

National Aeronautics and Space Administration



TALAMANCA-OSA ECOLOGICAL FORECASTING

Determining Habitat Suitability to Establish a Jaguar Corridor between the Talamanca Mountains and the Osa Peninsula in Costa Rica

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DEVELOP

Georgia - Athens | Spring 2019



- Jaguars are endangered throughout Costa Rica
- Corridors facilitate jaguar movement by linking habitat fragments to connect isolated populations







Study Area

- Costa Rica contains 5% of the world's biodiversity
- Talamanca Mountains and the Osa Peninsula
- 3 National Parks
 - La Amistad International Peace Park
 - Piedras Blancas National Park
 - Corcovado National Park

The study area encompasses 5382 km²





Arizona Center for Nature Conservation

Dr. Jan Schipper Field Conservation Research Director

Annie Johnson

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Osa Conservation

Hilary Brumberg Healthy Rivers Program Coordinator



Credit: Arizona Center for Nature Conservation



Credit: Osa Conservation



Conservation Goals

Dedicated to protecting at-risk jaguar populations and preserving biodiversity and ecosystem health in southern Costa Rica

Community Concerns

- Jaguar Habitats: Deforestation and crops such as pineapple and African oil palm result in habitat loss and landscape fragmentation which isolates jaguar populations, causing genetic diversity loss and an increased likelihood of inbreeding.
- Human-Jaguar Conflicts: Loss of habitat drives jaguars closer to human settlements, increasing instances of human-jaguar conflict such as retaliatory hunting.
- Ecosystem Health: Declines in jaguar populations cause ecological imbalances by changing predator-prey ratios.



Objectives

- Produce January 1987 through March 2019 Normalized Difference Vegetation Index (NDVI) and Enhanced Vegetation Index (EVI) time series maps to evaluate trends in vegetation health
- Conduct a current (March 2018 to March 2019) land use and land cover classification to evaluate habitat loss, fragmentation and jaguar corridor implementation suitability
- Forecast land use and land cover classifications to 2030 to identify areas of potential human-jaguar conflict and habitat loss
- Provide guidance on how to use land use and land cover forecasts to determine locations for potential jaguar corridors







Methodology





Results



Credit: Osa Conservation



Motivation for Use of NDVI and EVI





EVI Change from 1987 to 2019





Yearly Median NDVI and EVI







- Between 1987 and 2019
 - NDVI analyses show a **18% increase in vegetation** while EVI analyses show a **7% increase**.
 - However, the region between Piedras Blancas and La Amistad National Parks, a crucial development area for the corridor, experienced a decrease in vegetation and an increase in habitat fragmentation.
- NDVI tends to oversaturate in areas of high vegetation, which removes important details. Therefore, EVI is a better vegetation index for tropical areas.
- Localized NDVI and EVI decrease between 1987 and 2019 can be attributed to urbanization and exposed soil.
- Palm plantations dominate the area close to the Inter-American Highway, highlighting the need for focused restoration efforts in the region.





Limitations

• We were unable to use Landsat data for 2007 due to significant cloud cover and banding issues.

Santa Clara

Monte Lirio

Plaza de

Caisan

Sereno



Limitations

 Cloud cover resulted in some small regions of no data for the NDVI and EVI analyses, especially for 1987 and 1997.





Future Work

- Expand the process of forecasting land use and land cover changes to 2030 to include the entire study region
- Model potential jaguar corridors using CIRCUITSCAPE, Linkage Mapper and current jaguar location data to help our partner organizations narrow the focus of their restoration efforts



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Project Partners

Arizona Center for Nature Conservation

- Dr. Jan Schipper, Field Conservation Research Director
- Annie Johnson, Chelsey Tellez and Andrew Martinez, Field Conservation Research Assistants

Osa Conservation

 Hilary Brumberg, Healthy Rivers Program Coordinator

Questions?



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Appendix

Credit: Arizona Center for Nature Conservation

NDVI Change from 1987 to 2019



Calculating Vegetation Indices

$$NDVI = \frac{NIR-Red}{NIR+Red}$$

$$EVI = \frac{NIR - Red}{NIR + 6 \times Red - 7.5 \times Blue + 1}$$

	Landsat 5 TM		Landsat 8 OLI	
Surface Reflectance	Band	Wavelength (µm)	Band	Wavelength (µm)
Blue	1	0.45 - 0.52	2	0.45 - 0.51
Red	3	0.63 - 0.69	4	0.64 - 0.67
NIR	4	0.77 - 0.90	5	0.85 - 0.88

Refining Methodologies

- **Refine** our current land use and land cover classifications.
 - Supplement Landsat 8 data with Sentinel-2
 data.
 - Provide additional training data for the classification algorithms.



Aerial View of Crucial Classes



Coffee

Palm Plantation

Pineapple

Barriers to Movement: Pineapple



Barriers to Movement: Palm Plantation



Elevation Cutoffs for Classification

Class	Elevation Restriction in Code	Elevation Range from Literature	Partner Source	Authors
Grassland/Pasture	less than 2000 m	~1500 m	Dr. Jan Schipper	Holl & Quiros-Nietzen 1999
Paramos	greater than 2000 m	3100 to 3300 m	Dr. Jan Schipper	Kappelle & Horn 2016
Coffee	greater than 870 m	1000 to 1300 m	Dr. Jan Schipper	Avelino et al. 2005
Mangrove	less than 500 m	less than 200 m	Jiménez, J. A. 2016	Jiménez, J. A. 2016
Pineapple	greater than 500 m	496 to 944 m	Dr. Jan Schipper	Morton 1987
Wetland	less than 500 m	less than 200 m	Jiménez, J. A. 2016	Jiménez, J. A. 2016
	For the Osa Pen			
Melina/Teak	less than 120 m		Hilary Brumberg	