

Hot Science Cool Talks

UT Environmental Science Institute

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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...

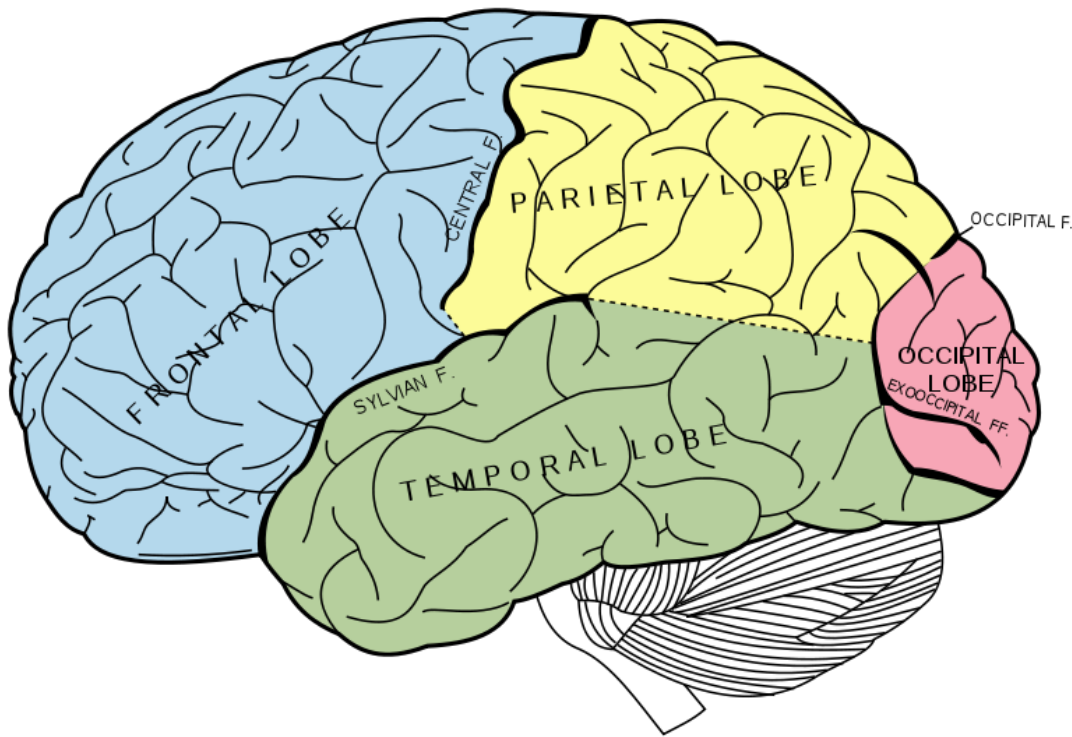
- An introduction to primates...
 - ... especially spider monkeys!
- A taste of primatology fieldwork
 - *How the heck do you study arboreal rainforest primates?*
- Four vignettes...
 - *Social media for spider monkeys*
 - *Mineral licks, predation risk, and safety in numbers*
 - *Patrols, raids, and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

Tarsier



<http://biologypop.com/tarsier/>

<http://www.gibbons.de/>



Neocortex

Self control

Abstract thought

Perspective taking

Geladas in the Ethiopian Highlands



Ancestral primate

~36MYA

Evolutionary Tree of Primates

60 50 40 30 20 10 0
Millions of years ago

Lemurs, lorises, and pottos



Tarsiers



New World monkeys



Old World monkeys



Gibbons



Orangutans



Gorillas



Chimpanzees



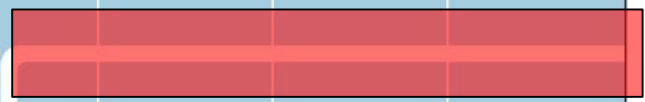
Humans



Monkeys

Anthropoids

Hominoids (apes)

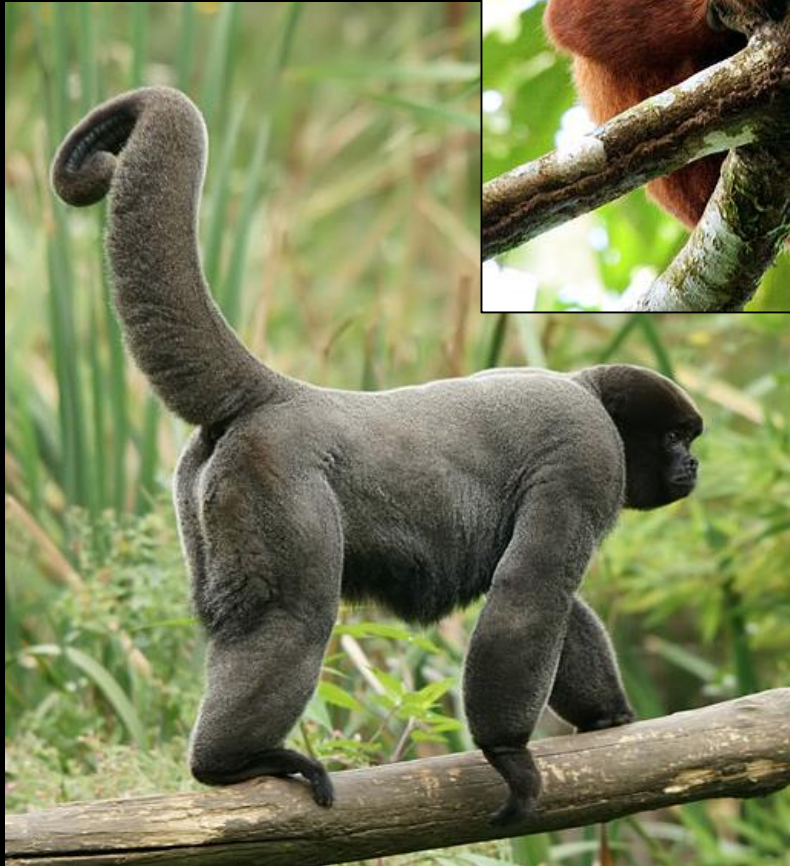


**Howler
Monkey**



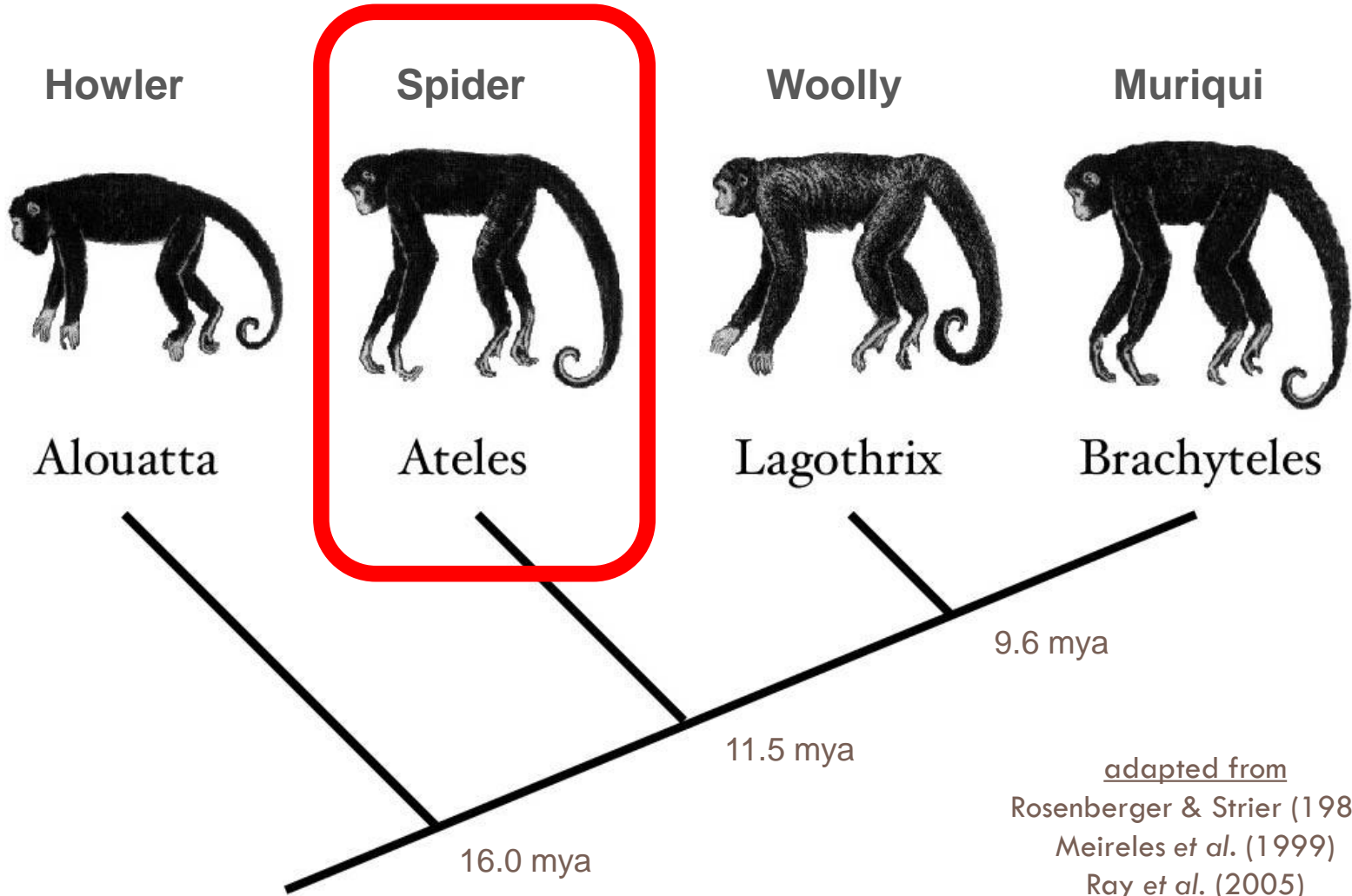
<http://commons.wikimedia.org/>

Muriqui

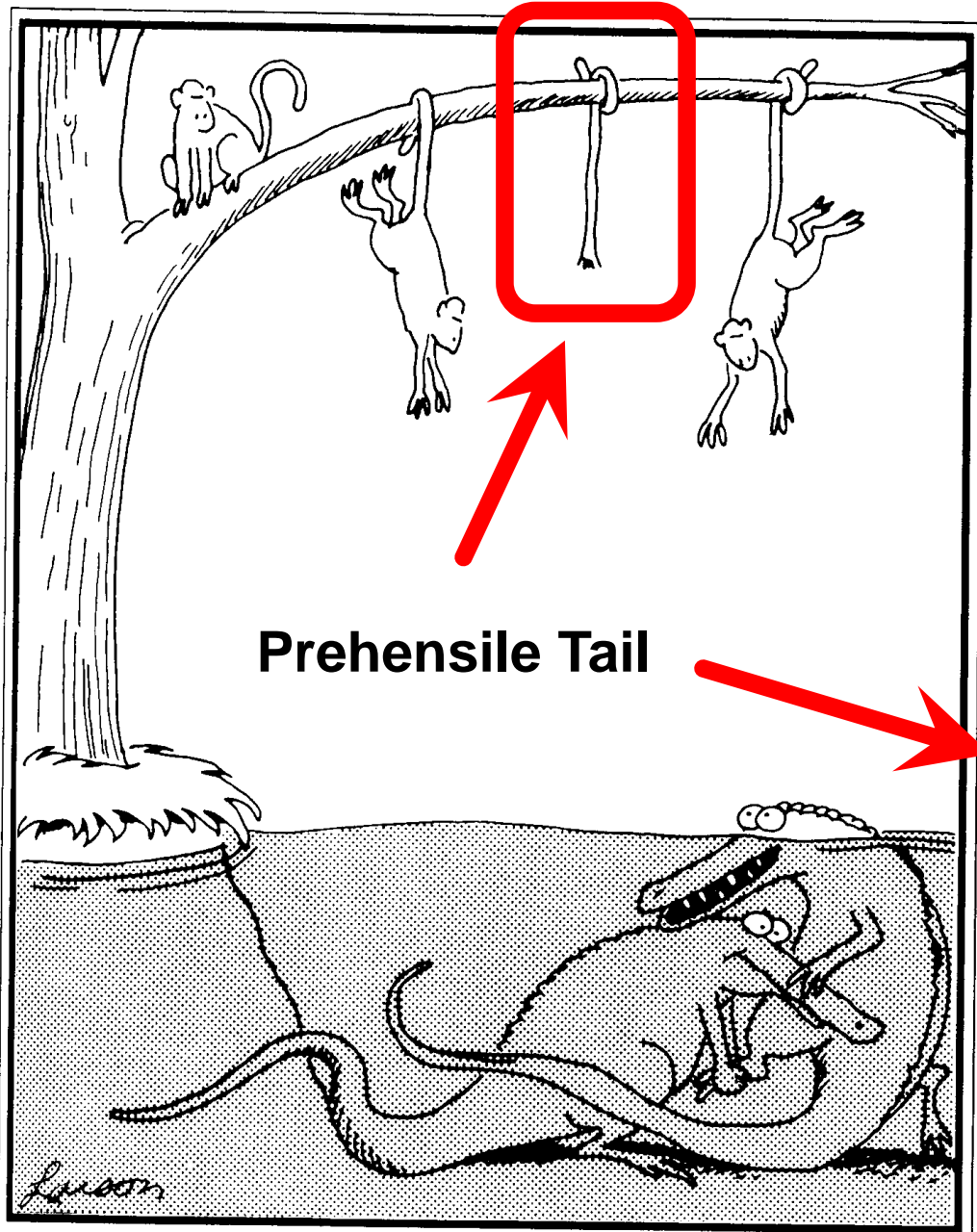


Woolly Monkey

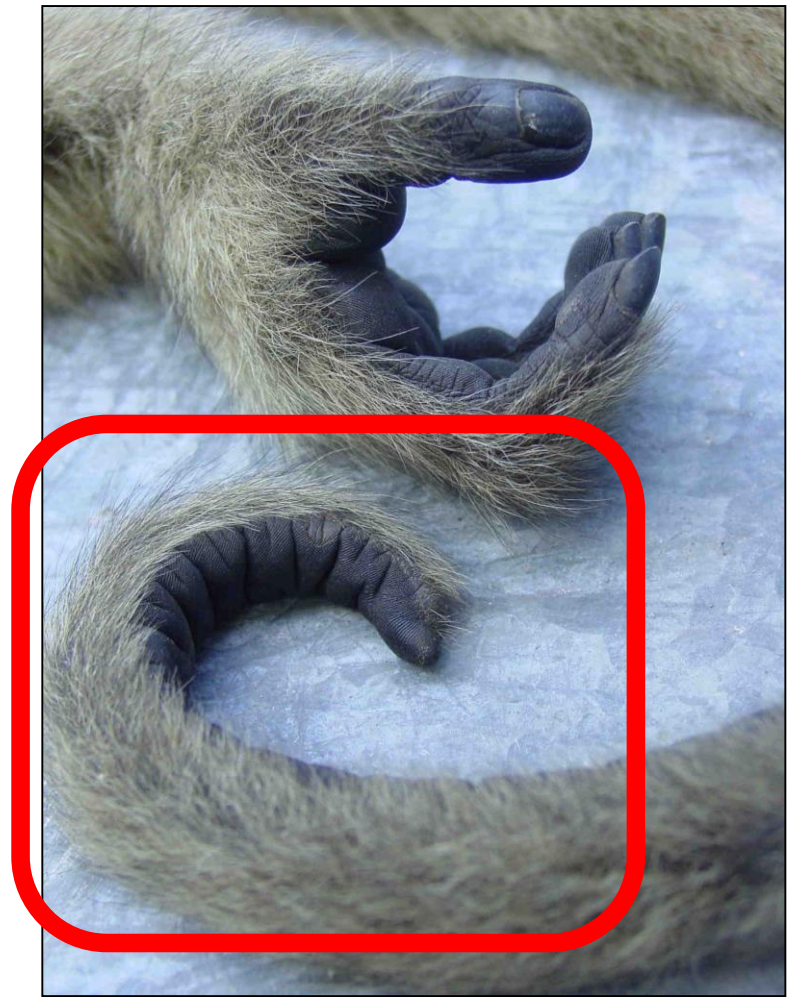
Family: Atelidae



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



Prehensile Tail



“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

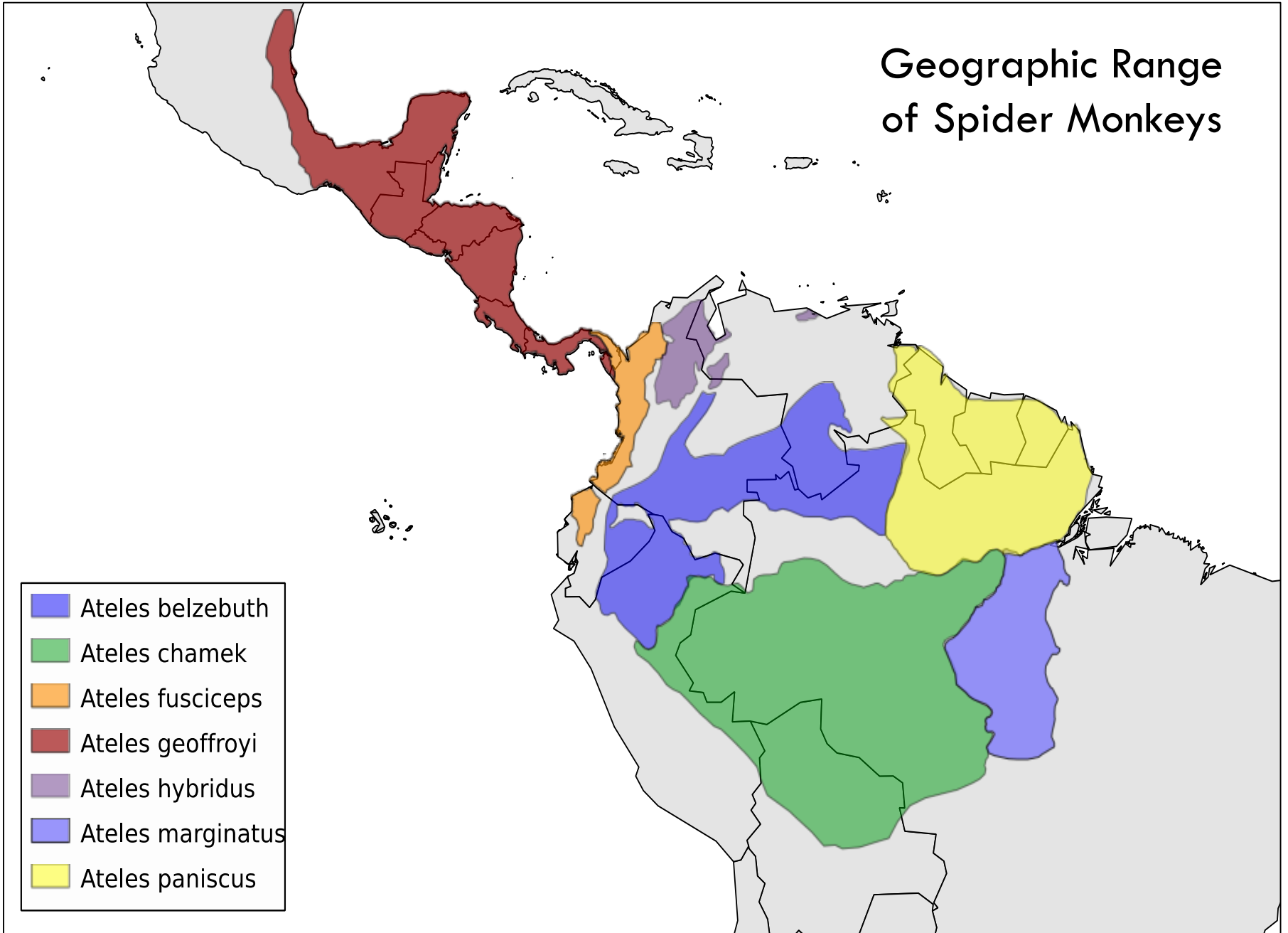
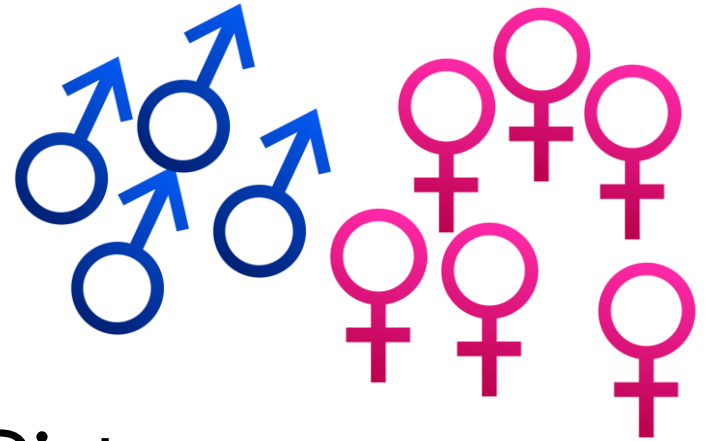


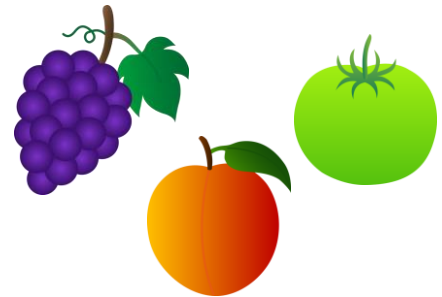
Photo: Dylan Schwindt, Proyecto Primates

Natural History

□ Group Composition



□ Diet



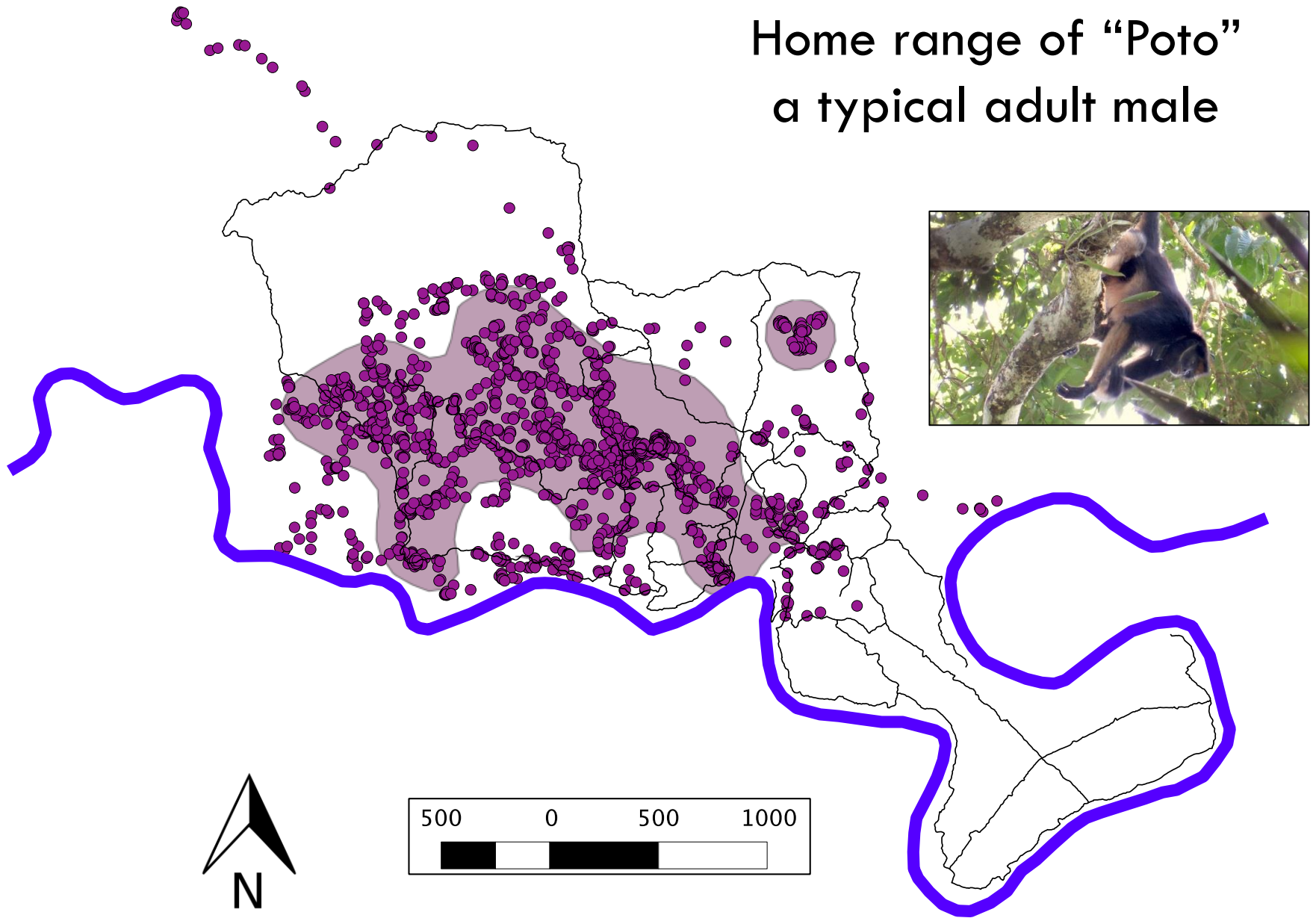
Home Range
408 hectares (1008 acres)

1 km

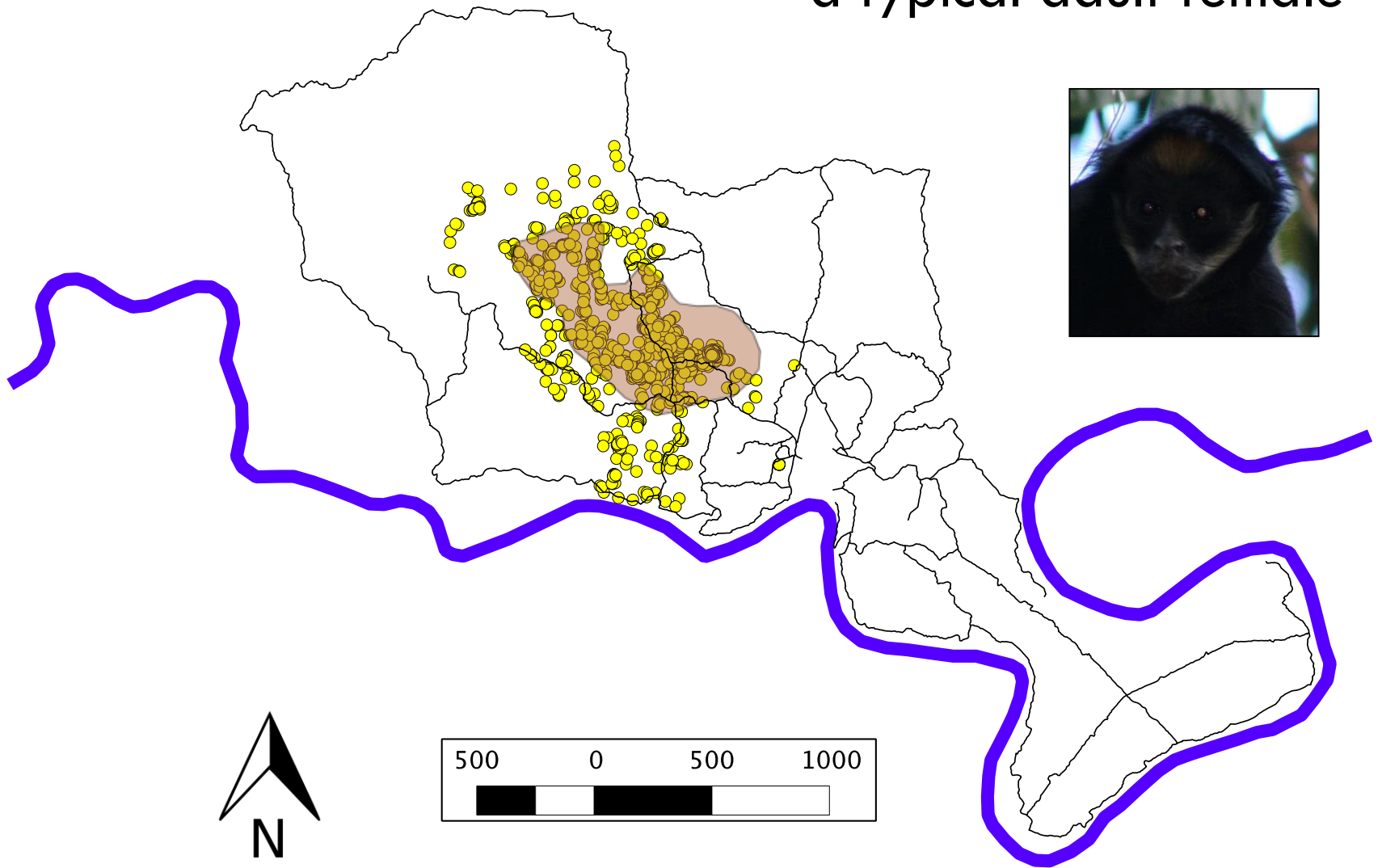
N



Home range of "Poto" a typical adult male

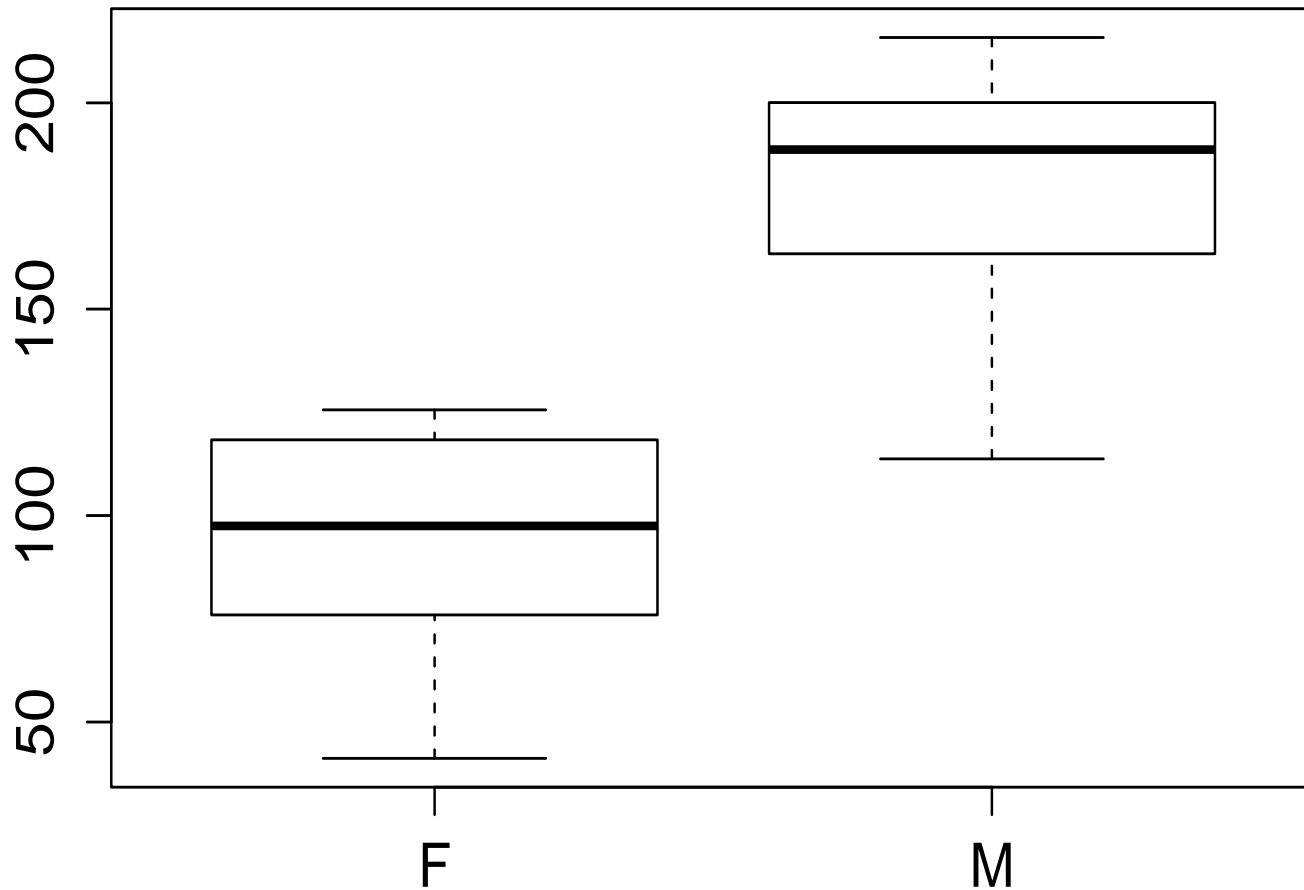


Home range of “Ana” a typical adult female



Sex Differences in Range Size

** $P < 0.001$, 12 females, 7 males





Natural History

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



Dolphins



Elephants



Spotted Hyenas

<http://www.hyaenidae.org/the-hyaenidae/spotted-hyena-crocota-crocota/crocota-social-behavior.html>



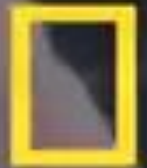


<http://connecticut.cbslocal.com/2014/02/10/weather-related-conditions-slow-commuter-rail/>

A Taste of Primatology Fieldwork



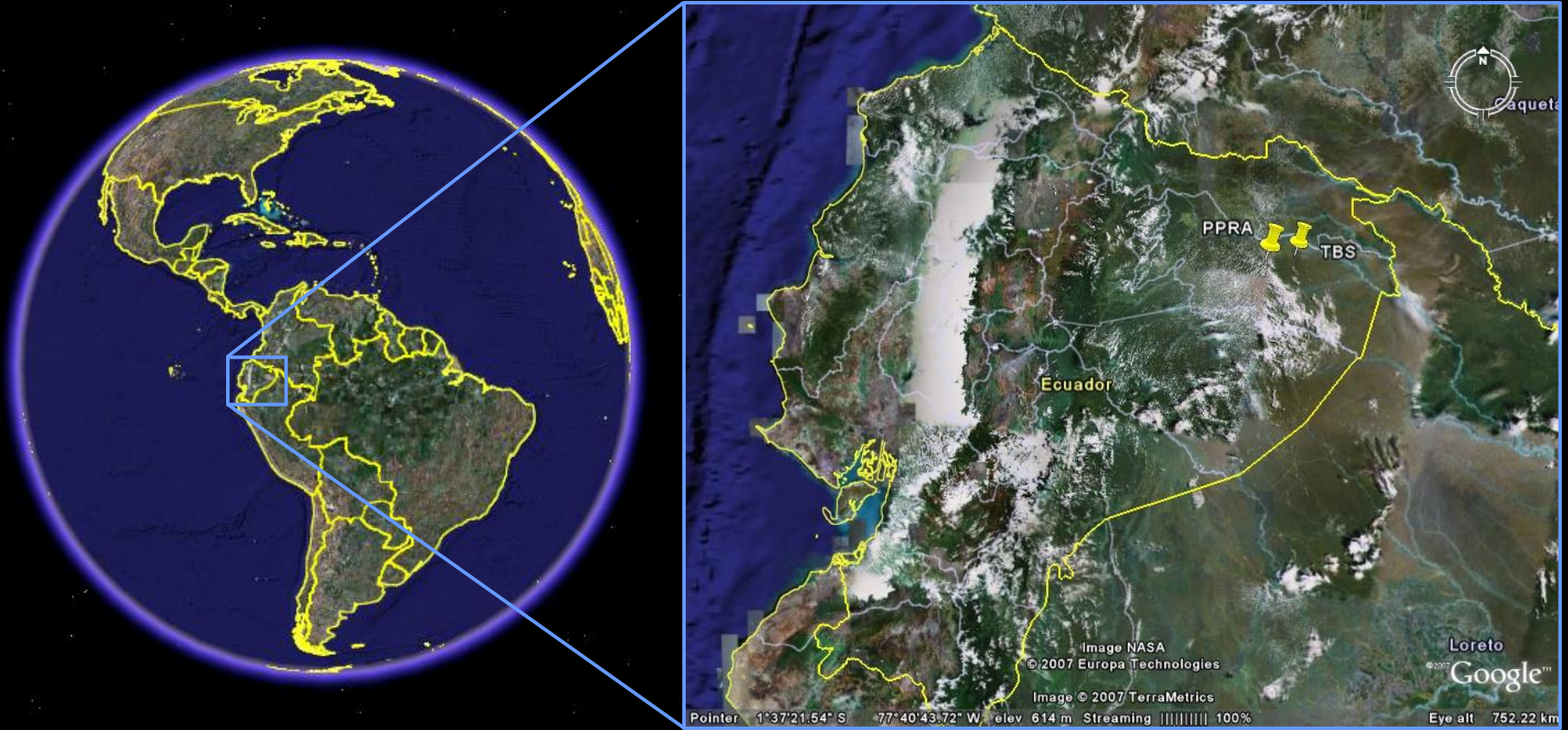
<http://www.janegoodall.org/media/videos/jane-goodall-retrospective>



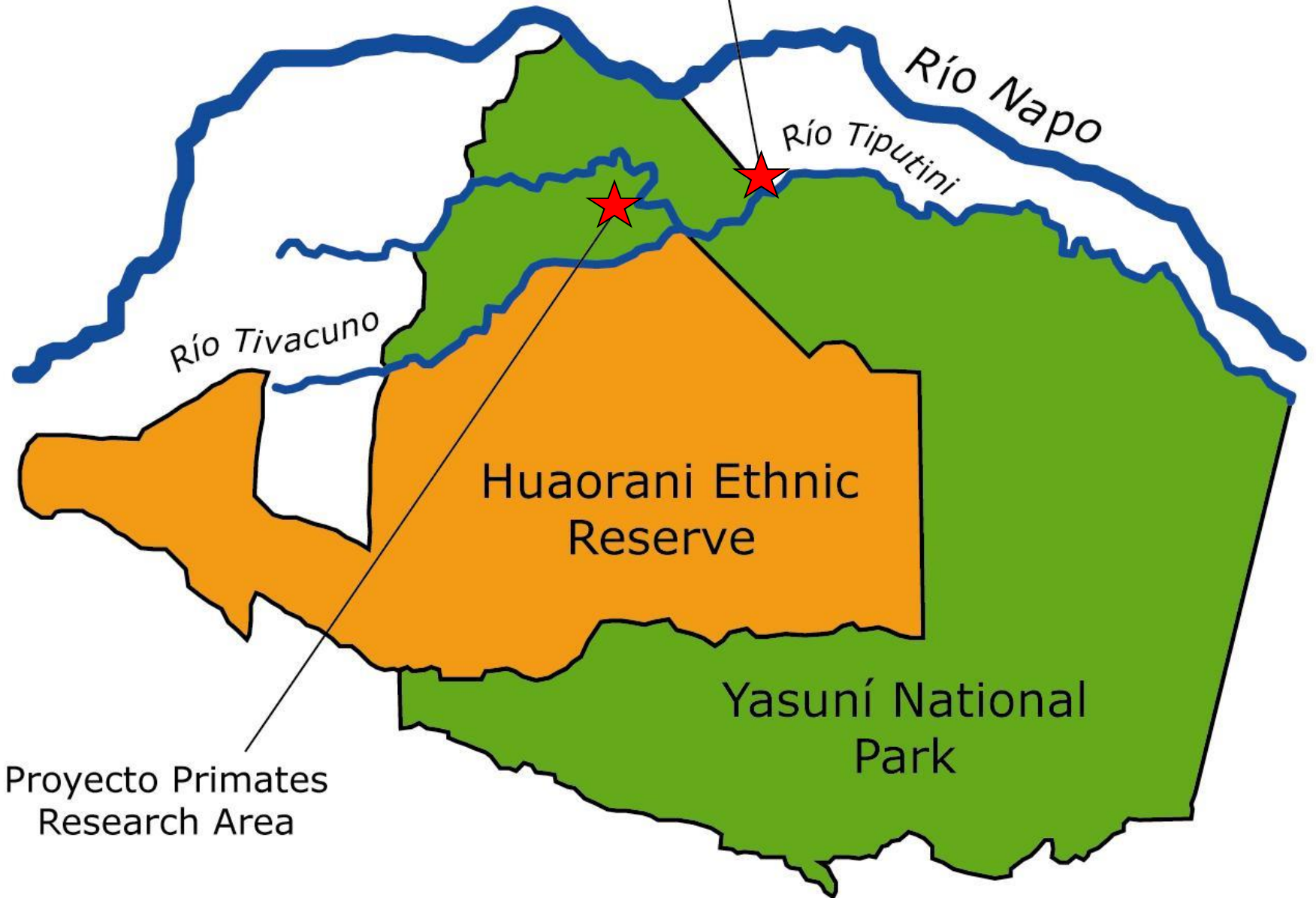


Tiputini Biodiversity Station

Yasuní Biosphere Reserve, Ecuador



Tiputini Biodiversity
Station



Río Napo

Río Tiputini

Río Tivacuno

Huaorani Ethnic
Reserve

Yasuní National
Park

Proyecto Primates
Research Area

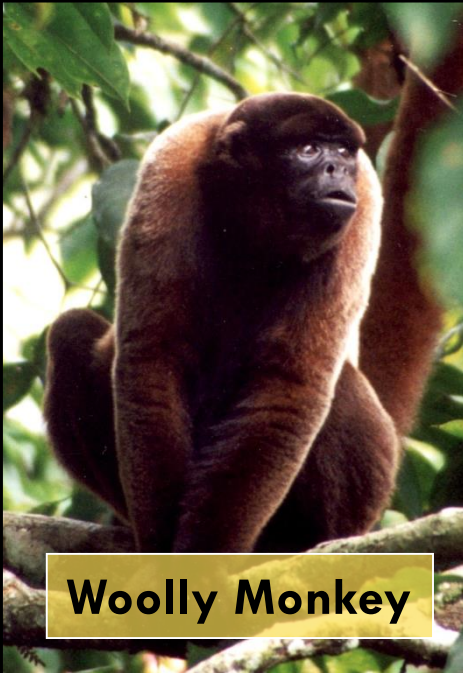








Ateles belzebuth
(white-bellied spider monkey)



Woolly Monkey



Saki



Owl Monkey



Titi



Squirrel Monkey



Howler Monkey



Pygmy Marmoset



Capuchin



Tamarin

<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



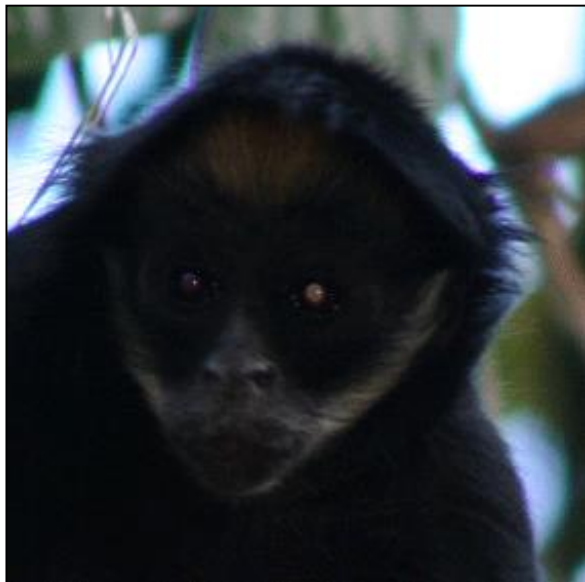
Basic Methods:

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



Behavioral Observations

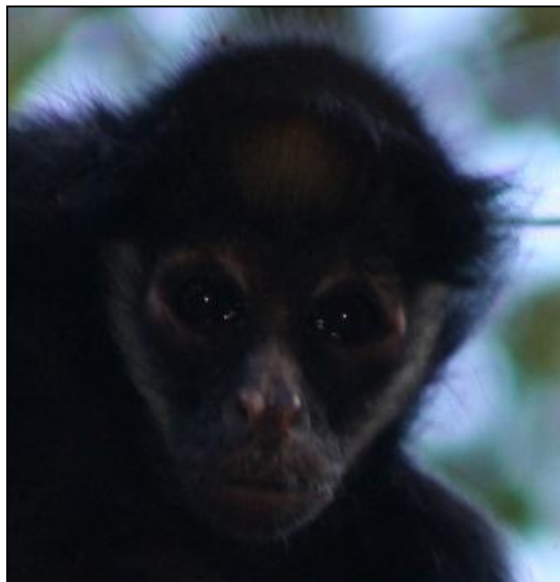
- Dawn-to-Dusk “Focal Animal” Follows
 - All non-juveniles
 - Animals individually identified



ANA



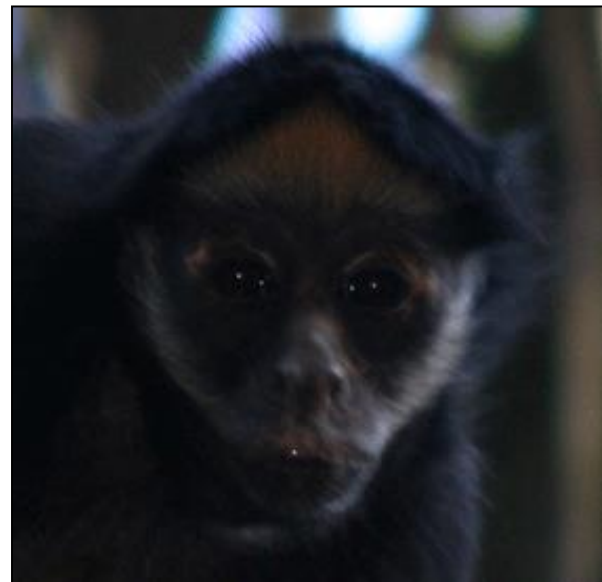
LAURA



EVITA

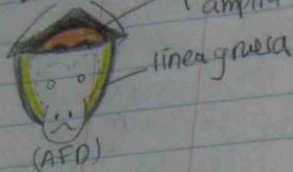


IAMONKA



EVA

• MIKA (MIK)



frente amplia

línea gruesa

(AFD)

• ANO

CLITORIS
↳ punto negro

↳ MALI (MAL)

♀

rosado arriba en ojos?



línea gr. delgada

trompa + rosada

(SAF)

↳ black dot end of clitoris

↳ MAQUI (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 araña)

línea tenue

(JF)

• OIKAMO (OIK)



Naranja-centro
Amarillo-lados

rosado en ojos

línea gruesa

(AFD)

CLITORIS
↳ largo

↳ OLIO (OLI)

♂



línea delgada con inconspicua

↳ grande

tambien tiene 2 pequeños entredios, uenos conspicuos

(JM)

• ANO
↳ pequeño
↳ muy salido poco

TESTES

• SOFIA (SOF)



Triángulo grande (muy blanco)

línea gruesa

(AFD)

• ANO
↳ pequeño

CLITORIS
↳ con pto. negro en la parte de adelante



WERPO
↳ muy clara

↳ SILVI (SIL)

♀

triángulo de pelo cado

boca + nariz rosada



línea delgada

medial muy achataada

(SAF) (JF)

- Muy grande

Clitoris largo y torcido

• ANO
↳ delgado
↳ un poco salido

rosado alrededor de ojos

↳ SUMMER (SUM)

♂

trompa bien rosada



mancha amplia

rosado a los lados de los ojos

(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

(15) Anthony Di Fiore

https://www.facebook.com/anthony.f.di.fiore/about

Apps Toodledo Google Translate Google Calendar Google Drive Gmail Facebook UT Ethoinformatics Other Bookmarks

Change Cover

Sammy, Adult Male
Ateles belzebuth

Update Info Activity Log 6 * ▾

Timeline About Photos 0 Friends 31 More ▾

About

Work and Education

The University of Texas at Austin

Status Photo Place Life Event

I'm hangin' out in the fig tree... C'mon by!

Austin

Friends ▾ Post

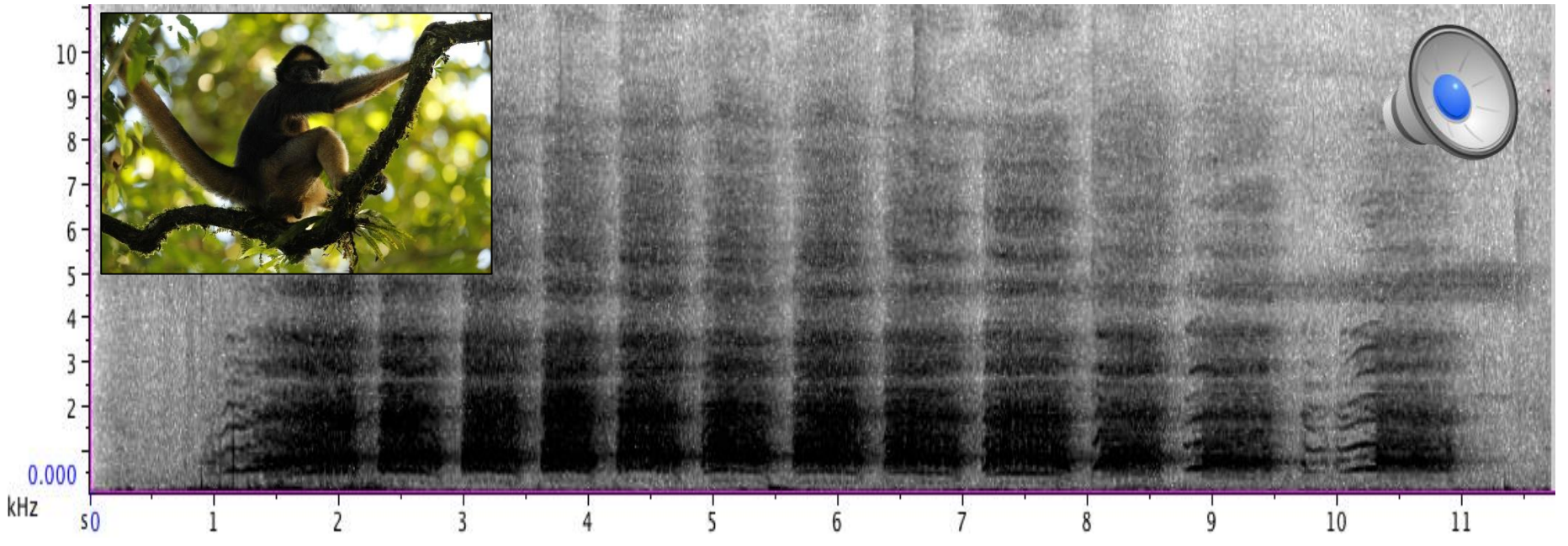
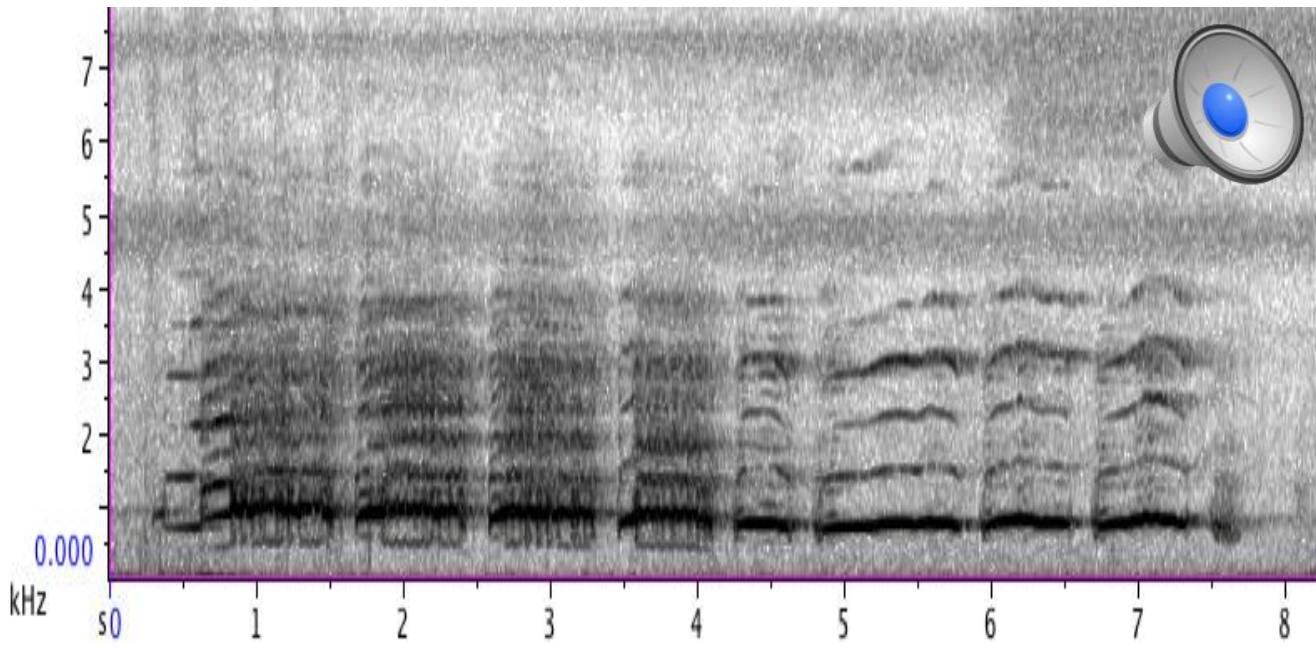
ORIGINAL PAPER

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

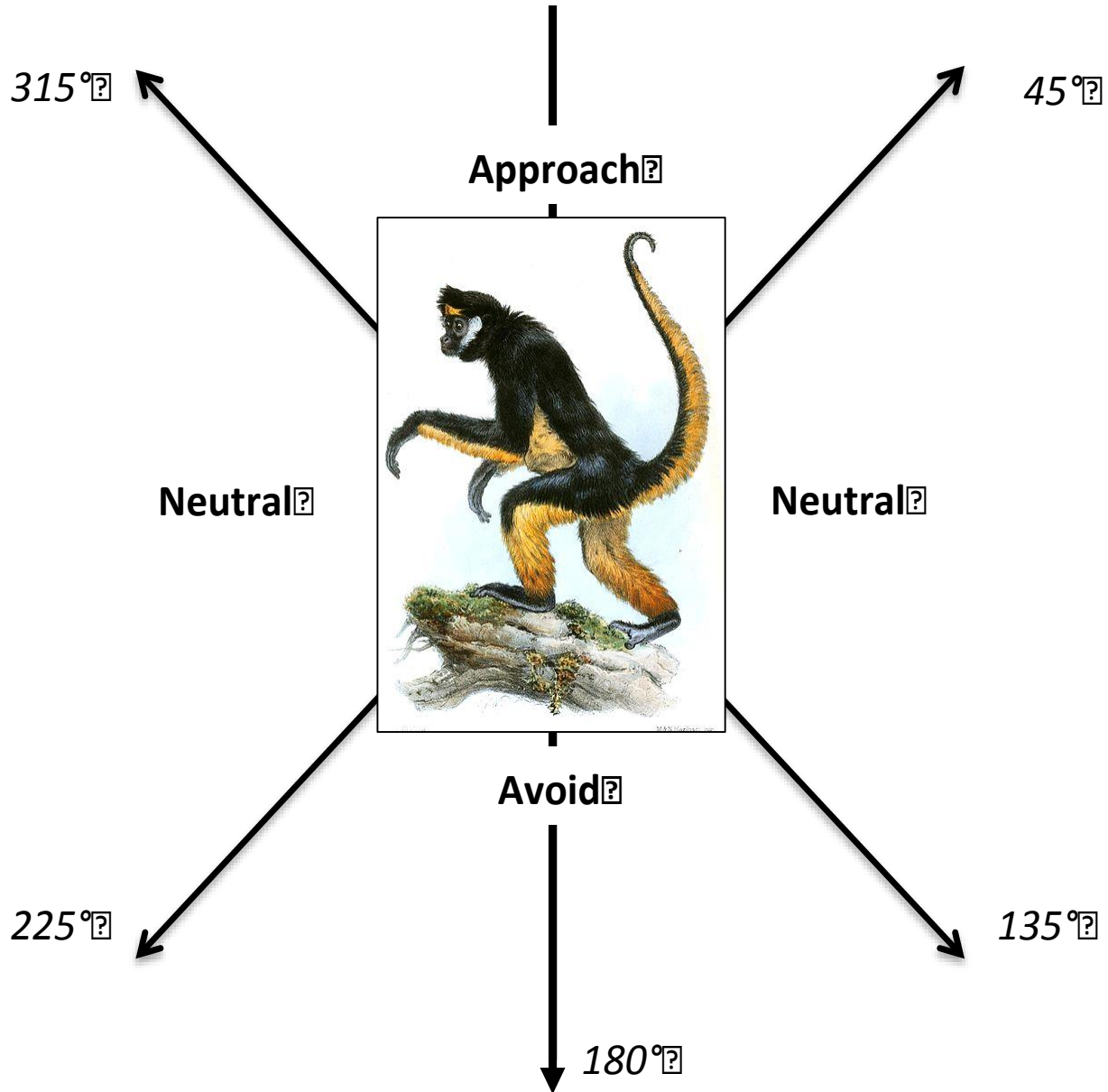
Stephanie N. Spehar • Anthony Di Fiore

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

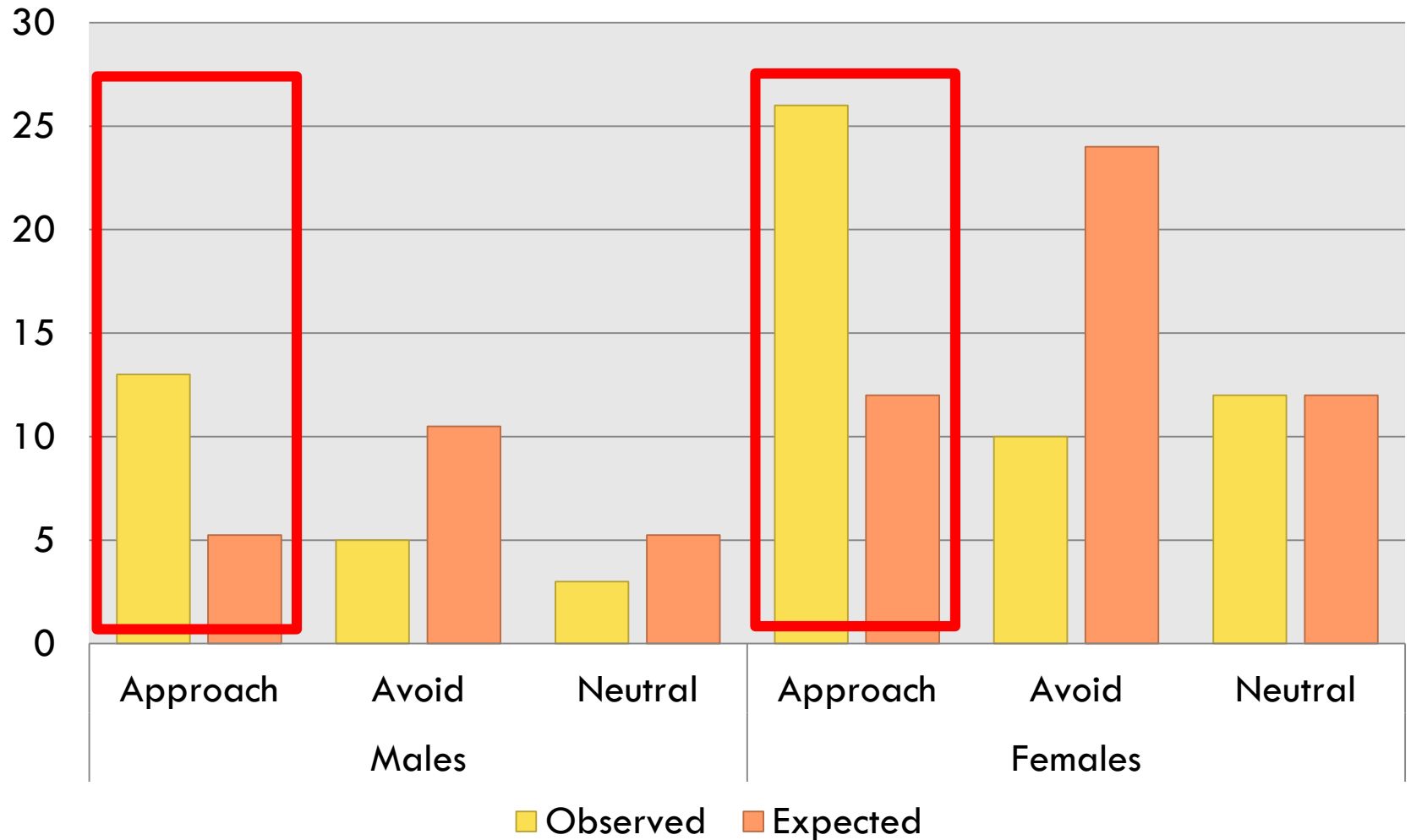




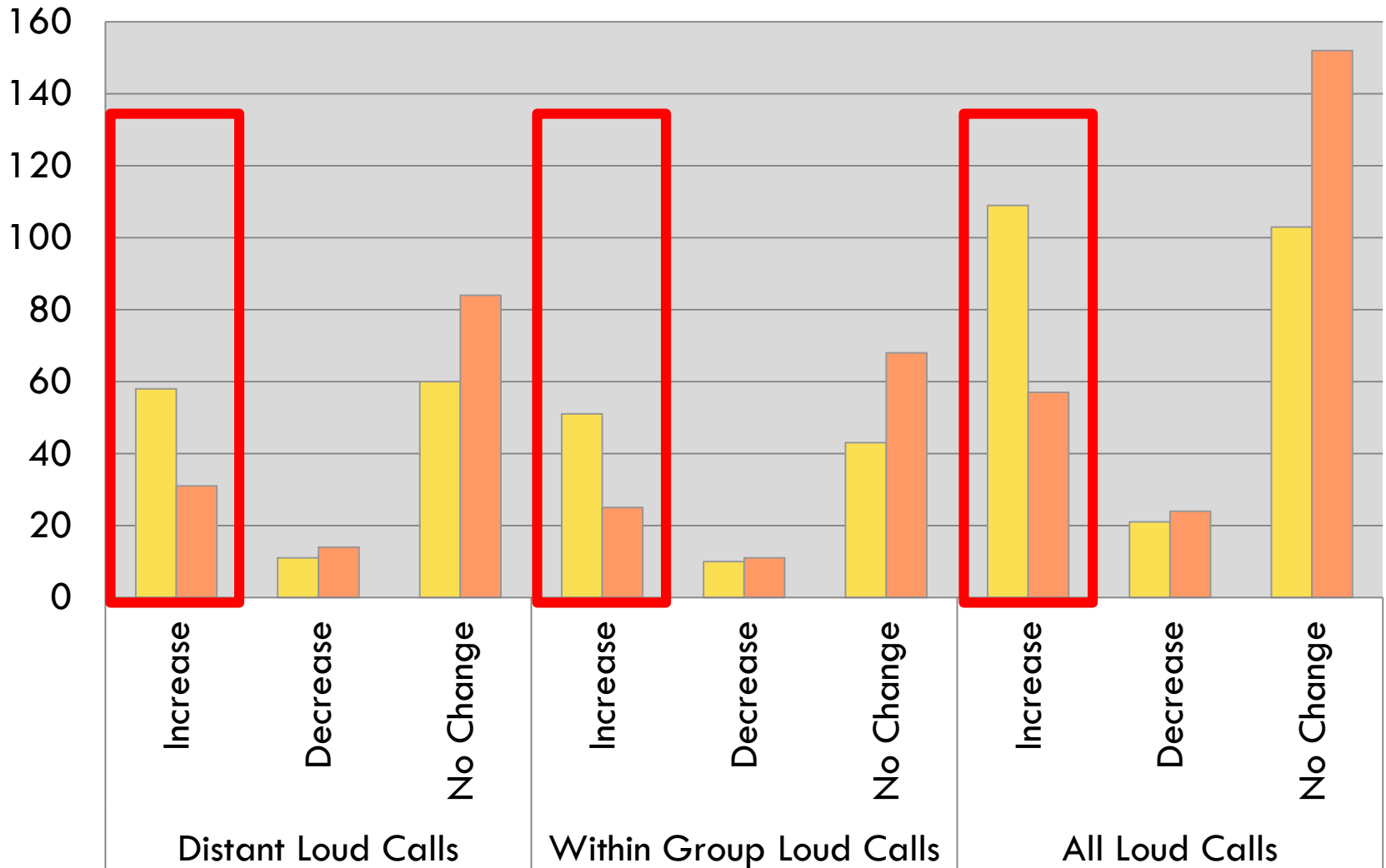
Direction of Caller



Male and Female Responses to Distant Loud Calls



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 ~ 1 x/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

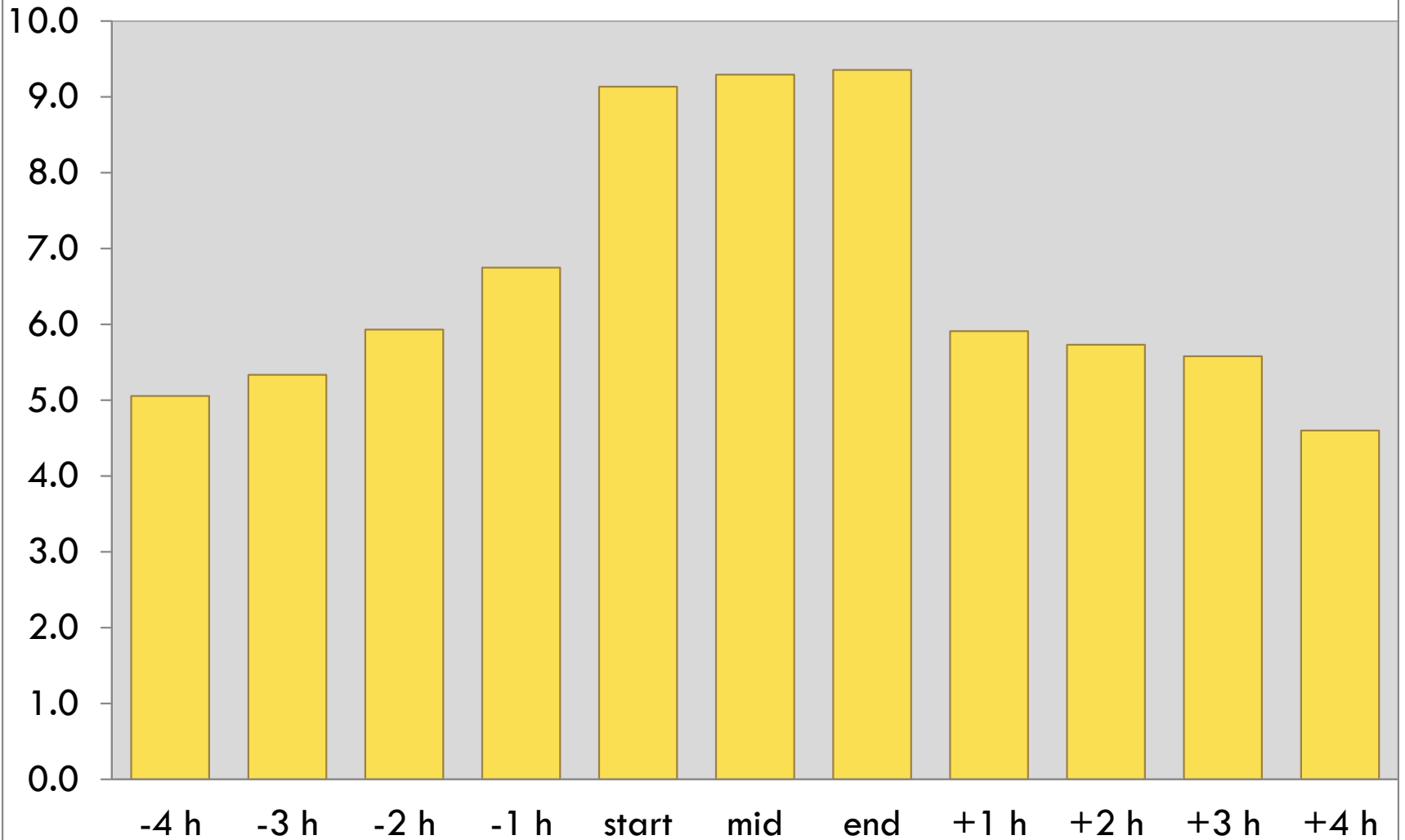




19 2:04PM



Subgroup Size Before, During, and After Mineral Lick Visits



VIGNETTE 3: PATROLS, RAIDS, and WARFARE



<http://www.janegoodall.org/media/videos/chimp-patrol>



Photos: John Mitani, University of Michigan

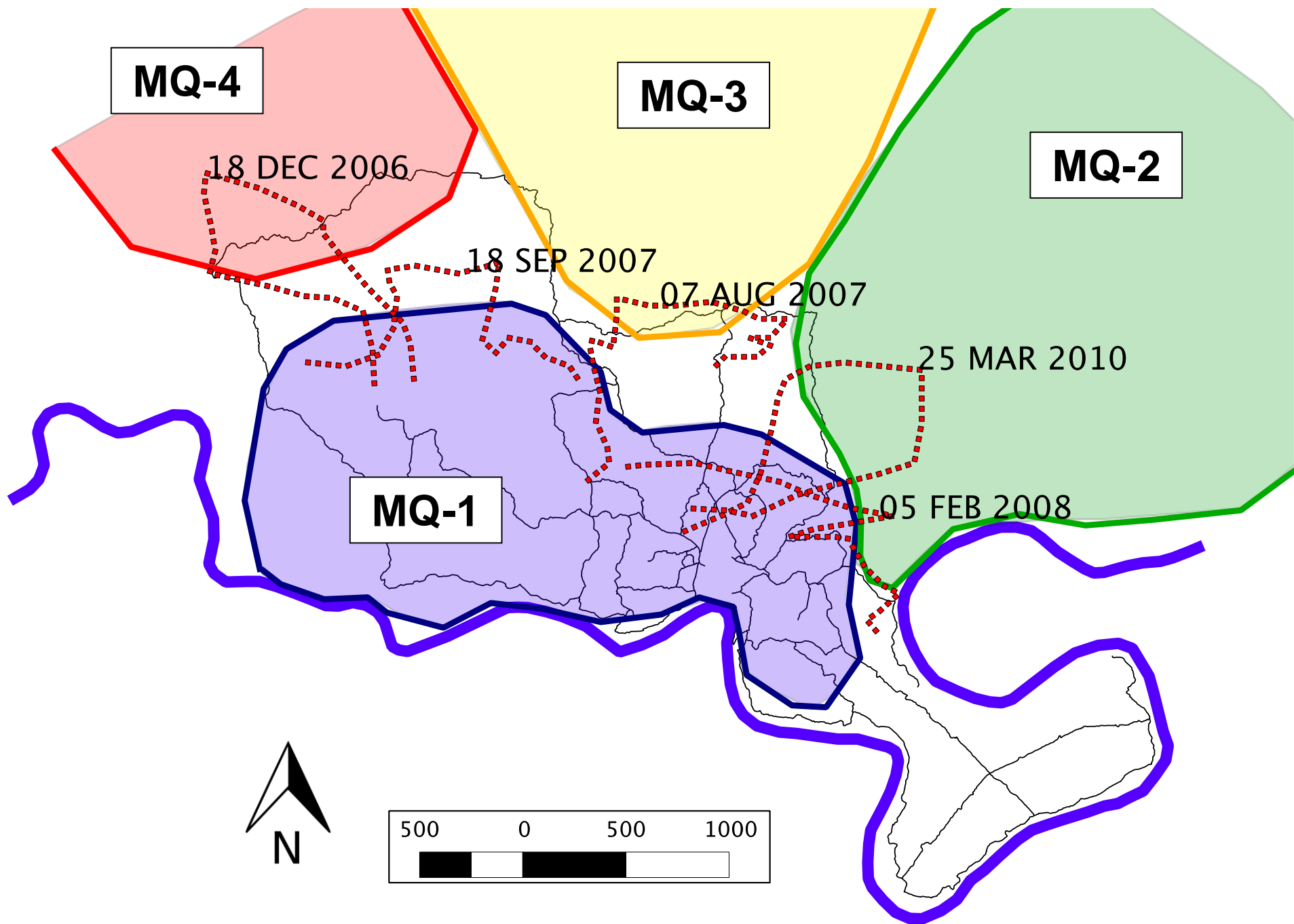
Male Coalitional Aggression

- $N = >50$ 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**





Male Patrols

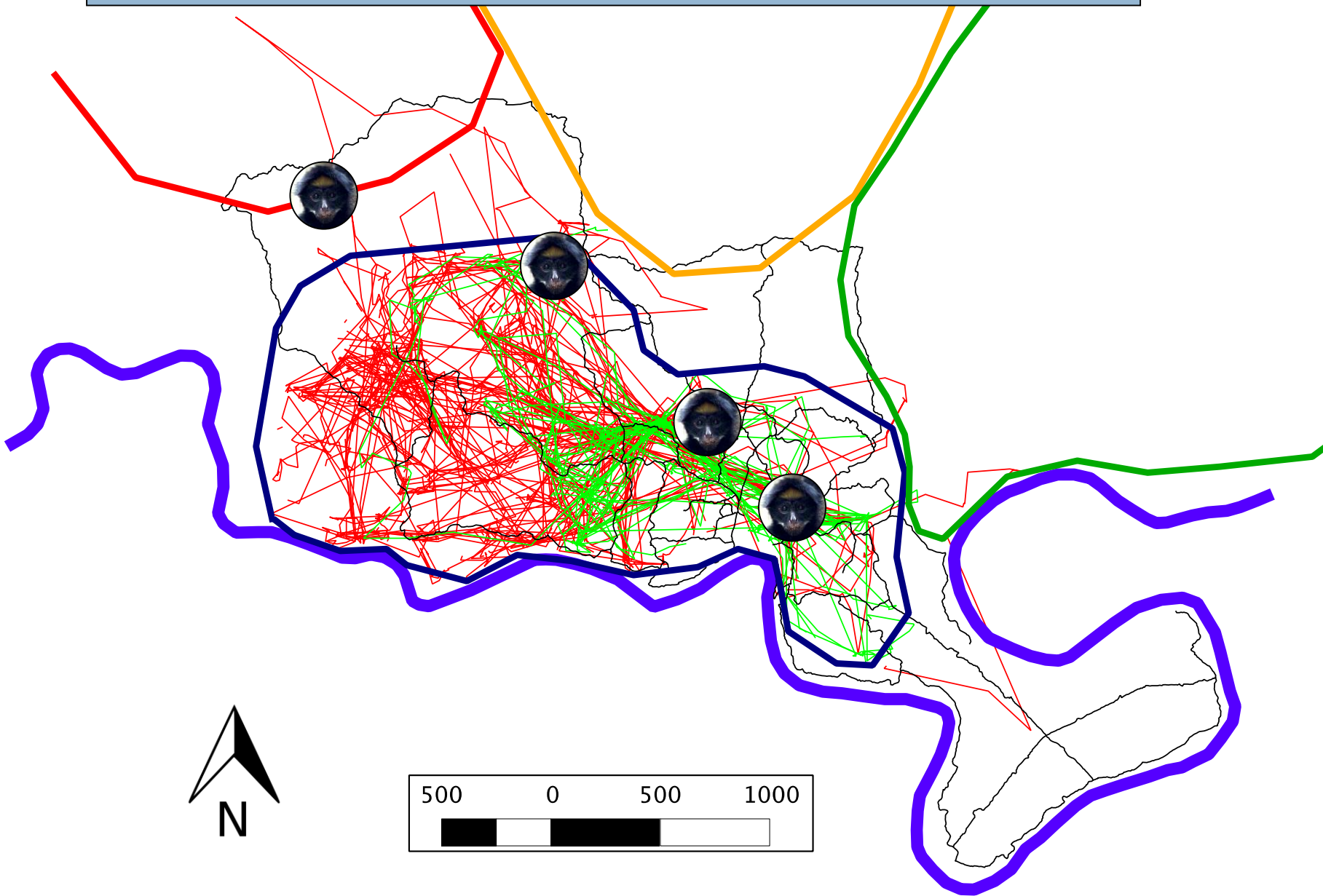
“There are some long calls at around 7:40 very far north and **five males fission off** and sprint in that direction. They move very fast **only stopping to long call**. In far north, another Group (MQ-3) also calling! At 8:20 the males come into a very large tree and stop. They **seem very vigilant** 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	<div style="border: 1px solid black; padding: 5px; text-align: center;"> Six of nine adult males were observed mating at some point... </div>							0	0			
PEDRO								0	0			
POTO								1	1			
GERONIMO	<div style="background-color: yellow; width: 100%; height: 100%;"></div>							0	0			
SAMMY								4	3	1	8	4
LUCAS								4	1	1	6	3
MONO	<div style="background-color: yellow; width: 100%; height: 100%;"></div>		1	5		1	7	3				
ANDREO			5	1	2	8	5					
NENKI	<div style="background-color: yellow; width: 100%; height: 100%;"></div>					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

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

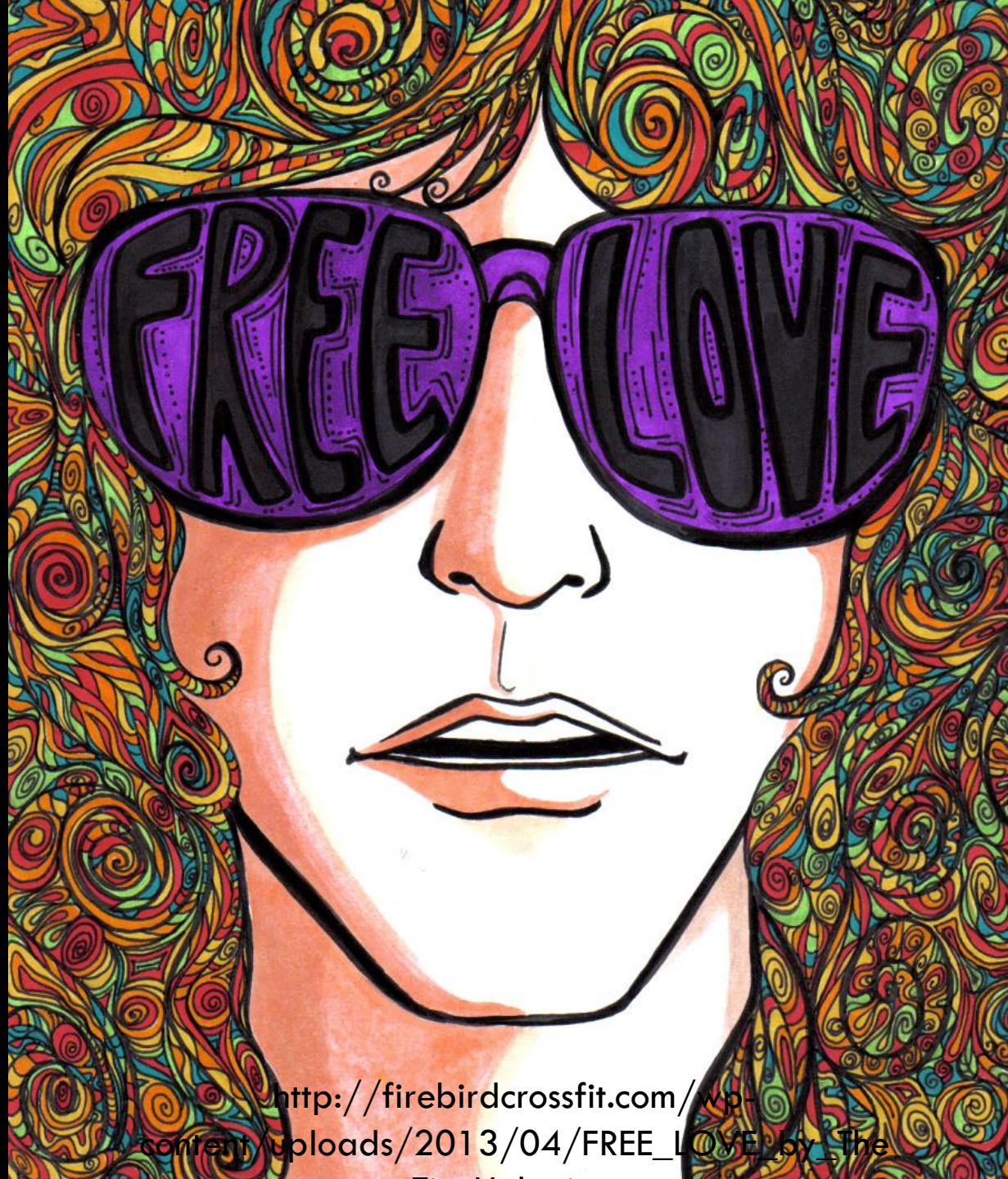
And all males seen to mate more than once mated with more than one female!

Copulations by Females

(N = 32 observed events)

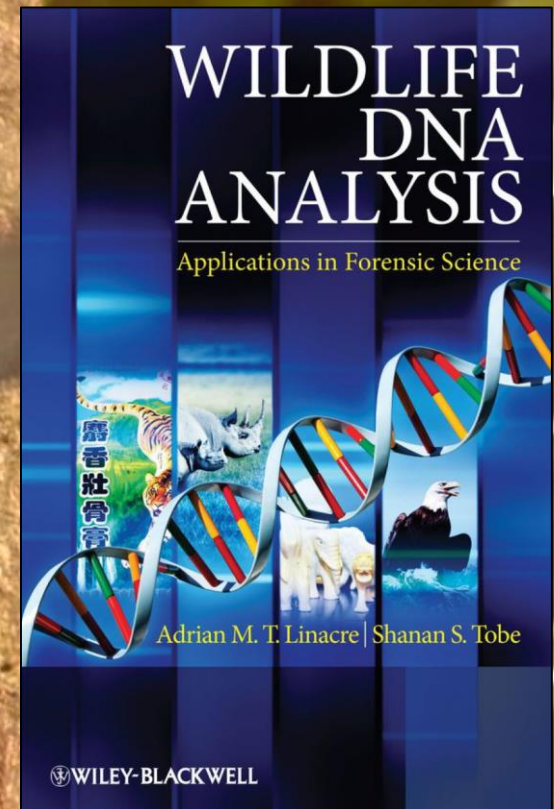
	2005	2006	2007	2008	2009	2010	2011	# COPS	# MALES
EVA				3		2		5	4
ANA								0	0
BUKA								0	0
SOFIA								1	1
MIKA								9	3
LUNA								5	3
OIKAMO						1		1	1
KAUO						1		1	1
NIPA							1	1	1
VITA			6				3	9	4
GISELLA								0	0
ZARI								0	0
EVITA								0	0

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



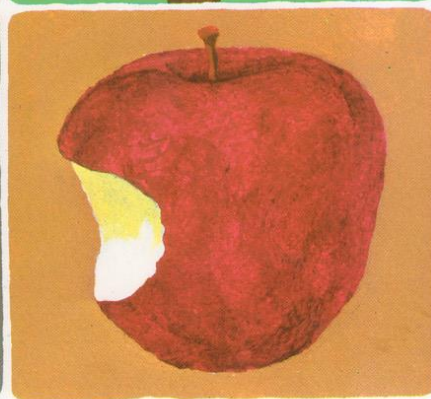
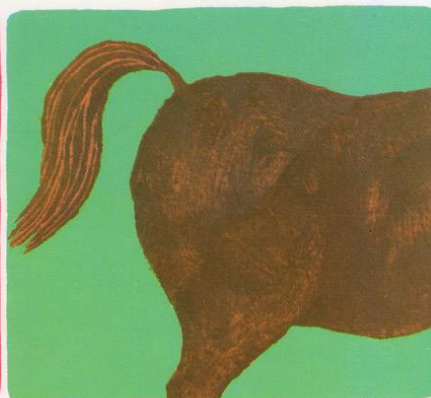
http://firebirdcrossfit.com/wp-content/uploads/2013/04/FREE_LOVE_by_The

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...



©PIOTR NASKRECKI 2012



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



Winner of the Poop Haiku Contest

"Rite in the Rain"
ALL-WEATHER WRITING PAPER



Name _____

Address _____

Phone _____

Project _____

CONTENTS

PAGE	REFERENCE	DATE
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Oh, spider monkey,

Swinging through the
forest trees,

May I have your poop?



Identifying species from pieces of faeces

Love Dalén¹, Anders Götherström² & Anders Angerbjörn^{1*}

¹Department of Zoology, Stockholm University, S-106 91 Stockholm, Sweden; ²Archaeological Research Laboratory, Stockholm University, S-106 91 Stockholm, Sweden (*Corresponding author: Phone: +46 8 16 40 35; E-mail: Anders.Angerbjorn@zoologi.su.se)

Received 26 February 2003; accepted 10 March 2003

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

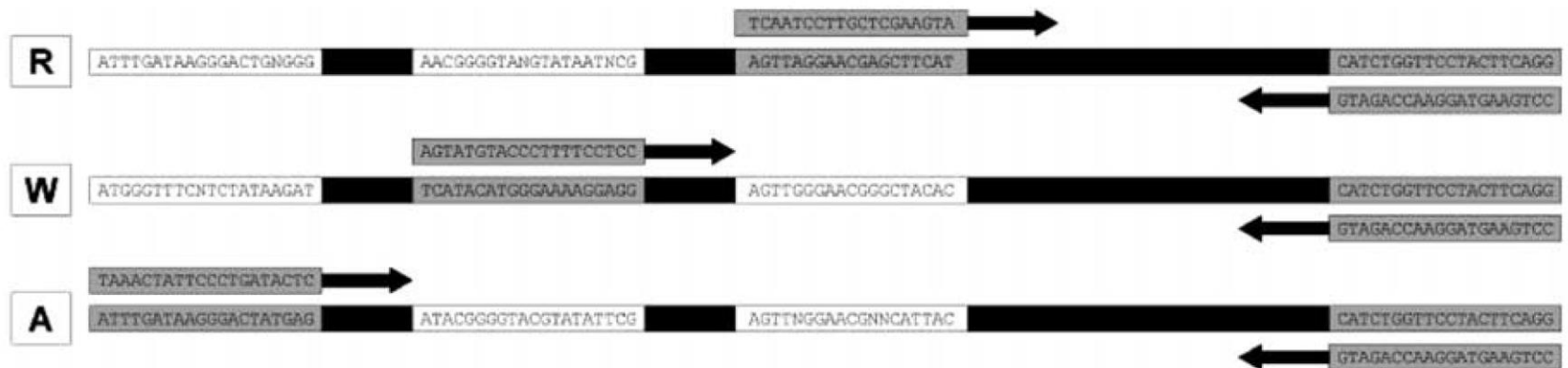


Figure 1. Illustration of the concept of RCP-PCR. One of the three species-specific primers will react with the general primer. The resulting fragment size depends on whether red fox (R), wolverine (W) or arctic fox (A) DNA is present in the extract. Intra-specific variable sites in the template are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

Paternalities: 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...

Paternalities: 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!

Paternalities: 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

Ancestral primate

~36MYA

Evolutionary Tree of Primates

60 50 40 30 20 10 0
Millions of years ago

Lemurs, lorises, and pottos



Tarsiers



New World monkeys



Old World monkeys



Gibbons



Orangutans



Gorillas



Chimpanzees



Humans

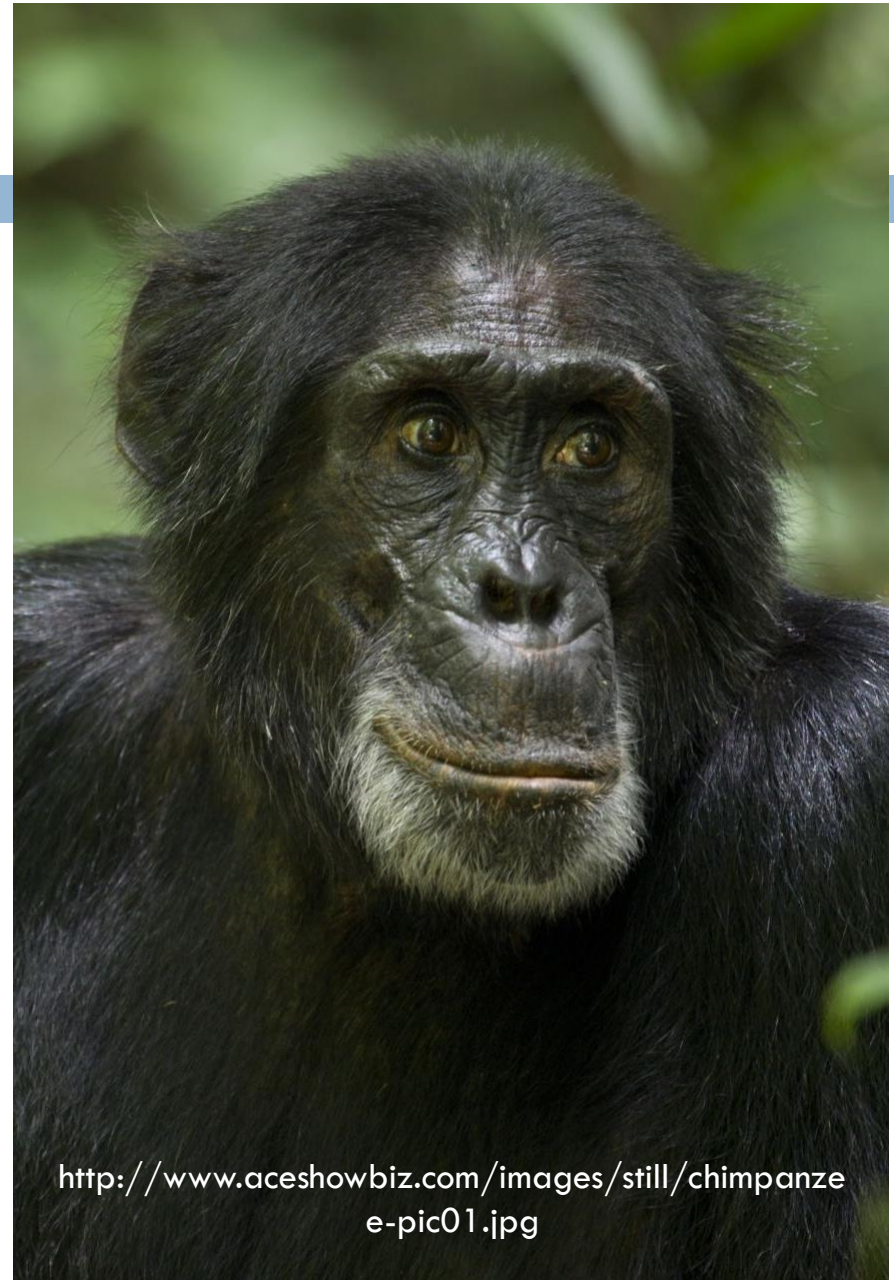


Monkeys
Anthropoids

Hominoids (apes)

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



Take Home?

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

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

Yasuní: A Global Biodiversity Hotspot

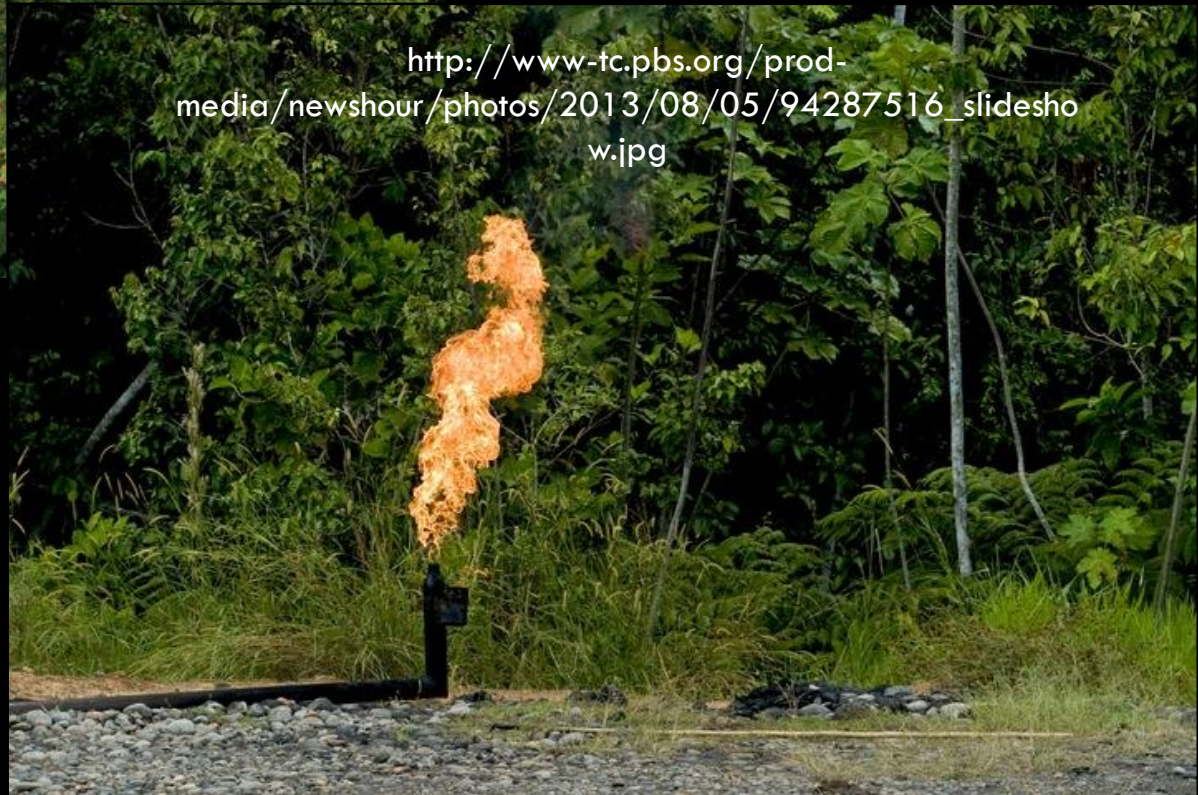
- 2,274 species of trees and shrubs
- 596 species of birds
- 105 species of amphibians; 83 of reptiles; 383 of fish
- Over 100,000 species of insects per hectare
- 204 species of mammals
 - *Including 25 protected under CITES or listed by the IUCN as threatened or endangered*

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





¿Qué pasaría si te dijera que juntos
podríamos salvar una selva mágica...

Thanks to... 

HOT SCIENCE – COOL TALKS

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Proyecto Primates

<http://www.proyectoprimates.org/>

<http://www.facebook.com/ProyectoPrimates>





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 flow, mating patterns, population structure, and the fitness consequences of individual behavior.