# Biodiversity, Peatlands, Forests, and the Risks of Oil Palm Expansion

*Mapping Priority Areas for Conservation in Ucayali and San Martin, Peru*

*Laterallus jamaicensis*

*Phoebastria irrorate*

*Cinclodes palliates*

*Eulidia yarrellii*

# INTRODUCTION

Ucayali and San Martin are two departments located in the Peruvian Amazon, recognized for their high levels of biodiversity. They are home to numerous endemic and threatened species. However, the expansion of commodity agriculture in the area such as oil palm, poses a threat to critical habitats, peatland and forests. To safeguard biodiversity in these departments, it is essential to identify and prioritize areas for protection against future agricultural encroachment. We identify key datasets to inform this effort that can evaluate the intersection of oil palm production and biodiversity at broad scales such as the mill supply shed, supply chain or jurisdiction.

## Key maps

**Current Oil Palm Plantations**: We use data from Mapbiomas (2024), Peru to map existing oil palm plantations and identify areas where oil palm is expanding in Ucayali and San Martin.

**Biodiversity Distribution and Critical Habitats**: We use data from the IUCN (2024) and BirdLife International (2024) to map the current areas or ranges where individual species are "extant," or where probability of occurrence in Ucayali and San Martin is high. We add up thousands of individual ranges to estimate the number of overall species and the number of threatened or endemic species potentially occurring in a given area, focusing on terrestrial and freshwater mammal, reptile, amphibian and bird species. These maps highlight regions with high species richness. We also use data from Ucayali's Zonificación Forestal (ZF) to map areas that the regional government identifies as 'critical habitats' for 6 endangered species.

**Peatland and Forests**: Using data on peatlands from Hastie et al. (2022) and forest data from GFW (2022), we map peat soils and forests across Peru to identify areas considered essential for climate change mitigation and biodiversity conservation.

**Oil Palm Suitability**: We then use data from Pirker et al. (2016) to map areas with high biophysical suitability for oil palm cultivation within these departments. By overlaying the oil palm maps with the biodiversity, forests and peatland layers, we identify the regions where future oil palm expansion could threaten important ecological areas.

Overall, we produced a set of maps of biodiversity hotspots, peatlands, forests, and oil palm extents and suitability. These maps can be used to identify priority areas, inform stakeholders and support decision-making for conservation planning and land use management at local, regional and national scales.

## Data Sources

- BirdLife International. (2024) Species Distribution Maps. Birdlife International. Accessed: https://datazone.birdlife.org/species/requestdis
- Gerencia Regional Forestal y de Fauna Silvestre (GERFFS) (2024). Zonificación Forestal. GERFFS
- Global Forest Watch (GFW) (2022). World Resource Institute. Accessed: https://globalforestwatch.org
- Hastie, A., Honorio Coronado, E. N., Reyna, J., Mitchard, E. T., Åkesson, C. M., Baker, T. R., ... & Lawson, I. T. (2022). Risks to carbon storage from land-use change revealed by peat thickness maps of Peru. Nature Geoscience, 15(5), 369-374.
- International Union for Conservation of Nature (IUCN) (2024). Species-level spatial distributions and ranges. Accessed: https://www.iucnredlist.org/resources/spatial-data-download
- Mapbiomas. (2024). Peru (Collection 2.0). Mapbionas. Accessed: https://peru.mapbiomas.org/en/colecciones-de-mapbiomas-peru/
- Pirker, J., Mosnier, A., Kraxner, F., Havlík, P., & Obersteiner, M. (2016). What are the limits to oil palm expansion?. Global Environmental Change, 40, 73-81.
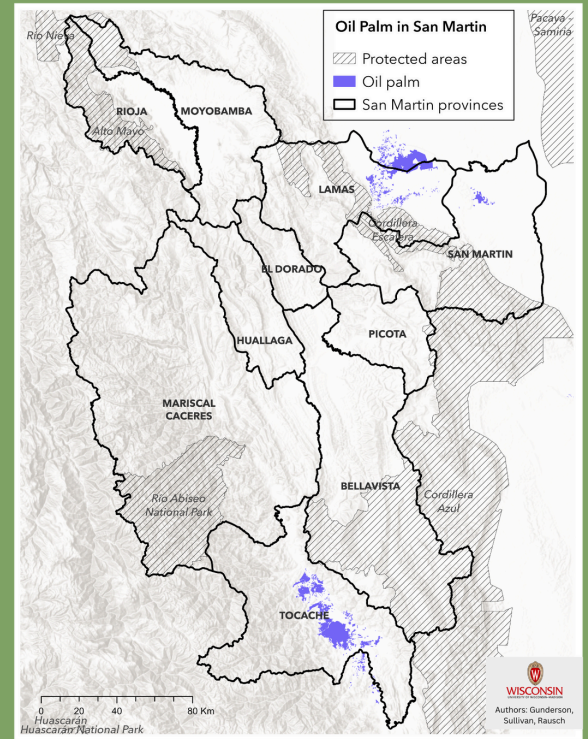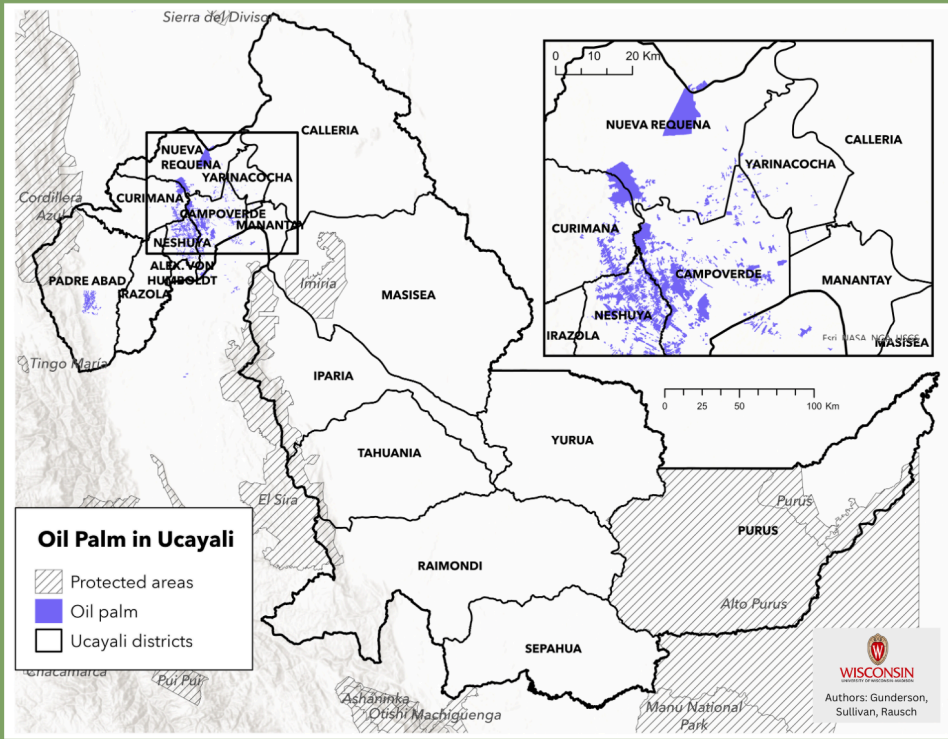
# OIL PALM PLANTATIONS

DATA: MAPBIOMAS, PERU 2024

Oil palm cultivation is rapidly expanding in the Peruvian Amazon, and 84% of palm grown in Peru is within Ucayali and San Martin.

In 2024, Ucayali had over 55,000 hectares (ha) of oil palm (~47% of the country's total), primarily in Campoverde, Neshuya, and Nueva Requena districts (MapBiomas 2024). Although these districts have already lost much of their forest cover, they remain critical peatland hotspots. In 2024, San Martin had 46,279 ha of oil palm (~37% of the country's total), concentrated in Tocache, Lamas, and San Martin provinces.
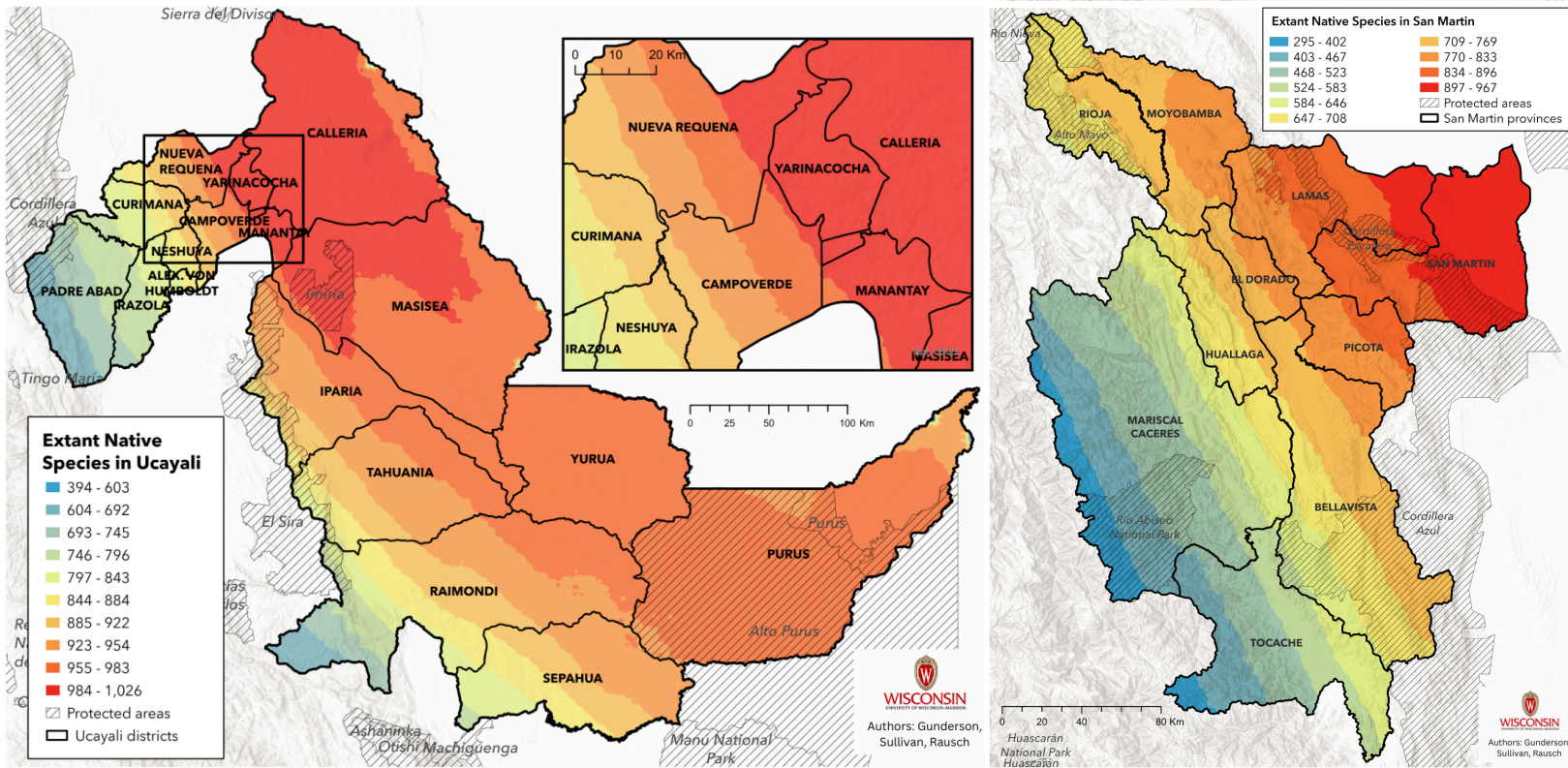
Together, these departments have over 327,000 ha of peatland and 13.2 million ha of forest, home to many threatened and endemic species. Protecting these areas from further oil palm encroachment is crucial.

## Ucayali

| | District | Oil palm area (ha) | % of total |
|---|---|---|---|
| 1 | Campoverde | 16,307 | 29.30% |
| 2 | Neshuya | 14,057 | 25.26% |
| 3 | Nueva Requena | 11,753 | 21.12% |
| 4 | Padre Abad | 6,698 | 12.04% |
| 5 | Curimana | 6,233 | 11.20% |
| 6 | Yarinacocha | 346 | 0.62% |
| 7 | Alexander Von Humboldt | 213 | 0.38% |
| 8 | Calleria | 43 | 0.08% |
| | TOTAL | 55,649 | |

## San Martin

| | Province | Oil palm area (ha) | % of total |
|---|---|---|---|
| 1 | Tocache | 32,419 | 70.1% |
| 2 | Lamas | 11,566 | 25.0% |
| 3 | San Martin | 2,294 | 5.0% |
| | TOTAL | 46,279 | |

Extant Native Species in Ucayali

| | 394 - 603 |
| | 604 - 692 |
| | 693 - 745 |
| | 746 - 796 |
| | 797 - 843 |
| | 844 - 884 |
| | 885 - 922 |
| | 923 - 954 |
| | 955 - 983 |
| | 984 - 1,026 |
| | Protected areas |
| | Ucayali districts |

Authors: Gunderson, Sullivan, Rausch

Extant Native Species in San Martin

| | 295 - 402 | | 709 - 769 |
| | 403 - 467 | | 770 - 833 |
| | 468 - 523 | | 834 - 896 |
| | 524 - 583 | | 897 - 967 |
| | 584 - 646 | | Protected areas |
| | 647 - 708 | | San Martin provinces |

Authors: Gunderson, Sullivan, Rausch

# EXTANT AND NATIVE SPECIES

DATA: IUCN 2024, BIRDLIFE INTERNATIONAL 2024

Biodiversity is high across both San Martin and Ucayali, with data revealing high species counts through both departments and a spatial trend of increasing species counts in the lower elevation forests of the western Amazon.
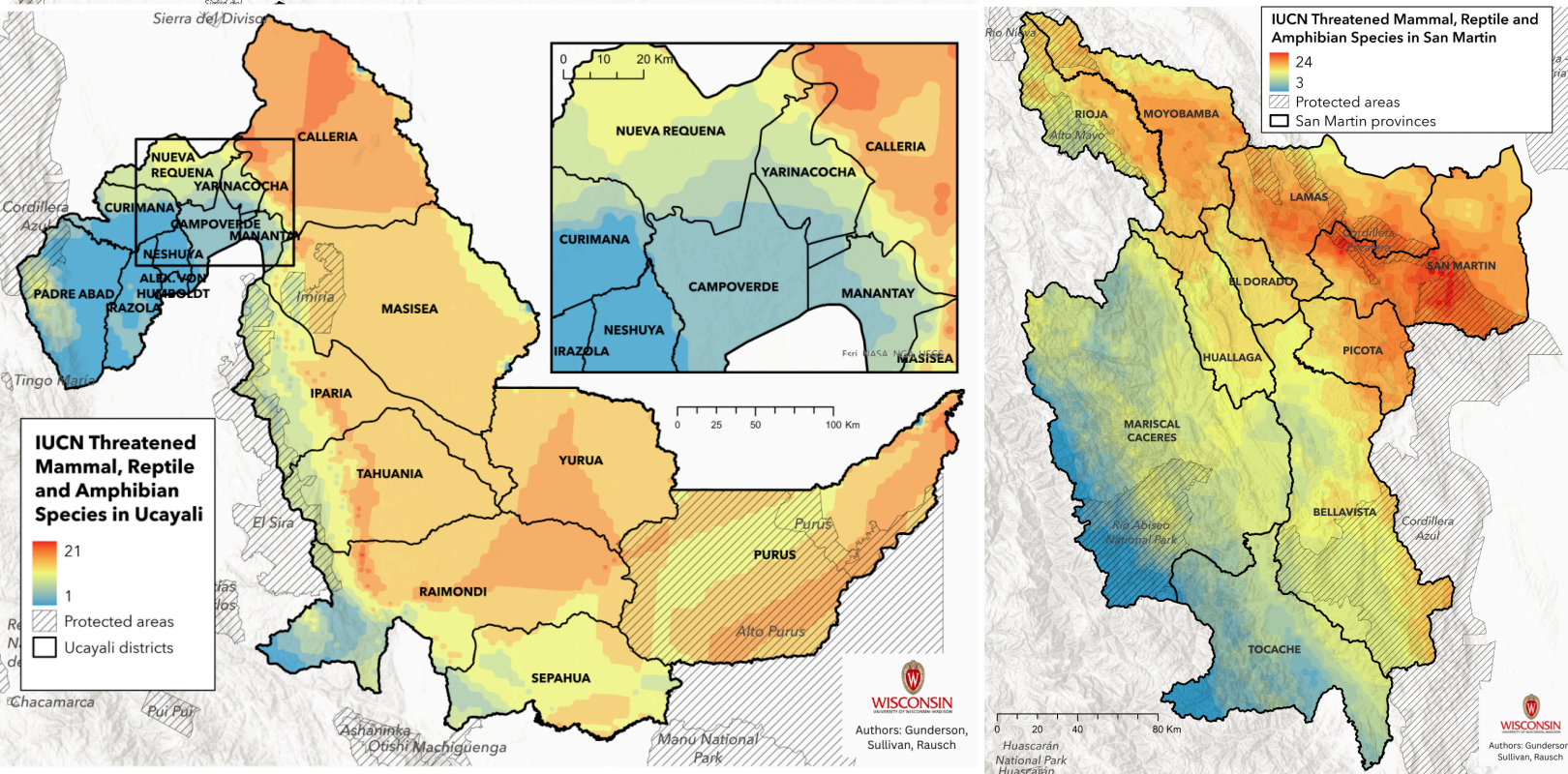
In Ucayali, the districts of Yarinacocha, Calleria, and Manantay boast the highest species richness, with average species counts of 1004, 999, and 994, respectively. In San Martin, the provinces of San Martin, Lamas, and Picota lead in biodiversity, with average counts of 913, 857, and 819 mammal, reptile, amphibian, and bird species.

## Ucayali

| | District | Average # of species | | District | Average # of species |
|---|---|---|---|---|---|
| 1 | Yarinacocha | 1004 | 10 | Tahuania | 927 |
| 2 | Calleria | 999 | 11 | Sepahua | 896 |
| 3 | Manantay | 994 | 12 | Raimondi | 878 |
| 4 | Masisea | 982 | 13 | Neshuya | 869 |
| 5 | Yurua | 973 | 14 | Alexander Von Humboldt | 842 |
| 6 | Purus | 962 | 15 | Curimana | 838 |
| 7 | Iparia | 945 | 16 | Irazola | 785 |
| 8 | Nueva Requena | 943 | 17 | Padre Abad | 713 |
| 9 | Campoverde | 939 | | | |

## San Martin

| | Province | Average # of species | | Province | Average # of species |
|---|---|---|---|---|---|
| 1 | San Martin | 913 | 6 | Bellavista | 702 |
| 2 | Lamas | 857 | 7 | Rioja | 700 |
| 3 | Picota | 819 | 8 | Huallaga | 688 |
| 4 | El Dorado | 768 | 9 | Tocache | 511 |
| 5 | Moyobamba | 764 | 10 | Mariscal Caceres | 506 |

IUCN Threatened Mammal, Reptile and Amphibian Species in Ucayali

IUCN Threatened Mammal, Reptile and Amphibian Species in San Martin

Authors: Gunderson, Sullivan, Rausch

# THREATENED MAMMAL, REPTILE AND AMPHIBIAN SPECIES

DATA: IUCN 2024

IUCN data from 2024 indicates that the same western districts of Yarinacocha, Calleria, and Manantay also harbor the highest counts of extant native freshwater mammal, terrestrial mammal, reptile, and amphibian species classified as near threatened, vulnerable, endangered and critically endangered. For instance, the province of San Martn hosts an average of 20 threatened species, while Callería in Ucayali supports an average of 19 threatened species —more than any other district in the department. In the following section, we highlight three of the most charismatic threatened species whose ranges are included in this map.

## Ucayali

| | District | Average # of species | | District | Average # of species |
|---|---|---|---|---|---|
| 1 | Calleria | 19 | 10 | Yarinacocha | 16 |
| 2 | Yurua | 18 | 11 | Manantay | 15 |
| 3 | Purus | 18 | 12 | Campoverde | 14 |
| 4 | Masisea | 18 | 13 | Curimana | 14 |
| 5 | Tahuania | 18 | 14 | Padre Abad | 14 |
| 6 | Raimondi | 17 | 15 | Irazola | 13 |
| 7 | Iparia | 17 | 16 | Neshuya | 13 |
| 8 | Sepahua | 17 | 17 | Alexander Von Humboldt | 13 |
| 9 | Nueva Requena | 16 | | | |

## San Martin

| | Province | Average # of species | | Province | Average # of species |
|---|---|---|---|---|---|
| 1 | San Martin | 20 | 6 | Rioja | 16 |
| 2 | Lamas | 18 | 7 | Huallaga | 16 |
| 3 | Picota | 18 | 8 | Bellavista | 15 |
| 4 | Moyobamba | 18 | 9 | Mariscal Caceres | 12 |
| 5 | El Dorado | 16 | 10 | Tocache | 11 |

# EXAMPLES OF INDIVIDUAL RANGES OF CHARISMATIC THREATENED SPECIES

SOURCE: IUCN 2024

## BLACK-FACED BLACK SPIDER MONKEY
### (Ateles chamek)

The Black-faced black spider monkey, an endangered primate, is native to western Brazil, northern Bolivia, and eastern Peru.  This species is found throughout the department of Ucayali, which makes up 4% of its 260 million ha range. They inhabit diverse forest ecosystems such as lowland unflooded and flooded forests, semi-deciduous forests, and riparian forests. Typically found in the upper canopy, these primates primarily feed on a variety of fruits. Sadly, their populations are rapidly declining due to subsistence and market hunting for their meat, alongside the escalating threats of habitat loss driven by agricultural expansion, mining, and logging.
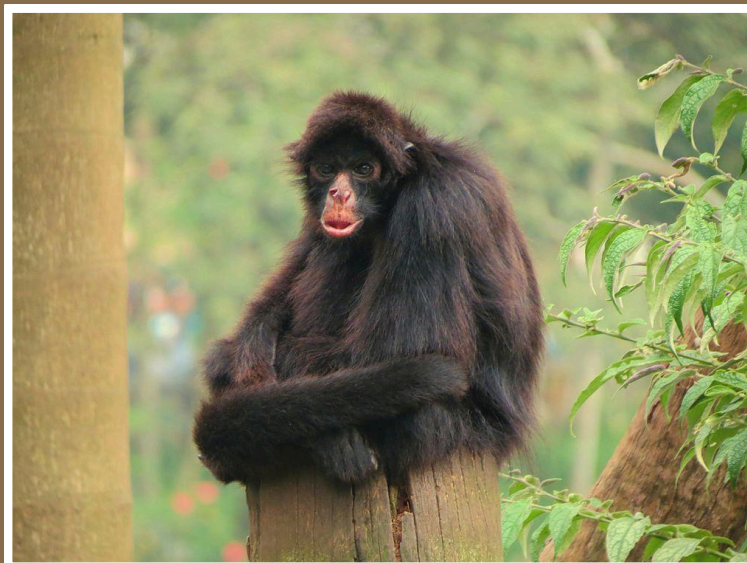


*Range of Black-faced black spider monkey*



Not only does Ucayali form a critical part of the range for some species, others are found almost entirely within the department—or even restricted to a single district. A limited range makes species particularly vulnerable to habitat loss, as they lack alternative habitats. Two examples are the Rana venenosa and Silverstone's poison frog, both of which are confined to small areas that are predominantly or entirely within the Padre Abad district.

# RANA VENENOSA
## (*Ameerega rubriventris*)



The Rana venonosa (Cordillera Azul poison frog) is an endangered amphibian species that inhabits tropical moist lowland rainforests. They are found within a limited range of 75,330 ha entirely within the district of Padre Abad, Ucayali. This species lives in the dense leaf litter of both primary and secondary forests. The main threat the Rana venonosa faces is habitat loss, largely stemming from smallholder agriculture, cattle ranching and timber logging.
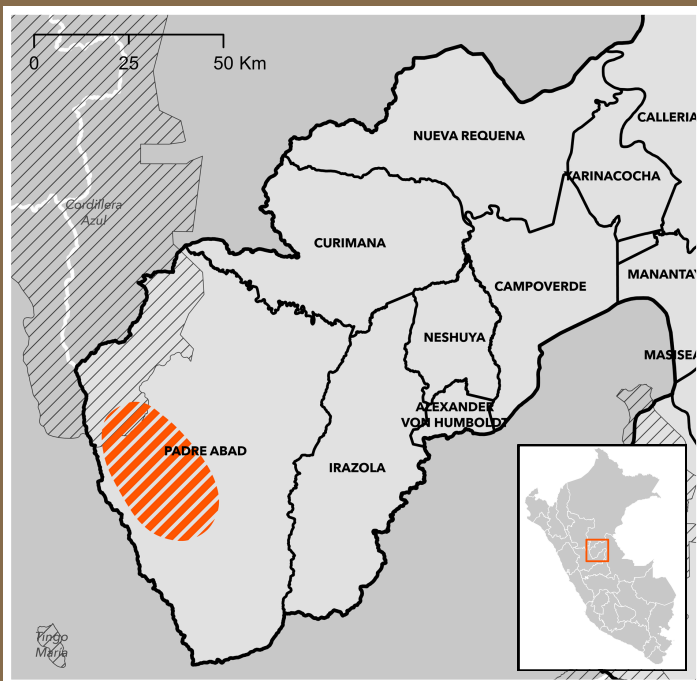


*Range of Rana venonosa*

# SILVERSTONE'S POISON FROG
## (*Ameerega silverstonei*)



The Silverstone's poison frog is another endangered species found in Ucayali. Of its 276,405 ha range, approximately 50% falls within the department. This frog is a montane tropical rainforest specialist, endemic to the Cordillera Azul region in the eastern Andes. Its specialized habitat makes it vulnerable to habitat loss driven by agricultural expansion. Additionally, the species is under pressure from illegal smuggling for the international pet trade.
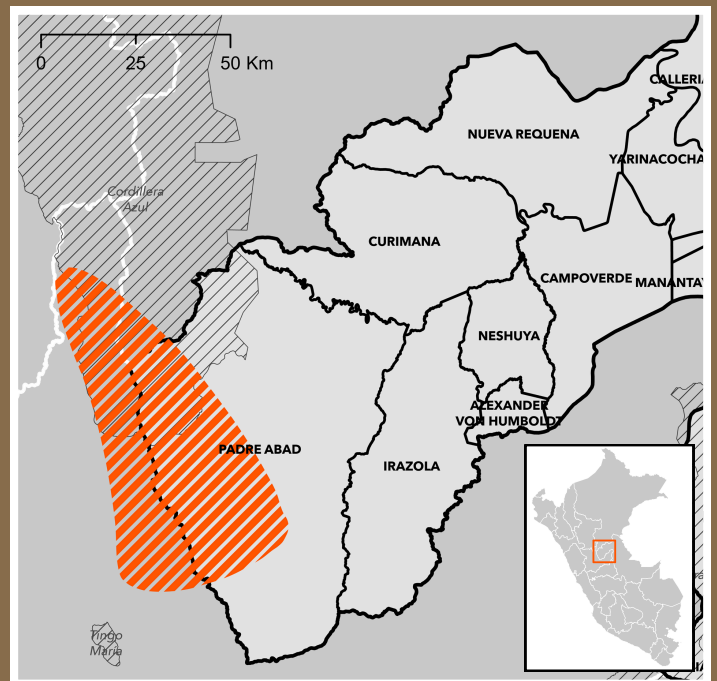


*Range of Silverstone's poison frog*

Critical Habitats and Oil Palm in Ucayali

Protected areas
Oil palm
Critical habitats
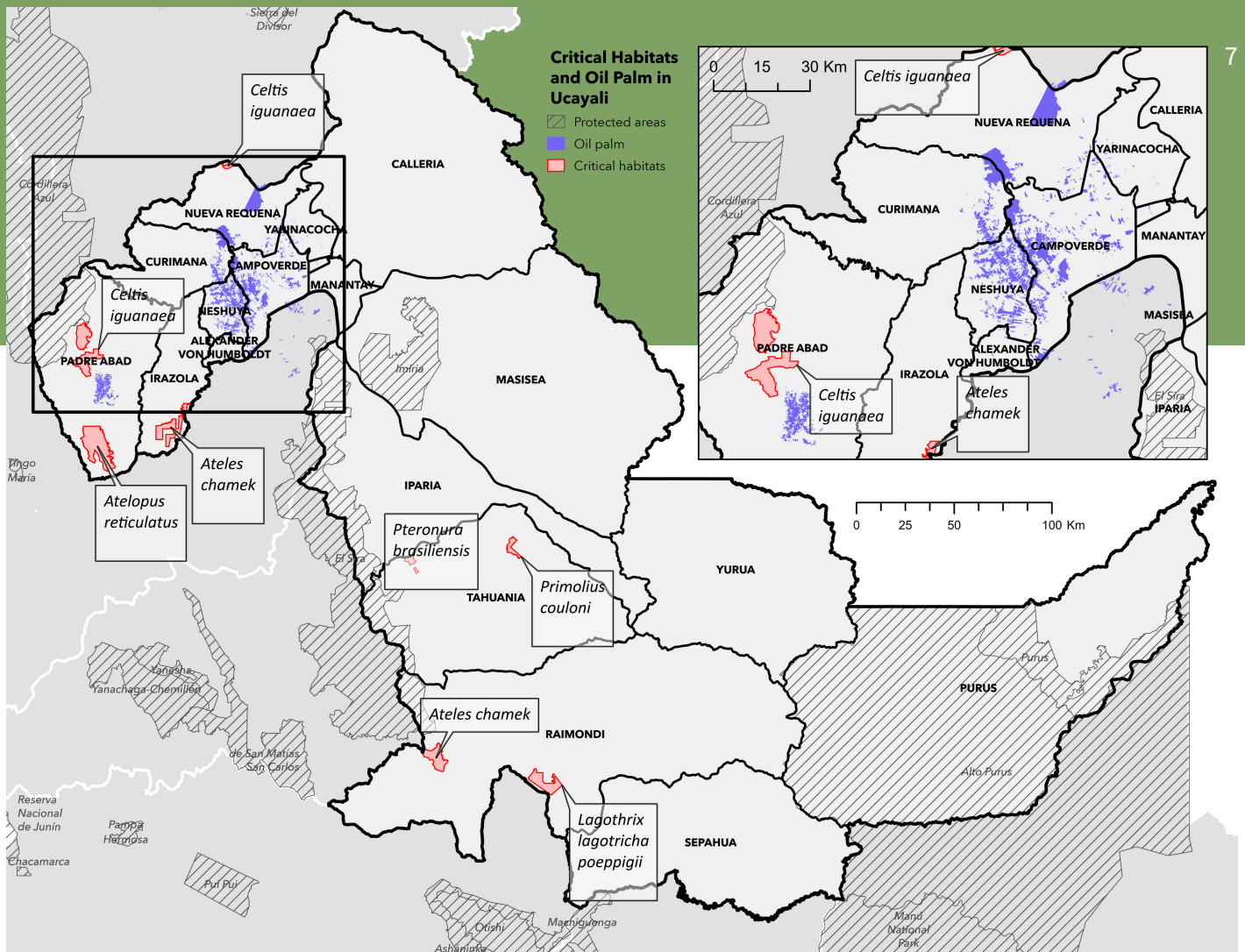
# REGIONAL ZONING EFFORTS: CRITICAL HABITATS IN UCAYALI

DATA: MAPBIOMAS, PERU 2024, GERFFS 2024

In March 2024, the department of Ucayali approved a Zonificación Forestal (ZF), establishing guidelines for land use, including designated areas for agriculture, conservation, forestry concessions, and other purposes. The ZF also identified eight Critical Habitats for six endangered plant and animal species. These include:

- White stick tree or Iguana hackberry (*Celtis iguanaea*)
- Reticulated harlequin frog (*Atelopus reticulatus*)
- Black-faced black spider monkey (*Ateles chamek*)
- Blue-headed macaw (*Primolius couloni*)
- Giant river otter (*Pteronura brasiliensis*)
- Poeppig's woolly monkey (*Lagothrix lagotricha poeppigii*)

Oil palm cultivation is expanding near four of these critical habitats, and IUCN assessments highlight that habitat loss due to agricultural expansion, including oil palm, is a significant threat to the survival of species like the Black-faced black spider monkey.
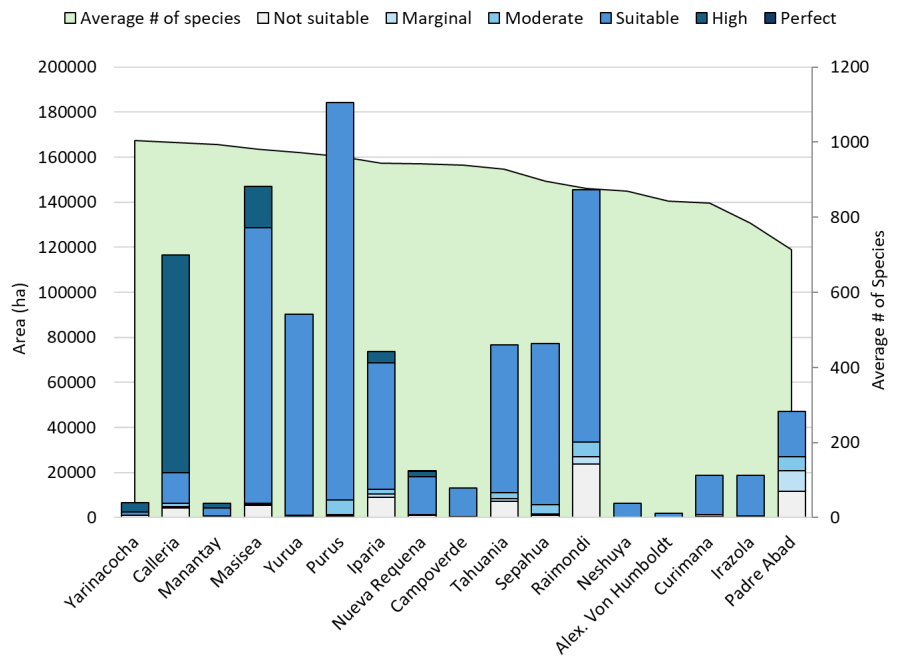
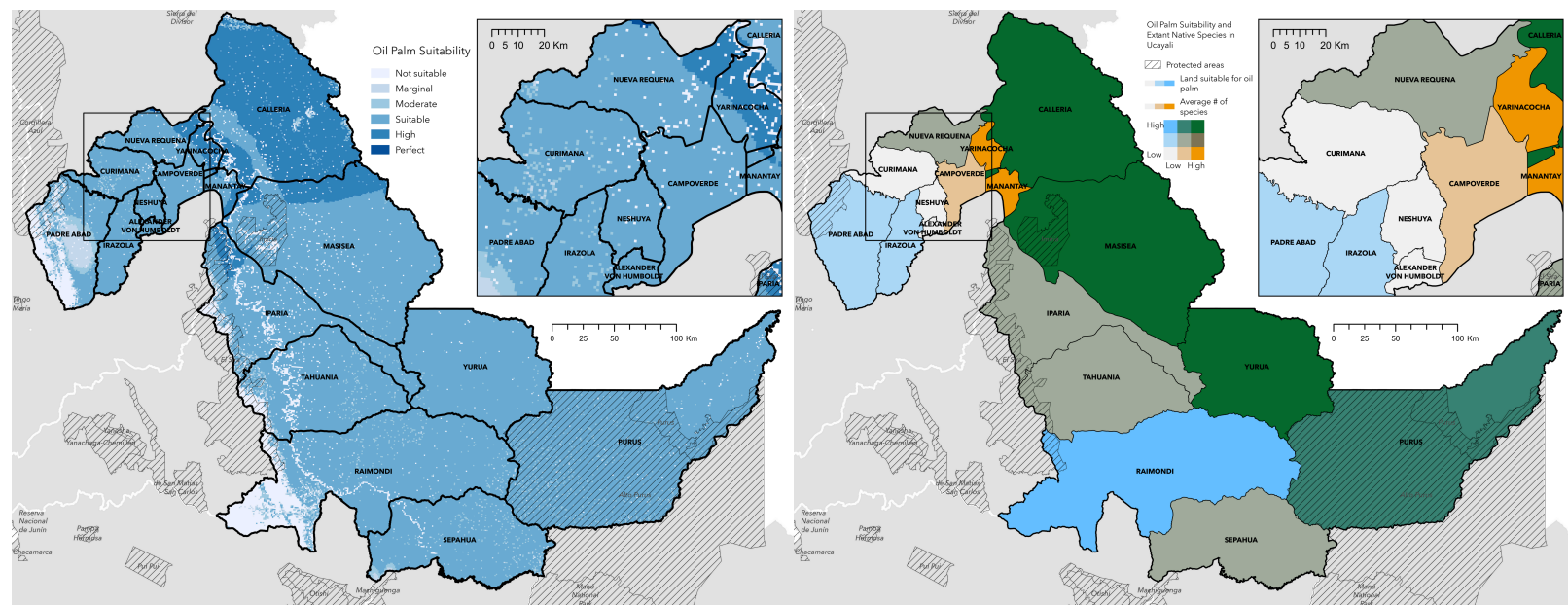# OIL PALM SUITABILITY AND EXTANT NATIVE SPECIES IN UCAYALI

DATA: PIRKER ET AL. 2016, IUCN 2024

Approximately 96% of Ucayali's land (9.84 million hectares) is biophysically suitable for oil palm cultivation, with 12.6% (1.28 million hectares) classified as highly suitable [1].

The primary physical constraint to expansion in the western part of the department is the region's high elevation and steep slopes. Consequently, the flat, low-lying areas of the western Amazon, which are rich in biodiversity, also represent the most suitable land for oil palm cultivation. For instance, the district of Callería, which has the largest area of highly suitable land for oil palm, also ranks second in species abundance and first in the average number of threatened mammal, reptile and amphibian species.
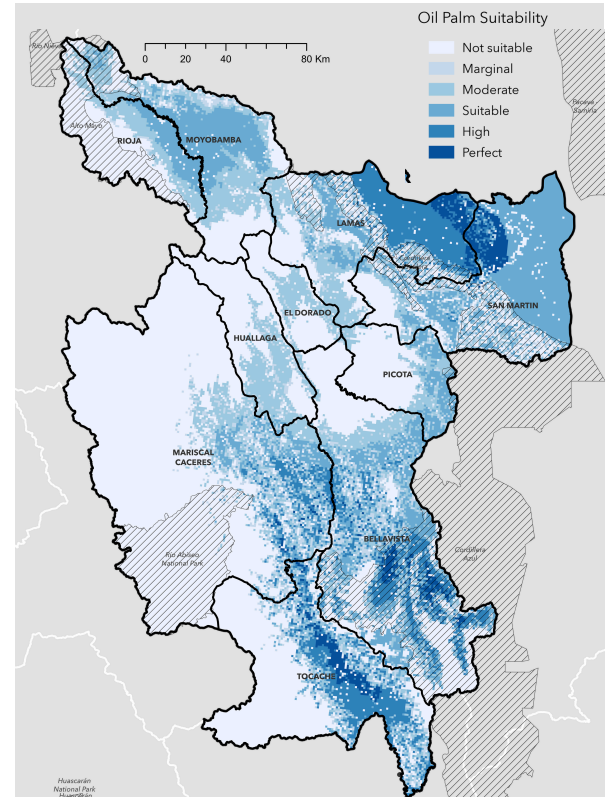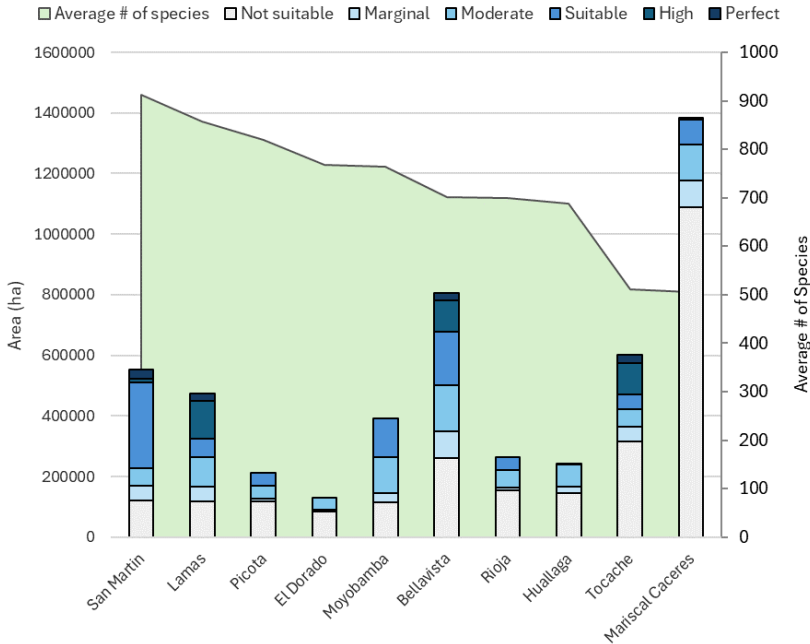


[1] Pirker, Johannes, Aline Mosnier, Florian Kraxner, Petr Havlík, and Michael Obersteiner. 2016. "What Are the Limits to Oil Palm Expansion?" Global Environmental Change 40 (September):73–81.

# OIL PALM SUITABILITY AND EXTANT NATIVE SPECIES IN SAN MARTIN

DATA: PIRKER ET AL. 2016, IUCN 2024





Compared to Ucayali, San Martin has less total suitable land for oil palm cultivation, largely constrained by high elevations in the west. However, the department still has close to 1.40 million ha of land identified by Pirker et al. as "suitable," "high" and "perfect" for oil palm expansion.

Much of the suitable land is located in the western region of the department, where oil palm is still largely absent. The province of San Martin, which has >800,000 ha of land considered suitable for oil palm cultivation, also has the highest number of total species and threatened mammal, reptile and amphibian species in the department.
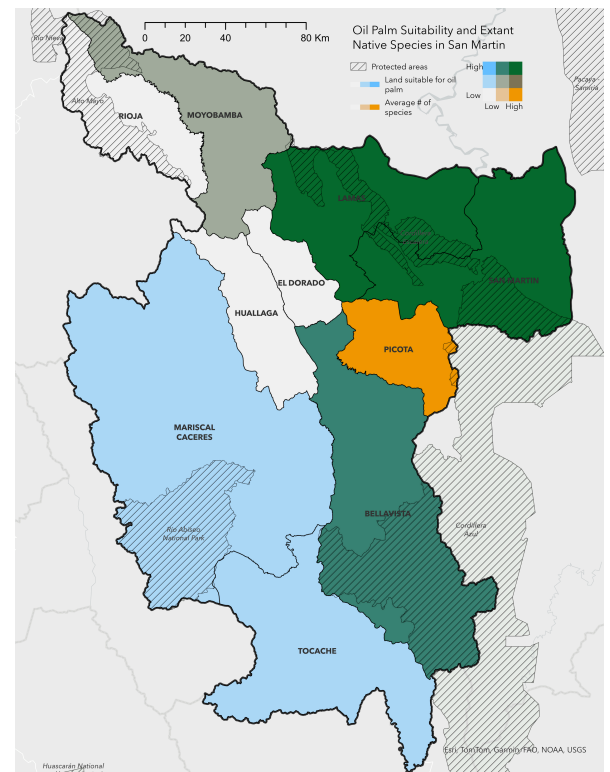
# PEATLAND

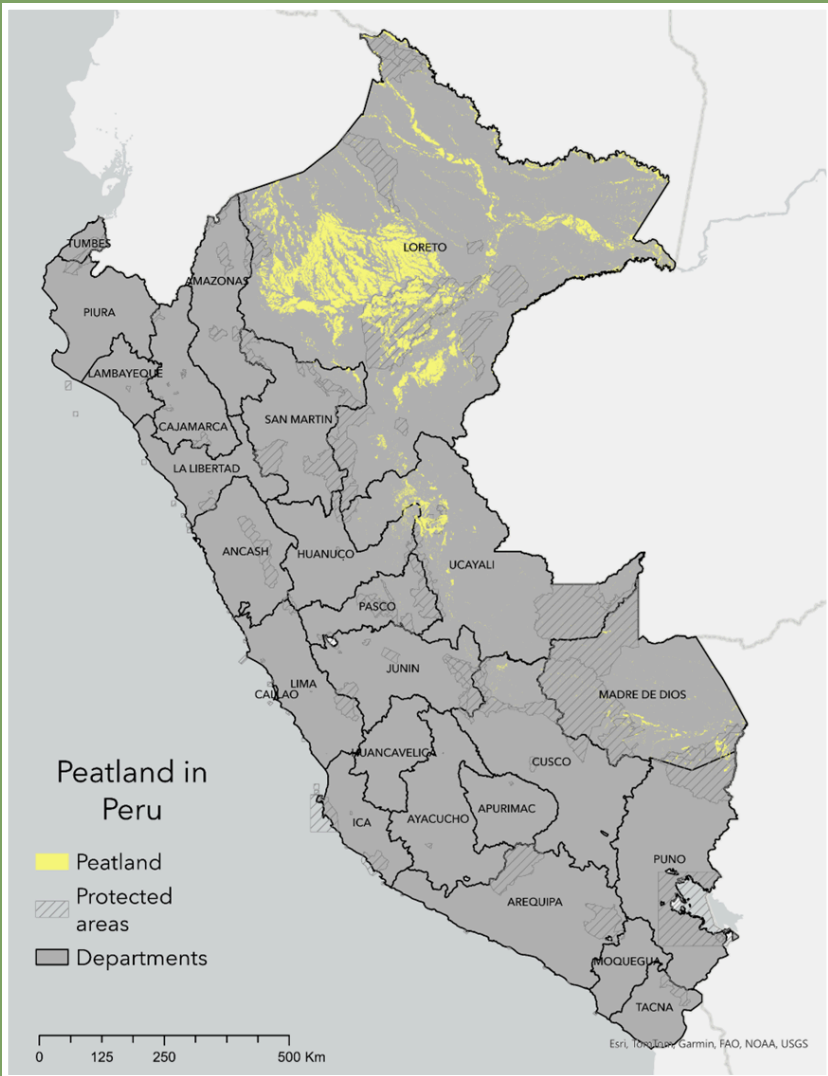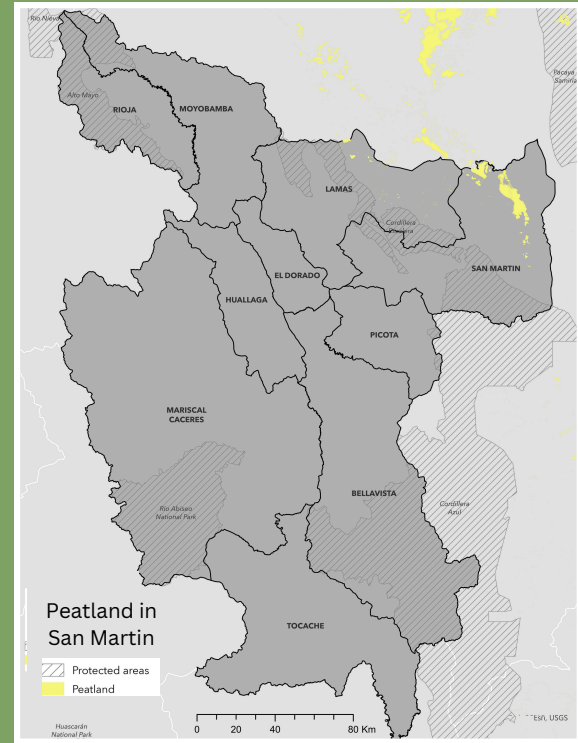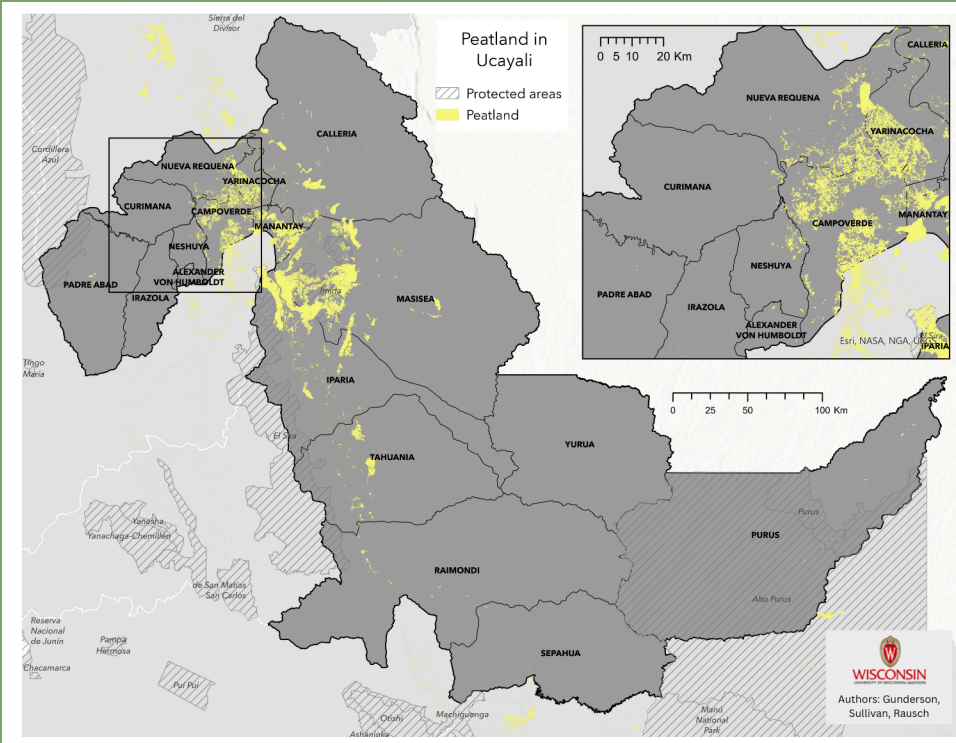DATA: HASTIE ET AL. 2022

Peatlands are wetland areas with an organic soil layer made up of decaying plant material. Mapping peatlands is important because they serve as crucial carbon sinks, helping to mitigate climate change. Conversely, they can become a source of significant greenhouse gas emissions when land use change occurs within them.

There are over 6 million hectares (ha) of peatland in Peru: 91% of which is in the department of Loreto (5.6 million ha), followed by 5% in Ucayali (307,184 ha) and 3% in Madre de Dios (184,310 ha). San Martin has 19,856 ha of peatland (~0.3% of the country's total), located in the Lamas and San Martin provinces.

Only 13% of the peatlands in Peru are currently within protected areas. However, as part of their Nationally Determined Contributions (NDCs), Peru has recently committed to protecting 2.5 million ha of Amazonian peatlands between 2023 and 2030 [2]. This initiative aims to support the country's climate change mitigation efforts, contributing toward the national goal of reducing total greenhouse gas emissions by 40% by 2030.

[2] Chavez, Astrid. 2024. "A Major Milestone: Peru Officially Includes Amazonian Peatlands in Its NDCs." Global Peatlands Initiative. June 18, 2024.

Peatland in Ucayali

Protected areas
Peatland

0 5 10 20 Km

Sierra del Divisor

Cordillera Azul

CALLERIA

NUEVA REQUENA
YARINACOCHA
CURIMANA
CAMPOVERDE
MANANTAY
NESHUYA
ALEXANDER VON HUMBOLDT
IRAZOLA
PADRE ABAD

Tingo Maria

MASISEA

IPARIA

TAHUANIA

YURUA

PURUS

RAIMONDI

SEPAHUA

Yanesha
Yanachaga-Chemillén

Reserva Nacional de Junín

Pampa Hermosa

Chacamarca

Pul Pul

Otishi
Ashaninka

Machiguenga

Manú National Park

El Sira

Esri, NASA, NGA, USGS

CALLERIA
NUEVA REQUENA
YARINACOCHA
CURIMANA
CAMPOVERDE
MANANTAY
NESHUYA
IRAZOLA
ALEXANDER VON HUMBOLDT
PADRE ABAD
PARIA

0 25 50 100 Km

WISCONSIN
UNIVERSITY OF WISCONSIN-MADISON

Authors: Gunderson, Sullivan, Rausch

Rio Mayo
Alto Mayo
RIOJA
MOYOBAMBA
LAMAS
EL DORADO
HUALLAGA
SAN MARTIN
PICOTA
MARISCAL CACERES
BELLAVISTA
Rio Abiseo National Park
Cordillera Azul
TOCACHE

Peatland in San Martin

Protected areas
Peatland

Huascarán National Park

0 20 40 80 Km

Esri, USGS

Peatland in Peru

Peatland
Protected areas
Departments

TUMBES
PIURA
LAMBAYEQUE
CAJAMARCA
LA LIBERTAD
AMAZONAS
LORETO
SAN MARTIN
ANCASH
HUANUCO
UCAYALI
PASCO
LIMA
CALLAO
JUNIN
MADRE DE DIOS
HUANCAVELICA
CUSCO
ICA
AYACUCHO
APURIMAC
PUNO
AREQUIPA
MOQUEGUA
TACNA

0 125 250 500 Km

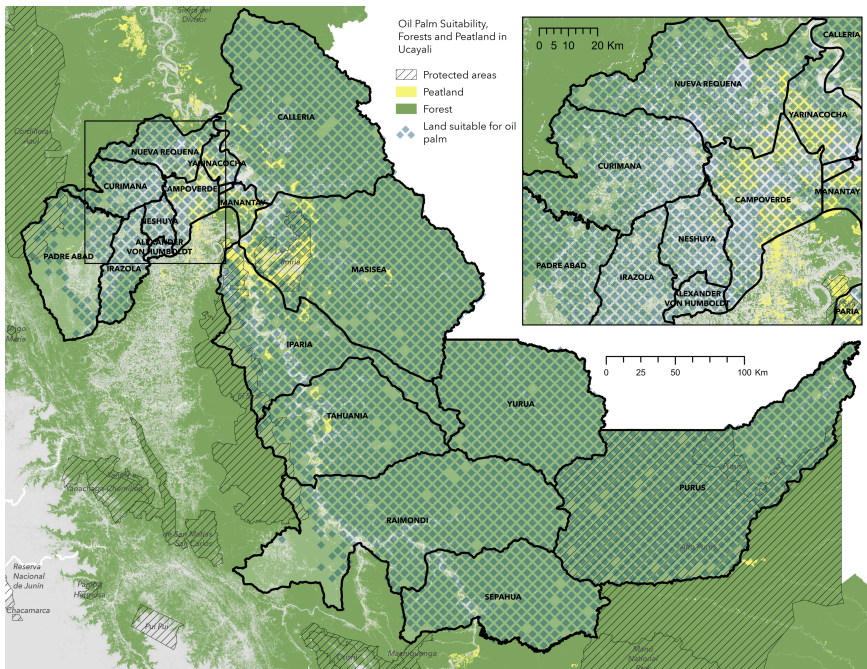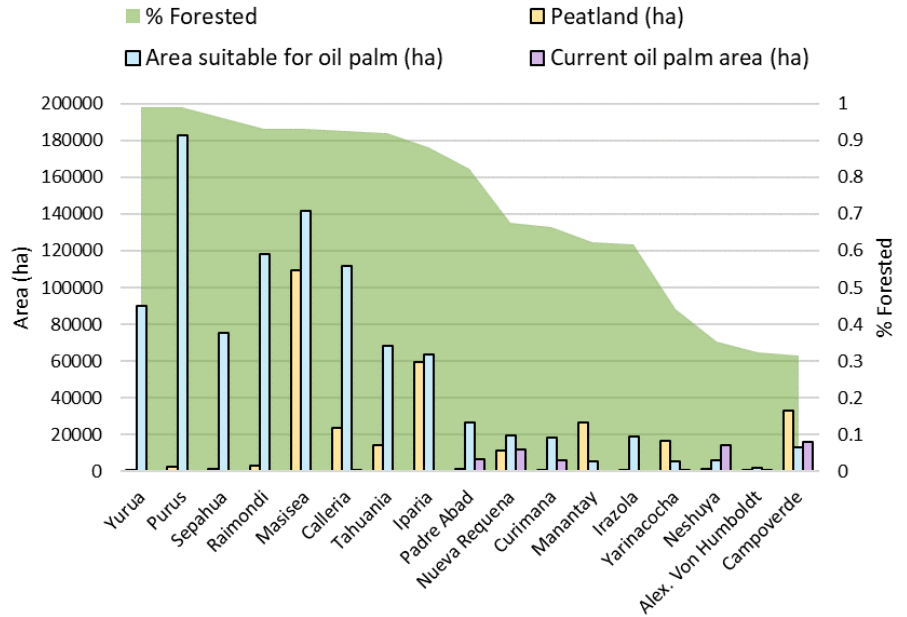Esri, Toporop, Garmin, FAO, NOAA, USGS

# OIL PALM SUITABILITY, PEATLAND AND FORESTS IN UCAYALI

DATA: PIRKER ET AL. 2016, MAPBIOMAS, PERU 2024, HASTIE ET AL. 2024, HANSEN ET AL. 2022

While much of Ucayali is biophysically suitable for oil palm cultivation, the majority of the expansion has thus far been concentrated in a few key districts, including Campoverde, Nueva Requena, Neshuya, Padre Abad, and Curimana. As land in these districts becomes increasingly scarce, oil palm cultivation is likely to push into other regions within the department.





Calleria and Masisea are among the districts with significant potential for expansion, as they contain vast areas of suitable land for production. However, they also harbor extensive peat soils—over 109,000 ha in Masisea and 23,800 ha in Calleria—which serve a vital role in climate change mitigation. They also have much of their forests intact. Without protection, these peatlands and forests risk being converted to agricultural use.

# OIL PALM SUITABILITY, PEATLAND AND FORESTS IN SAN MARTIN

DATA: PIRKER ET AL. 2016, MAPBIOMAS, PERU 2024, HASTIE ET AL 2024, HANSEN ET AL. 2022





Oil Palm Suitability, Forests and Peatland in San Martin
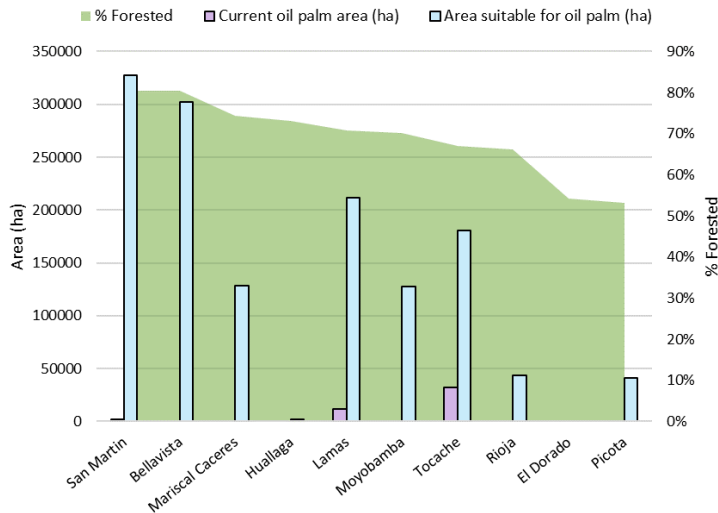
San Martin hosts 3.7 million hectares of forests, with provinces such as San Martin and Bellavista preserving over 80% of their original forest cover. These areas support significant biodiversity, including endemic, threatened, and forest-dependent species.

To date, oil palm expansion in San Martin has been relatively limited, with plantations established in Tocache, San Martin, and Lamas. However, similar to Ucayali, the region holds considerable potential for future growth.

The provinces of San Martin and Bellavista have the largest biophysically suitable areas for oil palm development. Promoting oil palm cultivation on previously deforested and degraded lands in these areas offers an opportunity to balance the commodity's expansion with the protection of critical biodiversity hotspots.
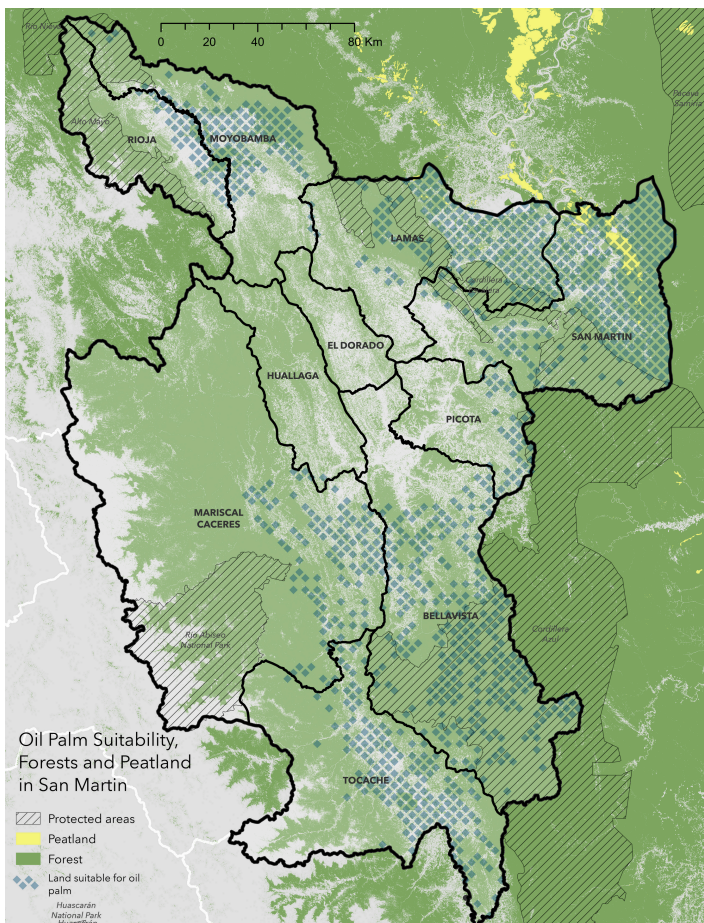
# CONCLUSION

Ucayali and San Martin, located within the Amazon biome, host biodiverse, carbon-rich forests and peatlands that are home to numerous endemic and threatened species. These critical environments are increasingly at risk from agricultural expansion, including the growing global demand for oil palm. While oil palm cultivation remains relatively limited in both Ucayali and San Martin, biophysical suitability modeling by Pirker et al. (2016) suggests considerable potential for future expansion, which poses a threat to these ecosystems.

To ensure a balance between oil palm development and the conservation of biodiversity, forests, and peatlands, it is crucial to prioritize production on already deforested and degraded lands, while steering clear of ecologically sensitive areas. Given that biophysical factors are unlikely to constrain oil palm expansion, careful planning of infrastructure —such as roads and processing mills— should be implemented with a focus on minimizing ecological disruption. Special attention must be given to protecting intact forests, peat soils, and habitats of vulnerable species from further degradation.



*Cinclodes aricomae*

*Synallaxis maranonica*

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