Smithsonian Institution

Biodiversity Monitoring: Challenges and Opportunities in Infrastructure Development Projects

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WAB IAIA, Washington DC

September 20, 2017

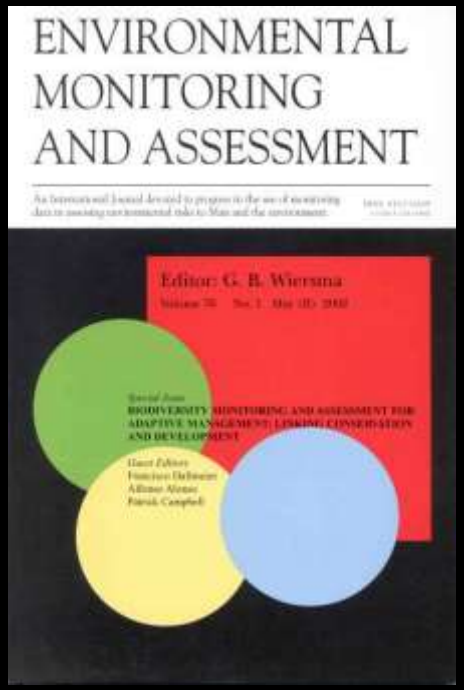
Smithsonian Institution

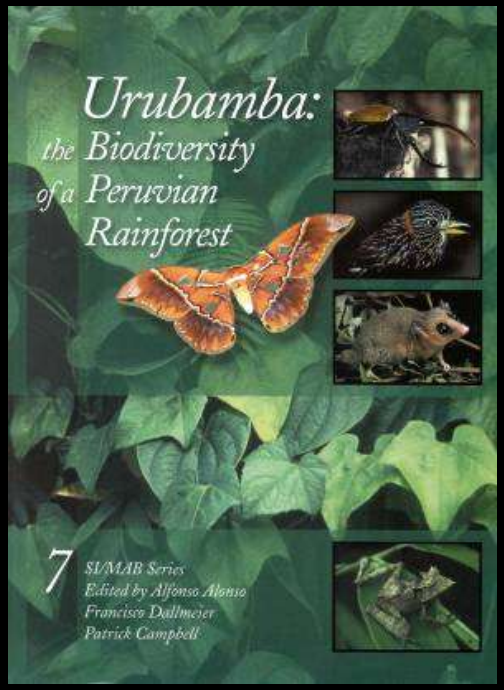
- Increase and diffuse knowledge among people (1846)
- > 20 years collaborating in development projects

Strategic Focus on Biodiversity

- Smithsonian Conservation Biology Institute

  "Integrate development priorities with conservation needs"

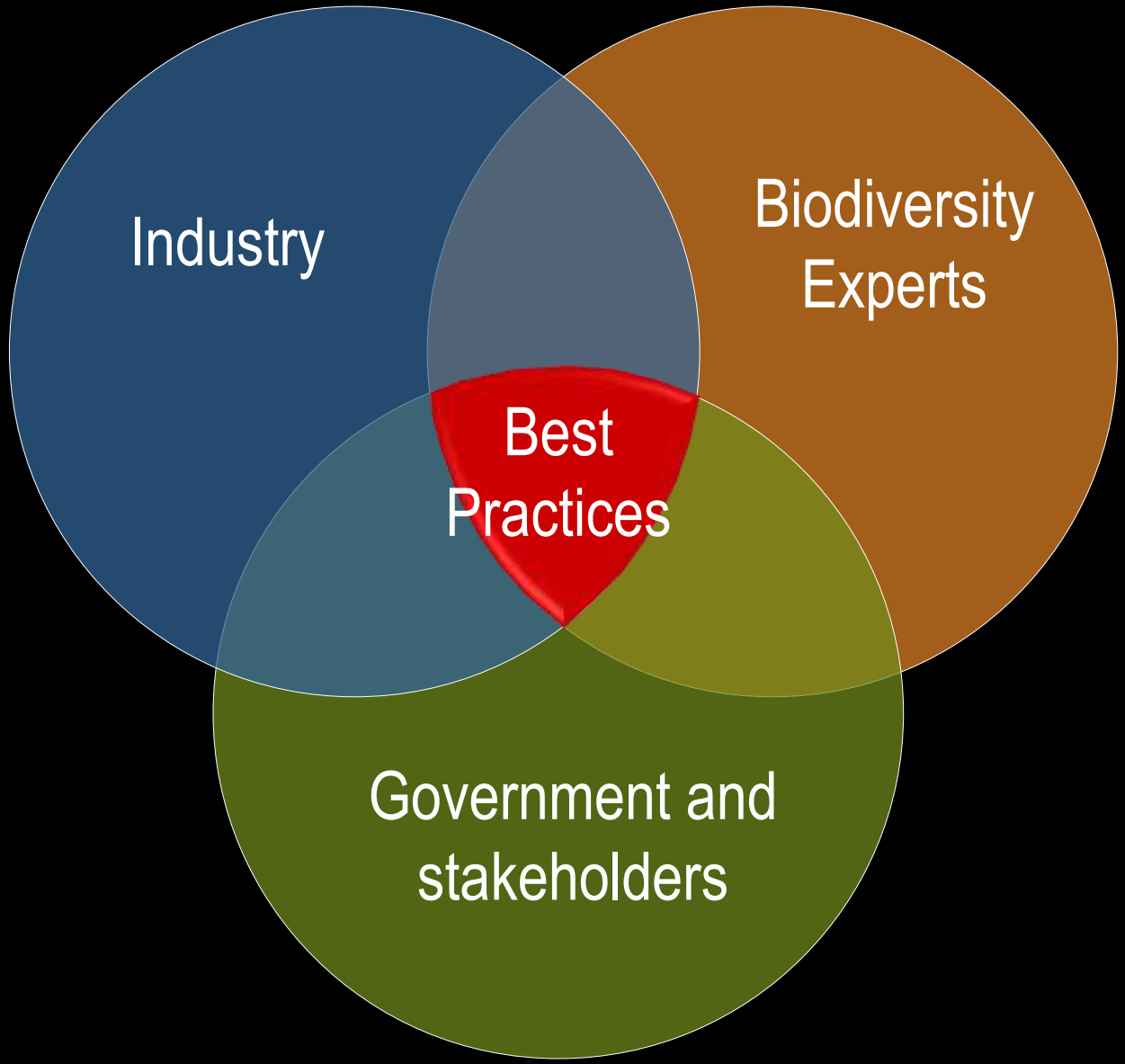




Importance of Economic Development

Gross Domestic Product (GDP) in Billions USD

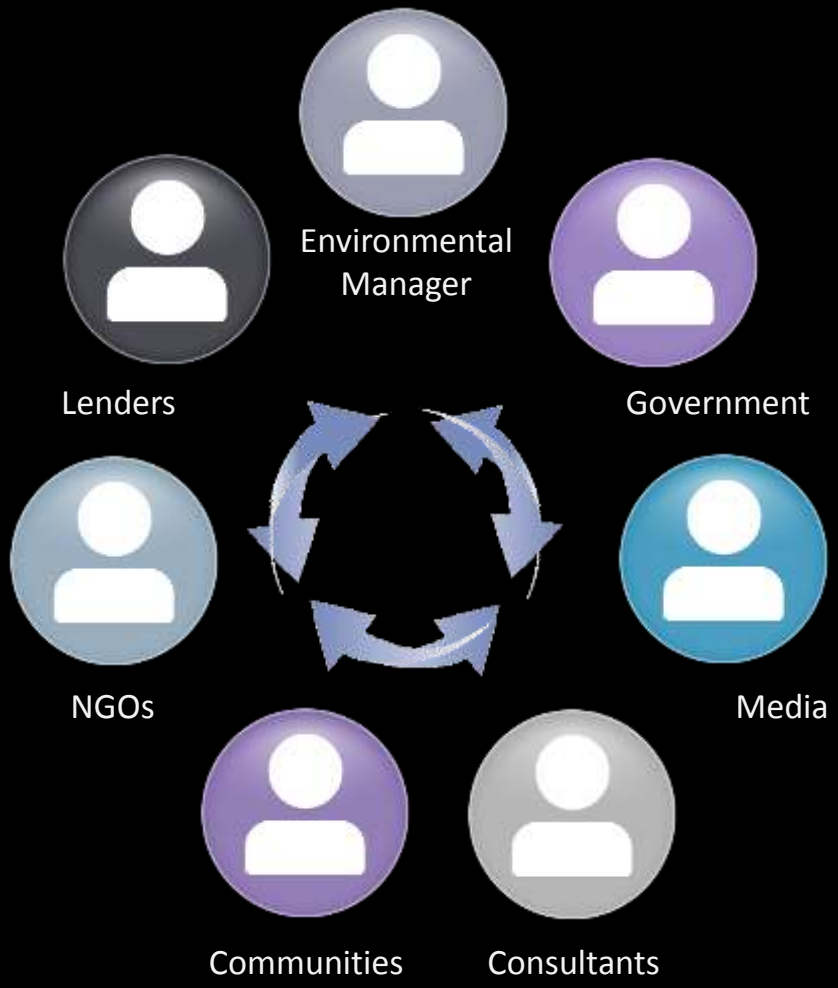
Collaborations



Team

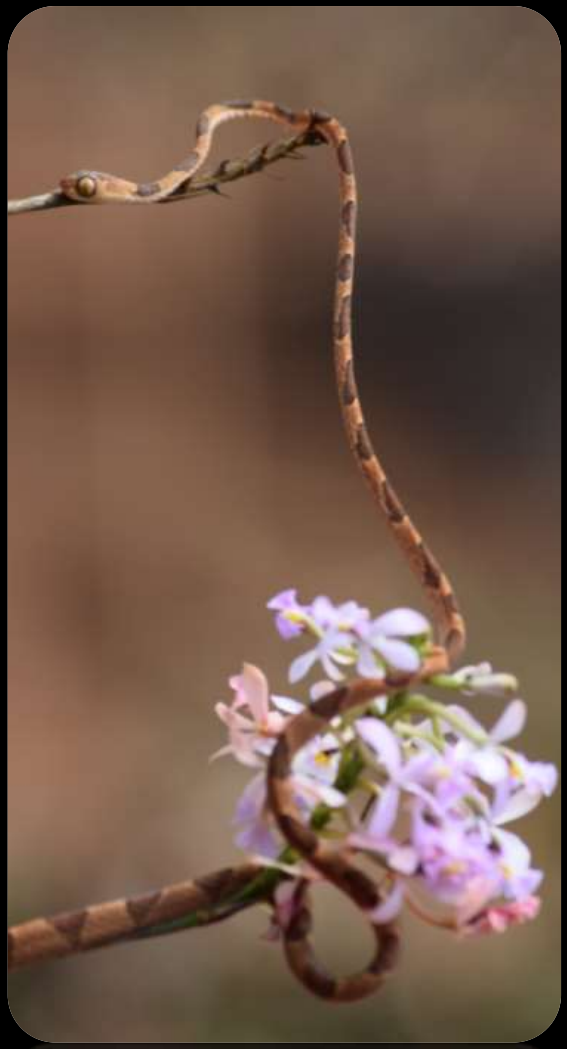

General Manager
Environmental Manager
Operations Manager
External Relations
Finance Manager
Community Liaison Manager
Advisors

Stakeholders

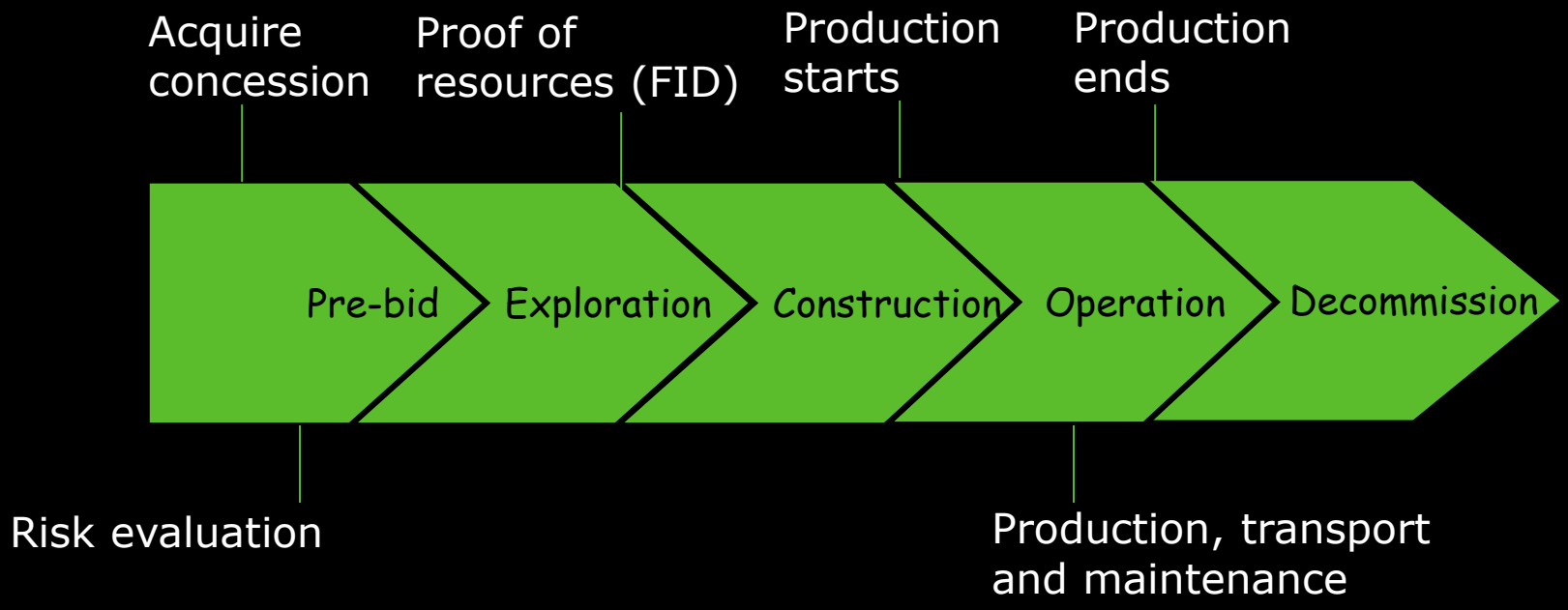


alons

- Framework
  - Project cycle
  - Mitigation hierarchy
  - BMAP (standard monitoring)
- Examples
  1. Biorestauration
  2. Soil + waste management
  3. Access to construction ponds
  4. Seismic operations
  5. Marine terminal design
  6. Linear infrastructure

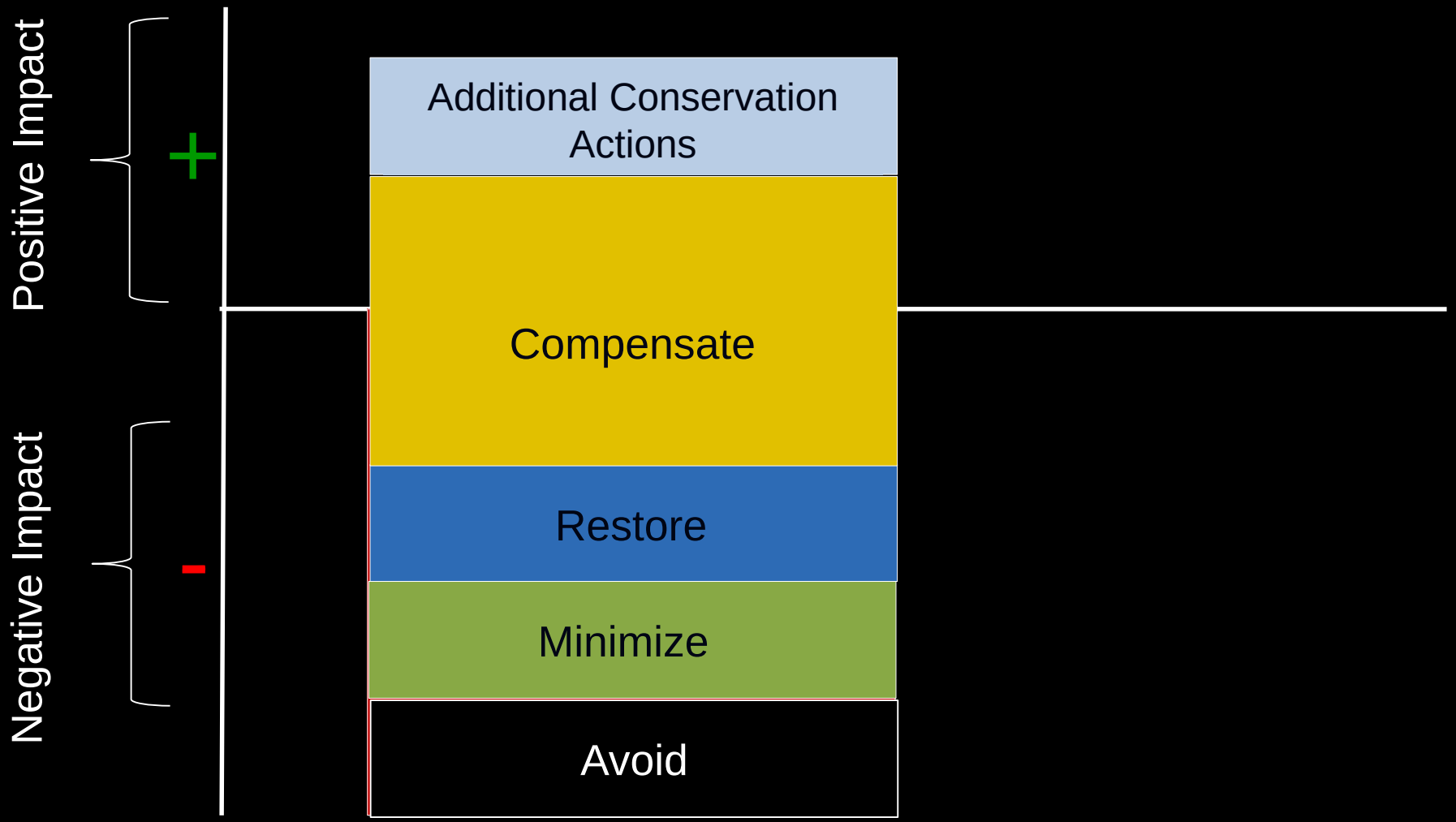


Project Cycle



EBI, 2003

Mitigation Hierarchy

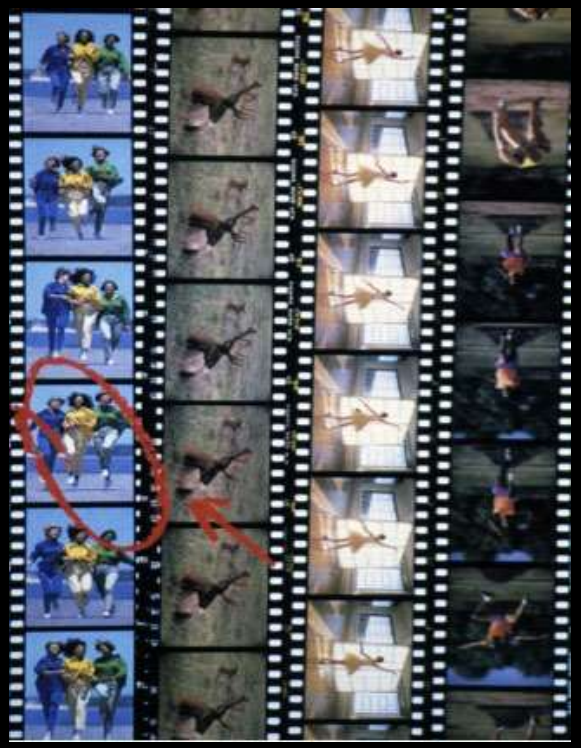


BBOP 2011

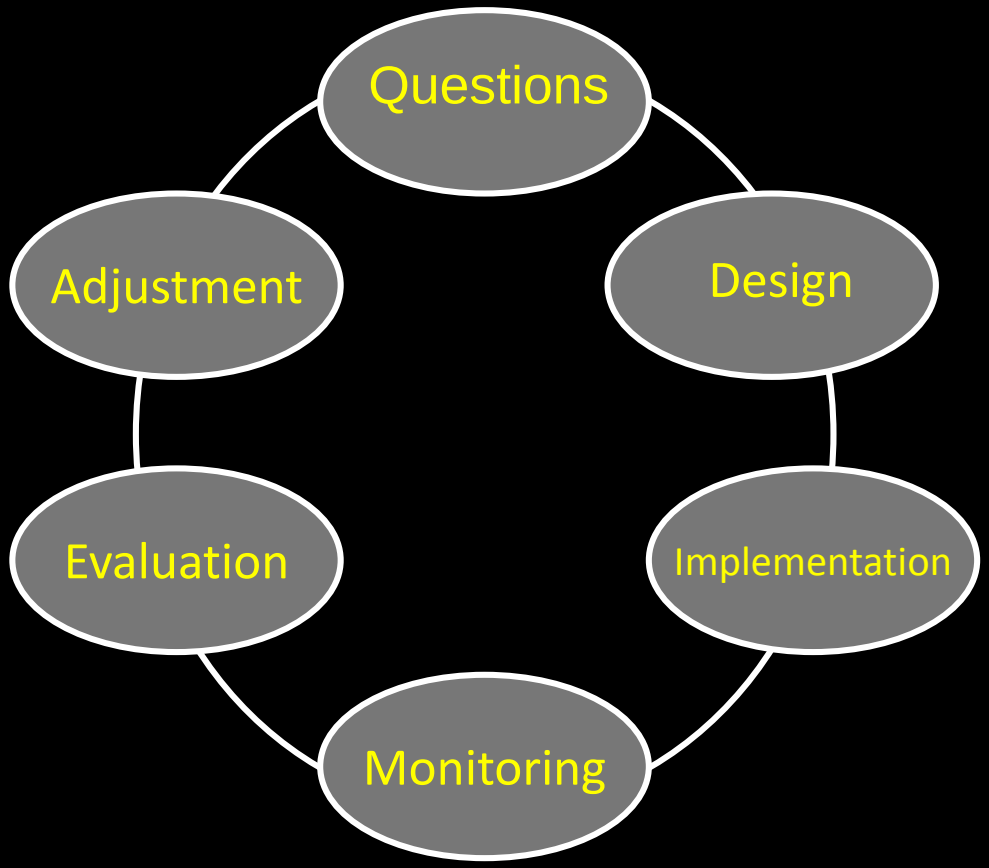
Biodiversity Monitoring and Assessment Program (BMAP)

Tool to determine changes over time

- Current status of resource
- Desired future condition
- Determine cause and effect
- Evaluate management objetives
- Understand impacts
- From photo to movie



Protocol BMAP

















What to Monitor?

Criteria for Determining What to Monitor

- Use (ESIA, BAP, BMAP)
- Legacy of information (1, 5, 10, 20, more? yrs)
- BD baseline (solid)
- Priority BD values (knowledge)
- Scale of the impact (spatial/temporal)
- Available budget (t $)
- Collaborators (competent)

Priority Biodiversity Values

- Species
  - Endangered (UICN CR, EN, VU)
  - Endemic
  - With restricted distributions
  - Commercial
  - With cultural values
  - Importance for local communties
- Habitats
  - Unique
  - With high biodiversity or unique spp
  - Pristine (native spp interactions + ecological functions)
  - Breeding grounds (e.g. fishes)

Additional Criteria for Selection

- Local abundance
- Habitat representation
- Effectiveness in impact identification
- Specialists availability
- Accessibility, security and logistics issues

1. Bio-restauration

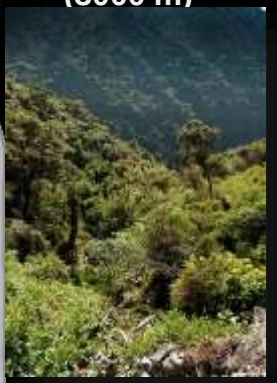
Habitats

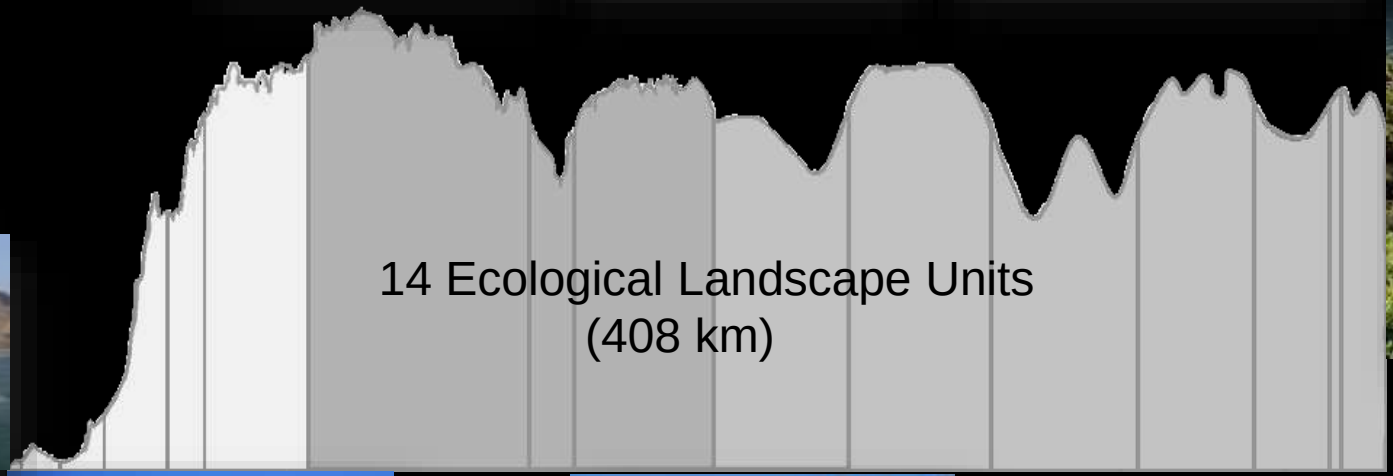
Grasslands

Wetlands

Interandean valleys

Montane Forest (3000 m)





Pacífic coast

Desert

Dry forest

Question

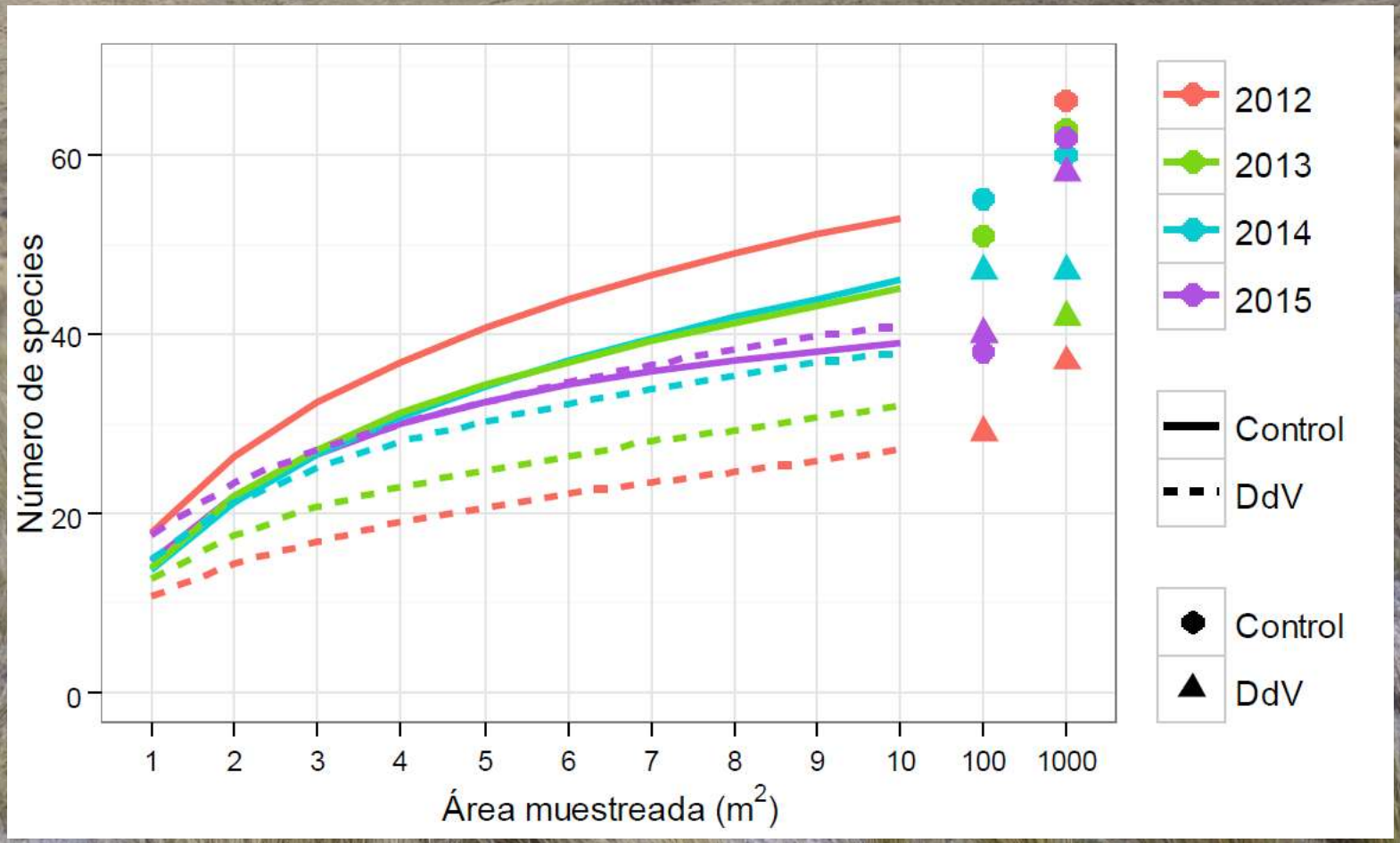
What is the state of recovery of the vegetation in high Andean grasslands?


2013

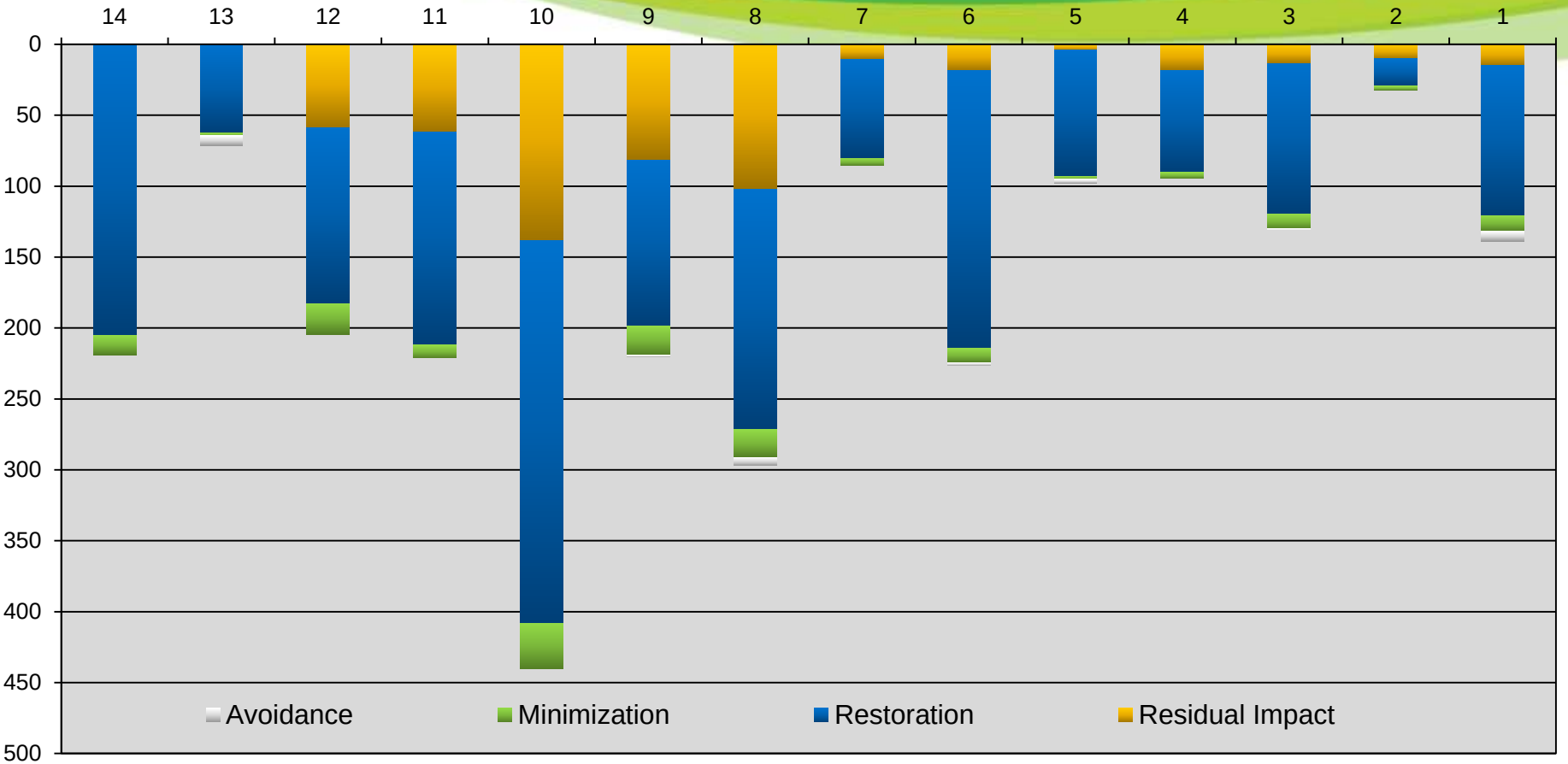

2014


2015

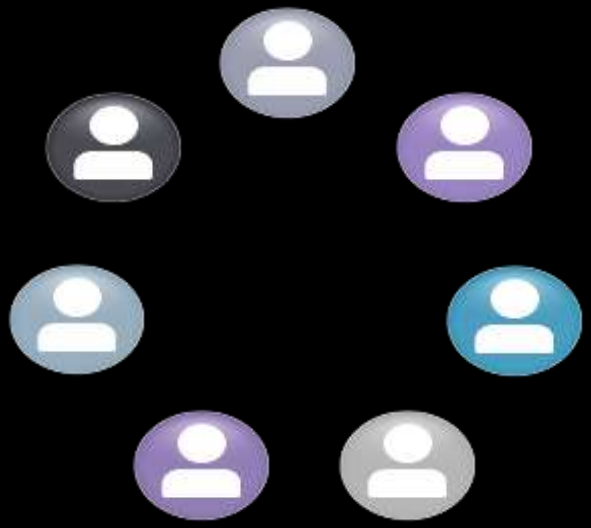
2015


Número de species
0
20
40
60
1
2
3
4
5
6
7
8
9
10
100
1000
Área muestreada (m2)
2012
2013
2014
2015
Control
DdV
Control
DdV

Monitoing Residual Impacts

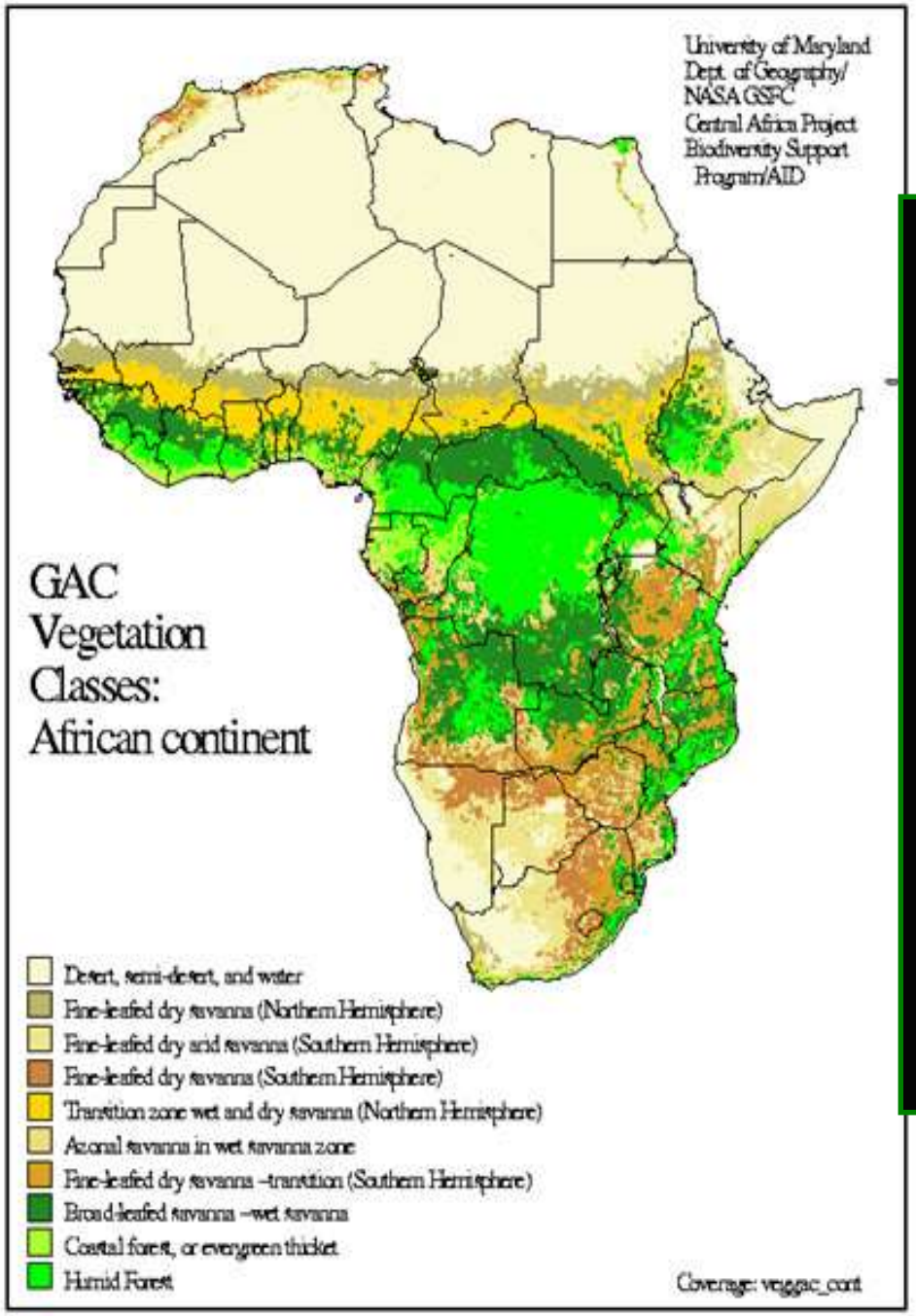


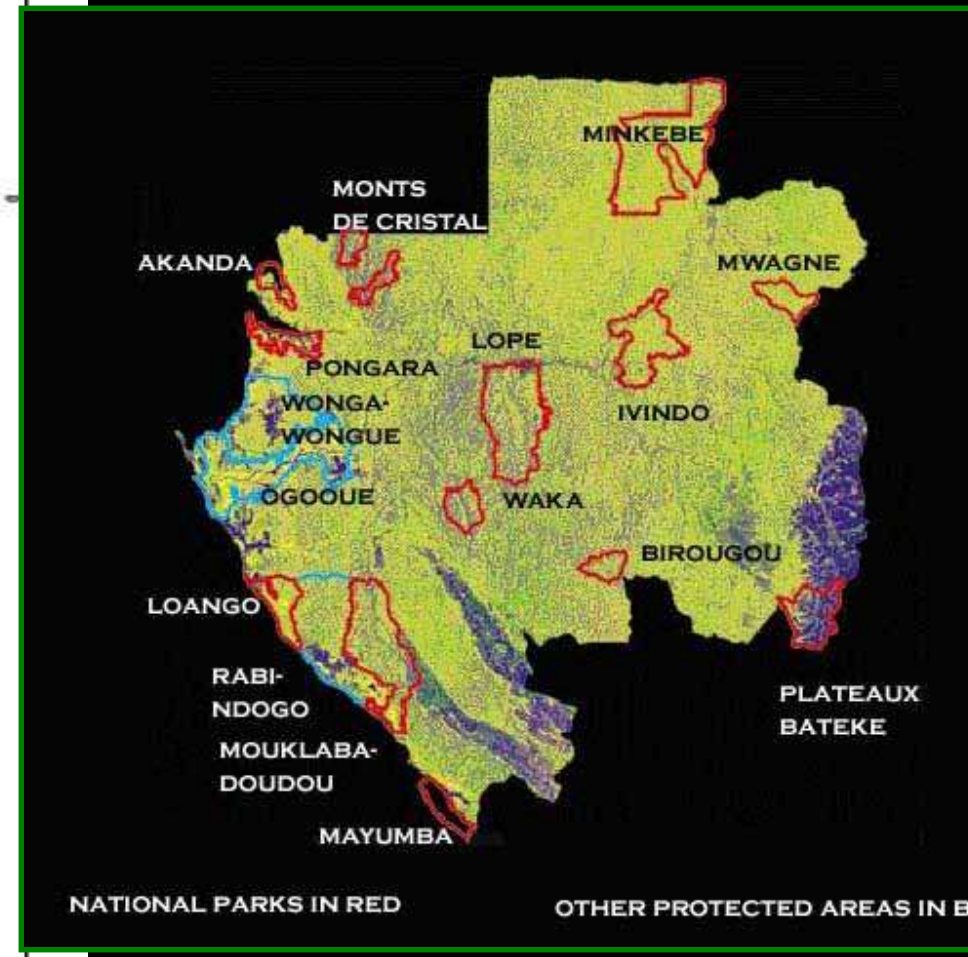
Management



- Vegetation restoration worked in several ELUs
- Investments in areas that need it

2. Soil and Waste Management

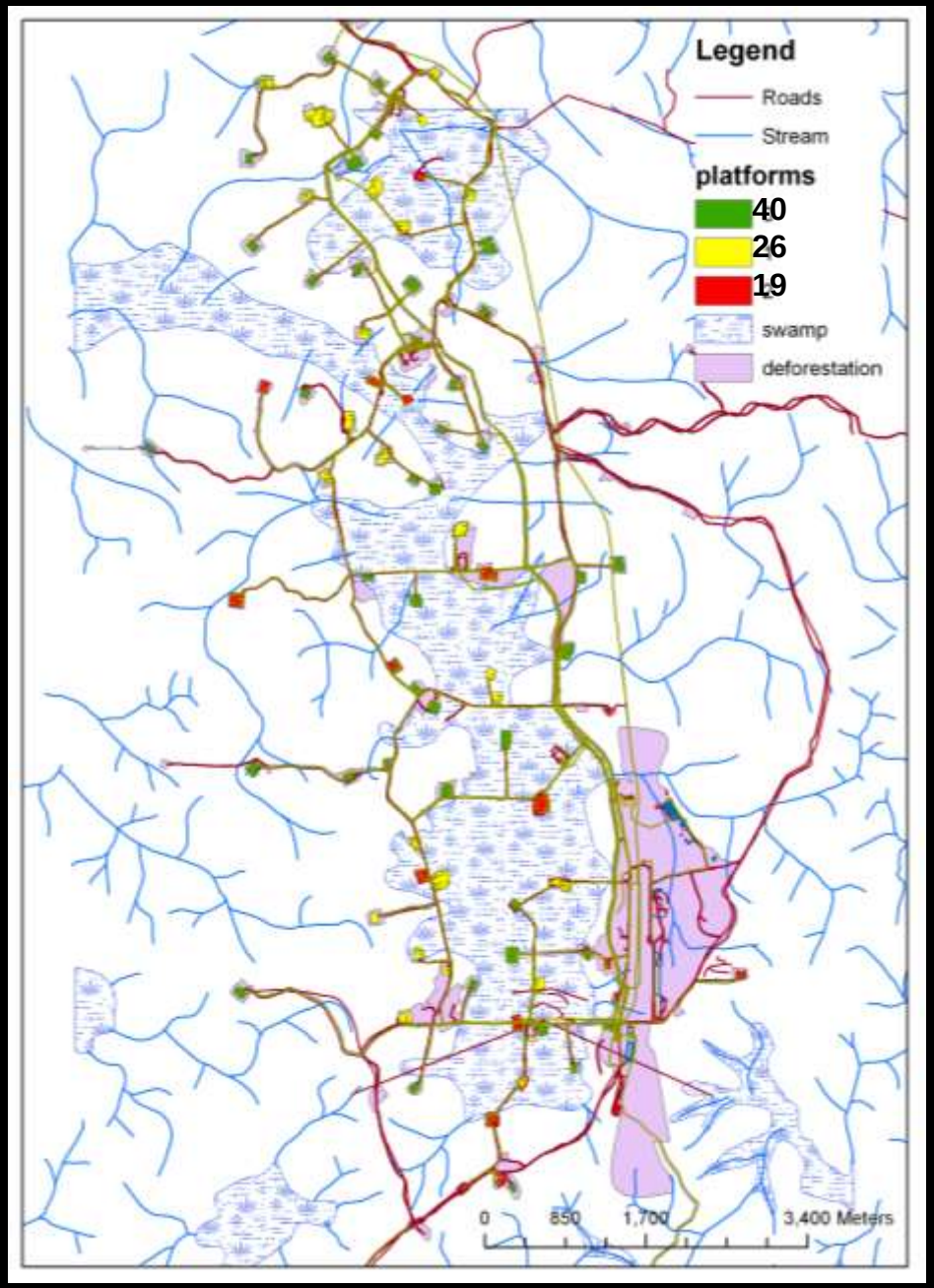

University of Maryland
Dept. of Geography/
NASA GSFC
Central Africa Project
Biodiversity Support
Program/AID
GAC
Vegetation
Classes:
African continent
Desert, semi-desert, and water
Fine-leafed dry savanna (Northern Hemisphere)
Fine-leafed dry arid savanna (Southern Hemisphere)
Fine-leafed dry savanna (Southern Hemisphere)
Transition zone wet and dry savanna (Northern Hemisphere)
Azonal savanna in wet savanna zone
Fine-leafed dry savanna –transition (Southern Hemisphere)
Broad-leafed savanna –wet savanna
Coastal forest, or evergreen thicket
Humid Forest
Coverage: veggac_cont


MINKEBE
MONTS
DE CRISTAL
AKANDA
MWAGNE
LOPE
PONGARA
WONGA-
WONGUE
IVINDO
OGOOUE
WAKA
BIROUGOU
LOANGO
RABI-
NDOGO
PLATEAUX
BATEKE
MOUKLABA-
DOUDOU
MAYUMBA
NATIONAL PARKS IN RED
OTHER PROTECTED AREAS IN B

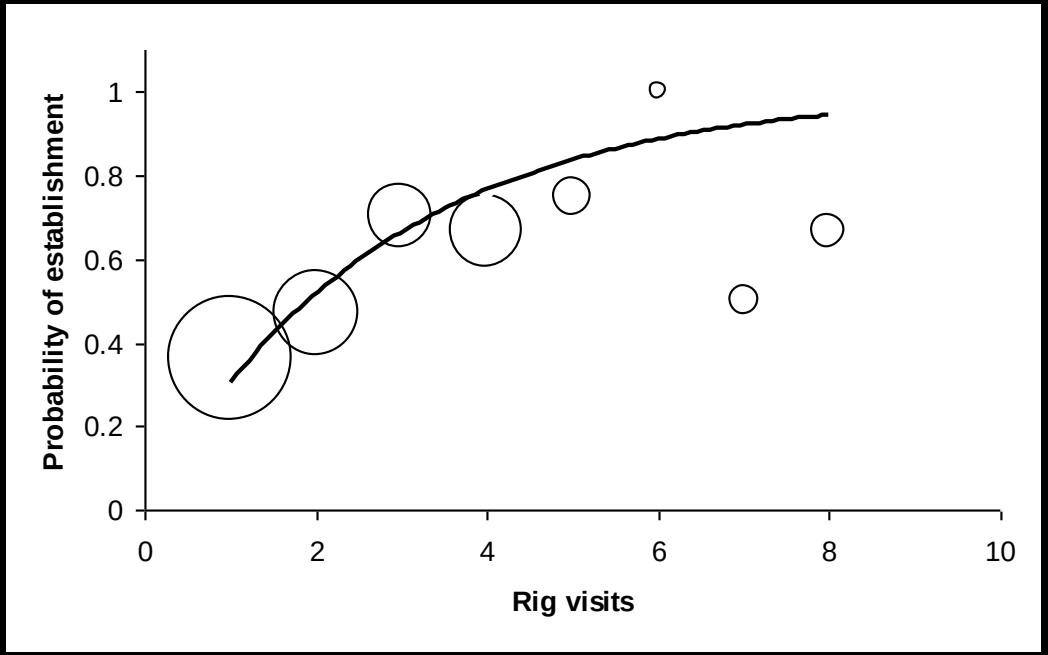

Loango National Park
Rabi-Ndogo
Protected Area
(Industrial Corridor)
Moukalaba-Doudou
National Park
Water
Protected Area
National Parks
Roads
10
20
40 km
N
Gamba Complex of Protected Areas

Question

What is the distribution of an invasive ant in an oil field?

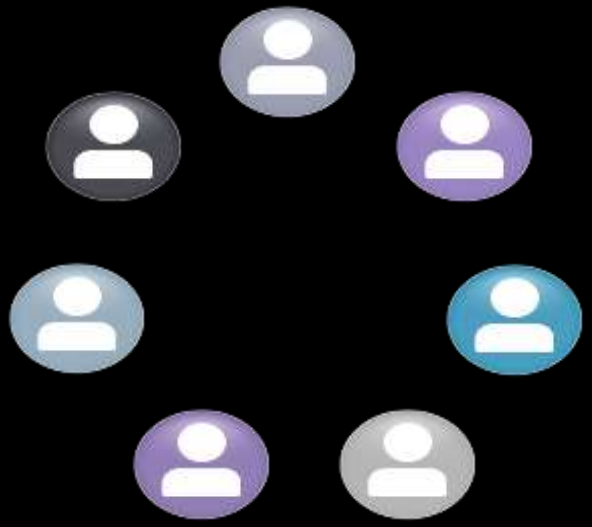

Legend
Roads
Stream
platforms
40
26
19
swamp
deforestation
0
850
1,700
3,400 Meters

- The probability of establishment depends on # of drilling events



Mikheyev *et al*. 2008

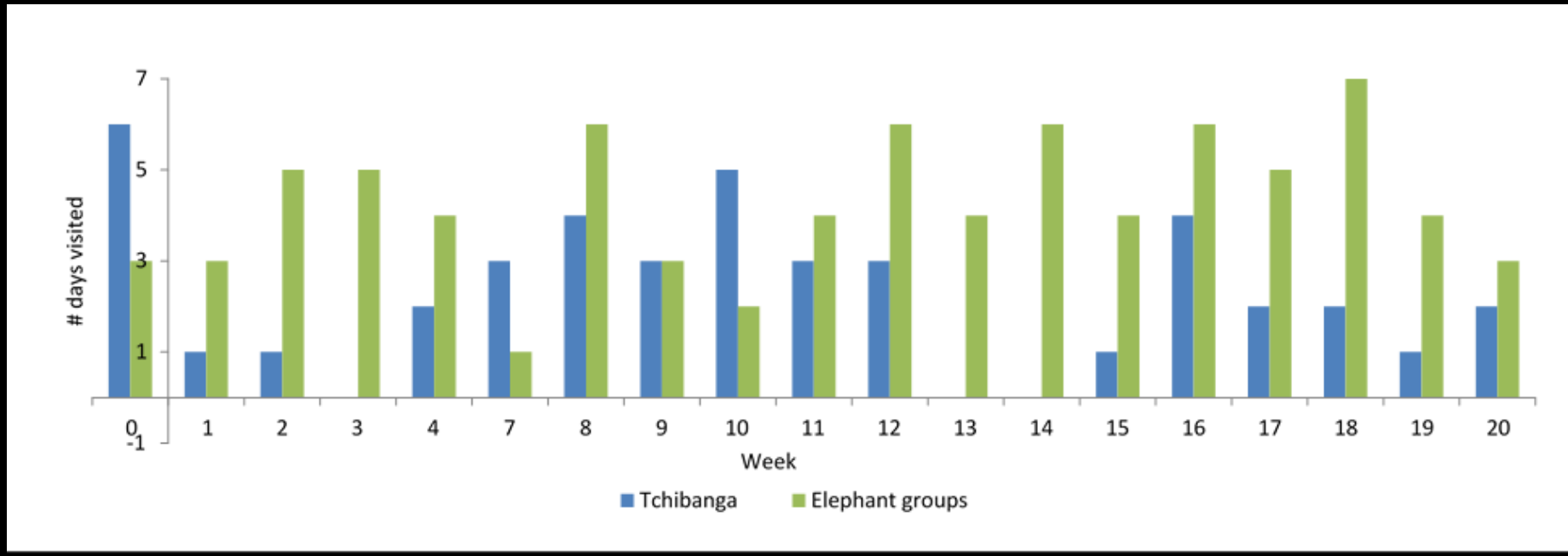
Management



- Operations have dispersed the colonies
- Mitigation: management plan to minimize dispersion (e.g. power wash equipment)

Question

What is the visitation pattern of elephants to human living areas?

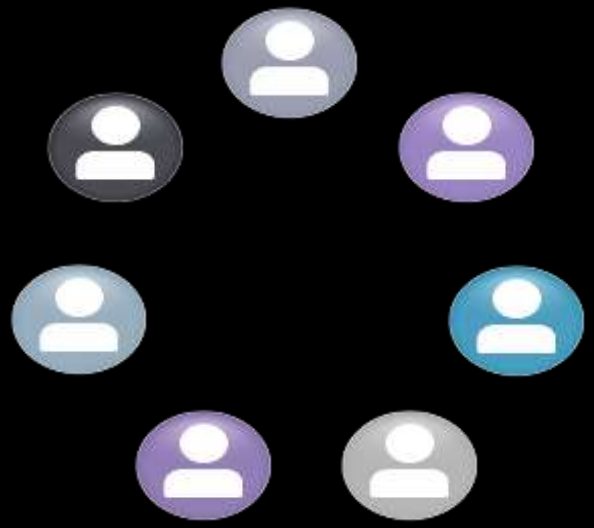

7
5
3
1
days visited
0
-1
1
2
3
4
7
8
9
10
11
12
13
14
15
16
17
18
19
20
Week
Tchibanga
Elephant groups








Management



- Waste attracts bulls
- Mitigation: waste in containers (no access)
- Awareness campaign

3. Access to Construction Ponds

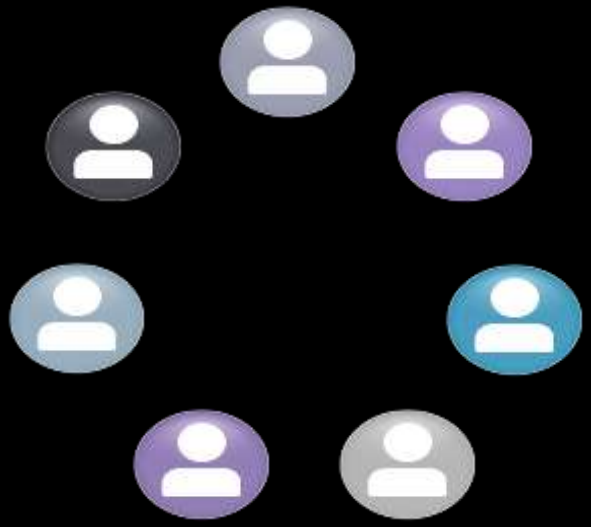

©RB-DESKKART www.welt-atlas.de
WHITE-HORSE
YUKON TERRITORY
NORTHWEST TERRITORIES
Hay River
Watson Lake
Fort Liard
Atlin
Cassiar
Fort Nelson
High Level
Juneau
Dease Lake
Rainbow Lake
Vermilion Chutes
ALASKA, USA
BRITISH COLUMBIA
ALBERTA
BRITISH COLUMBIA
Fort St John
Peace River
Stewart
Dawson Creek
New Hazelton
Grande Prairie
Prince Ruppert
Burns Lake
Prince George
Masset
Kitimat
Skidegate
Queen Charlotte Islands
McBride
Jasper
Bella Coola
Williams Lake
Alexis Creek
Banff
Golden
Port Hardy
Whistler
Fairmont Hot Springs
Powell River
Kamloops
Courtenay
Kelowna
Cranbrook
Vancouver Island
Vancouver
Trail
VICTORIA
USA
Seattle
Pazifischer Ozean
500 km


Kitimat
KLNG Plant Site
N
SS 1
Area A
Wetland 2.3
KLNG Plant Site
West Creek
N
1 km

Question

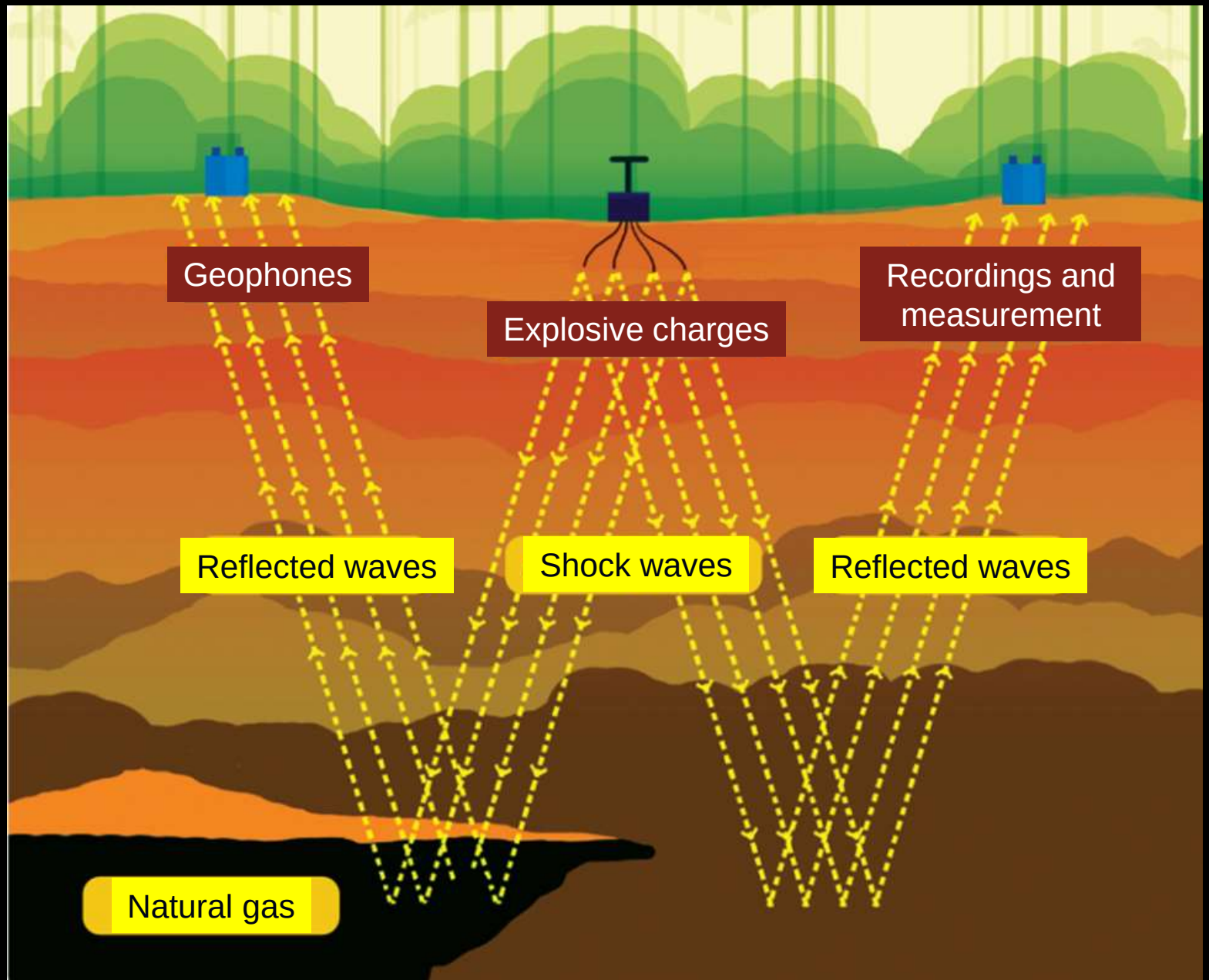
Why are there hundreds of tadpoles at the construction site?

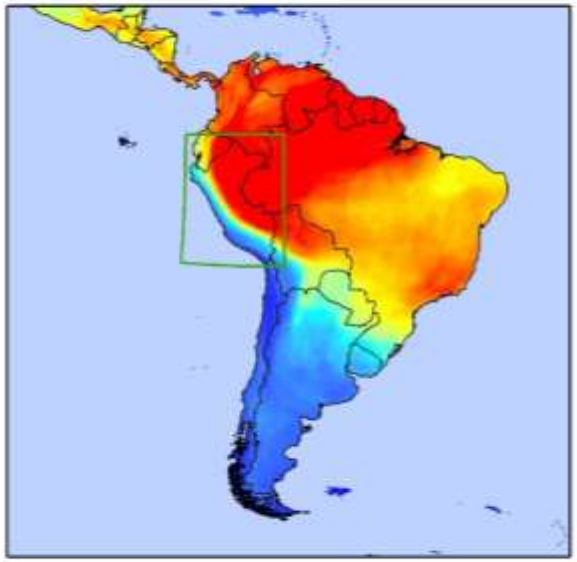
Management



- Population of endangered spp in good condition
- Nets around construction ponds eliminate access

4. Seismic Exploration





Mammal Diversity

High : 217

Low : 1

On-Shore Fossil Fuels

Exploratory Wells

Blocks Under Contract

Colombia

Ecuador

Brazil

Peru

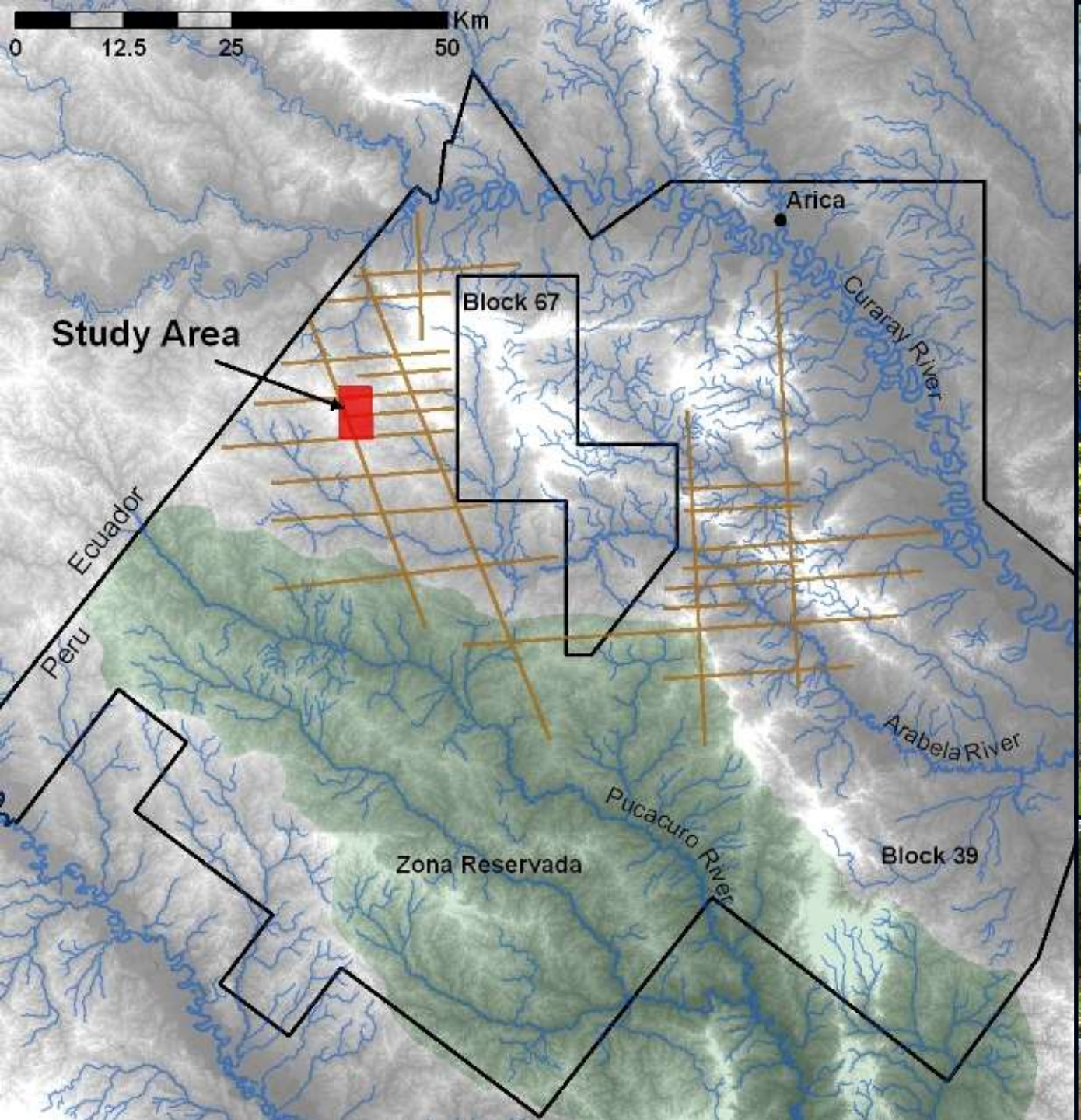
Bolivia

N

0 250 500 1,000 Km

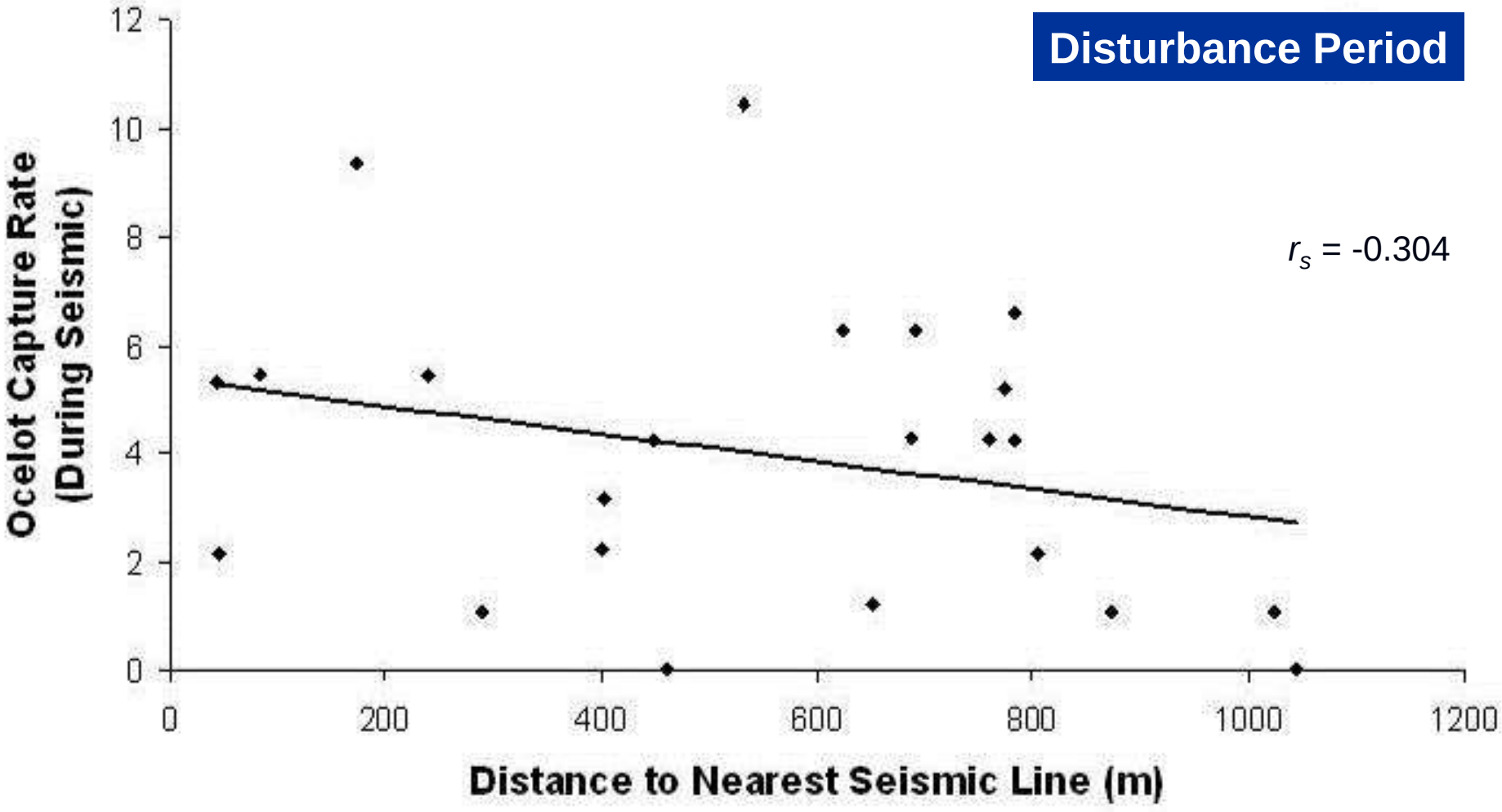
Question

Does seismic exploration impact wildlife?


0
12.5
25
50
Km
Arica
Block 67
Study Area
Curaray River
Ecuador
Peru
Arabela River
Pucacuro River
Zona Reservada
Block 39






Disturbance Period
r_s = -0.304
Ocelot Capture Rate (During Seismic)
0
2
4
6
8
10
12
0
200
400
600
800
1000
1200
Distance to Nearest Seismic Line (m)


Short-eared dog


Bush dog


Jaguarundi


Brazilian tapir


Giant armadillo


Giant anteater

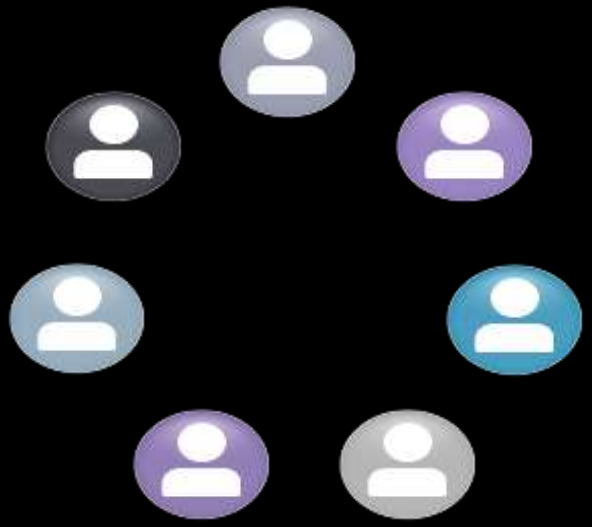

Jaguar


Puma


White-lipped Peccary


Margay

Management



- Managers have confirmation that their seismic environmental policies are effective
- “In-land Off-shore” model, lines 1m wide, workers only in camps

5. Marine Terminal Design


Dubai


Copyright © Matthew
matthewmeierphoto
Santa Barbara, CA


Boredandawake.com

Samcheok LNG, Korea

Gorgon LNG, W Australia

Question

How can a marine terminal be designed and managed to benefit wildlife?


Peru
PLNG

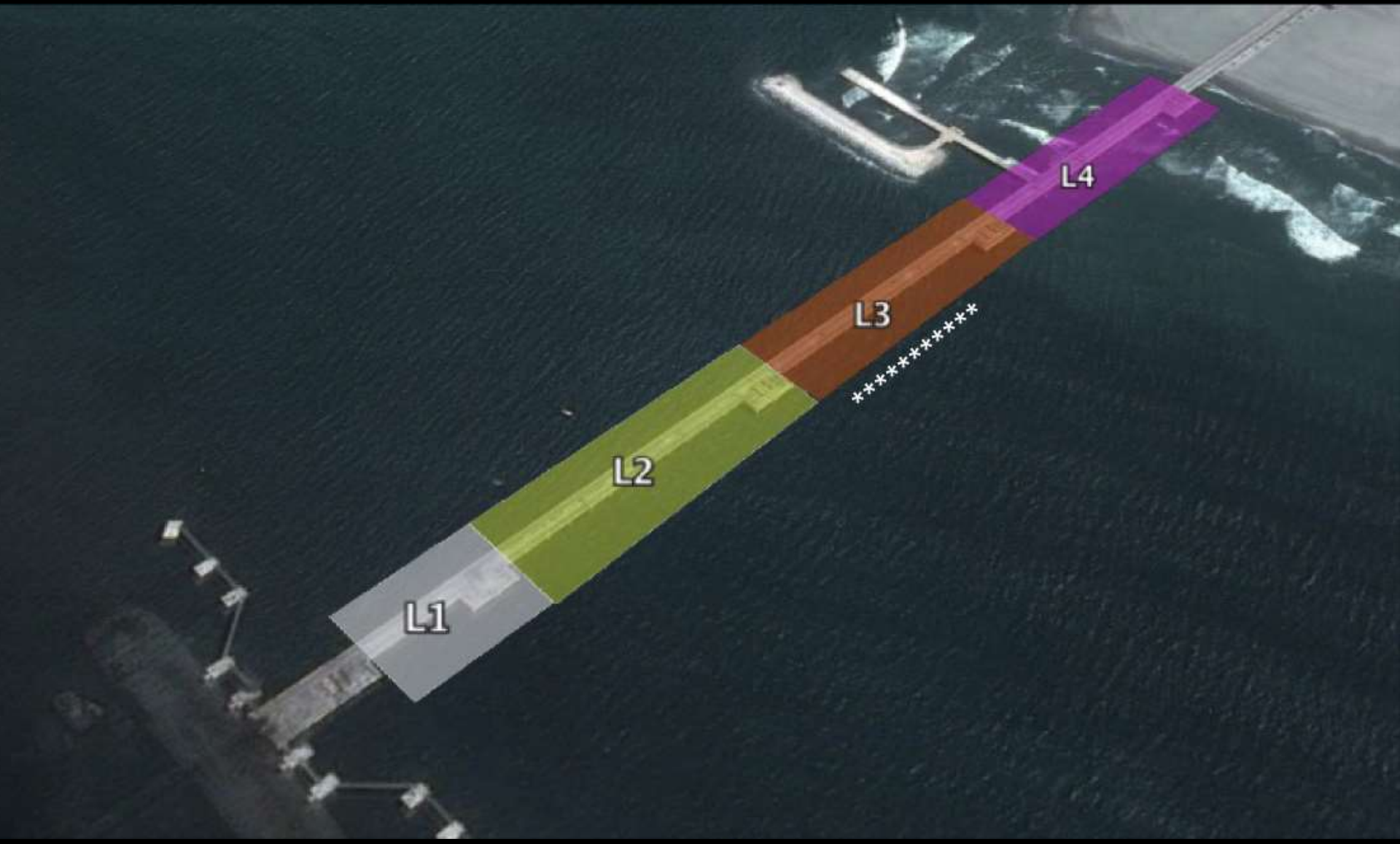
Giant blenny, *Scartichthys gigas*

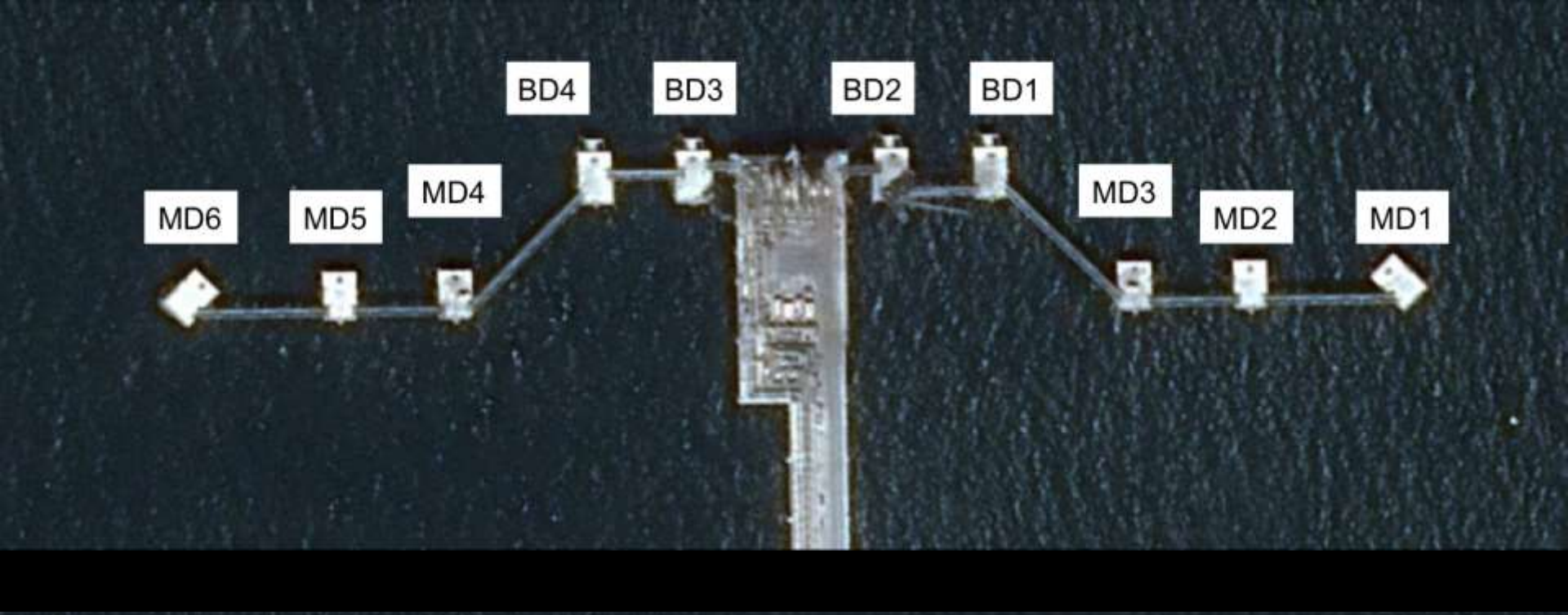

Inca tern
Larosterna inca
(NT)

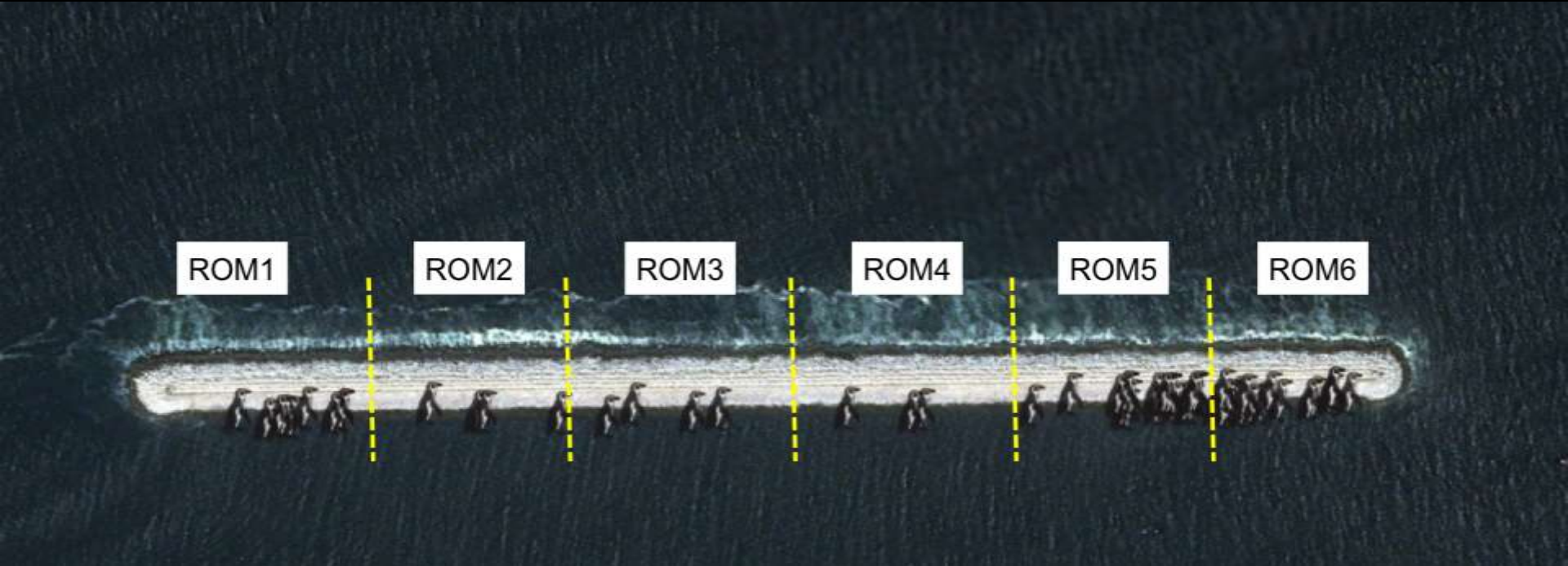

Neotropical cormorant
Phalacrocorax brasilianus
(LC)

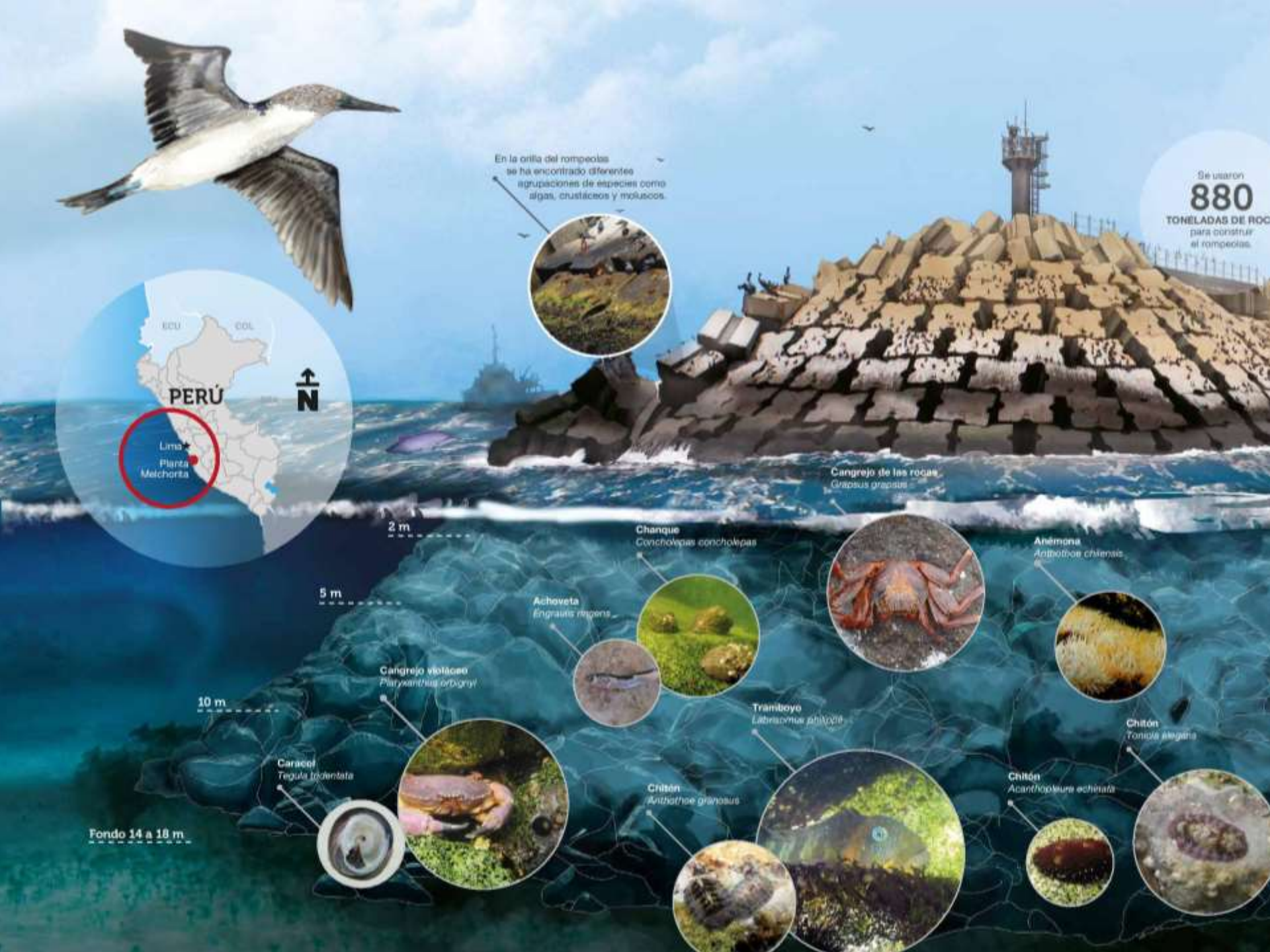

Peruvian booby
Sula variegata
(LC)


Guanay cormorant
P. bougainvillii
(NT)


L4
L3
****
L2
L1


BD4
BD3
BD2
BD1
MD6
MD5
MD4
MD3
MD2
MD1


ROM1
ROM2
ROM3
ROM4
ROM5
ROM6


En la orilla del rompeolas se ha encontrado diferentes agrupaciones de especies como algas, crustáceos y moluscos.
Se usaron
880
TONELADAS DE ROC
para construir el rompeolas.
ECU
COL
PERÚ
N
Lima
Planta Melchorita
2 m
5 m
10 m
Fondo 14 a 18 m
Cangrejo de las rocas
Grapsus grapsus
Chanque
Concholepas concholepas
Anémona
Anthothoe chilensis
Achoveta
Engraulis ringens
Cangrejo violáceo
Platyxanthus orbignyi
Tramboyo
Labrisomus philippii
Chitón
Tonicia elegans
Caracol
Tegula tridentata
Chitón
Anthothoe granosus
Chitón
Acanthopleura echinata

VULNERABLE
VU

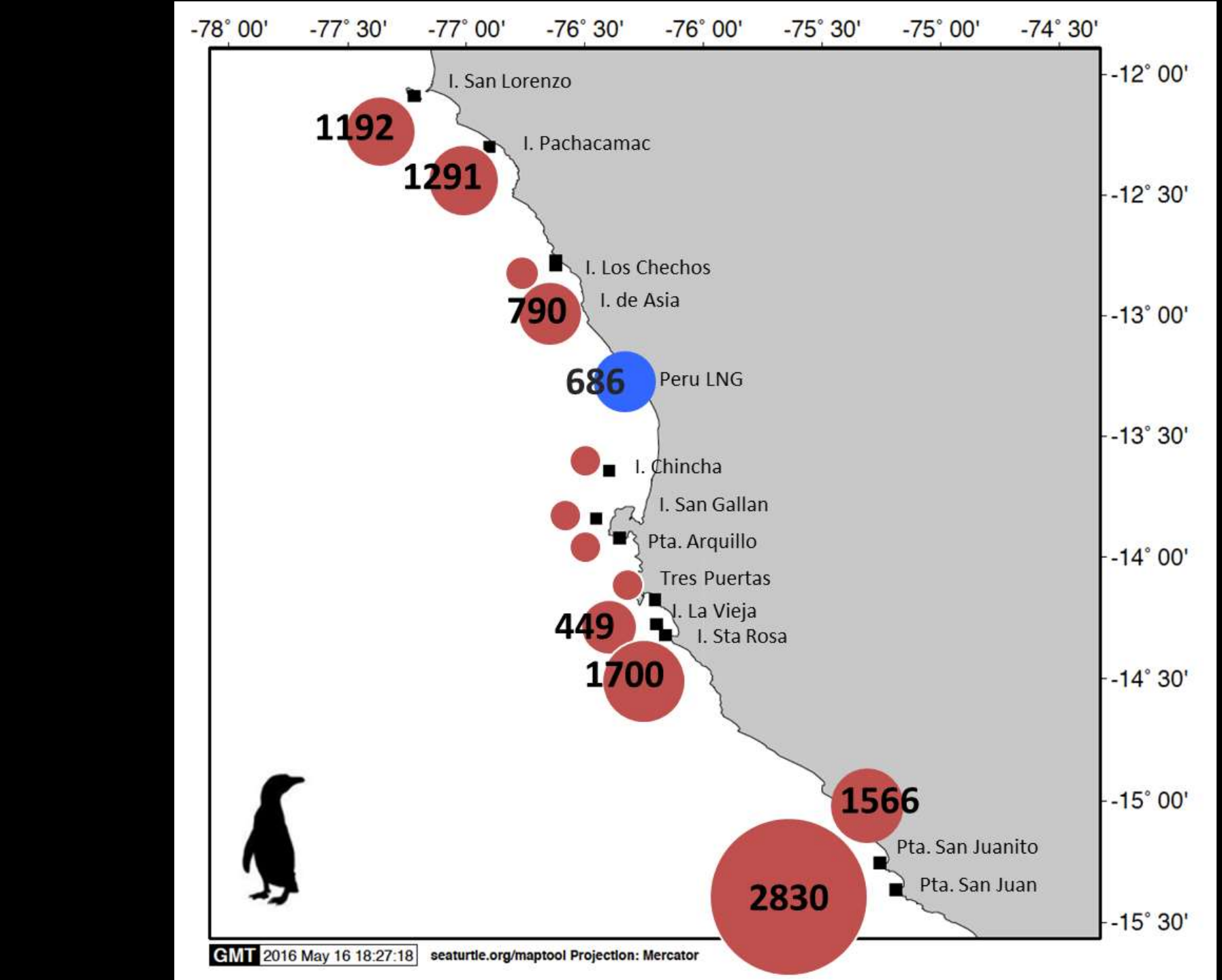
686
penguins
2017

BREAKWATER

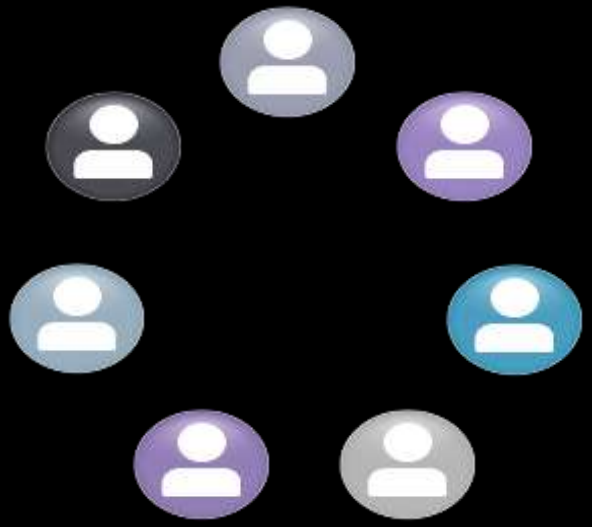
381 2013

60 2012

Humboldt penguin (*Spheniscus humboldti*)

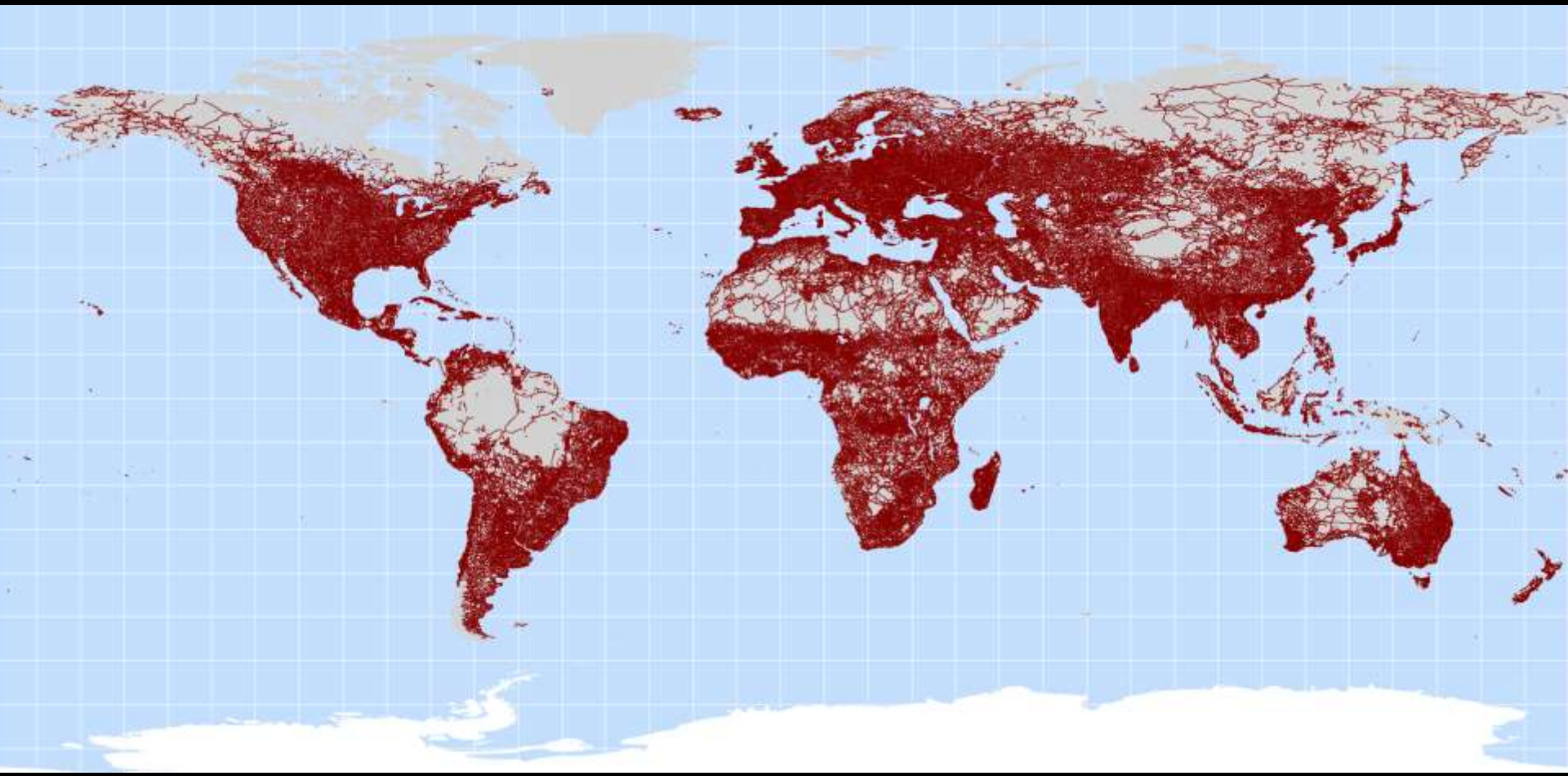

-78° 00'
-77° 30'
-77° 00'
-76° 30'
-76° 00'
-75° 30'
-75° 00'
-74° 30'
-12° 00'
-12° 30'
-13° 00'
-13° 30'
-14° 00'
-14° 30'
-15° 00'
-15° 30'
I. San Lorenzo
1192
I. Pachacamac
1291
I. Los Chechos
I. de Asia
790
686
Peru LNG
I. Chincha
I. San Gallan
Pta. Arquillo
Tres Puertas
I. La Vieja
449
I. Sta Rosa
1700
1566
Pta. San Juanito
2830
Pta. San Juan
GMT 2016 May 16 18:27:18
seaturtle.org/maptool Projection: Mercator

Management



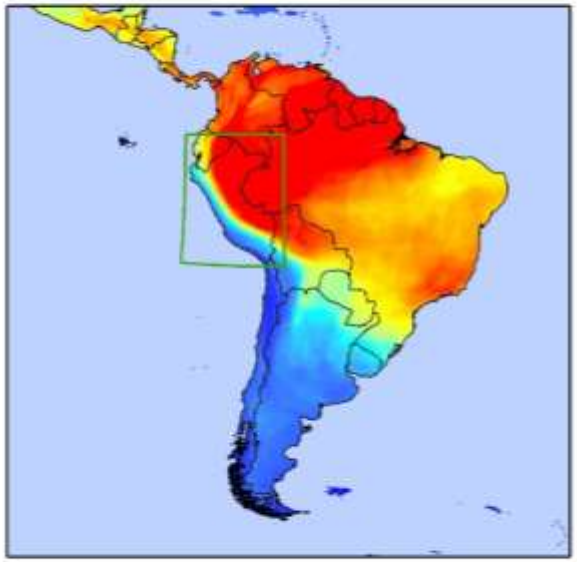
- Well designed infrastructure can have less impact on wildlife
- Marine infrastructure provides important habitat for wildlife

6. Linear Infrastructure




2013-09-07 8:02:54 AM M 1/3
27°C
PERU172
RECONYX


2013-05-28 11:38:11 AM M 2/5
35°C
PERU143
RECONYX



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Blocks Under Contract

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Ecuador

Peru

Brazil

Bolivia

N

0 250 500 1,000 Km

Data: PeruPetro, Biodiversitymapping.org/IUCN


Ivan Kashinsky

Question

Are canopy bridges an effective method to mitigate linear infrastructure-induced forest fragmentation?


Natural canopy bridge


2012-09-24 11:17:00 PM M 3/3
23°C
PERU113
RECONYX


2012-12-17 7:02:38 AM M 2/3
26°C
PERU147
RECONYX


2012-12-19 9:04:11 AM M 3/3
27°C
PERU113
RECONYX


2013-07-14 2:02:50 PM M 3/3
32°C
PERU131
RECONYX

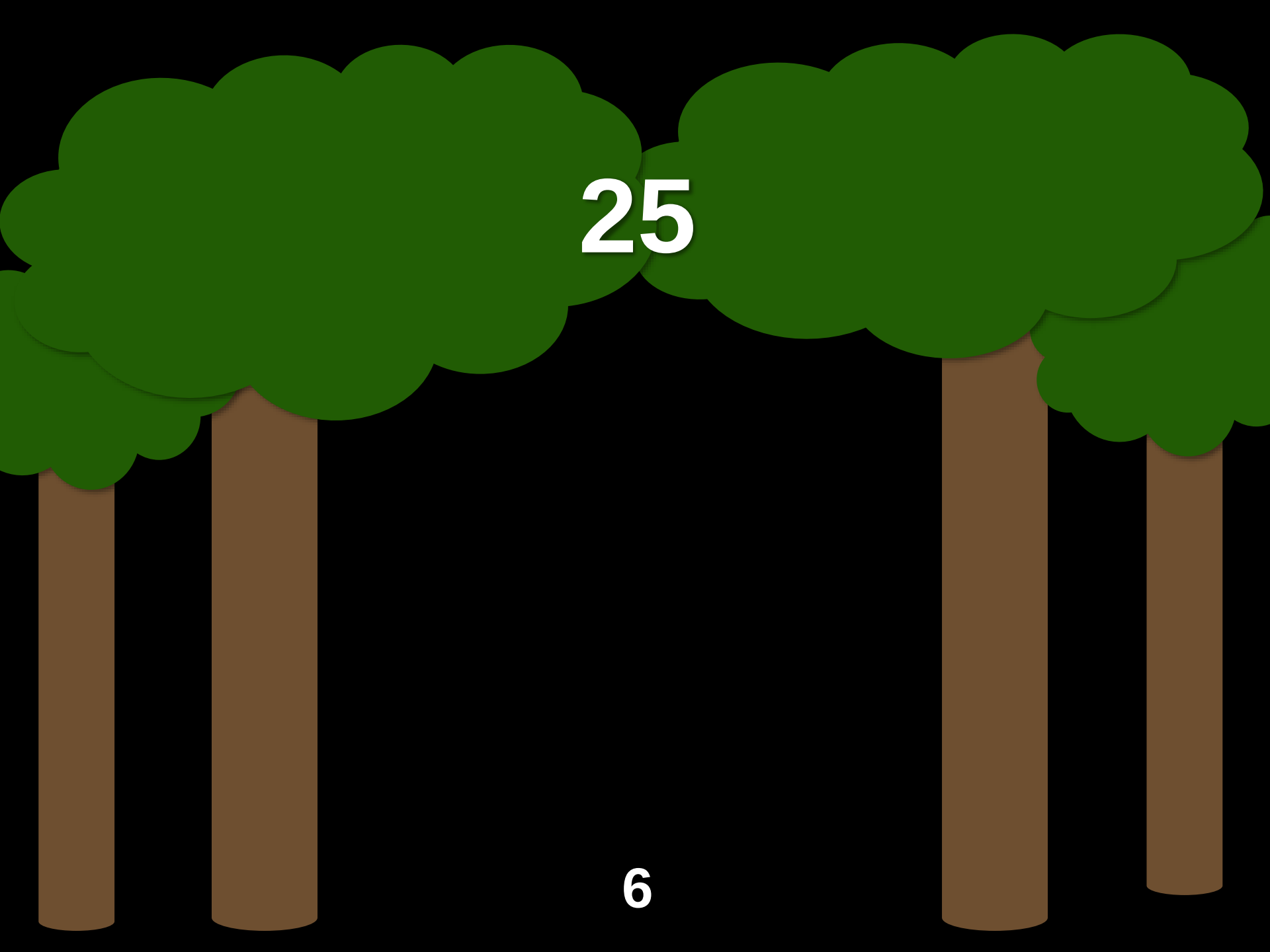

2013-07-18 7:17:06 AM M 1/3
19°C
PERU106
RECONYX


2013-07-31 12:14:54 AM M 4/5
20°C
PERU116
RECONYX


2012-09-20 2:00:20 AM M 1/3
23°C
PERU122
RECONYX


2013-01-15 10:23:17 PM M 2/3
23°C
PERU109
RECONYX


2012-12-17 11:36:52 PM M 3/3
22°C
PERU118
RECONYX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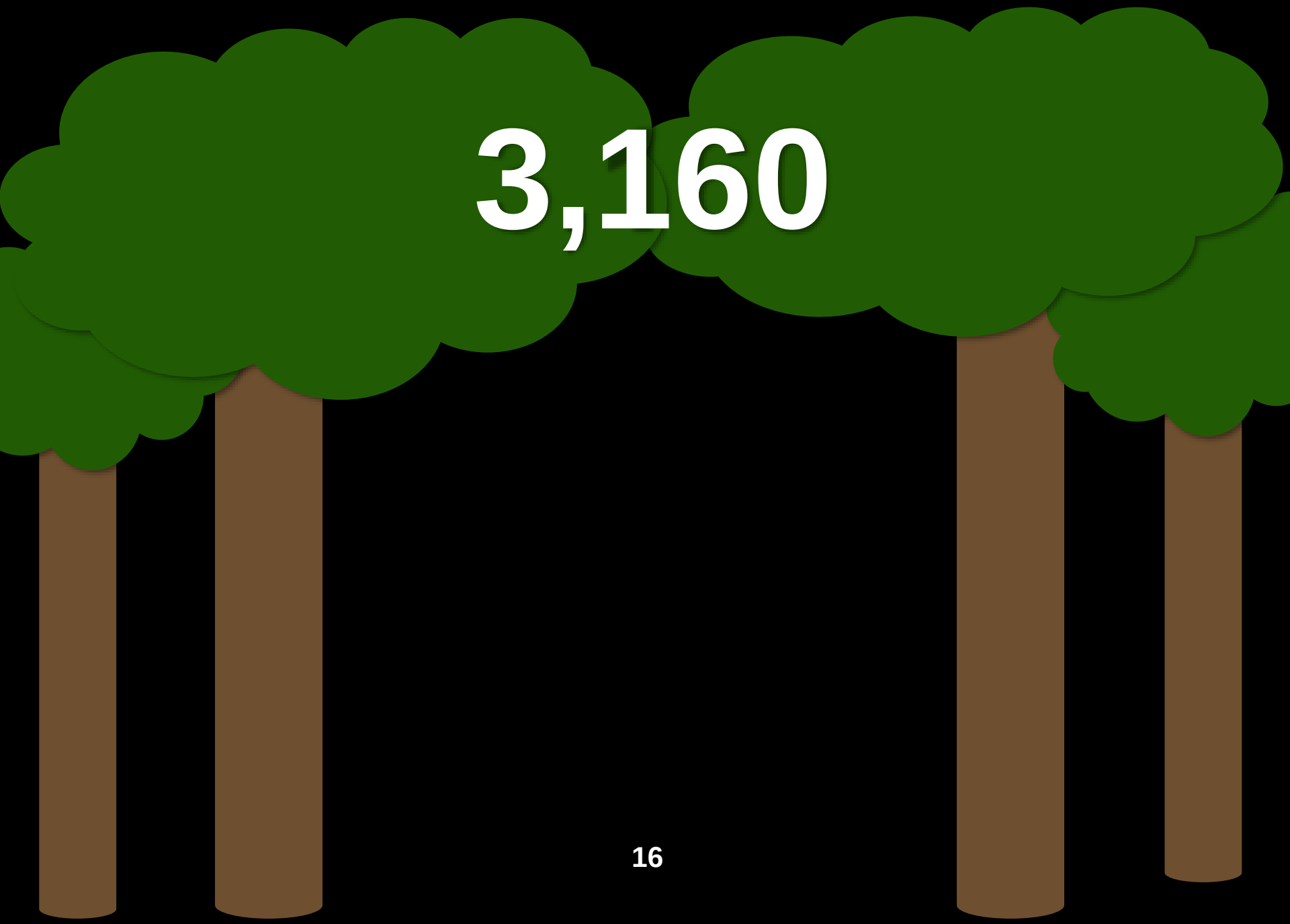
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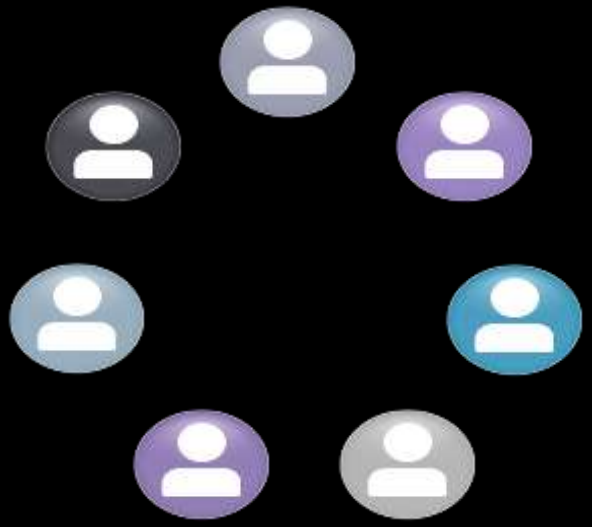
Management



- Canopy bridges mitigate fragmentation
- Early planning keeps costs low

Conclusions I

- By investing in BD, managers:
    - Use restoration information to invest in areas that need it (bio-restoration)
    - Know operations have dispersed ant colonies (soil management)
    - Implement waste management awareness campaign to reduce elephant visitation (waste management)
    - Place nets around construction ponds to eliminate access to toads (access to ponds)

Conclusions II

- By investing in BD, managers:
    - Know that their seismic environmental policies are effective (seismic operations)
    - Know that marine terminals provide habitat for endangered species (marine terminal design)
    - Know that canopy bridges mitigate forest fragmentation (linear infrastructure)

Working together for the study and sustainable use of biodiversity...