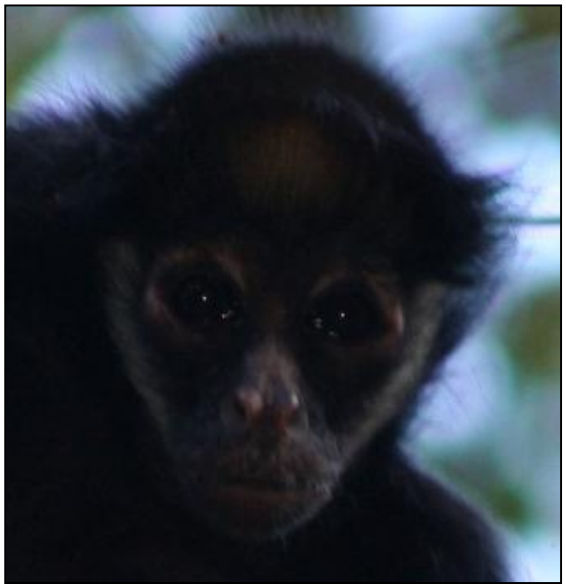
- Dawn-to-Dusk "Focal Animal" Follows
  - All non-juveniles
  - Animals individually identified

ANA



IAMONKA

LAURA



EVITA

EVA

• MIKA (MIK)

frente amplia
línea gruesa
(AFD)

ANO
CLITORIS
↳ punto negro

⇨ MALI (MAL)

♀
rosado arriba en ojos?
línea gris delgada
trompa + rosada
(SAF)

black dot end of clitoris

⇨ MAQUIS (MAQ)

♀
(IF)

• NIPA (NIP)

frente naranja-amarillo
doble pico "M"
línea muy gruesa
(AFD)

ANO
↳ muy salido
↳ punto negro arriba-izquierda
CLITORIS

⇨ NIKA (NIK)

♀
rectángulo claro (como una cinta)
línea tenue
(JF)

• OIKAMO (OIK)

Naranja-centro
Amarillo-lados
rosado en ojos
línea gruesa
(AFD)

ANO
↳ poco salido/pequeño
CLITORIS
↳ largo

⇨ OLIO (OLI)

♂
línea delgada con inconspicua
también tiene 2 líneas entrecortadas, ojos conspicuos
(JM)
↳ grande

ANO
↳ pequeño
↳ salido poco

TESTS

• SOFÍA (SOF)

Triángulo grande (muy blanco)
línea gruesa
(AFD)

ANO
↳ pequeño

CLITORIS
↳ con pto. negro en la parte de adelante/arriba

CUERPO
↳ muy clara

⇨ SILVI (SIL)

triángulo ♀ despeinado
línea delgada
rectángulo achatado
boca + nariz rosada
(SAF) (JF)
- Muy grande
rosado alrededor de ojos

- Clitoris largo y torcido

ANO
↳ delgado
↳ un poco salido

⇨ SUMMER (SUM)

♂
manocha amplia
rosado a los lados de los ojos
trompa bien rosada
(IM)

ANO un poco salido

Cuerpo oscuro

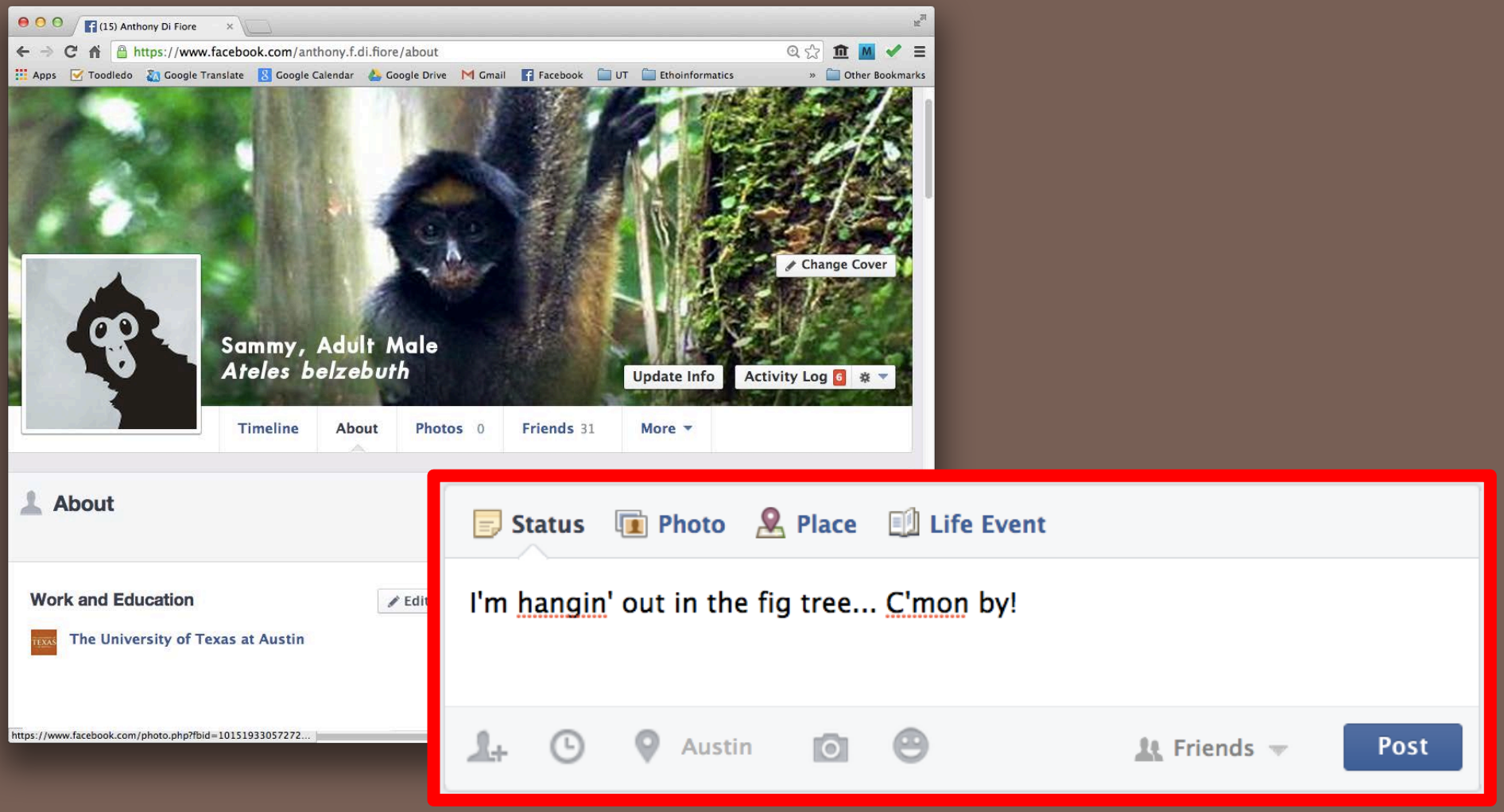
Behavioral Data

- Range use data via GPS fixes
- Subgroup composition (every 15 min)

  Fusion → When a new member joins the subgroup

  Fission → When we do not see a member for > 1 hour
- Social interactions involving focal animals
  - Aggression, grooming, play, sexual behavior
- Intergroup encounters
  - Location, participants, winners, and losers

VIGNETTE 1:
SOCIAL MEDIA FOR SPIDER MONKEYS



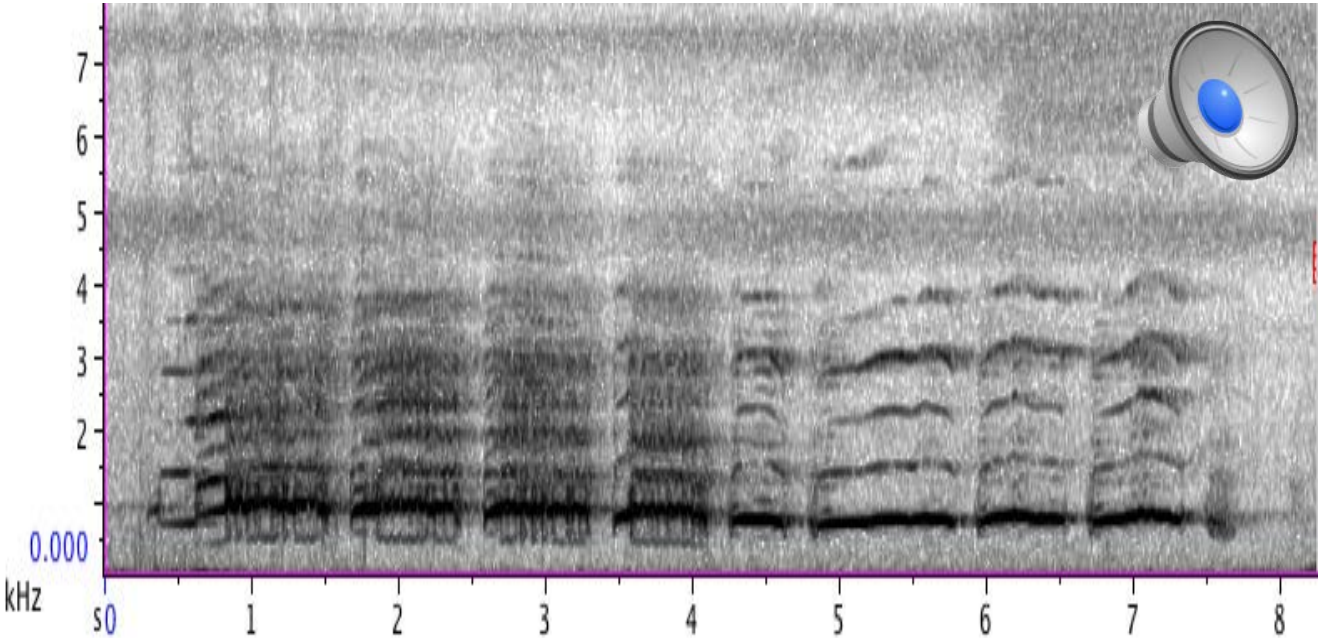
Behav Ecol Sociobiol (2013) 67:947–961
DOI 10.1007/s00265-013-1520-y

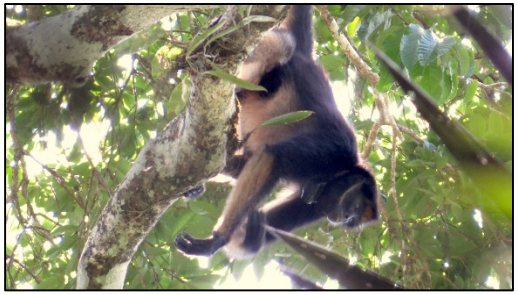
ORIGINAL PAPER

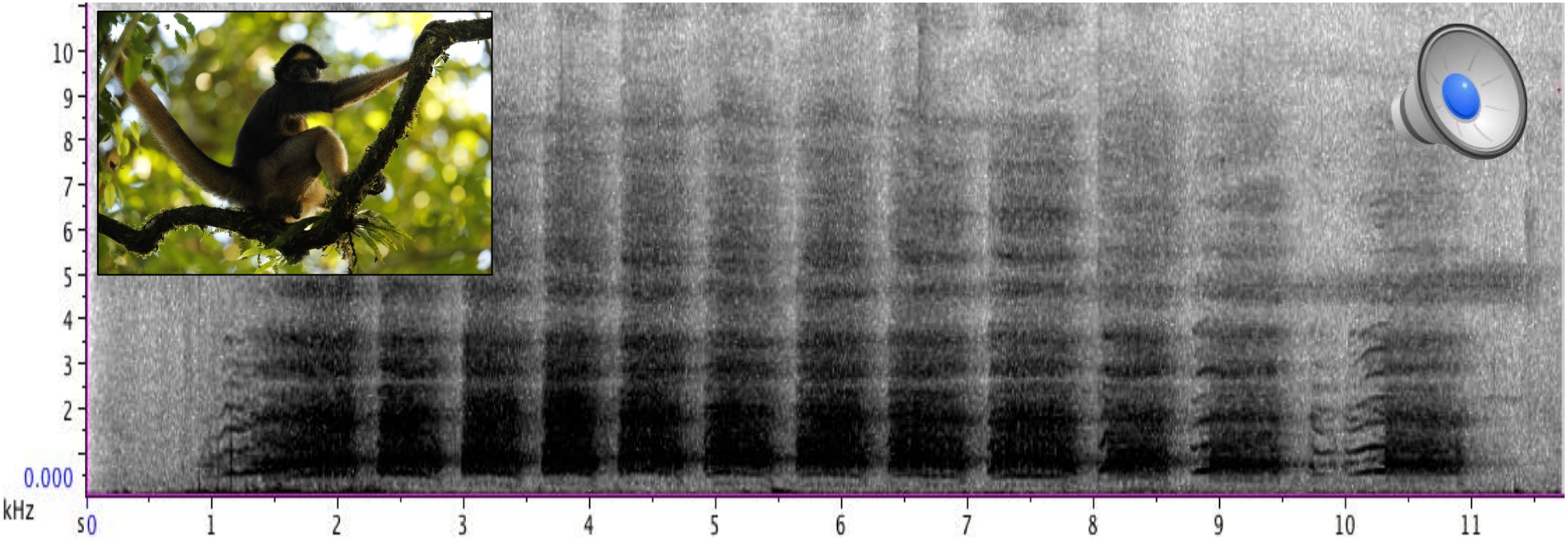
Loud calls as a mechanism of social coordination in a fission–fusion taxon, the white-bellied spider monkey (*Ateles belzebuth*)

Stephanie N. Spehar · Anthony Di Fiore

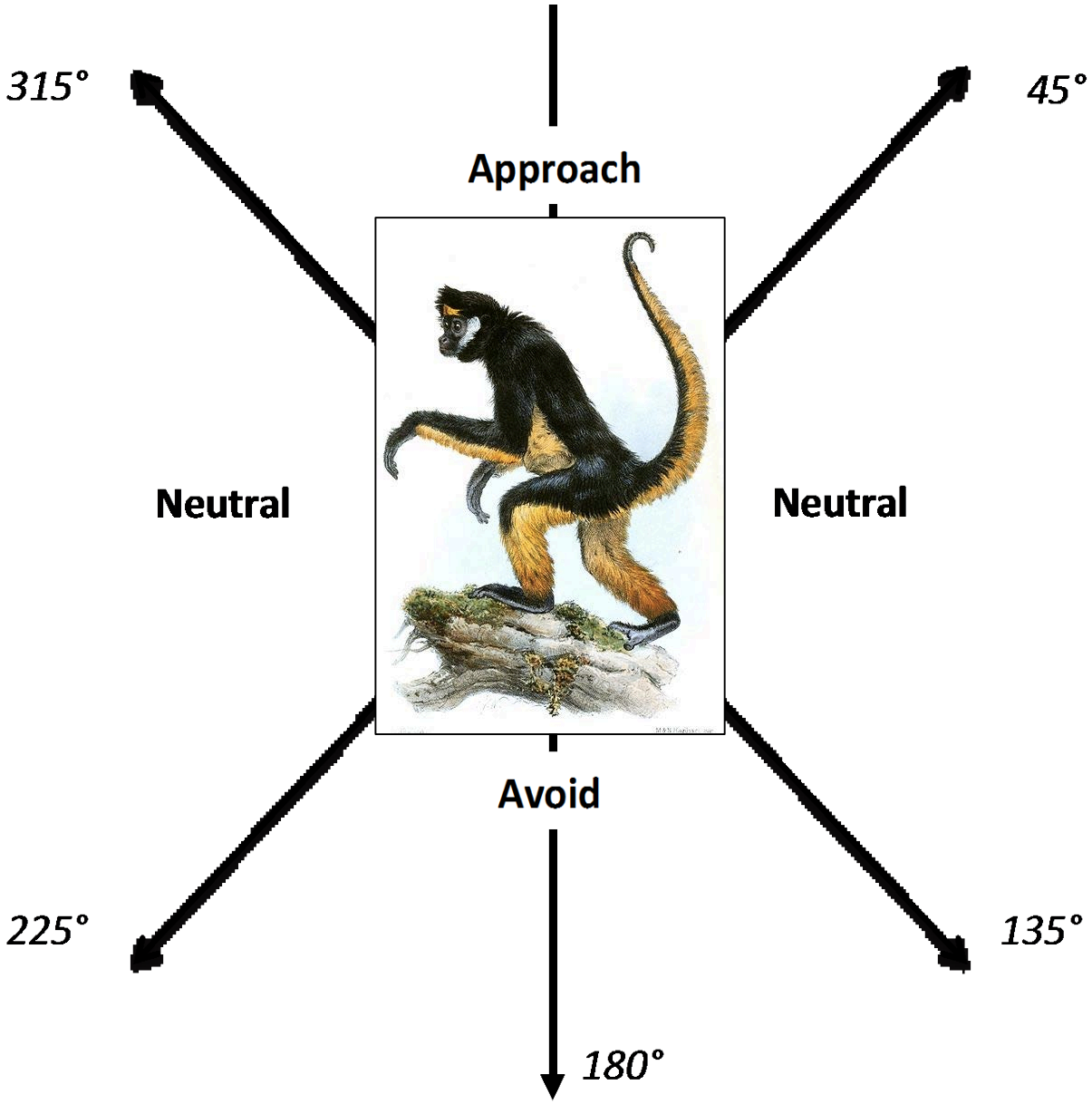
- *Recordings and spectrographic analysis*
- *Direction of movement and changes in subgroup size after hearing calls*

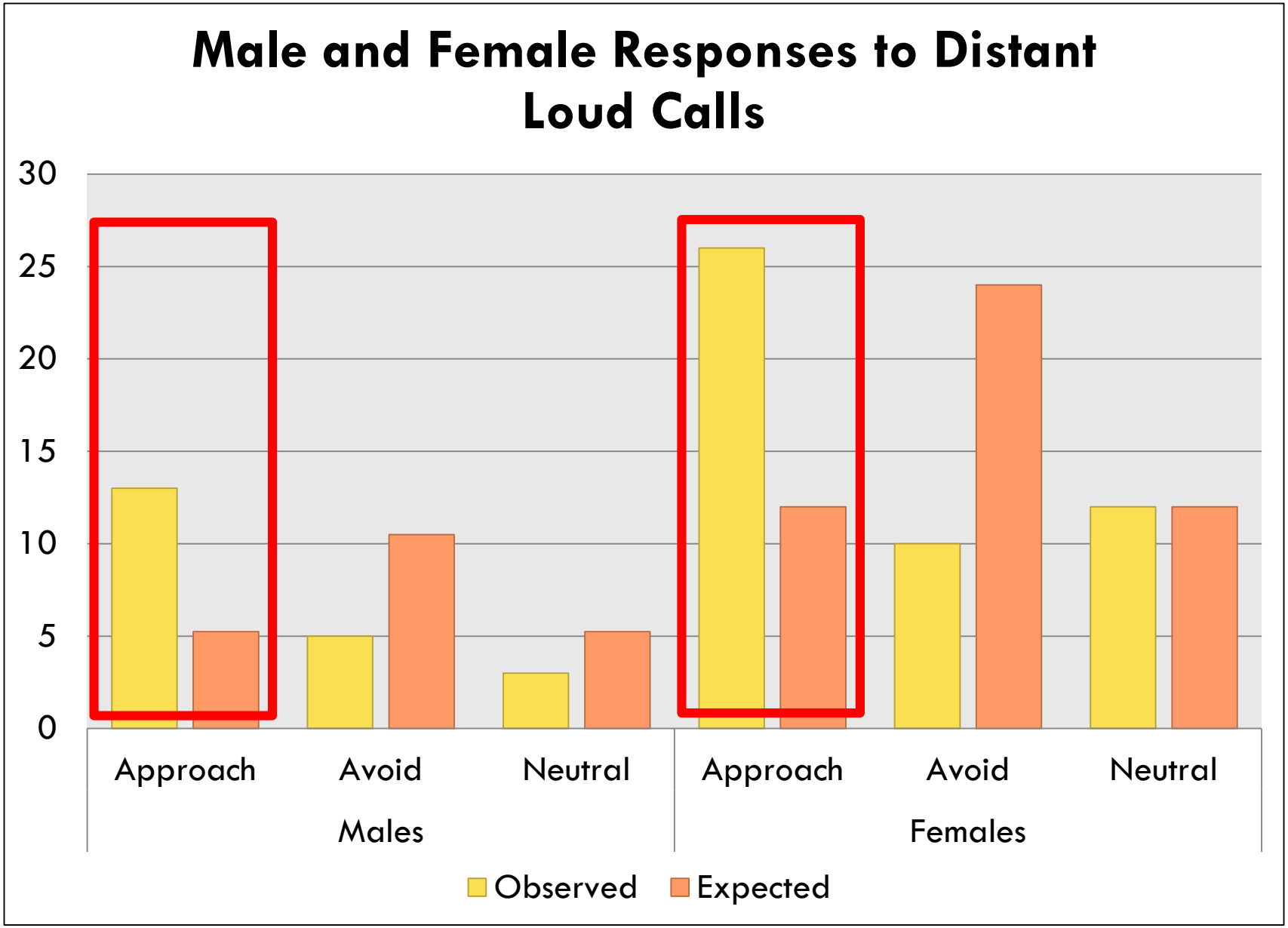

7
6
5
4
3
2
0.000
kHz
s0
1
2
3
4
5
6
7
8



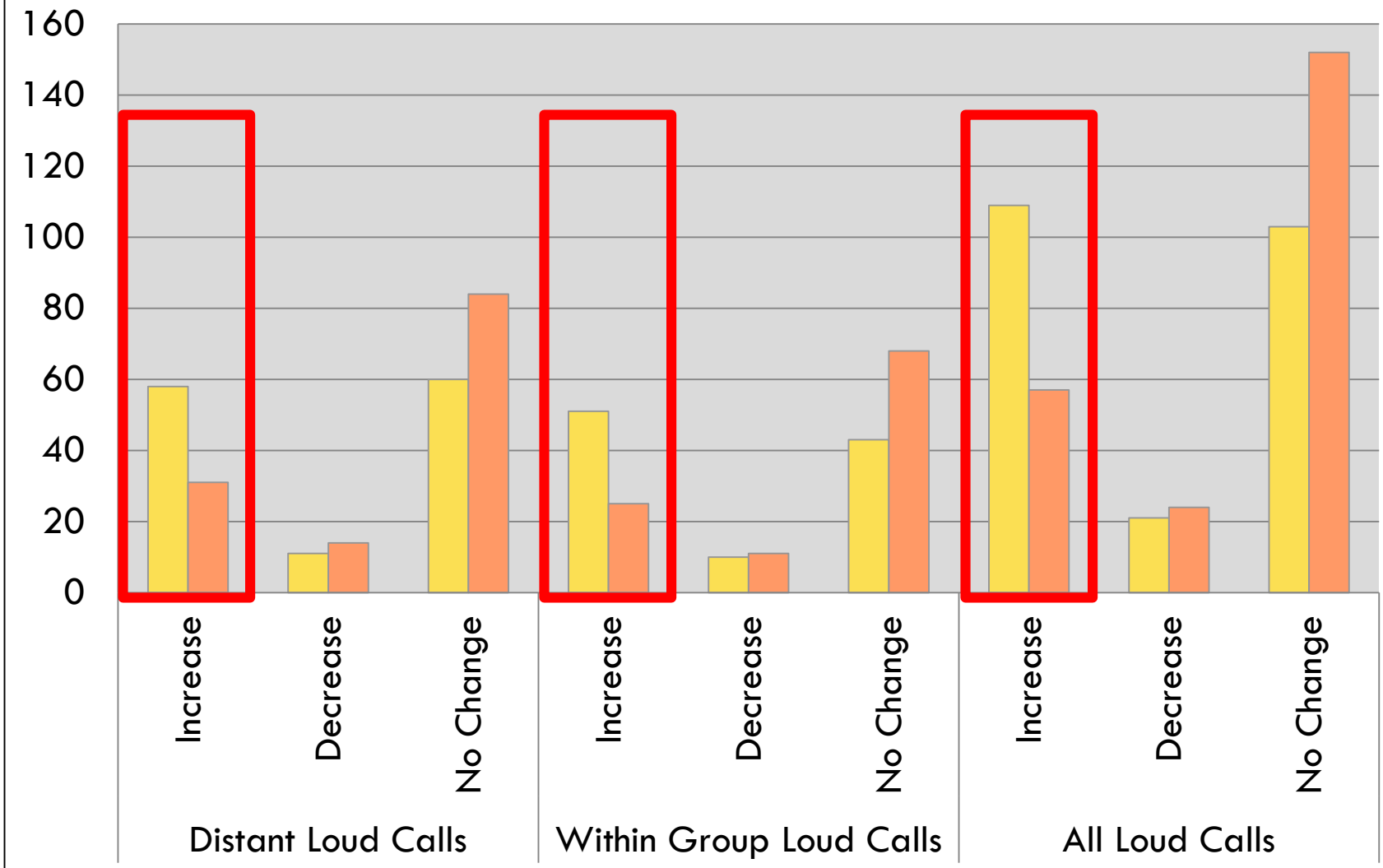

10
9
8
7
6
5
4
3
2
0.000
kHz
s0
1
2
3
4
5
6
7
8
9
10
11

Direction of Caller




Male and Female Responses to Distant Loud Calls
30
25
20
15
10
5
0
Approach
Avoid
Neutral
Approach
Avoid
Neutral
Males
Females
Observed
Expected

Changes In Subgroup Size within 1 Hour of Loud Calls

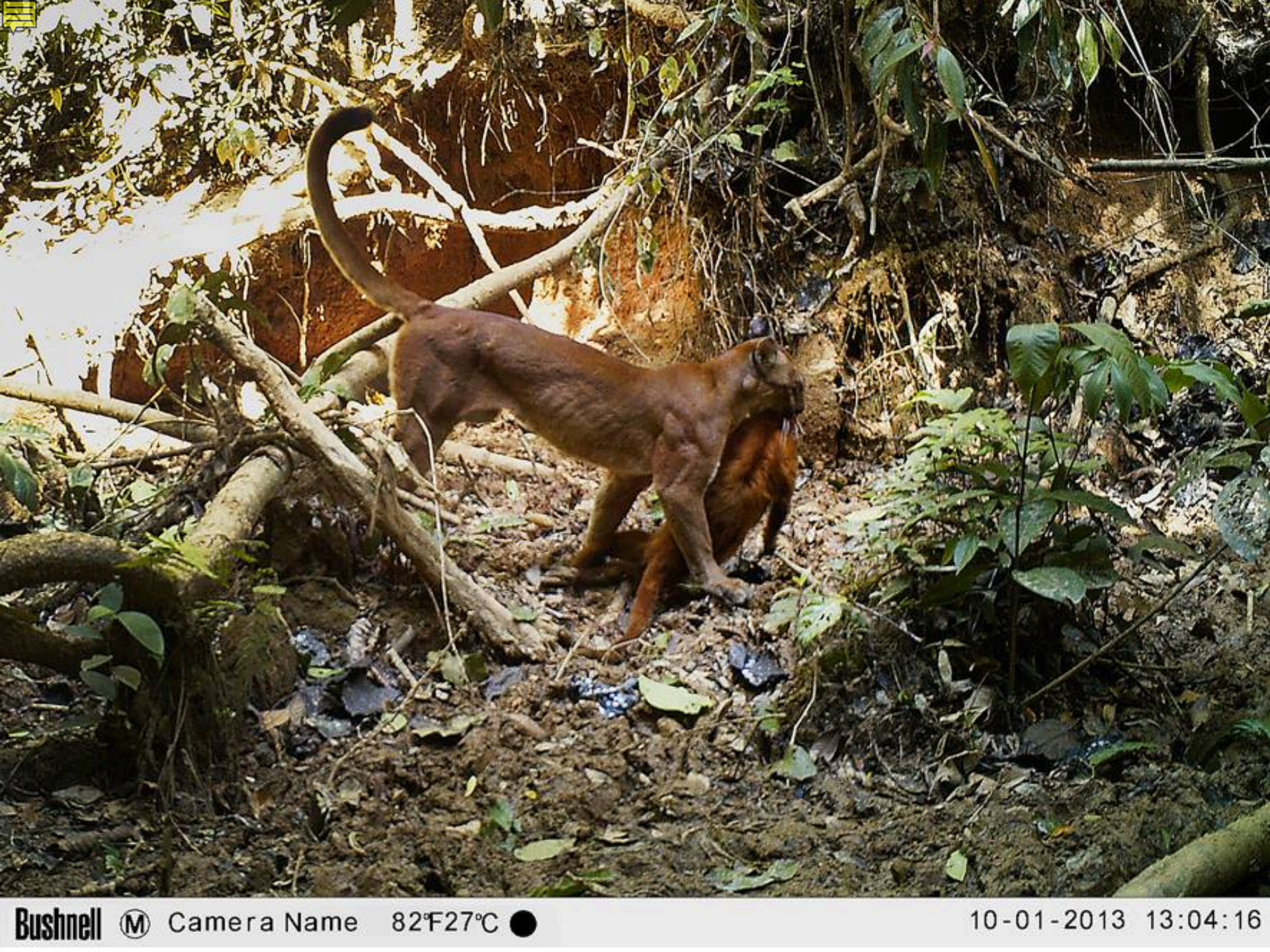


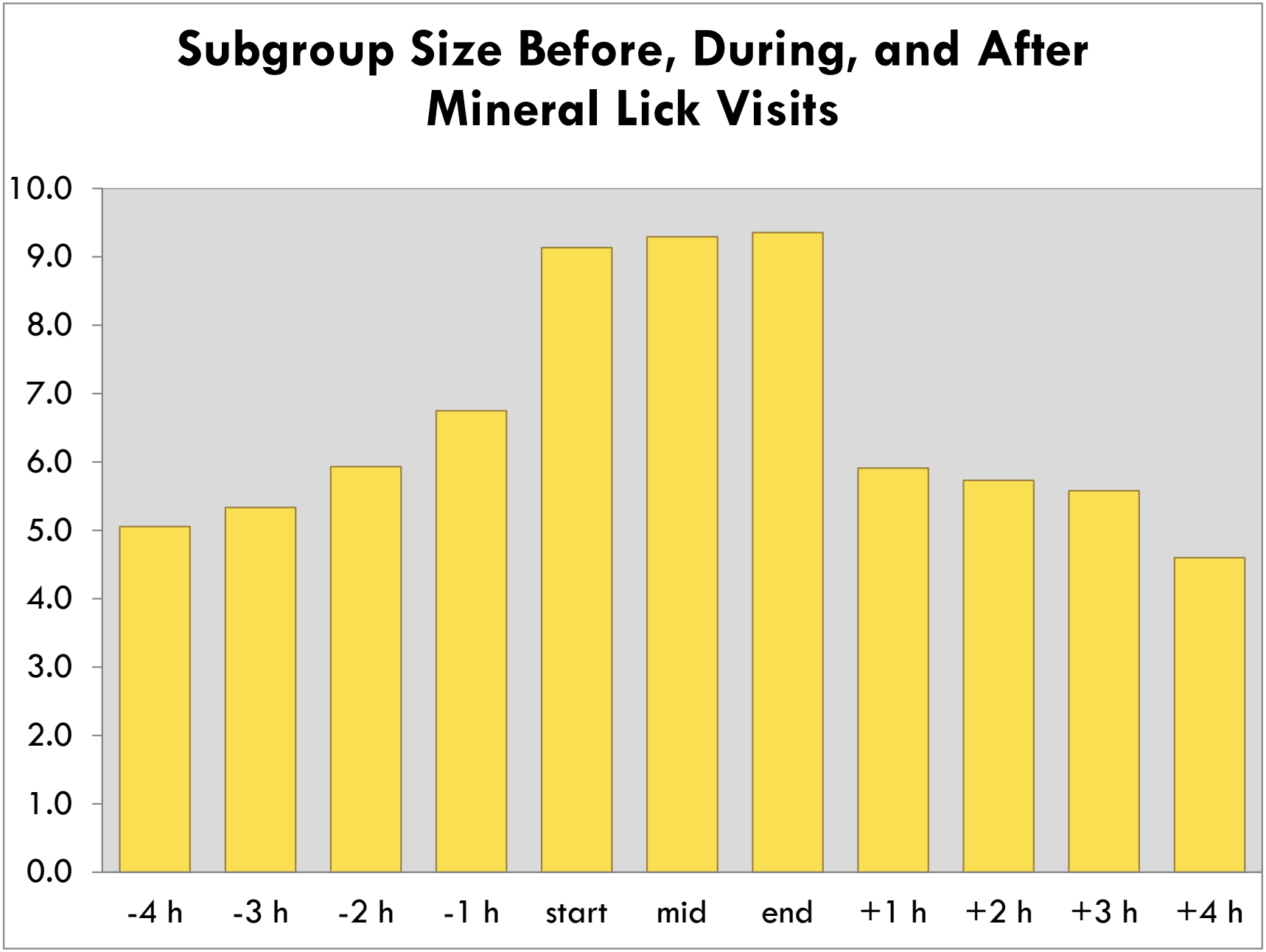
VIGNETTE 2:
MINERAL LICKS, PREDATION RISK, and SAFETY IN NUMBERS

Mineral Lick Usage

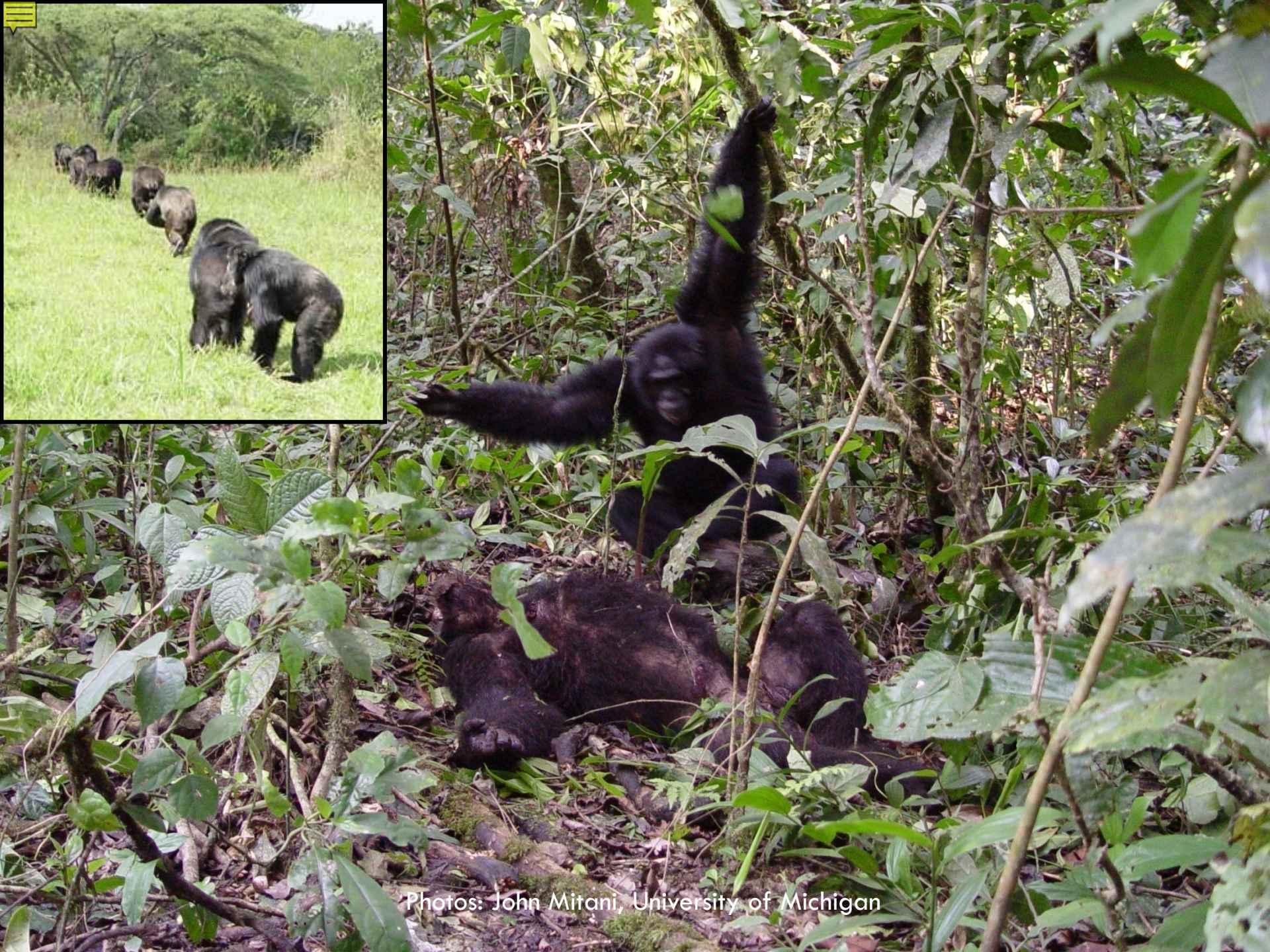
- Visit licks ~1x/week
- Spend ~3 hours in the lick area, but each animal only comes to the ground for only ~2 minutes
- Visit licks with howler monkeys more often than expected

19 2:04PM


Bushnell
Camera Name
82°F27°C
10-01-2013 13:04:16


Subgroup Size Before, During, and After Mineral Lick Visits
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
-4 h
-3 h
-2 h
-1 h
start
mid
end
+1 h
+2 h
+3 h
+4 h

VIGNETTE 3:
PATROLS, RAIDS, and WARFARE



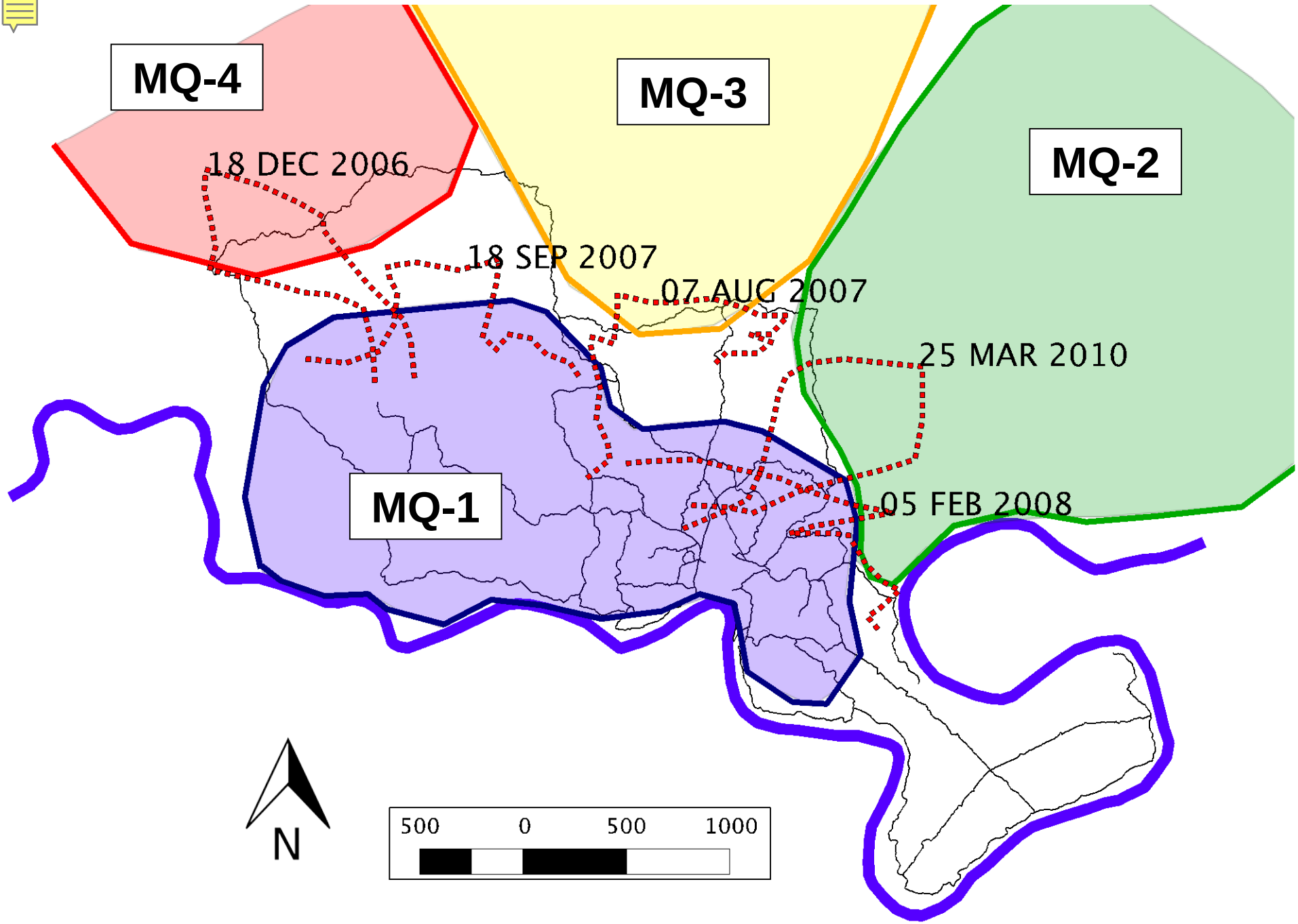
Photos: John Mitani, University of Michigan

Male Coalitionary Aggression

- N = >50 border patrols or IGEs since 2005
- Aggression can escalate and be potentially lethal
- During 2006-2008, our main study group lost 3 fully adult males

"Poto"

Adult Male


MQ-4
MQ-3
MQ-2
MQ-1
18 DEC 2006
18 SEP 2007
07 AUG 2007
25 MAR 2010
05 FEB 2008
N
500
0
500
1000

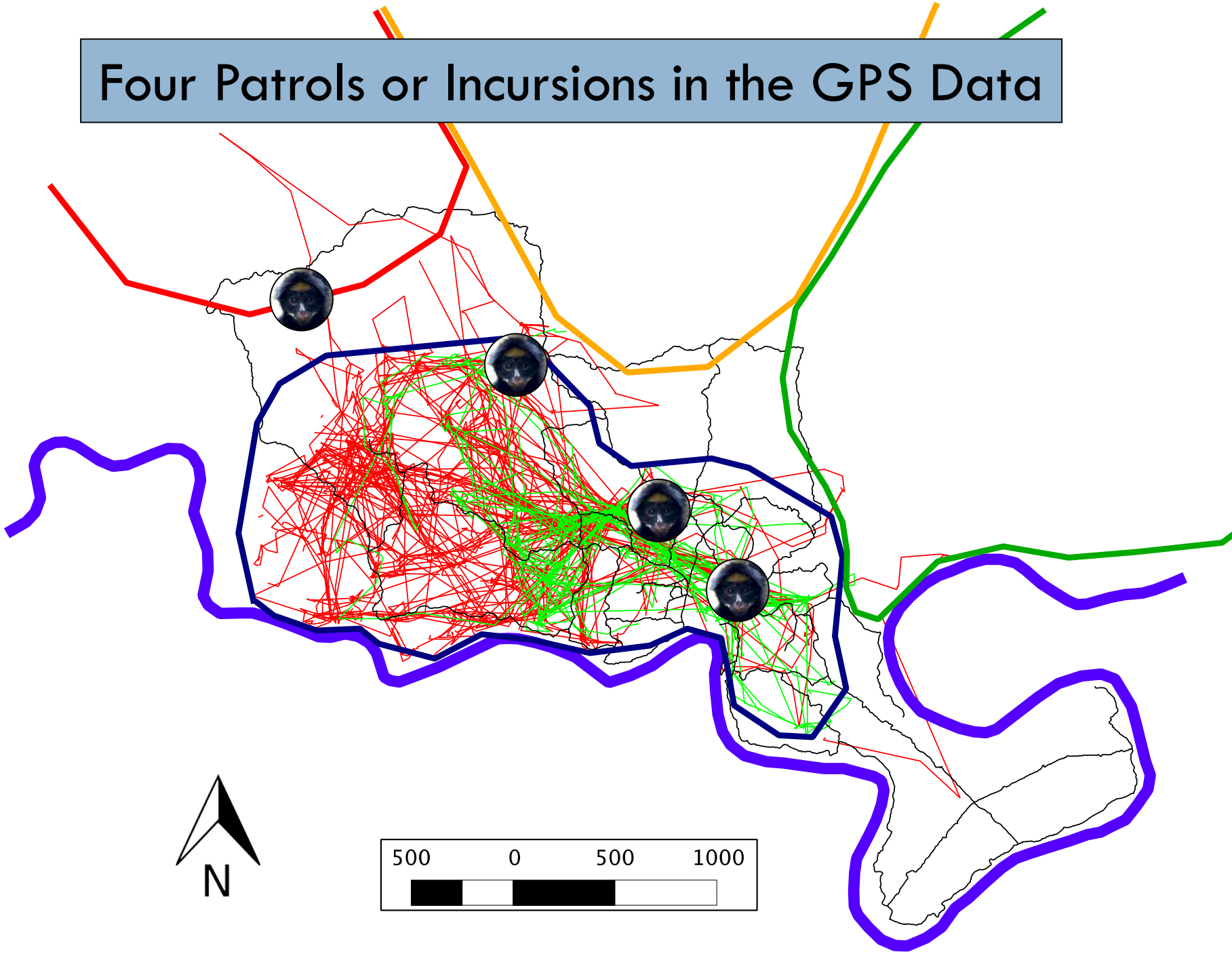
Male Patrols

*"There are some long calls at around 7:40 very far north and **five males fission off** and sprint in that direction. They move very fast **only stopping to long call**. In far north, another Group (MQ-3) also calling! At 8:20 the males come into a very large tree and stop. They **seem very vigilant** and Juan and Geronimo are **embracing and growling**, and they all stare at a nearby emergent tree where 3 AM's from MQ-3 are also "resting-vigilant" staring towards MQ-1 males. They stare for several minutes... At 8:40 the MQ-3 males **retreat** into their home range…"*

*"The MQ-1 males rest for ~40 minutes and then at 9:22 **begin patrolling the southern border** of MQ-3's territory. The males **move very silently** and only stop for a couple of minutes to remain completely silent. They **actively patrol from 9:22 until 12:00…** They go straight into the mineral lick area of MQ-3 and then continue moving further east… where they stopped to rest. Only at 17:00 do they start moving back into their home range."*

GPS Collars on Males

Four Patrols or Incursions in the GPS Data



VIGNETTE 4:
SEX AND THE SINGLE MONKEY

Sexual Behavior (really hard to see!)

- Very low rate (< 5 obs per 1000 hours with the monkeys)
- Mostly takes place during secretive "consortships"
- No aggression and no dominance hierarchy among males

Minimal overt ♂-♂ competition!

Copulations by Males

(N = 32 observed events)

	2005	2006	2007	2008	2009	2010	2011	# COPS	# FEMS
JUAN								**0**	**0**
PEDRO								**0**	**0**
POTO				1				**1**	**1**
GERONIMO								**0**	**0**
SAMMY			4	3		1		**8**	**4**
LUCAS			4	1		1		**6**	**3**
MONO			1	5			1	**7**	**3**
ANDREO				5		1	2	**8**	**5**
NENKI						1	1	**2**	**2**

Copulations by Males

(N = 32 observed events)

	2005	2006	2007	2008	2009	2010	2011	# COPS	# FEMS
JUAN								0	0
PEDRO								0	0
POTO								1	1
GERONIMO								0	0
SAMMY			4	3		1		8	4
LUCAS			4	1		1		6	3
MONO			1	5			1	7	3
ANDREO				5		1	2	8	5
NENKI						1	1	2	2

Six of nine adult males were observed mating at some point…

Copulations by Males

(N = 32 observed events)

	2005	2006	2007	2008	2009	2010	2011	# COPS	# FEMS
JUAN								**0**	**0**
PEDRO								**0**	**0**
POTO								**1**	**1**
GERONIMO								**0**	**0**
SAMMY			4	3		1		**8**	**4**
LUCAS			4	1		1		**6**	**3**
MONO			1	5			1	**7**	**3**
ANDREO				5		1	2	**8**	**5**
NENKI						1	1	**2**	**2**

No males were observed mating as subadults…

Copulations by Males

(N = 32 observed events)

	2005	2006	2007	2008	2009	2010	2011	# COPS	# FEMS
JUAN								0	0
PEDRO								0	0
POTO								1	1
GERONIMO								0	0
SAMMY			4	3		1		8	4
LUCAS			4	1		1		6	3
MONO			1	5			1	7	3
ANDREO				5		1	2	8	5
NENKI						1	1	2	2

And all males seen to mate more than once mated with more than one female!

Copulations by Females

(N = 32 observed events)

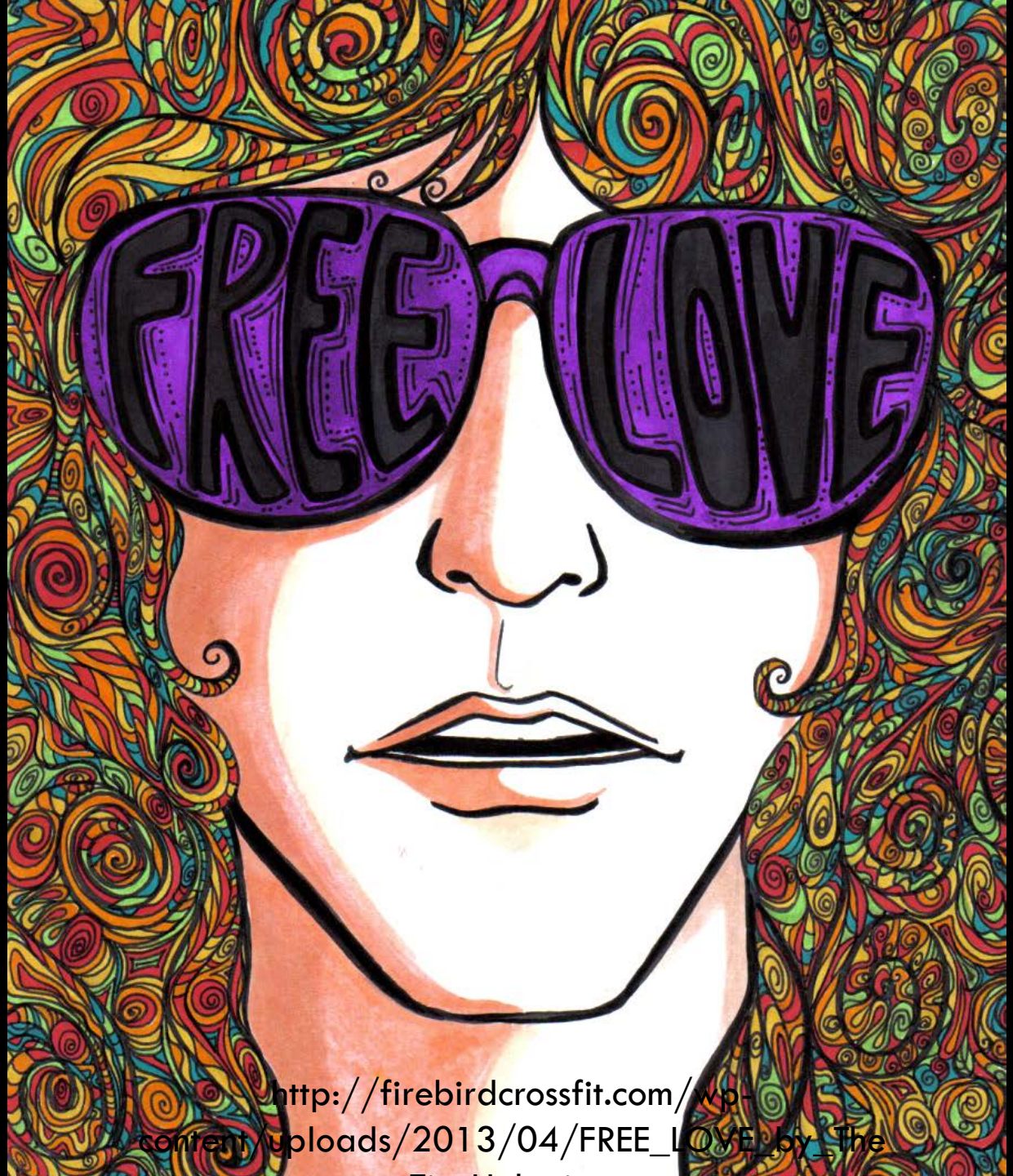
	2005	2006	2007	2008	2009	2010	2011	# COPS	# MALES
EVA				3		2		**5**	**4**
ANA								**0**	**0**
BUKA								**0**	**0**
SOFIA				1				**1**	**1**
MIKA			2	7				**9**	**3**
LUNA			1	4				**5**	**3**
OIKAMO						1		**1**	**1**
KAUO						1		**1**	**1**
NIPA							1	**1**	**1**
VITA			6				3	**9**	**4**
GISELLA								**0**	**0**
ZARI								**0**	**0**
EVITA								**0**	**0**

Copulations by Females

(N = 32 observed events)

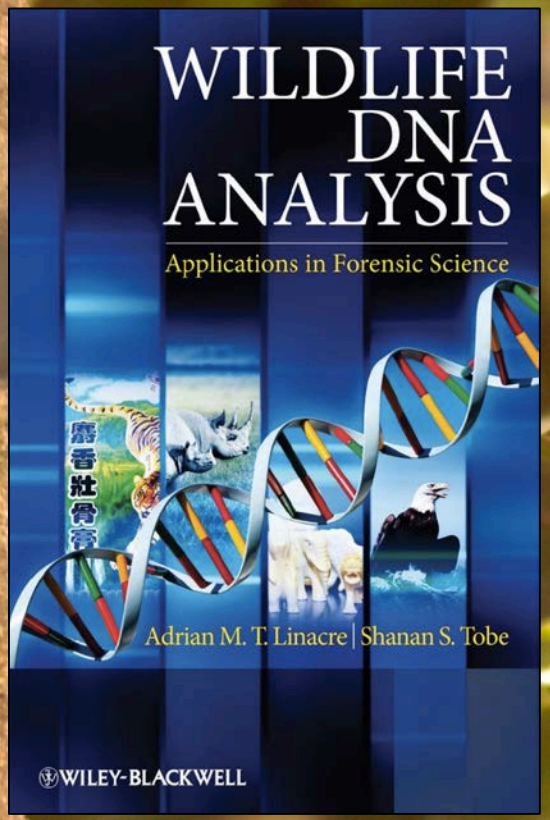
	2005	2006	2007	2008	2009	2010	2011	# COPS	# MALES
EVA				3		2		5	4
ANA								0	0
BUKA								0	0
SOFIA								1	1
MIKA								9	3
LUNA								5	3
OIKAMO						1		1	1
KAUO						1		1	1
NIPA							1	1	1
VITA			6				3	9	4
GISELLA								0	0
ZARI								0	0
EVITA								0	0

All females seen to mate more than once
mated with more than one male



http://firebirdcrossfit.com/wp-content/uploads/2013/04/FREE_LOVE_by_The

IDENTIFYING PARENTS USING DNA…



EVERYONE POOPS

By Taro Gomi

Kane/Miller
BOOK PUBLISHERS

Our complicated, technical sampling protocol…

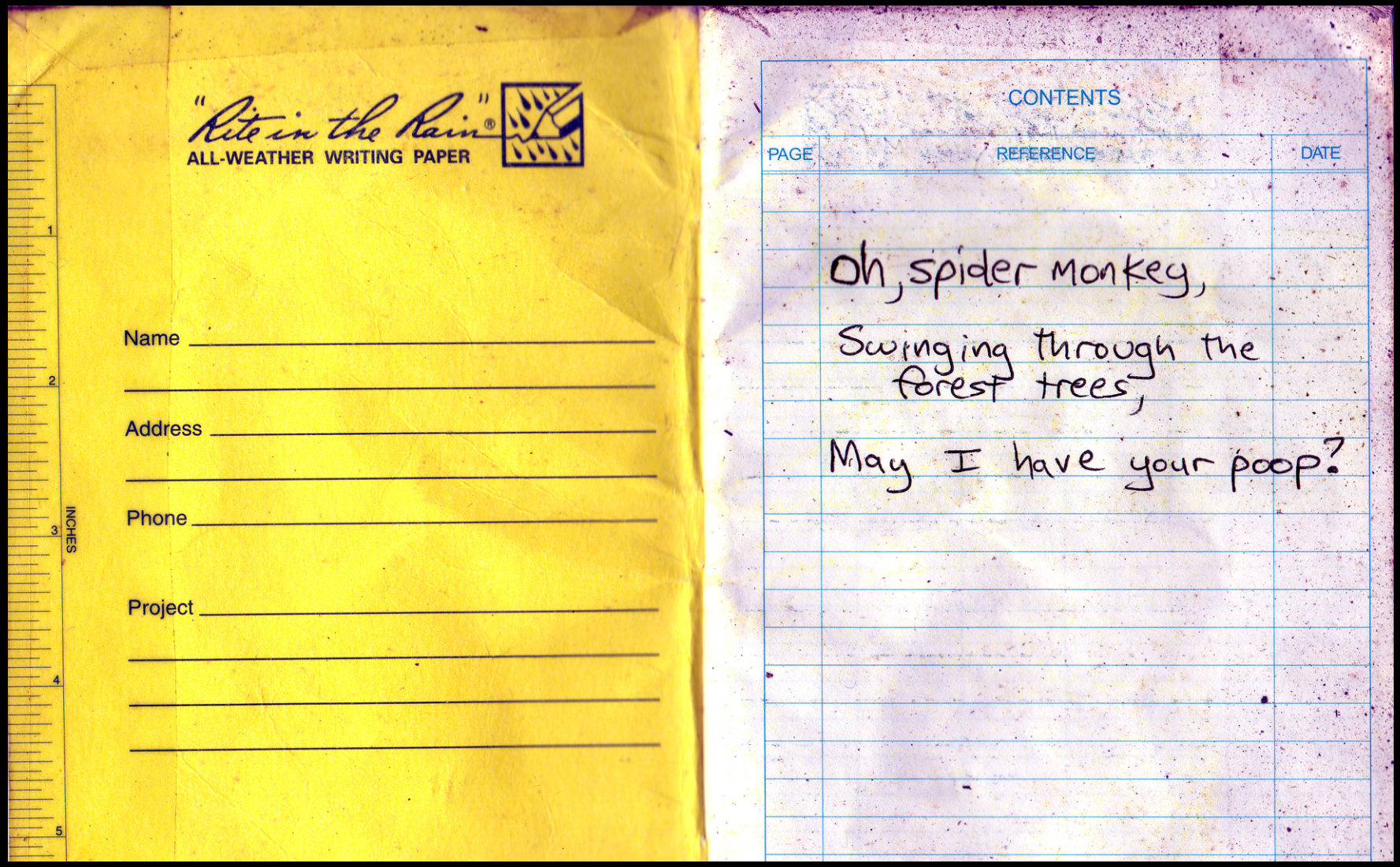
- Get pooped on!
- Scrape poop off shirt/pants/hair

Or…

http://blogs.scientificamerican.com/guest-blog/files/2012/08/Dung-beetle.jpeg

NIKON

Winner of the Poop Haiku Contest



Conservation Genetics **5:** 109–111, 2004.
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Identifying species from pieces of faeces

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Received 26 February 2003; accepted 10 March 2003

Key words: Alopex lagopus, DNA, *Gulo gulo*, PCR, primers, *Vulpes vulpes*

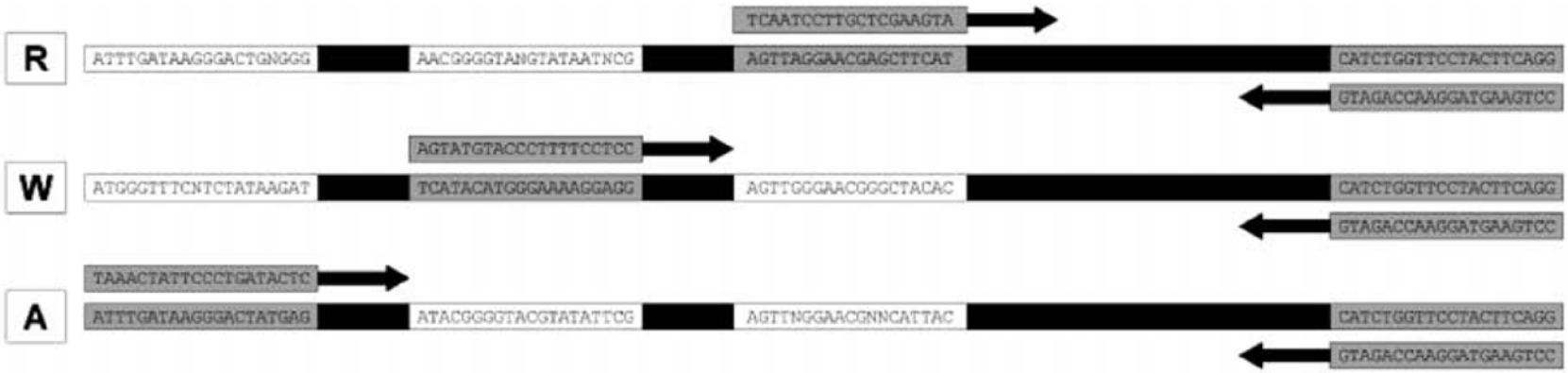


Figure 1. Illustration of the concept of RCP-PCR. One of the three species-specific primers will react with the general primer. The resulting fragment size depends on whether red fox (R), wolverine (W) or arctic fox (A) DNA is present in the extract. Intra-specific variable sites in the template are are shown as (N).

Genetic Dataset

- Bring poop to Texas!
- Extract DNA
- DNA "fingerprint" at up to 16 loci plus a sex typing marker

Combined DNA Index System

Spider Monkey Paternities

Spider Monkey Paternities

- **28 kids born between 1998 and 2011**
  - 7 assigned to *Poto*
  - 6 assigned to *Sammy*
  - 5 assigned to *Juan*
  - 4 assigned to *Geronimo*
  - 3 assigned to *Pedro*
  - 1 assigned to *Mono*
  - 2 could not be assigned and mismatched with all group males at 4+ loci

Paternities: Male Perspective

(N = 26 from within-group sires)

	# KIDS	Pre-1999	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	# MOMS
JUAN	5	2	1		1		1									5
PEDRO	3								1	2						3
POTO	7															7
GERONIMO	4															4
SAMMY	6										1	1	3	1		6
LUCAS	0															0
MONO	1												1			1
ANDREO	0															0
NENKI	0															0

Six of nine males who were adults in this period sired offspring…

Paternities: Male Perspective

(N = 26 from within-group sires)

	# KIDS	Pre-1999	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	# MOMS
JUAN	5	2	1		1		1									5
PEDRO	3								1	2						3
POTO	7															7
GERONIMO	4															4
SAMMY	6										1	1	3	1		6
LUCAS	0															0
MONO	1												1			1
ANDREO	0															0
NENKI	0															0

…and almost always sired these offspring with different females!

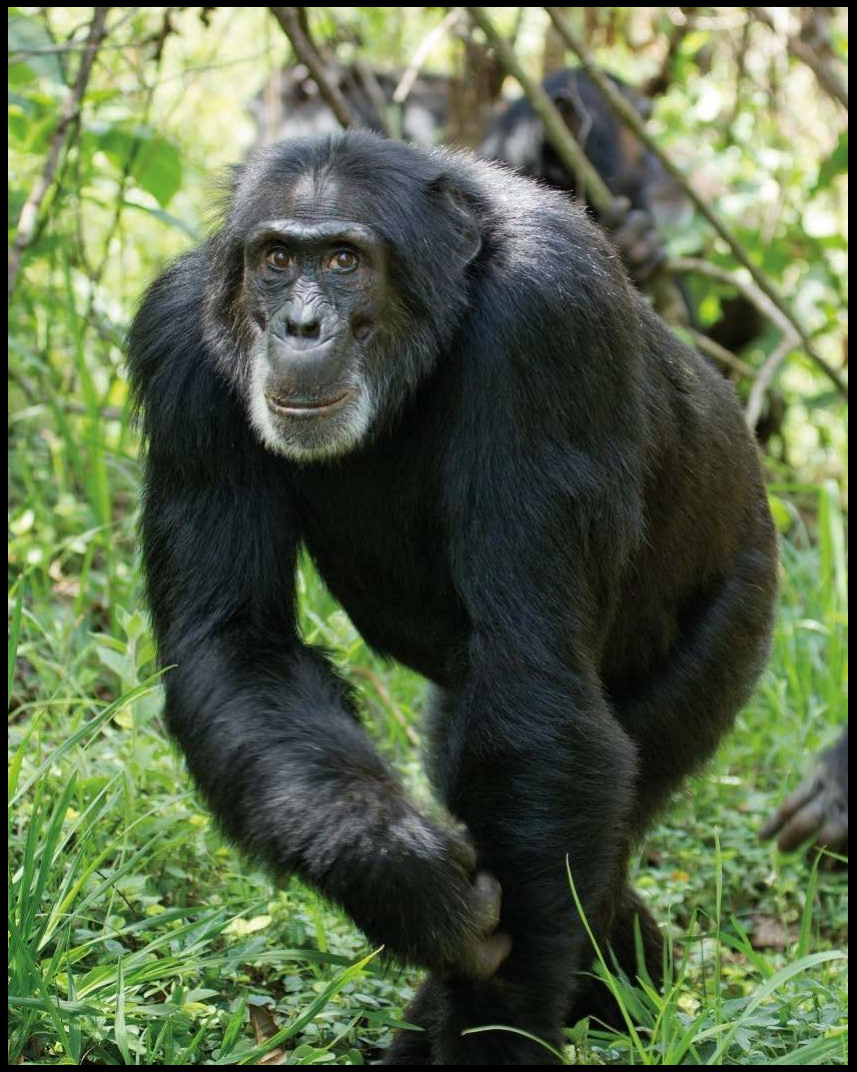
Paternities: Female Perspective

(N = 34, with 26 within-group sires and 2 unassigned)

	# KIDS	Pre-1999	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	# SIRES
EVA	3					1				1			1			3
ANA	4		1		1					1			1			4
BUKA	3	1								1				1		≥2
SOFIA	3		1						1				1			3
MIKA	2															2
LUNA	3															3
OIKAMO	4														1	≥2
KAUO	3										1			1	1	≥1
NIPA	4	1					1				1				1	≥3
VITA	1											1				1
GISELLA	2				1			1								≥1
ZARI	0															0
EVITA	1													1		1
UNKNOWN	1	1														1

Almost all of a female's kids are sired by different males!

Parallels with Chimpanzees



From: Walt Disney Pictures' Chimpanzee (2012)

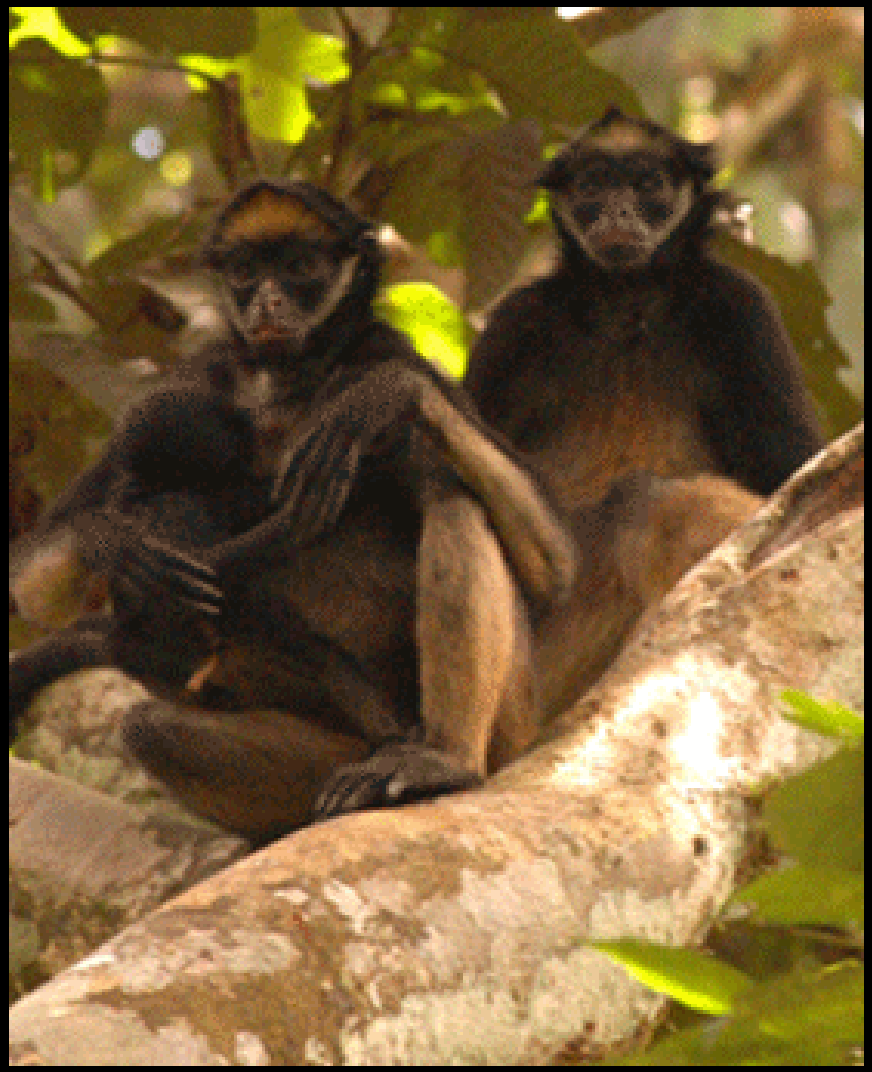
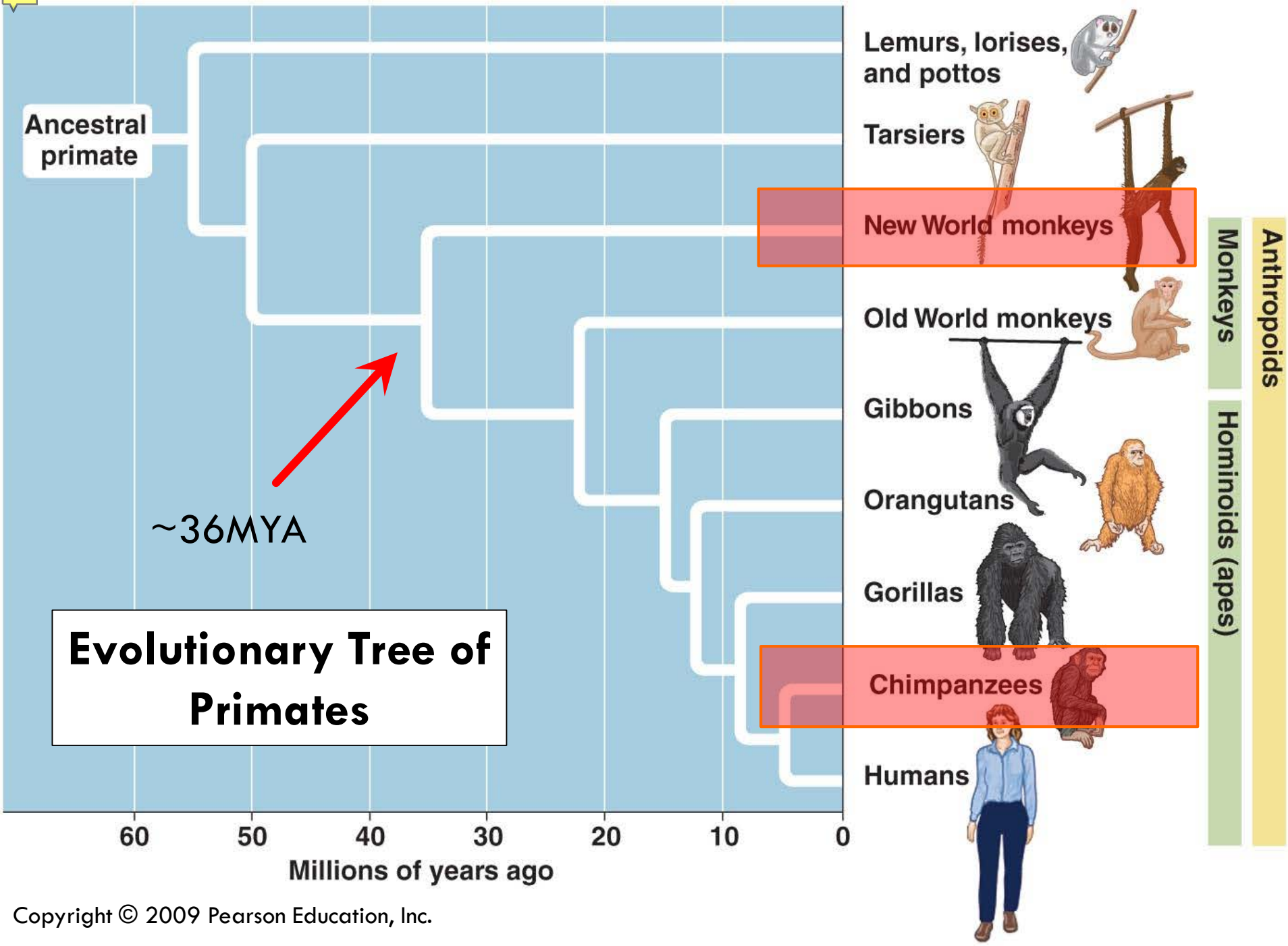


Photo By: Dylan Schwindt, Proyecto Primates



Evolutionary Tree of Primates

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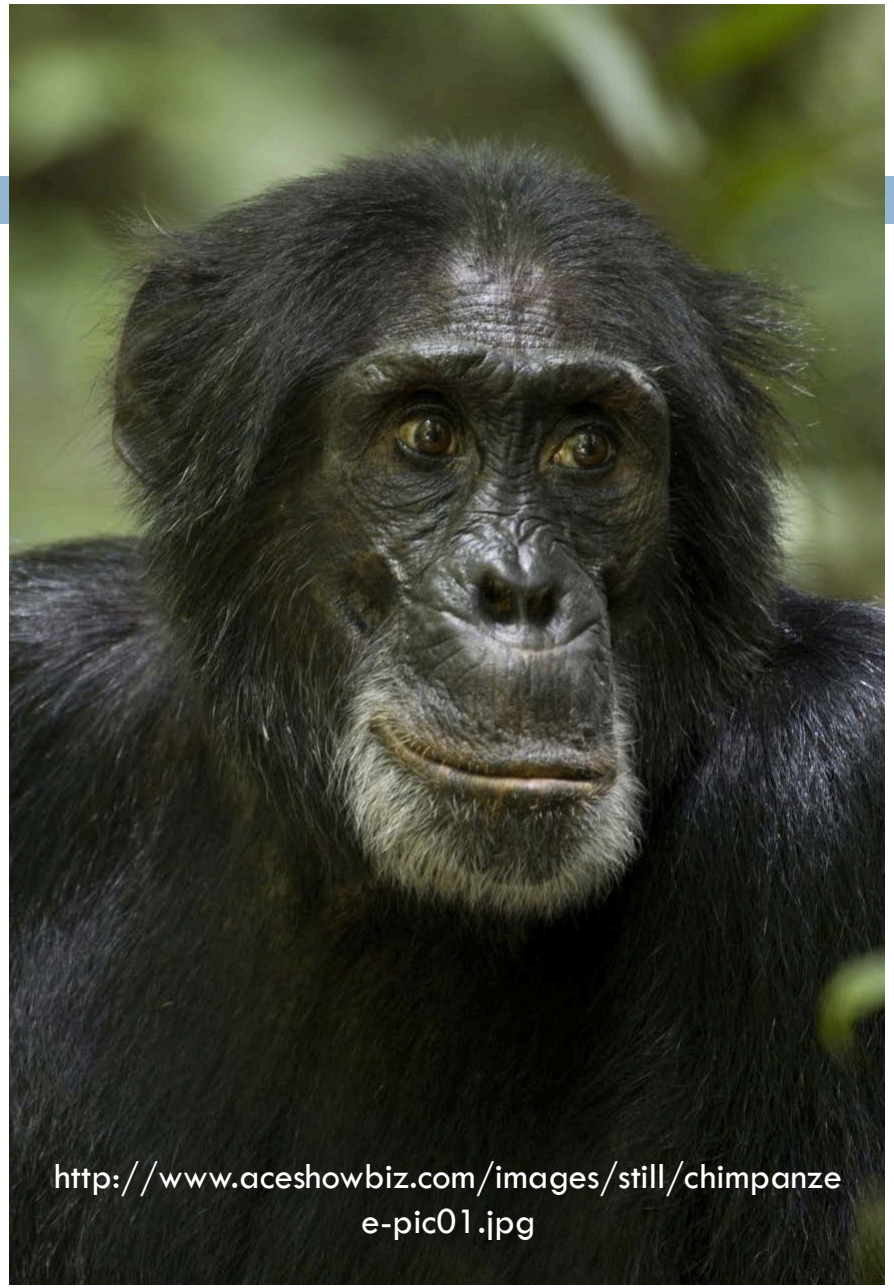
Key Convergences…

- Fission-fusion associations
- Loud, distinctive calls to coordinate associations at a distance
- Large ranges with little overlap between groups
- Female dispersal and patrilineality
- Cooperative territorial defense, patrolling, and raids by males


http://www.aceshowbiz.com/images/still/chimpanzee-pic01.jpg

Take Home?

- Spider monkeys may make **good models** for studying the factors underlying aspects of **chimpanzee and early human sociality**

Photo: Dylan Schwindt, Proyecto Primates

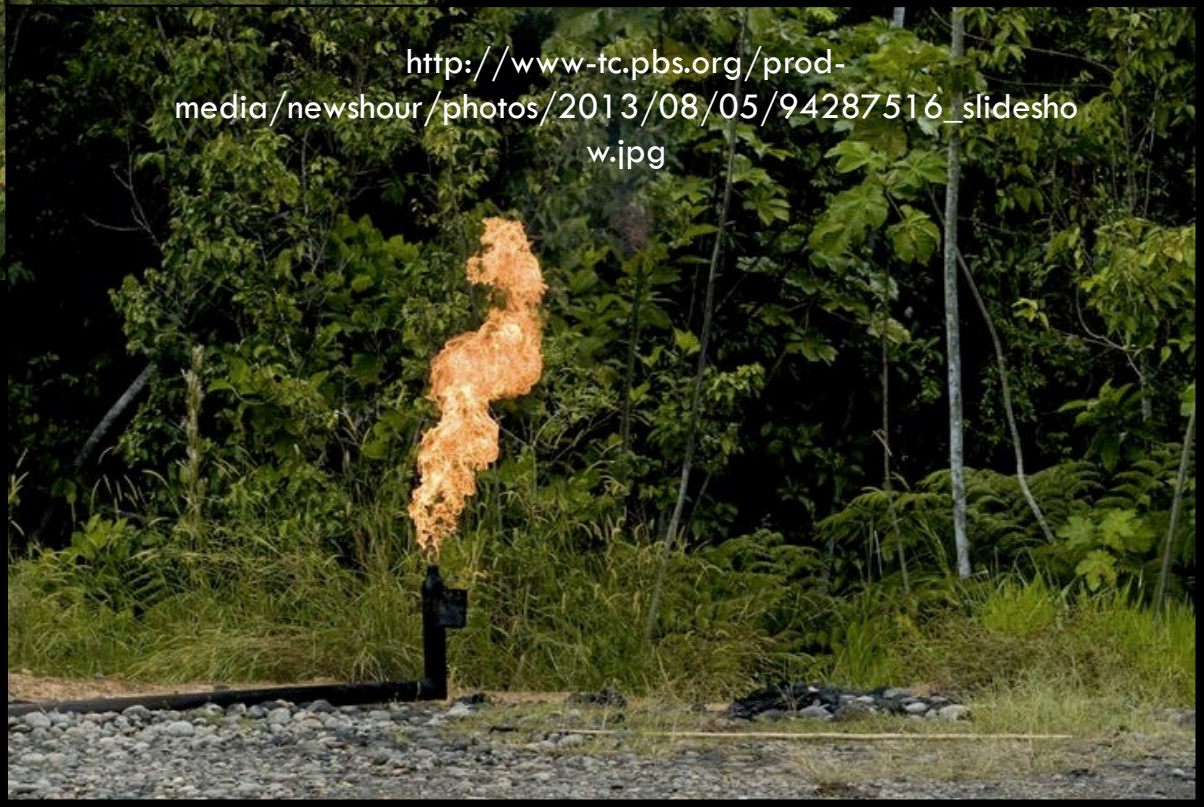
- *Flexible association patterns*
- *Female exogamy*
- *Male bonding*
- *Patrilineality*
- *Cooperative range defense*
- *Cooperative male aggression against other groups*

Yasuní: A Global Biodiversity Hotspot

- 2,274 species of trees and shrubs
- 596 species of birds
- 105 species of amphibians; 83 of reptiles; 383 of fish
- Over 100,000 species of insects per hectare
- 204 species of mammals
  - *Including 25 protected under CITES or listed by the IUCN as threatened or endangered*

Photo: Steve Winter, National Geographic

http://ngm.nationalgeographic.com/2013/01/yasuni-national-park/img/22-petroamazonas-road-670.jpg


http://www-tc.pbs.org/prod-media/newshour/photos/2013/08/05/94287516_slideshow.jpg

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HOT SCIENCE – COOL TALKS

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Proyecto Primates

http://www.proyectoprimates.org/

http://www.facebook.com/ProyectoPrimates

Proyecto Primates

Want More Info?

- International Campaign for Yasuní

Foreigners cannot sign the petition for the referendum, but they can sign the open letter to President Correa on AVAAZ, Save Yasuní, the Last Wonder of the Amazon!

- Mongabay.com – Tropical rainforest conservation and environmental science news

- National Geographic – Special article on Yasuní

Dr. Anthony Di Fiore

Anthony Di Fiore is a professor at UT Austin. He conducts long-term behavioral and ecological field research on several species in the primate community of Amazonian Ecuador to investigate the ways in which ecological conditions (such as the abundance and distribution of food resources) and the strategies of conspecifics together shape primate behavior and social relationships and ultimately determine the kinds of societies we see primates living in.

Dr. Fiore complements his field studies with molecular genetic laboratory work in order to address issues that are typically difficult to explore through observational studies alone, including questions about dispersal behavior, gene glow, mating patterns, population structure, and the fitness consequences of individual behavior.