Quantification of the mitigation hierarchy

A CASE STUDY FOR THE PLNG NATURAL GAS PIPELINE

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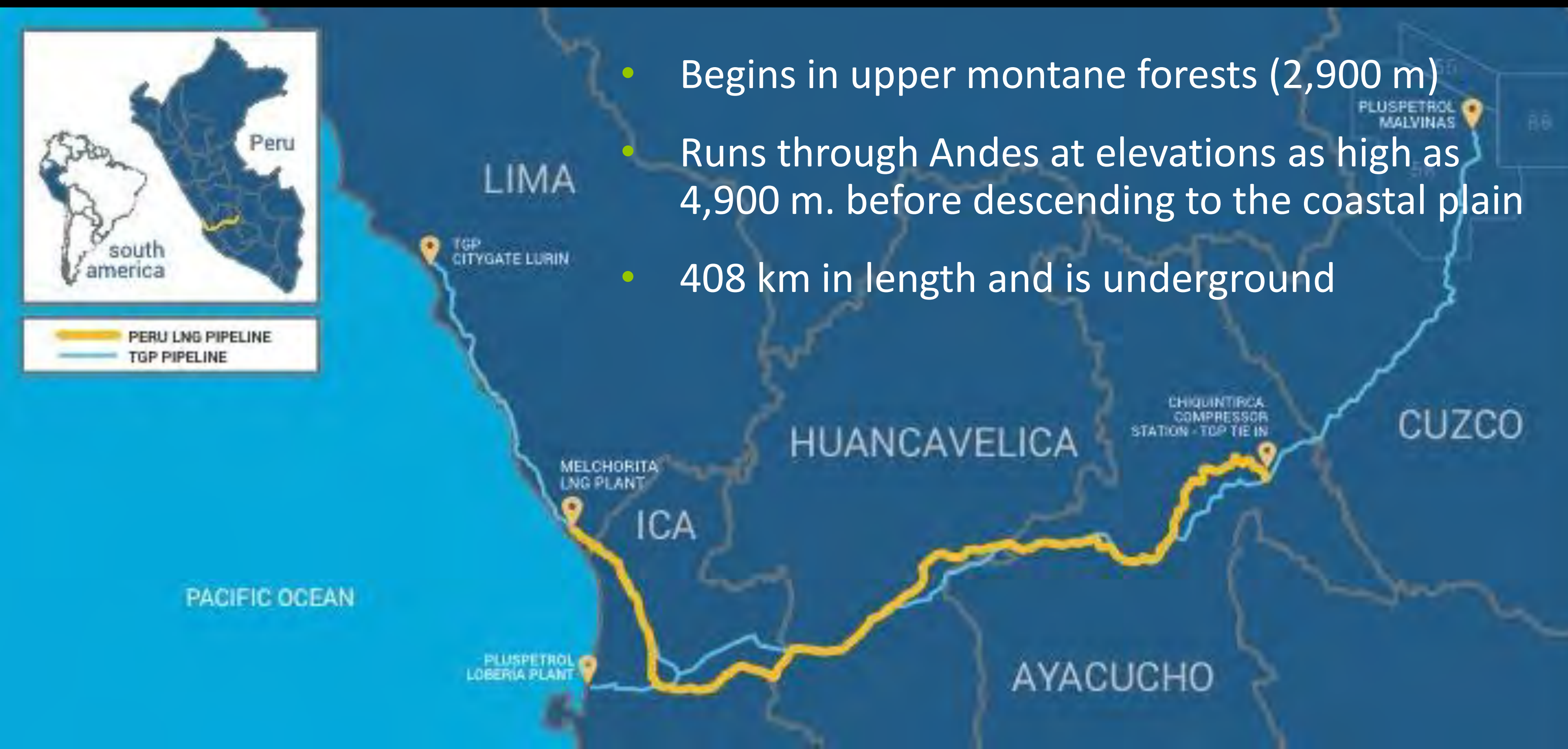
Smithsonian Conservation Biology Institute/ Biodiversity and Monitoring Assessment Program
Peru LNG

PERU LNG

Location Map

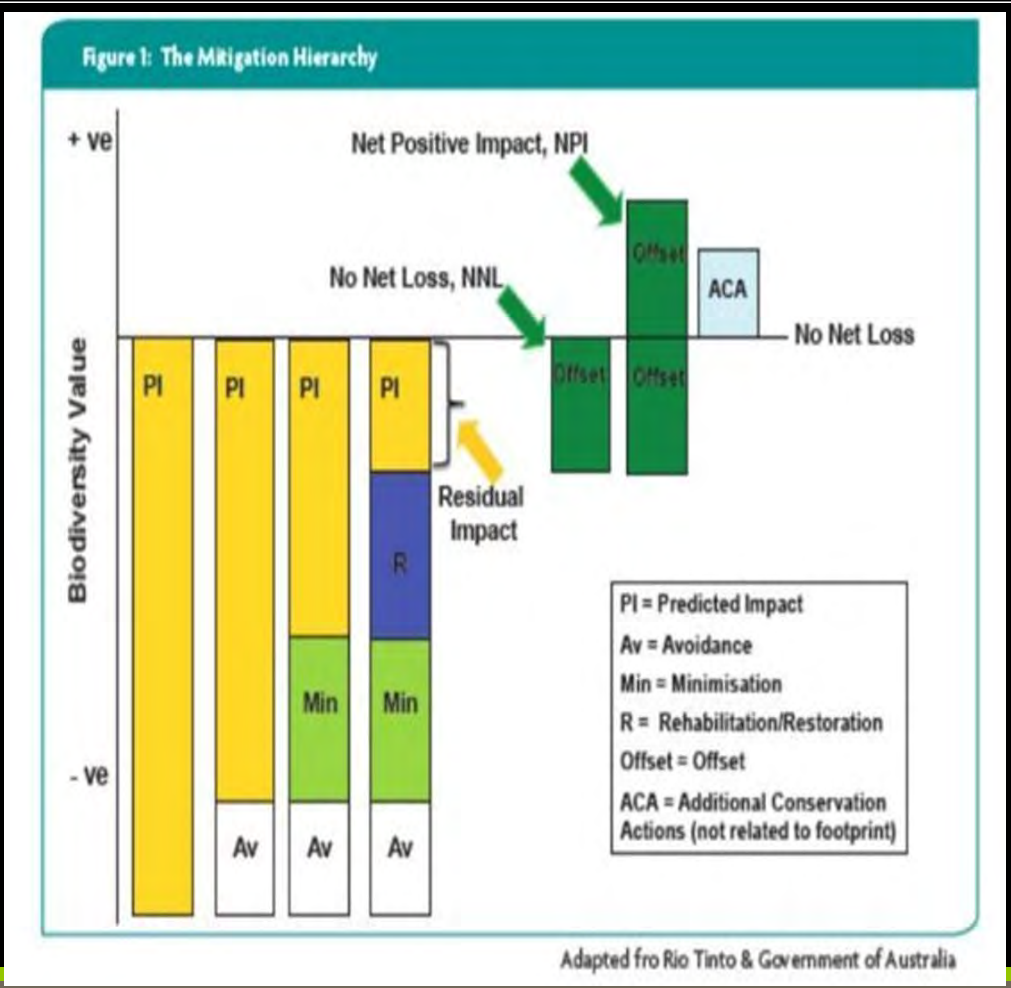


- Begins in upper montane forests (2,900 m)
- Runs through Andes at elevations as high as 4,900 m. before descending to the coastal plain
- 408 km in length and is underground

PERU LNG

14 Ecological Landscape Units (ELU)

Challenge: Quantify avoidance, minimization, restoration and residual impacts



Overview: Objectives & Methods

- **Avoidance** by micro-route changes: comparison of original vs final pipeline route.
- **Minimization** by reduction of width of pipeline RoW (spatial)
  - Additional measures (topsoil conservation)-measured via restoration success
- **Restoration** data from restoration monitoring program
- **Calculation** of residual impacts in Quality Hectares
- Data from **BMAP** (Biodiversity and Assessment Program) used to determine scale of impacts, degree of impact, obtain data on habitats and species trends.

Methods: Data available

Previous surveys

ESIA, Ecological Field Survey, Ecological Management Plan

Satellite data

GIS data

Restoration monitoring data

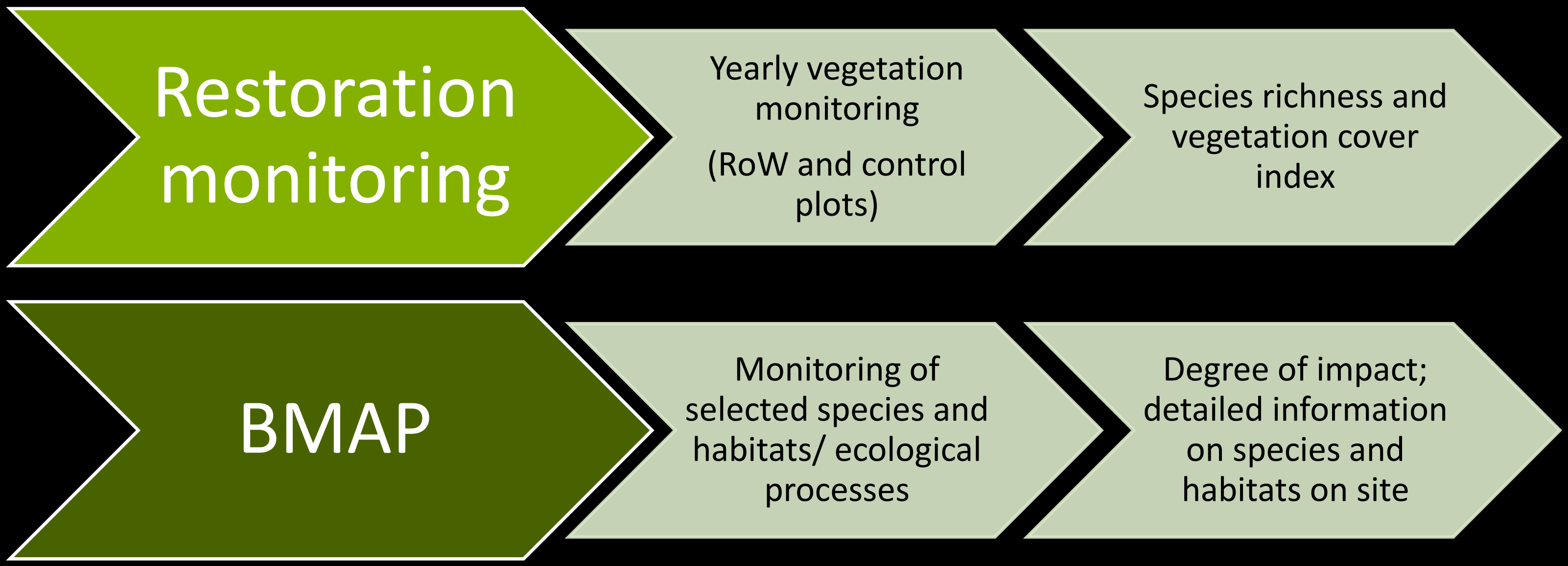
Biodiversity monitoring data

BMAP/SI

Steps

Satellite data	Habitat characterization	Wetland, grassland, forest, shrub, etc. **Assigned BES value**
GIS data	Habitat polygons by area	Avoidance and minimization in Hectares
Google earth	Visual inspection	Determine areas minimized, confirm avoidance

Steps


Restoration monitoring
Yearly vegetation monitoring
(RoW and control plots)
Species richness and vegetation cover index
BMAP
Monitoring of selected species and habitats/ ecological processes
Degree of impact; detailed information on species and habitats on site

Quantifying impacts of RoW

Residual Impact = Original route impact - {∑Avoidance + ∑Minimization + ∑Δ Restoration}

Final footprint

Predicted footprint

Micro-routing

Route width minimization

Restoration Effectiveness

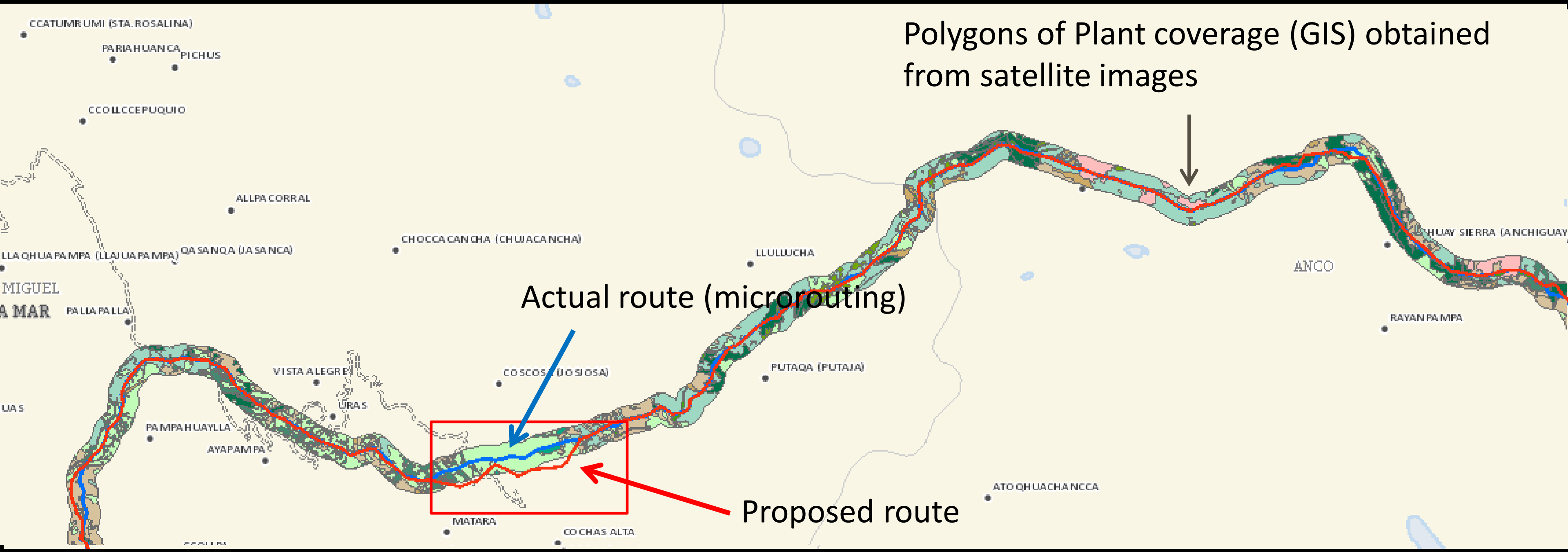
<u>Spatial Data</u>

GIS analysis of satellite data

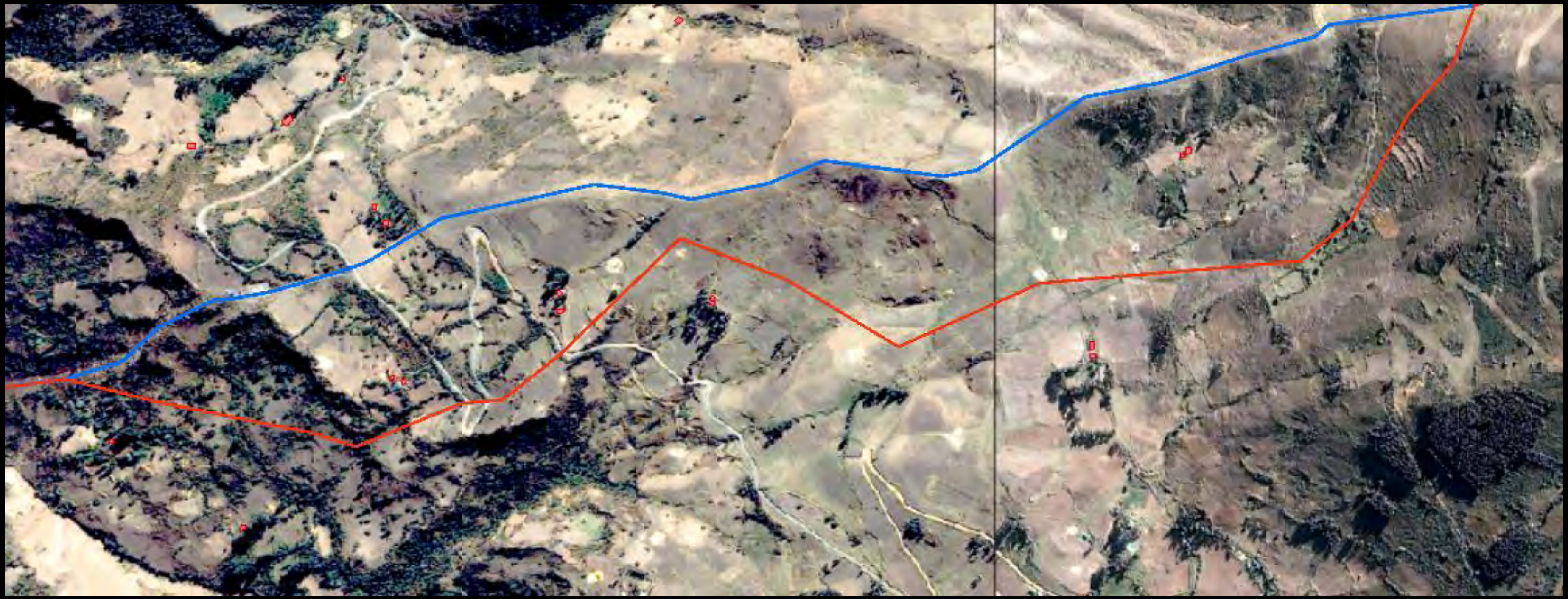
<u>Biodiversity/Ecology Data</u>

Data from restoration monitoring (vegetation cover and diversity as compared to control) Assigned a measure of quality as compared to control

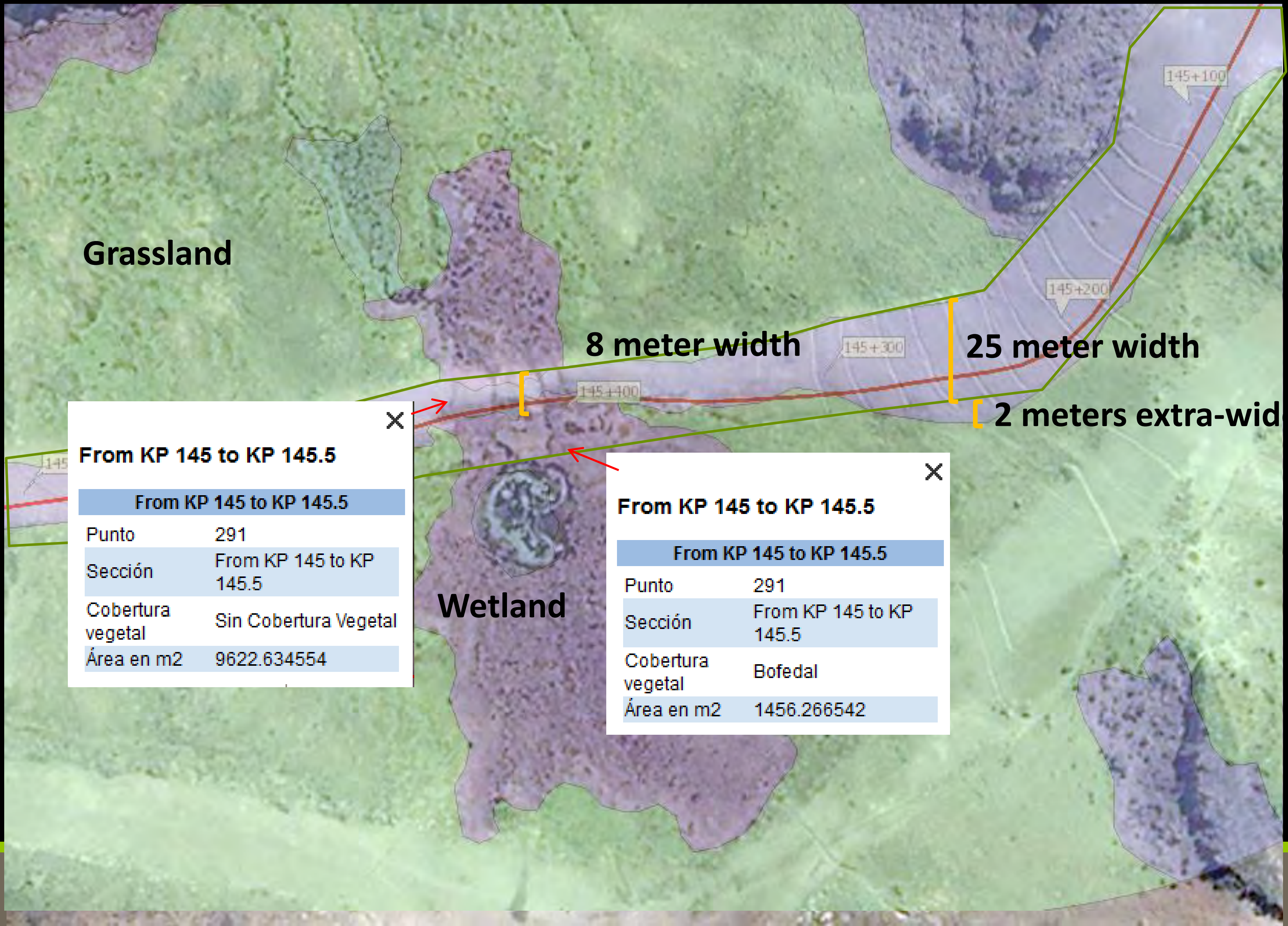
Quantifying original route impact and impact reduction through micro-routing



Quantifying original route impact and impact reduction through micro-routing



Reduction of on-site impact through minimization of RoW width



Restoration


Calomys sorellus


Oligoryzomys andinus

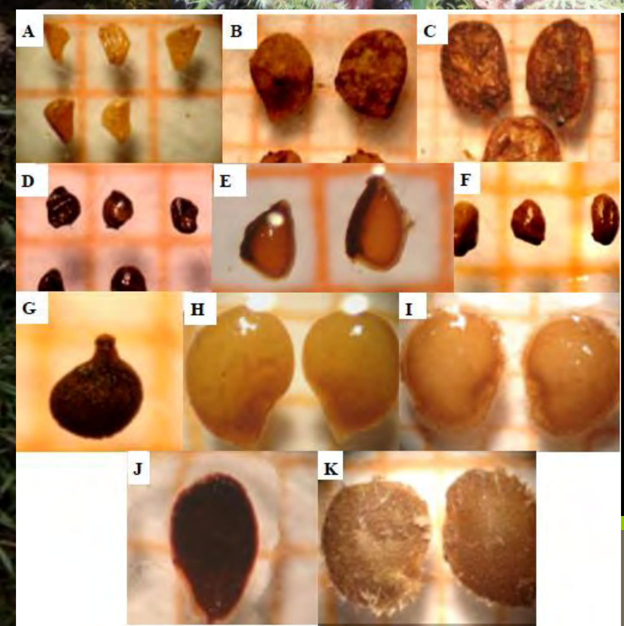

Microryzomys minutu


Akodon torques


Thomasomys aureus

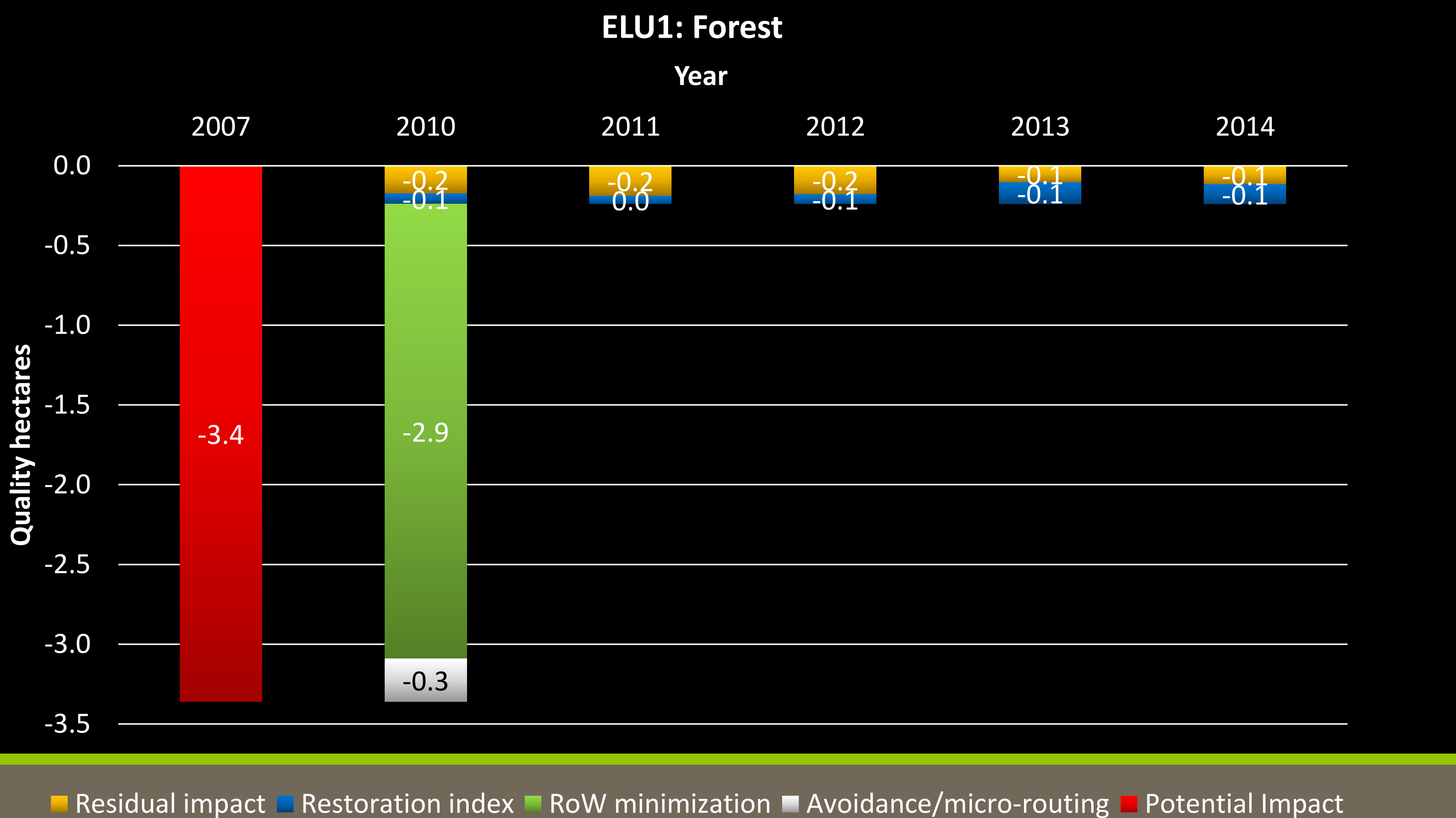

Thomasomys oreas


Thomasomys kalinowskii

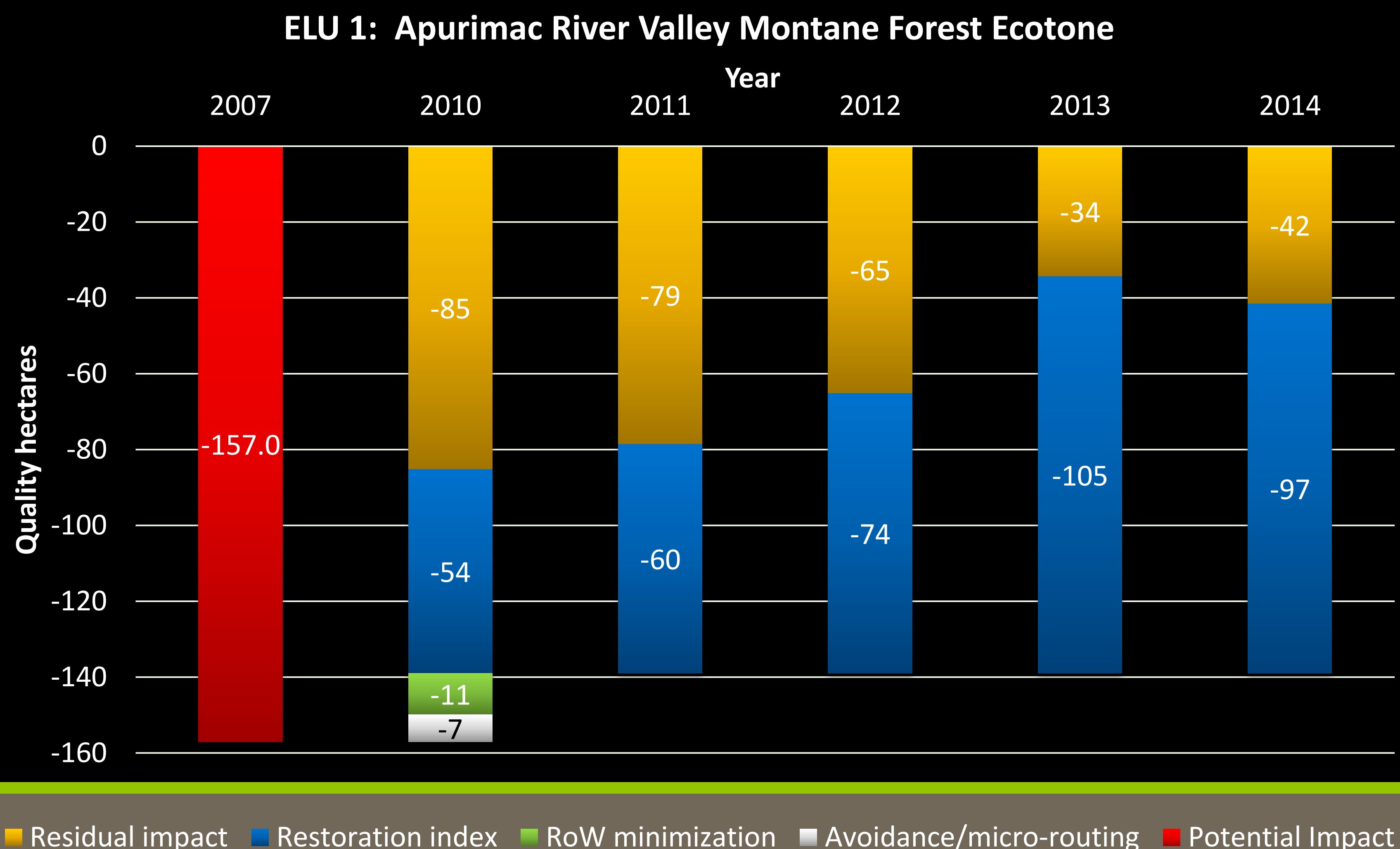

A
B
C
D
E
F
G
H
I
J
K

ELU 1 Apurimac Valley Montane River Forest

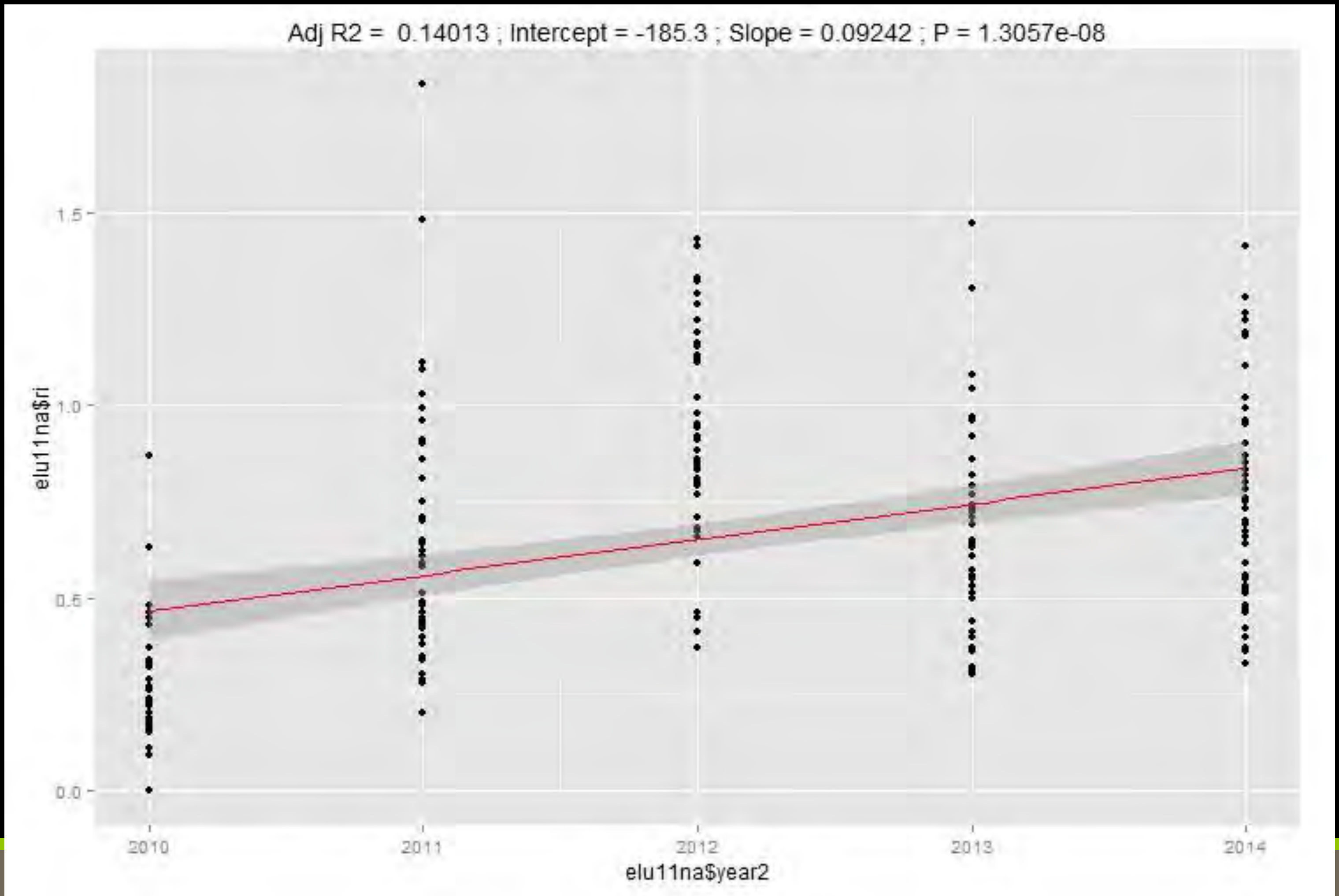
ELU 1: Forest


ELU1: Forest
Year
2007
2010
2011
2012
2013
2014
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
-3.0
-3.5
Quality hectares
-3.4
-0.2
-0.1
-2.9
-0.3
-0.2
0.0
-0.2
-0.1
-0.1
-0.1
-0.1
-0.1
Residual impact
Restoration index
RoW minimization
Avoidance/micro-routing
Potential Impact

ELU 1: All habitats



Regression: year by restoration index ELU 1

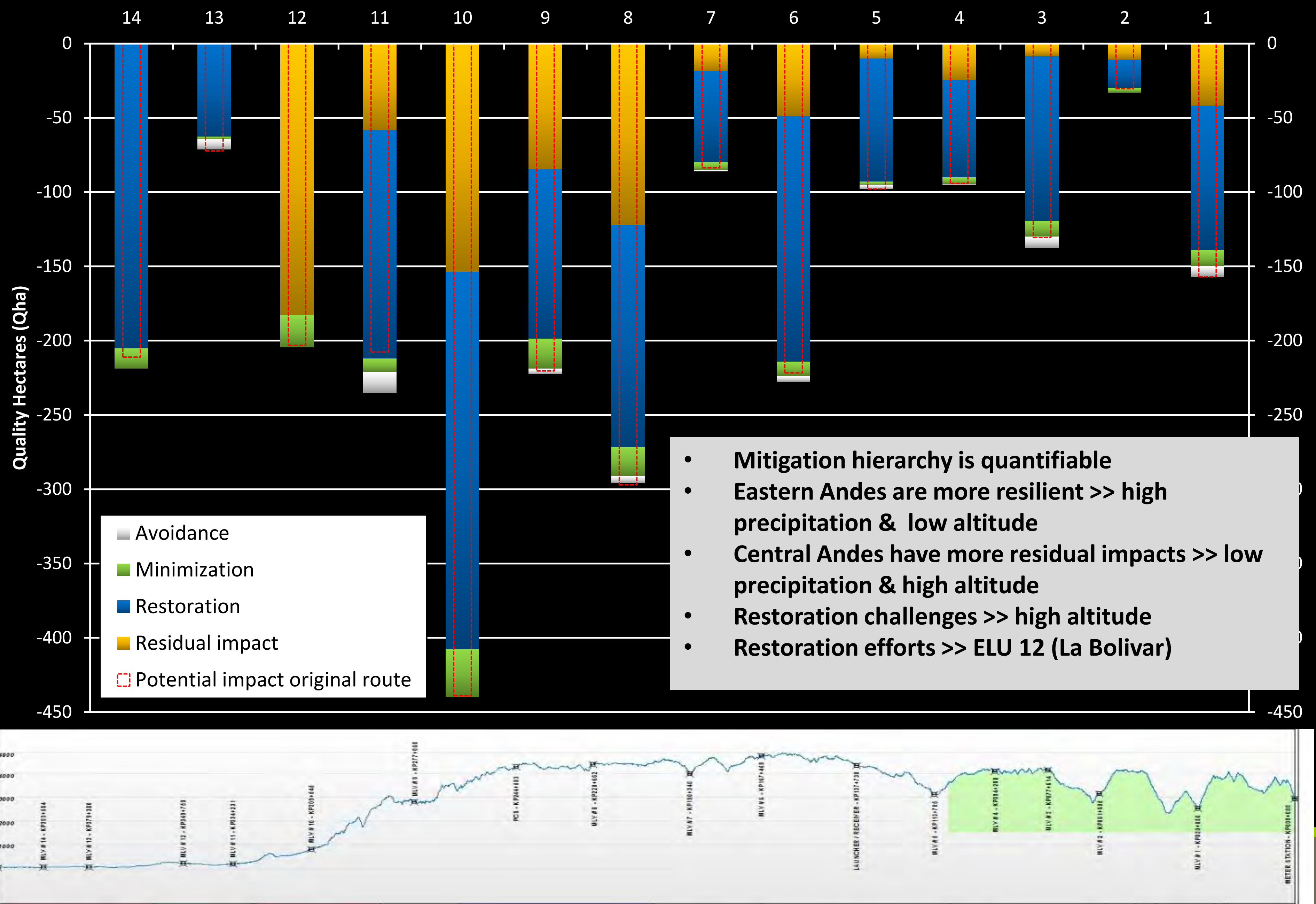


ELU 1 Apurimac Valley Montane River Forest

2011

2015

Mitigation Hierarchy by ELU from PERU LNG pipeline



Summary

Avoidance and minimization played significant roles in reducing impacts.

Restoration efforts play a major role for most habitats

Tendencies are positive for most ELU’s and habitats.

Lessons learned

- Importance of homogenizing diversity “currencies” (habitat classification, vegetation, monitoring protocols) across different data sets
- Planning for database and data collection prior to initiation of project is important
- Consistent monitoring essential; needs to be statistically valid
- Working in partnership with the company maximized efforts

Conclusions

-Mitigation Hierarchy quantification fosters a well-informed and cost-effective decision making process, can help guide offset/restoration/ conservation actions.

-Excellent tool for adaptively managing a project

A science based, statistically sound monitoring program is essential

Thank you

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Quantifying impact reduction due to avoidance, minimization and restoration of a natural gas pipeline in the Peruvian Andes. Environmental Impact Assessment Review : 66 (53-65)