

INVESTIGACIONES CIENTÍFICAS AMBIENTALES 2020-2021



APORTES PARA LA TOMA DE DECISIONES TOMO I

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Viceministerio de Gestión Ambiental
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PARA LAS INVERSIONES SOSTENIBLES



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PRÓLOGO

El Perú es un país megadiverso y con una gran diversidad cultural, en el que existen permanentes amenazas a los distintos ecosistemas, a la enorme diversidad de formas de vida y a la salud humana. Para atender estos problemas, resulta fundamental contar con información certera, confiable y oportuna, que permita tomar las decisiones apropiadas, y con tecnología adecuada para asegurar la sostenibilidad ambiental, económica y social de nuestro país.

En la Política Nacional del Ambiente al 2030 se enuncia como situación futura deseada: “Al 2030, el Perú ha disminuido el índice de fragilidad en menos de 4 % y se mantuvo en 55 % en el índice de biodiversidad y los bienes y servicios que los ecosistemas proveen en relación al 2020, lo cual contribuyó de manera efectiva a la gestión sostenible de la naturaleza, a la adopción de medidas frente al cambio climático, a la sostenibilidad ambiental y al desarrollo de las personas”.

Las investigaciones realizadas, promovidas y/o desarrolladas en el sector ambiente, por los organismos adscritos al Ministerio del Ambiente, explicita los avances en la generación de conocimiento en temas relacionados a la gestión ambiental del país referidos a la calidad ambiental, conservación de las especies y la diversidad genética, deforestación y degradación de ecosistemas, economía circular y cadenas productivas sostenibles, gestión de riesgos y adaptación al cambio climático, gobernanza ambiental, reducción de emisiones de gases de efecto invernadero y gestión integral de residuos sólidos, en el periodo 2020-2021.

Esta publicación pretende facilitar el acceso y uso de los resultados de investigaciones científicas para la toma de decisiones, así como propiciar alianzas estratégicas que permitan solucionar los problemas ambientales entre los organismos adscritos al sector, investigación del Instituto Geofísico del Perú (IGP), Instituto de Investigaciones de la Amazonía Peruana (IIAP), Instituto Nacional de Investigación en Glaciares y Ecosistemas de Montaña (Inaigem), Organismo de Evaluación y Fiscalización (OEFA), Servicio de Certificación y Evaluación (Senace), Servicio Nacional de Áreas Naturales Protegidas por el Estado (Sernanp) y Servicio Nacional de Meteorología e Hidrología (Senamhi); así como con otros sectores nacionales, la academia y a nivel internacional.

Modesto Montoya Zavaleta
Ministro del Ambiente

PRESENTACIÓN

El Estado peruano, en el primer decenio del siglo 21, promulgó la Ley Marco del Sistema Nacional de Gestión Ambiental, la Ley de creación del Ministerio del Ambiente y la Ley General del Ambiente, que fortalecen la institucionalidad ambiental, con el propósito de definir y orientar el accionar de las entidades del gobierno nacional, regional y local, las del sector privado y las de la sociedad civil, en materia ambiental.

La Política Nacional del Ambiente al 2030 determina como problema público la “Disminución de los bienes y servicios que proveen los ecosistemas que afectan el desarrollo de las personas y la sostenibilidad ambiental”, considerando que a pesar de que la acción humana está generando una acción sostenida, el reto es ser ambientalmente sostenible sobre la naturaleza y sus recursos, en la búsqueda del bienestar humano. Resaltamos, el MINAM ha identificado que la degradación de los ecosistemas del país está causando la disminución de los bienes y servicios que proveen los ecosistemas; afectando al bienestar de los peruanos.

La recuperación de los bienes y servicios ecosistémicos en el país será posible si se logra evitar la pérdida continua de la diversidad biológica, implementar soluciones para los impactos negativos de la calidad ambiental y reducir los riesgos e impactos ante peligros de origen natural y antrópicos frente al cambio climático, en ese sentido, el conocimiento científico y el desarrollo de tecnología son las rutas para la solución de problemas ambientales.

Con el propósito de dar soporte a las políticas públicas ambientales y a la toma de decisiones basadas en evidencias, presentamos de forma sistematizada, en relación a ejes estratégicos al 2030, las investigaciones ambientales desarrolladas por los institutos de investigación adscritos al MINAM en el periodo 2020-2021, resaltando los aspectos más importantes de cada publicación científica, así como el acceso directo a los artículos científicos de forma completa. Con la difusión de esta publicación procuramos motivar el fortalecimiento de las capacidades de generación del conocimiento ambiental y el desarrollo de sinergias dentro del marco que vincula a los generadores y usuarios del conocimiento.

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I. CALIDAD AMBIENTAL



A global observational analysis to understand changes in air quality during exceptionally low anthropogenic emission conditions

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Resumen

Este estudio global, que ha sido coordinado por el programa Global Atmospheric Watch (WMO/GAW) de la Organización Meteorológica Mundial, tiene como objetivo comprender el comportamiento de las principales especies contaminantes del aire durante el período de la pandemia de COVID-19 de emisiones excepcionalmente bajas en todo el mundo. Investigamos los efectos de las diferencias tanto en las emisiones como en la meteorología regional y local en 2020 en comparación con el período 2015-2019. Al adoptar un enfoque coherente a nivel mundial, este análisis observacional integral se centra en los cambios en la calidad del aire en las ciudades de todo el mundo y sus alrededores para los siguientes contaminantes atmosféricos PM_{2,5}, PM₁₀, PMC (fracción gruesa de PM), NO₂, SO₂, NO_x, CO, O₃ y el oxidante gaseoso total (OX = NO₂ + O₃) durante el prebloqueo, el bloqueo parcial, el bloqueo total y dos períodos de relajación que abarcan de enero a septiembre de 2020. El análisis se basa en observaciones in situ de la calidad del aire en tierra en más de 540 estaciones de tráfico, de fondo y rurales, de 63 ciudades y cubriendo 25 países en siete regiones geográficas del mundo. Se calcularon las anomalías en las concentraciones de contaminantes del aire (aumentos o disminuciones durante los períodos de 2020 en comparación con los períodos equivalentes de 2015 a 2019) y se analizaron los posibles efectos de las condiciones meteorológicas calculando las anomalías de los reanálisis de ERA5 y las observaciones locales para estos períodos. Observamos una correlación positiva entre las reducciones de NO₂ y concentraciones de NO_x y movilidad de las personas para la mayoría de las ciudades. También se observó una correlación entre el PMC y los cambios de movilidad en algunas ciudades de Asia y América del Sur. No se observó una señal clara para otros contaminantes, lo que sugiere que otras fuentes, además de las emisiones vehiculares, también contribuyeron sustancialmente al cambio en la calidad del aire.

Como resumen global y regional de los cambios en las concentraciones ambientales de especies clave para la calidad del aire, observamos disminuciones de hasta un 70 % en la media de NO₂ y entre un 30 % y un 40 % en las concentraciones medias de PM_{2,5} durante el confinamiento total de 2020 en comparación con el mismo período en 2015-2019. Sin embargo, PM_{2,5} mostró señales complejas, incluso dentro de la misma región, con aumentos en algunas ciudades españolas, atribuidos principalmente al transporte de largo alcance de polvo africano y/o quema de biomasa (corroborado con el análisis de la relación NO₂/CO). Algunas ciudades chinas mostraron aumentos similares en PM_{2,5} durante los períodos de confinamiento, pero en este caso, probablemente se debió a la formación secundaria de PM. Cambios en O₃ las concentraciones fueron muy heterogéneas, sin cambios generales o pequeños aumentos (como en el caso de Europa), y anomalías positivas del 25 % y 30 % en el este de Asia y América del Sur, respectivamente, con

Colombia mostrando la mayor anomalía positiva de ~70 %. Las anomalías de SO₂ fueron negativas para 2020 en comparación con 2015-2019 (entre ~25 y 60 %) para todas las regiones. Para CO, se observaron anomalías negativas para todas las regiones con la mayor disminución para América del Sur de hasta ~40%. La relación NO₂ /CO indicó que sitios específicos (como los de las ciudades españolas) se vieron afectados por penachos de quema de biomasa, que compensaron la disminución de NO₂ debido a la reducción general de la movilidad (relación de ~60%). Análisis del oxidante total (OX = NO₂ + O₃) mostró que las emisiones primarias de NO₂ en ubicaciones urbanas fueron mayores que la producción de O₃, mientras que en los sitios de fondo, OX fue impulsado principalmente por las contribuciones regionales en lugar de las locales de NO₂ y O₃ concentraciones. El presente estudio destaca claramente la importancia de la meteorología y las contribuciones episódicas (p. ej., del polvo, la quema de biomasa doméstica y agrícola y la fertilización de cultivos) al analizar la calidad del aire en las ciudades y sus alrededores, incluso durante grandes reducciones de emisiones. Todavía existe la necesidad de comprender mejor cómo las respuestas químicas de los contaminantes secundarios a los cambios de emisión en condiciones meteorológicas complejas, junto con el cambio climático y los factores socioeconómicos, pueden afectar la calidad del aire en el futuro. Las implicaciones para las políticas regionales y globales también son significativas, ya que nuestro estudio indica claramente que el PM_{2.5} es probable que las concentraciones no cumplan con las pautas de la Organización Mundial de la Salud en muchas partes del mundo, a pesar de las drásticas reducciones en la movilidad. En consecuencia, es posible que se requieran revisiones de la regulación de la calidad del aire (por ejemplo, el Protocolo de Gotemburgo) con objetivos más ambiciosos que sean específicos para las diferentes regiones del mundo.

Abstract

This global study, which has been coordinated by the World Meteorological Organization Global Atmospheric Watch (WMO/GAW) programme, aims to understand the behaviour of key air pollutant species during the COVID-19 pandemic period of exceptionally low emissions across the globe. We investigated the effects of the differences in both emissions and regional and local meteorology in 2020 compared with the period 2015–2019. By adopting a globally consistent approach, this comprehensive observational analysis focuses on changes in air quality in and around cities across the globe for the following air pollutants PM_{2.5}, PM₁₀, PM_{10-2.5} (coarse fraction of PM), NO₂, SO₂, NO_x, CO, O₃ and the total gaseous oxidant (OX = NO₂ + O₃) during the pre-lockdown, partial lockdown, full lockdown and two relaxation periods spanning from January to September 2020. The analysis is based on in situ ground-based air quality observations at over 540 traffic, background and rural stations, from 63 cities and covering 25 countries over seven geographical regions of the world. Anomalies in the air pollutant concentrations (increases or decreases during 2020 periods compared to equivalent 2015–2019 periods) were calculated and the possible effects of meteorological conditions were analysed by computing anomalies from ERA5 reanalyses and local observations for these periods. We observed a positive correlation between the reductions in NO₂ and NO_x concentrations and peoples' mobility for most cities. A correlation between PM_{10-2.5} and mobility changes was also seen for some Asian and South American cities. A clear signal was not observed for other pollutants, suggesting that sources besides vehicular emissions also substantially contributed to the change in air quality.

As a global and regional overview of the changes in ambient concentrations of key air quality species, we observed decreases of up to about 70% in mean NO₂ and between 30% and 40% in mean PM_{2.5} concentrations over 2020 full lockdown compared to the same period in 2015–2019.

However, PM_{2.5} exhibited complex signals, even within the same region, with increases in some Spanish cities, attributed mainly to the long-range transport of African dust and/or biomass burning (corroborated with the analysis of NO₂/CO ratio). Some Chinese cities showed similar increases in PM_{2.5} during the lockdown periods, but in this case, it was likely due to secondary PM formation. Changes in O₃ concentrations were highly heterogeneous, with no overall change or small increases (as in the case of Europe), and positive anomalies of 25% and 30% in East Asia and South America, respectively, with Colombia showing the largest positive anomaly of ~70%. The SO₂ anomalies were negative for 2020 compared to 2015–2019 (between ~25 to 60%) for all regions. For CO, negative anomalies were observed for all regions with the largest decrease for South America of up to ~40%. The NO₂/CO ratio indicated that specific sites (such as those in Spanish cities) were affected by biomass burning plumes, which outweighed the NO₂ decrease due to the general reduction in mobility (ratio of ~60%). Analysis of the total oxidant (OX = NO₂ + O₃) showed that primary NO₂ emissions at urban locations were greater than the O₃ production, whereas at background sites, OX was mostly driven by the regional contributions rather than local NO₂ and O₃ concentrations. The present study clearly highlights the importance of meteorology and episodic contributions (e.g., from dust, domestic, agricultural biomass burning and crop fertilizing) when analysing air quality in and around cities even during large emissions reductions. There is still the need to better understand how the chemical responses of secondary pollutants to emission change under complex meteorological conditions, along with climate change and socio-economic drivers may affect future air quality. The implications for regional and global policies are also significant, as our study clearly indicates that PM_{2.5} concentrations would not likely meet the World Health Organization guidelines in many parts of the world, despite the drastic reductions in mobility. Consequently, revisions of air quality regulation (e.g., the Gothenburg Protocol) with more ambitious targets that are specific to the different regions of the world may well be required.

Enlace: <https://doi.org/10.1016/j.envint.2021.106818>

Chemical Characteristics and Identification of PM10 Sources in Two Lima Districts, Peru

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Resumen

El presente estudio evalúa la concentración de PM10 y PM2.5 e identifica las fuentes contaminantes en los distritos de San Juan de Lurigancho (SJL) y Puente Piedra (PPD), Lima-Perú. Las muestras fueron colectadas por el servicio nacional de Meteorología e Hidrología del Perú en abril a mayo del 2017. La concentración de PM10 y PM2.5, registradas a través de técnicas gravimétricas, excedieron el estándar internacional (OMS) y nacional; encontrándose valores máximos para PM10 y PM2.5 de 160 y 121.56 $\mu\text{g}/\text{m}^3$ en PPD y 295.06 y 154.58 $\mu\text{g}/\text{m}^3$ en SJL. La identificación de fuentes contaminantes para PM10 y PM2.5, obtenidas mediante el Modelo de Factorización de Matriz Positiva (PMF v. 5.0) y análisis por componentes principales (ACP), mostraron fuentes similares para ambos. En SJL se determinó la combinación de tráfico vehicular + resuspensión de polvo de suelo, aerosol marino e industria de hierro y acero; mientras que, en PPD se logró identificar la resuspensión de polvo del suelo, fuente vehicular, actividad industrial y aerosol marino.

Abstract

This study evaluates the concentration of PM10 and PM2.5 and identification of source in the districts of San Juan de Lurigancho and Puente Piedra (PPD) in Lima-Peru. The samples were collected from April to May 2017 by the National Meteorology and Hydrology Service of Peru (Senamhi). The concentration of PM10 and PM2.5, measured by gravimetric techniques, exceeded the international (WHO) and national standards; with maximum values for PM10 and PM2.5 of 160 and 121.56 $\mu\text{g}/\text{m}^3$ in PPD and 295.06 and 154.58 $\mu\text{g}/\text{m}^3$ in SJL. Identification of sources by the Positive Matrix Factorization Model (PMF 5.0) and Principal Component Analysis (ACP), showed similar sources for both districts. In SJL, the combination of vehicular traffic and resuspension of soil dust, marine aerosol and iron and steel industry was determined, while in PPD the resuspension of soil dust, vehicular source, industrial activity and marine aerosol.

Enlace: <https://doi.org/10.15446/dyna.v87n215.83688>

Comportamiento de los aerosoles atmosféricos en el Observatorio de Huancayo durante los eventos de quema de biomasa del año 2019

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Resumen

Se determinaron las características del aerosol recuperado en la estación AERONET de Huancayo. El estudio se realizó durante los eventos de quema de biomasa del año 2019. Se procesaron los datos del sensor MODIS de los satélites Aqua y Terra, y del fotómetro CIMEL. Se ha calculado los valores medios, mínimos y máximos del espesor óptico del aerosol (AOD) y el exponente de Angstrom (EA), así mismo se determinó los tipos de aerosoles presente en el Observatorio de Huancayo. Para la intercomparación de los resultados se utilizaron los datos in-situ del Fotómetro de la red internacional AERONET localizado Huancayo. La media del AOD y el EA medido con AERONET respectivamente es 0.159 ± 0.073 y 1.624 ± 0.198 . Los valores medios del AOD Aqua y Terra son respectivamente 0.088 ± 0.056 y 0.098 ± 0.087 . El análisis de retrotrayectoria realizado mediante HYSPLIT muestra que la mayor parte de aerosoles que llegan al observatorio de Huancayo provienen de las regiones de Ucayali, Huánuco y Pasco, sin embargo, hay un pequeño porcentaje que se genera en los territorios de Brasil y Bolivia. Al intercomparar el AOD Aqua y Terra con AERONET, se obtuvo respectivamente los coeficientes de correlación $r = 0.794$ y 0.796 .

Enlace: <https://doi.org/10.15381/rif.v24i1.20246>

Impacto de las medidas implementadas por COVID-19 en la contaminación del aire en el Área de Lima Metropolitana, Perú

Effects of COVID-19 pandemic control measures on air pollution in Lima metropolitan area, Peru in South America

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Resumen

Las medidas sanitarias implementadas para controlar y prevenir un aumento de los contagios por la pandemia de COVID-19 han producido una mejora en la calidad del aire de muchas zonas urbanas de todo el mundo. Evaluamos la calidad del aire durante la pandemia de COVID-19 para partículas (PM_{2.5} y PM₁₀), NO₂ y O₃ en el área metropolitana de Lima, Perú entre período previo al confinamiento (1 de febrero y 15 de marzo de 2020), período histórico (16 de marzo al 30 de abril de 2017-2019) y período de confinamiento (16 de marzo al 30 de abril de 2020). El confinamiento nacional completo que se implementó en Perú produjo reducciones estadísticamente significativas en el contaminante en el aire (PM₁₀ (-40% y -58%), PM_{2.5} (-31% y -43%) y NO₂ (-46% y -48%)), según lo registrado por la red de monitoreo de la calidad del aire terrestre en toda el área metropolitana, en comparación con las concentraciones correspondientes para las semanas anteriores y durante el mismo período para 2017-2019. El análisis de la distribución espacial de los datos satelitales también muestra disminuciones en las concentraciones de PM₁₀, PM_{2.5} y NO₂ como resultado de las medidas de contención y suspensión de actividades implementadas por el gobierno peruano. Las concentraciones de O₃ aumentó significativamente (11% y 170%) como resultado de la disminución en la concentración de NO₂, confirmando que el área de estudio es un sistema limitado en hidrocarburos, como se informó anteriormente. Los resultados obtenidos contribuyen a la evaluación por parte de los organismos reguladores de las posibles estrategias de control y seguimiento de la contaminación atmosférica en el área de estudio.

Abstract

The sanitary measures implemented to control and prevent an increase in infections due to the COVID-19 pandemic have produced an improvement in the air quality of many urban areas around the world. We assessed air quality during the COVID-19 pandemic for particulate matter (PM_{2.5} and PM₁₀), NO₂ and O₃ in in metropolitan area of Lima, Peru between pre-lockdown period (February 1 and March 15 of 2020), historical period (March 16 to April 30 2017–2019) and lockdown period (March 16 to April 30, 2020). The complete national lockdown that was implemented in Peru produced statistically significant reductions in the in-air pollutant (PM₁₀ (-40% and -58%), PM_{2.5} (-31% and -43%) and NO₂ (-46% and -48%)), as recorded by the by the ground-based air quality monitoring network throughout the metropolitan area, compared with the corresponding concentrations for the previous weeks and over the same period for 2017–2019. Analysis of the spatial Distribution of satellite data also show decreases in the concentrations of PM₁₀, PM_{2.5} and

NO₂ as a result of the containment measures and suspension of activities implemented by the Peruvian government. The concentrations of O₃ significantly increased (11% and 170%) as a result of the decrease in the concentration of NO₂, confirming that the study area is a hydrocarbon-limited system, as previously reported. The results obtained contribute to the assessment by the regulatory agencies of the possible strategies of control and monitoring of air pollution in the study area.

Enlace: <https://doi.org/10.1007/s11869-021-00990-3>

Seasonal variability of daily evapotranspiration and energy fluxes in the Central Andes of Peru using eddy covariance techniques and empirical methods

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Abstract

In this study, we analyze the mechanisms associated to evapotranspiration over the high central Peruvian Andes, a place where evapotranspiration has been poorly characterized. We made use of the eddy covariance system (sonic anemometer and a krypton hygrometer) installed at the Huancayo Observatory (12.04° S, 75.32°, 3330 m.a.s.l.) to document for the first time the hourly, daily and monthly variability of surface energy fluxes from July 2016 to June 2017. The relationship between evapotranspiration and meteorological variables is also examined. Furthermore, we evaluated the performance of three empirical equations that estimate the potential evapotranspiration to explore their adequacy in the central Peruvian Andes. These are the FAO Penman-Monteith (PM), Priestley-Taylor (PT) and Hargreaves. Likewise, the accuracy of the MODIS16A2 evapotranspiration product was also examined.

Enlace: <http://hdl.handle.net/20.500.12816/5005>

<https://doi.org/10.1016/j.atmosres.2021.105760>

II. CONSERVACIÓN DE LAS ESPECIES Y LA DIVERSIDAD GENÉTICA



Alimentación, comportamiento de oviposición, ciclo de vida y enemigos naturales de *Hamadryas feronia* (Nymphalidae) en la amazonía del Perú

Feeding, oviposition behavior, life cycle, and natural enemies of *Hamadryas feronia* (Nymphalidae) in the Peruvian amazon

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Instituto de Investigaciones de la Amazonía Peruana

Resumen

Introducción: *Hamadryas feronia feronia*, se mimetiza sobre las cortezas de los árboles y suele emitir sonidos al volar que llaman la atención; posee un buen potencial para los bionegocios (exportación, elaboración de artesanías y centros turísticos de crianza). Sin embargo, aún se desconocen sus aspectos biológicos que obstaculizan su crianza en cautiverio. **Objetivos:** Determinar los aspectos biológicos de alimentación, comportamiento de oviposición, ciclo de vida y los enemigos naturales de *Hamadryas feronia feronia* L. en San Rafael-Indiana, Loreto, Perú. **Métodos:** Los muestreos fueron realizados desde enero 2018 a diciembre 2019 en la comunidad de San Rafael, río Amazonas. Los adultos fueron observados durante el día, se registraron sus plantas alimenticias, su comportamiento de oviposición, su ciclo biológico y sus enemigos naturales. El ciclo de vida fue evaluado en el laboratorio, utilizando 20 huevos recientemente depositados en las hojas de su planta hospedera. **Resultados:** Las larvas de *H. feronia feronia* se alimentan de las hojas de *Dalechampia juruana* y los adultos se alimentan de la savia de la corteza de los árboles de *Cedrela odorata*, *Spondias mombin*, *Uncaria guianensis* y de los frutos fermentados de *Syzygium malaccense* y *Pouteria caimito*. Los adultos vuelan en días soleados, los machos emiten un fuerte sonido al volar. Las hembras previo a la oviposición revolotean de forma irregular alrededor de su planta hospedera entre las 8.00 y las 14.00 h y depositan sus huevos en el haz y envés de las hojas de forma aislada con mayor frecuencia en el envés (N= 85). La duración del ciclo, desde huevo hasta adulto fue de 28.24 días. El periodo promedio del huevo fue 3.75 ± 0.40 días. La larva pasa por cinco estadios larvales: el primero duró 3.21 ± 1.03 días, el segundo 2.78 ± 0.73 días, el tercero 2.67 ± 0.77 días, el cuarto 3.22 ± 0.81 días, y el quinto 4.61 ± 0.70 días. El periodo de la prepupa duró 1.33 ± 0.49 días y el de pupa 6.67 ± 0.80 días; los adultos nacieron entre las 10:00 y 11:00 h. Los machos adultos viven en promedio 31.80 ± 3.29 días, la hembra 42.00 ± 2.14 días y sus huevos son parasitados por un microhimenóptero (Scelionidae). **Conclusiones:** Este estudio permitió conocer los aspectos biológicos de *H. feronia feronia* identificando sus plantas alimenticias tanto de las larvas como de los adultos, su comportamiento de oviposición, así mismo se ha determinado que tiene un ciclo biológico relativamente corto con un periodo menor de un mes y sus huevos son consumidos por un pequeño Himenóptero que puede obstaculizar su producción. Este trabajo brinda información necesaria para desarrollar la crianza de *H. feronia feronia*, orientado a su conservación, la educación ambiental y los bionegocios (turismo y artesanía) en la Amazonia peruana.

Abstract

Introduction: *Hamadryas feronia feronia*, which mimics the bark of trees and often makes attention-grabbing sounds when flying, has good potential for bio-business (export, handicrafts and tourist breeding centers). However, its biological aspects are still unknown, which hinder its captive breeding. **Objectives:** To determine the biological aspects of feeding, oviposition behavior, life cycle and natural enemies of *Hamadryas feronia feronia* L. in San Rafael-Indiana, Loreto, Peru. **Methods:** Sampling was conducted from January 2018 to December 2019 in the community of San Rafael, Amazon River. Adults were observed during the day, their food plants, oviposition behavior, biological cycle and natural enemies were recorded. The life cycle was evaluated in the laboratory, using 20 eggs recently deposited on the leaves of their host plant. **Results:** The larvae of *H. feronia feronia* feed on the leaves of *Dalechampia juruana* and the adults feed on the bark sap of *Cedrela odorata*, *Spondias mombin*, *Uncaria guianensis* and the fermented fruits of *Syzygium malaccense* and *Pouteria caimito*. Adults fly on sunny days, males emit a loud sound when flying. Females prior to oviposition flit irregularly around their host plant between 8.00 and 14.00 h and deposit their eggs on the upper and underside of leaves in isolation, most frequently on the underside. The duration of the cycle from egg to adult was 28.24 days. The average egg period was 3.75 ± 0.40 days. The larvae passed through five larval instars: the first instar 3.21 ± 1.03 days, the second 2.78 ± 0.73 days, the third 2.67 ± 0.77 days, the fourth 3.22 ± 0.81 days, and the fifth 4.61 ± 0.70 days. The prepupal period lasted 1.33 ± 0.49 days and the pupal period 6.67 ± 0.80 days; the adults hatched between 10:00 to 11:00 h. Adult males lived on average 31.80 ± 3.29 days, the female 42.00 ± 2.14 days and their eggs were parasitized by a microhymenopteran (Scelionidae). **Conclusions:** This study allowed to know the biological aspects of *H. feronia feronia* identifying its food plants of both larvae and adults, its oviposition behavior, as well as it has been determined that it has a relatively short biological cycle with a period of less than one month and its eggs are consumed by a small Hymenoptera that can hinder its production. This work provides necessary information to develop the breeding of *H. feronia feronia*, oriented to its conservation, environmental education and biotrade (tourism and handicrafts) in the Peruvian Amazon.

Enlace: <https://doi.org/10.15517/rbt.v69i2.44969>

A new species of nurse-frog (Aromobatidae, Allobates) from the Amazonian Forest of Loreto, Peru

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Abstract

We describe a new species of nurse-frog (Aromobatidae, Allobates) from the Amazonian Forest of Loreto, Peru using morphological, acoustic and genetic data. Our phylogenetic analysis placed *Allobates sieggreenae* sp. nov. as the sister species of *A. trilineatus*, the most similar-looking species and with which it was previously confused. However, the new species has a brown dorsum, solid dark brown lateral dark stripe not fading towards groin, adult males with few and sparse melanophores over a cream background on chin, chest, and belly, dark transverse bars absent on thighs, and an advertisement call formed by a trill of single notes (in *A. trilineatus* dorsum dark brown, blackish brown lateral dark stripe, paler from mid-body to groin, adult males with a dark background color on chin, chest, and belly due to a dense layer of melanophores, dark transverse bar present on dorsal surface of thighs, and trills of paired notes). *Allobates sieggreenae* is known from two localities of Amazonian white-sand forest ecosystems east of the Ucayali River.

Enlace: <https://doi.org/10.11646/zootaxa.5026.3.3>

A New Species of *Mymarothecium tantaliani* n. sp (Monogenea: Dactylogiridae) in the Gills of Gamitana *Colossoma macropomum* (Cuvier) from Madre de Dios, Peru

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Abstract

Introduction

Members of the genus *Mymarothecium* Kritsky, Boeger & Jégu, 1996 infect characiform fish in the Amazon River Basin. Although the Peruvian Amazon hosts rich fauna of fish, the taxonomic diversity of parasitic organisms such as *Mymarothecium* has been few explored. A new species of *Mymarothecium* in *Colossoma macropomum* Cuvier, from the southeast of the Peruvian Amazon, is described.

Methods

Monogeneans were isolated from gills of *C. macropomum*, fixed in formaldehyde in 4% solution. For morphological examinations were stained with Gomori's trichrome and others were clarified with Hoyer's medium.

Results

Mymarothecium is the third species of the genus recorded in *C. macropomum*. These new species have been characterized by a slightly sigmoid male copulatory organ (MCO) and the accessory piece with sinuous distal rod with hook-shaped process and a bifurcation in the middle part. Furthermore, the anteromedial projection of the ventral rod has a small conspicuous filament in both anchors.

Conclusions

With the description of this new species, eight species of *Mymarothecium* have been reported in fish of the Serrasalminidae family originating in the Amazon.

Enlace: <https://doi.org/10.1007/s11686-020-00248-5>

Biased-corrected richness estimates for the Amazonian tree flora

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Abstract

Amazonian forests are extraordinarily diverse, but the estimated species richness is very much debated. Here, we apply an ensemble of parametric estimators and a novel technique that includes conspecific spatial aggregation to an extended database of forest plots with up-to-date taxonomy. We show that the species abundance distribution of Amazonia is best approximated by a logseries with aggregated individuals, where aggregation increases with rarity. By averaging several methods to estimate total richness, we confirm that over 15,000 tree species are expected to occur in Amazonia. We also show that using ten times the number of plots would result in an increase to just ~50% of those 15,000 estimated species. To get a more complete sample of all tree species, rigorous field campaigns may be needed but the number of trees in Amazonia will remain an estimate for years to come.

Enlace: <https://doi.org/10.1038/s41598-020-66686-3>

Biogeographic history and habitat specialization shape floristic and phylogenetic composition across Amazonian forests

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Abstract

A major challenge remains to understand the relative contributions of history, dispersal, and environmental filtering to the assembly of hyperdiverse communities across spatial scales. Here, we examine the extent to which biogeographical history and habitat specialization have generated turnover among and within lineages of Amazonian trees across broad geographic and environmental gradients. We replicated standardized tree inventories in 102 0.1-ha plots located in two distant regions—the western Amazon and the eastern Guiana shield. Within each region, we used a nested design to replicate plots on contrasted habitats: white-sand, terra firme, and seasonally flooded forests. Our plot network encompassed 26,386 trees that together represented 2,745 distinct taxa, which we standardized across all plots and regions. We combined taxonomic and phylogenetic data with detailed soil measurements and climatic data to: (1) test whether patterns of taxonomic and phylogenetic composition are consistent with recent or historical processes, (2) disentangle the relative effects of habitat, environment, and geographic distance on taxonomic and phylogenetic turnover among plots, and (3) contrast the proportion of habitat specialists among species from each region. We found substantial species turnover between Peru and French Guiana, with only 8.8% of species shared across regions; genus composition remained differentiated across habitats and regions, whereas turnover at higher taxonomic levels (family, order) was much lower. Species turnover across plots was explained primarily by regions, but also substantially by habitat differences and to a lesser extent by spatial distance within regions. Conversely, the composition of higher taxonomic levels was better explained by habitats (especially comparing white-sand forests to other habitats) than spatial distance. White-sand forests harbored most of the habitat specialists in both regions, with stronger habitat specialization in Peru than in French Guiana. Our results suggest that recent diversification events have resulted in extremely high turnover in species and genus composition with relatively little change in the composition of higher lineages. Our results also emphasize the contributions of rare habitats, such as white-sand forests, to the extraordinary diversity of the Amazon and underline their importance as conservation priorities.

Enlace: <https://doi.org/10.1002/ecm.1473>

Caracterización hematológica de *Astronotus ocellatus* (Cichliformes: Cichlidae)

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Resumen

El estudio tuvo como objetivo caracterizar los parámetros hematológicos de *Astronotus ocellatus* y determinar posibles correlaciones entre variables. Se colectaron muestras de sangre de 15 especímenes (peso: 109.43 ± 22.9 g; longitud total: 15.43 ± 1.28 cm), mantenidos en tanques de concreto. Los peces recibieron una alimentación con dieta comercial extruida, que contenía 42% de proteína bruta. La extracción de sangre se realizó mediante punción del vaso caudal usando jeringas con EDTA (10%). Los valores obtenidos de la serie eritrocítica fueron: hematocrito $24.5 \pm 1.2\%$, hemoglobina 8.8 ± 2.4 g/dl, eritrocitos totales $1.10 \pm 0.10 \times 10^6/\mu\text{l}$, VCM 222.1 ± 41.0 fl, y CHCM 36.7 ± 10.4 g/dl. En la serie leucocítica se identificaron: leucocitos totales $7.3 \pm 2.6 \times 10^3/\mu\text{l}$, linfocitos $67.3 \pm 7.6\%$, monocitos $4.13 \pm 1.4\%$, eosinófilos $27.5 \pm 8.9\%$ y neutrófilos $1.08 \pm 1.3\%$. Para bioquímica sérica fueron: proteína total 3.44 ± 1.1 g/dl, glucosa 64.39 ± 28.8 mg/dl y colesterol 253.4 ± 91.2 mg/dl. Se registró correlación positiva entre hemoglobina-CHCM y correlación negativa entre peso y longitud con número de eritrocitos totales. La mayoría de los valores encontrados están dentro del rango reportado para esta especie.

Enlace: <https://doi.org/10.15381/rivep.v31i2.17827>

Confronting ethical challenges in long-term research programs in the tropics

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Abstract

Ecologists and conservation biologists conducting long-term research programs in the tropics must confront serious ethical challenges that revolve around economic inequalities, cultural differences, supporting the local communities as much as possible, and sharing the knowledge produced by the research. In this collective article, researchers share their experiences and perspectives in dealing with the ethical issues that arise during research activities and cannot be ignored.

Enlace: <https://doi.org/10.1016/j.biocon.2020.108933>

Conservation of migratory fishes in the Amazon basin

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Abstract

The Amazon basin hosts the Earth's highest diversity of freshwater fish. Fish species have adapted to the basin's size and seasonal dynamics by displaying a broad range of migratory behavior, but they are under increasing threats; however, no study to date has assessed threats and conservation of Amazonian migratory fishes. Here, the available knowledge on the diversity of migratory behaviour in Amazonian fishes is synthesized, including the geographical scales at which they occur, their drivers and timing, and life stage at which they are performed. Migratory fishes are integral components of Amazonian society. They contribute about 93% (range 77–99%) of the fisheries landings in the basin, amounting to ~US\$436 million annually. These valuable fish populations are mainly threatened by growing trends of overexploitation, deforestation, climate change, and hydroelectric dam development. Most Amazonian migratory fish have key ecological roles as apex predators, ecological engineers, or seed-dispersal species. Reducing their population sizes could induce cascading effects with implications for ecosystem stability and associated services. Conserving Amazonian migratory fishes requires a broad portfolio of research, management, and conservation actions, within an ecosystem-based management framework at the basin scale. This would require trans-frontier coordination and recognition of the crucial importance of freshwater ecosystems and their connectivity. Existing areas where fishing is allowed could be coupled with a chain of freshwater protected areas. Management of commercial and subsistence species also needs fisheries activities to be monitored in the Amazonian cities and in the floodplain communities to allow assessments of the status of target species, and the identification of management units or stocks. Ensuring that existing and future fisheries management rules are effective implies the voluntary participation of fishers, which can be achieved by increasing the effectiveness and coverage of adaptive community-based management schemes.

Enlace: <https://doi.org/10.1002/aqc.3550>

CRECIMIENTO DE PLÁNTULAS DE CAOBA (*Swietenia macrophylla* King) EN RESPUESTA A EXTRACTOS VEGETALES

GROWTH OF MAHOGANY SEEDLINGS (*Swietenia macrophylla* King) IN RESPONSE TO VEGETABLE EXTRACTS

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Resumen

La caoba (*Swietenia macrophylla* King) requiere nutrientes para que las plantas muestren buena calidad durante su crecimiento en vivero. El objetivo de este estudio fue evaluar la respuesta a extractos foliares de *Ricinus communis* L., *Solanum torvum* Sw. y frutos de *Solanum mammosum* L. en plántulas de caoba. La hipótesis fue que estos extractos mejoran la calidad de las plántulas. El diseño experimental fue completamente al azar, con cuatro tratamientos: T1) *R. communis* L., T2) *S. torvum* Sw., T3) *S. mammosum* L., y T4) testigo sin extracto vegetal, y con cuatro repeticiones de 45 unidades experimentales. Las variables evaluadas fueron morfológicas (tasas de crecimiento de altura y diámetro de tallo, y longitud y número de raíces) y de calidad (peso seco, índice de robustez e índice de calidad de Dickson). Los datos se analizaron mediante ANDEVA de una vía y las medias se compararon con la prueba de Tukey ($p \leq 0.05$). Los tratamientos se aplicaron a las plántulas a los 15 d de emergencia y los extractos se aplicaron vía foliar cada 15 d, con dosis de 60 mL 20 L⁻¹ de cada extracto. Las unidades se midieron cada 15 d, durante 60 d. La aplicación de los extractos produjo tasas de crecimiento y pesos secos 38% superiores respecto a los testigos. El extracto de *R. communis* obtuvo las tasas más altas y el mejor índice de calidad de Dickson (0.28). Por lo tanto, el extracto de esta especie fue la mejor alternativa orgánica para mejorar el crecimiento y la calidad de las plántulas de caoba en vivero.

Abstract

Mahogany (*Swietenia macrophylla* King) requires nutrients for the plants to present good quality during their growth in a nursery. The objective of the present study was to evaluate the response to foliar extracts of *Ricinus communis* L., *Solanum torvum* Sw. and fruits of *Solanum mammosum* L. in mahogany seedlings. The hypothesis was that these extracts improve the quality of the seedlings. The experimental design was completely randomized, with four treatments: 1) *R. communis* L., 2) *S. torvum* Sw., 3) *S. mammosum* L., and T4) control without vegetable extracts, and four replications of 45 experimental units. The variables evaluated were morphological (rates of growth in height and stem diameter, and length and number of roots) and of quality (dry weight, robustness index and Dickson quality index). The data were analyzed through one-way ANOVA and the means were compared with the Tukey test ($p \leq 0.05$). The treatments were applied to the seedlings at 15 d of emergence and the extracts were applied to the foliar surfaces every 15 d, with a dose of 60 mL 20 L⁻¹ of each extract. The units were measured every 15 d, during 60 d. The application of the extracts produced growth rates and dry weights 38% higher with respect to the controls. The extract of *R. communis* obtained the highest rates and the best Dickson quality index (0.28). Therefore, the extract of this species was the best alternative for improving growth and quality of the mahogany seedlings in the nursery.

Enlace: <https://doi.org/10.47163/agrociencia.v54i5.2124>



***Cosmetocleithrum gigas* sp. n. (Monogenoidea: Dactylogyridae) from the gills of *Oxidoras niger* (Siluriformes: Doradidae) from the Peruvian Amazon**

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Abstract

A new species of the Dactylogyridae is reported parasitizing the gills of *Oxidoras niger* (Valenciennes, 1821) from the Peruvian Amazon. *Cosmetocleithrum gigas* sp. n. does not show any resemblance to other species of the genus and can be morphologically differentiated from other congeneric species by presenting a hammer-shaped accessory piece; a small haptor with small bars and anchors; both anchors presenting developed superficial roots and reduced deep roots; conspicuous folds on both roots and bars hat-shaped, expanded laterally forming two protuberances covered with rough folds. Additionally, *C. gigas* sp. n. is the largest species of the genus so far reported.

Enlace: <https://doi.org/10.2478/s11756-019-00331-x>

Daphnanes diterpenes from the latex of *Hura crepitans* L. And activity against human colorectal cancer cells Caco-2

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Abstract

Hura crepitans (Euphorbiaceae) is a tree from South America that produces an irritant latex used as a fish poison. A bio-guided fractionation of an ethanolic extract of the latex led to the isolation and structural identification of three known daphnane-type diterpenes (1–3) including huratoxin (1), together with two new analogs (4, 5). Compound 1 was found to exhibit significant and selective cell growth inhibition against the colorectal cancer cell line Caco-2, with morphological modifications suggesting formations mimicking the intestinal crypt architecture. The underlying mechanism of 1 was further investigated, in comparison with 12-O-tetradecanoylphorbol-13-acetate (TPA), revealing two different mechanisms.

Enlace: <https://doi.org/10.1016/j.bioorg.2020.104132>

DIVERSIDAD DE FLORA Y VEGETACIÓN DEL INTERFLUVIO NAPO-PUTUMAYO-AMAZONAS, PERÚ

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Resumen

El interfluvio Napo-Putumayo-Amazonas en la Amazonía peruana, alberga una gran diversidad de especies de plantas y tipos de vegetación que son muy requeridas por el poblador rural amazónico para subsistencia y comercialización; por lo tanto, la comprensión de su diversidad contribuye con información básica para crear posibles estrategias de conservación que regulen su aprovechamiento. Los objetivos de este estudio fueron evaluar la diversidad de la flora y elaborar un modelo espacial de la vegetación del interfluvio Napo- Putumayo-Amazonas. Los datos se obtuvieron de 10 estudios de inventarios de la flora realizados en el interfluvio. Para la similaridad de la flora se realizó un análisis de similitud (ANOSIM). Se generó un modelo de la distribución espacial de las unidades de vegetación en base a tres parámetros geomorfométricos, los cuales se calcularon a partir de un modelo de elevación digital (con imágenes del sensor Palsar del satélite Alos) e integrados con datos espectrales (de las imágenes ópticas del satélite Sentinel 2) y datos espaciales oficiales. Se encontraron 1807 especies correspondientes a 140 familias de plantas. Existen siete tipos de vegetación, los de mayor superficie corresponden al Bosque de terraza alta, Bosque de colina baja y Bosque de colina alta. La comunidad de plantas entre el bosque de tierra firme y bosque inundable fueron diferentes de acuerdo al análisis de similitud (p -value = 0.001). Las especies: *Oxandra euneura* Diels, *Mauritia flexuosa* L. f., *Euterpe precatoria* Mart., *Cynometra spruceana* Benth., *Pouteria gomphiifolia* (Mart. ex Miq.) Radlk., *Tovomita laurina* Planch. & Triana y *Macrolobium limbatum* Spruce ex Benth. estuvieron más relacionados a los bosques inundables.

Enlace: <https://doi.org/10.24841/fa.v29i2.531>

DIVERSIDAD DE MAMÍFEROS EN EL INTERFLUVIO NAPO- PUTUMAYO-AMAZONAS, AL NORTE DE LA AMAZONÍA PERUANA

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Resumen

Los mamíferos mantienen la estructura del bosque y son importantes como fuente proteica y económica para las comunidades amazónicas. Para conocer la diversidad de mamíferos (excepto murciélagos, roedores pequeños y marsupiales) en los hábitats del interfluvio Putumayo-Napo-Amazonas, se recorrieron 1908,1 km de transectos lineales en donde se avistaron y registraron huellas, 146 cámaras trampa fueron instaladas y se tuvo 977 días/cámaras trampa, se buscaron madrigueras en 118,4 km de transectos. Además, se recopiló información de 13 publicaciones desde 2004 hasta 2020 para conocer la diversidad en el interfluvio. La diversidad fue tomada como riqueza de especies registradas, mientras que la riqueza esperada fue estimada con Chao 1 y la similitud entre hábitats fue analizada con el índice de Morisita. La riqueza fue alta, se registraron 56 especies de 26 familias y 9 órdenes, y fue similar en colina baja, terraza alta, terraza media y aguajal mixto, pero fue muy bajo en el varillal pantanoso y en el bosque de orilla. Los hábitats de terraza media y aguajal mixto fueron muy similares, así como el de terraza alta con colina baja. Los primates *Leontocebus nigricollis*, *Pithecia hirsuta* y *Cheracebus lucifer*, *Lagothrix lagothericha lagothericha* están restringidas a este interfluvio y las especies con mayor amenaza fueron *Pteronura brasiliensis* y *L. lagothericha*. Las amenazas antropogénicas más frecuentes fueron, sobre caza, tala selectiva y deforestación. Este interfluvio tiene una enorme diversidad de mamíferos que puede soportar programas de uso sostenible de animales de caza para beneficiar a las comunidades nativas y de esta forma mitigar las amenazas más frecuentes.

Enlace: <https://doi.org/10.24841/fa.v29i2.529>

Diversidad y composición de mariposas (Lepidoptera: Morphinae y Satyrinae) de los varillales en la Reserva Nacional Allpahuayo Mishana, Loreto, Perú

Diversity and composition of butterflies (Lepidoptera: Morphinae and Satyrinae) in white sand forest (varillales) in the National Reserve Allpahuayo Mishana, Loreto, Peru

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Resumen

Introducción. Las mariposas son indicadores ecológicos muy sensibles a los cambios ambientales; el inventario de sus comunidades es una herramienta válida para conocer el estado de conservación o alteración de su hábitat.

Objetivos. Evaluar la diversidad y composición de las mariposas (Lepidoptera: Morphinae y Satyrinae) en los Varillales de la Reserva Nacional Allpahuayo Mishana (RNAM), Perú.

Metodología. Los muestreos fueron realizados de enero a diciembre del 2015. En un Varillal alto y bajo a lo largo de 7 transectos de 25 m, las mariposas fueron atraídas con cebos de frutas fermentadas y capturadas con una red entomológica, durante 1 semana de cada mes; con recolectas diarias en el transcurso de la mañana y la tarde.

Resultados. Se registraron un total de 2662 individuos, incluidos en 38 especies y 16 géneros, siendo las especies más abundantes *Pierella lena*, *Pierella lamia* y *Cithaerias pireta aurorina* dentro de los Satyrinae; y en los Morphinae figuran *Morpho helenor* y *Caligo eurilochus*. Entre las especies comerciales, resaltan *Morpho menelaus*, *M. helenor*, *Caligo idomeneus*, *C. eurilochus*, *C. pireta aurorina* y *Haetera piera negra*.

Alcance. La mayor riqueza de especies se encontró en el Varillal alto y albergan varias especies de alto valor para fines de educación ambiental y bionegocios.

Abstract

Introduction. Butterflies are very sensitive ecological indicators to environmental changes. The inventory of their communities is a valid tool to know the state of conservation or alteration of their habitat.

Objective. To evaluate the diversity and composition of butterflies (Lepidoptera: Morphinae and Satyrinae) in the varillales of the Allpahuayo Mishana National Reserve (RNAM for its acronym in Spanish), Peru.

Methodology. Sampling was carried out from January to December 2015. Butterflies were attracted with fermented fruit baits and captured with an entomological net in a high and low Varillal along 7 transects of 25m during 1 week of each month, with daily collections in the morning and the afternoon.

Results. A total of 2,662 individuals were recorded, included in 38 species and 16 genera, being the most abundant species *Pierella lena*, *Pierella lamia* and *Cithaerias pireta aurorina* within the Satyrinae, and *Morpho helenor* and *Caligo eurilochus* within the Morphinae. Among the commercial species, *Morpho menelaus*, *M. helenor*, *Caligo idomeneus*, *C. eurilochus*, *C. pireta aurorina* and *Haetera piera negra* stand out.

Scope. The highest species richness was found in the upper Varillal and they host several species of high value for environmental education and biobusiness purposes.

Enlace:

http://www.scielo.org.co/scielo.php?pid=S0123-30682021000100177&script=sci_abstract&tlng=es

<https://doi.org/10.17151/bccm.2021.25.1.11>.



Dynamics of Chemical Diversity during Co-Cultures: An Integrative Time-Scale Metabolomics Study of Fungal Endophytes *Cophiniforma mamane* and *Fusarium solani*

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Abstract

A rapid and efficient metabolomic study of *Cophiniforma mamane* and *Fusarium solani* co-cultivation in time-series based analysis was developed to study metabolome variations during their fungal interactions. The fungal metabolomes were studied through the integration of four metabolomic tools: MS-DIAL, a chromatographic deconvolution of liquid-chromatography-mass spectrometry (LC/MS); MS-FINDER, a structure-elucidation program with a wide range metabolome database; GNPS, an effective method to organize MS/MS fragmentation spectra, and MetaboAnalyst, a comprehensive web application for metabolomic data analysis and interpretation. Co-cultures of *C. mamane* and *F. solani* induced different patterns of metabolite production over 10 days of incubation and induced production of five de novo compounds not occurring in monocultures. These results emphasize that co-culture in time-frame analysis is an interesting method to unravel hidden metabolome in the investigation of fungal chemodiversity.

Enlace: <https://doi.org/10.1002/cbdv.202000672>

Effect of stocking density of juvenile *Arapaima gigas* on rearing water quality hematological and biochemical profile, and productive performance

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Abstract

At inadequate stocking density, fish generally show different physiological responses. The effects of stocking density on *Arapaima gigas* larvae productive parameters have been determined in a previous study. This study aimed to evaluate the effect of the stocking density on the water quality, hematological and biochemical profile, and productive performance of juvenile *A. gigas*. One hundred and eighty twelve months old, *A. gigas* were distributed into tanks using initial densities of 103.90, 157.95 and 220.11 kg m⁻³ with three replicates. Ammoniacal nitrogen, carbon dioxide, dissolved oxygen pH, alkalinity, and hardness were determined using a LaMotte Fish Farm 9, AQ-2 model, Maryland, USA, freshwater test kit. Blood samples were taken at 13, 14, and 15 months old by pricking the caudal vein and profiles of glucose (Glu), total protein (TP), albumin, aspartate transaminase (AST), alanine transaminase (ALT), and urea, were determined in blood serum. Rearing water was saturated in ammoniac nitrogen, carbon dioxide, and dissolved oxygen but have not changed with the increase of stocking density ($P > 0.05$), Erythrocyte's count (EC) diminished ($P < 0.05$), nonetheless, hemoglobin, mean concentration hemoglobin (MCH) and mean cell volume (MCV) increased ($P < 0.05$). Albumin, AST, ALT and urea diminished at 220.11 kg m⁻³ stocking density ($P < 0.05$). The feed intake increased, final biomass gain was 100.26 ± 19.00 , 119.10 ± 13.95 , and 130.24 ± 08.07 kg m⁻³, but did not change as density increased ($P > 0.05$). Juveniles of *A. gigas* showed no variation in productive performance with an increase in the stocking density. Furthermore, hematological and biochemical adapting profile to high stocking densities characterized this species.

Enlace: <https://doi.org/10.3856/vol49-issue2-fulltext-2588>

El conocimiento tradicional para la mejoría de su salud, con especies medicinales en las comunidades indígenas de la etnia Shawi, en la Amazonia peruana

Traditional knowledge for the improvement of their health, with medicinal species in the indigenous communities of the Shawi ethnic group, in Peruvian Amazon

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Resumen

Los Shawi de amazonia peruana conocen y aplican, en su salud plantas medicinales. El estudio se desarrolló en las comunidades de Buenos Aires, Nuevo Cachiyacu y Santa Cruz en el distrito Balsapuerto, provincia Alto Amazonas, región Loreto. Con participación de los pobladores en talleres, visitas a sus chacras y bosques. Los involucrados fueron 27% mujeres y 73% varones, las edades en el rango de 19 a 70 años. El objetivo fue documentar los conocimientos del uso de plantas medicinales, con entrevistas abiertas, los datos analizados fueron nombres comunes de la especie, tipo de enfermedad que cura y formas de preparación. Se colectó información de 24 especies, que consideran las más utilizadas, corresponden a 17 familias botánicas para el tratamiento de 22 enfermedades, mayor número en tratamientos fueron diarrea, cólicos estomacales y heridas externas con cinco especies, y el resto de enfermedades con tres, dos a una especie. Las hojas las más utilizadas en infusiones.

Abstract

Shawi ethnic group located in the Peruvian Amazon know and apply medicinal plants to their health. The study was carried out in communities of Buenos Aires, Nuevo Cachiyacu and Santa Cruz in the Balsapuerto district, Alto Amazonas province, Loreto region; in workshops, visits to their farms and local forests. 27% were women and 73% male, ages in the range of 19 to 70 years old. The objective was to document the knowledge of uses of medicinal plants, with open interviews. Analyzed data included species common names, type of most common diseases, how they cure them and methods of plant preparation. Information of 24 species which they consider the most used was collected. Those corresponded to 17 botanical families and they use them for treatment of 22 diseases. The largest number in treatments were diarrhea, stomach colic and external wounds with five species, and the rest of diseases with three, two to one species. The leaves are the most used in infusions.

Enlace: <https://doi.org/10.37360/mpc.20.3.3.10>

Extending Our Scientific Reach in Arboreal Ecosystems for Research and Management

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Abstract

The arboreal ecosystem is vitally important to global and local biogeochemical processes, the maintenance of biodiversity in natural systems, and human health in urban environments. The ability to collect samples, observations, and data to conduct meaningful scientific research is similarly vital. The primary methods and modes of access remain limited and difficult. In an online survey, canopy researchers ($n = 219$) reported a range of challenges in obtaining adequate samples, including ~10% who found it impossible to procure what they needed. Currently, these samples are collected using a combination of four primary methods: (1) sampling from the ground; (2) tree climbing; (3) constructing fixed infrastructure; and (4) using mobile aerial platforms, primarily rotorcraft drones. An important distinction between instantaneous and continuous sampling was identified, allowing more targeted engineering and development strategies. The combination of methods for sampling the arboreal ecosystem provides a range of possibilities and opportunities, particularly in the context of the rapid development of robotics and other engineering advances. In this study, we aim to identify the strategies that would provide the benefits to a broad range of scientists, arborists, and professional climbers and facilitate basic discovery and applied management. Priorities for advancing these efforts are (1) to expand participation, both geographically and professionally; (2) to define 2–3 common needs across the community; (3) to form and motivate focal teams of biologists, tree professionals, and engineers in the development of solutions to these needs; and (4) to establish multidisciplinary communication platforms to share information about innovations and opportunities for studying arboreal ecosystems.

Enlace: <https://doi.org/10.3389/ffgc.2021.712165>

First record of the gray-legged tinamou, *Crypturellus duidae*, and other poor-soil specialist birds from peatlands in the Putumayo River basin, Loreto, Peru

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Abstract

Crypturellus duidae (Tinamidae) is a poor-soil specialist with isolated populations in Amazonia, and is considered restricted to white-sand forest habitats. We report the first record of *C. duidae* in a peatland forest in northern Peru, in the Putumayo River basin. Our record extends the known distribution of *C. duidae* between two disjoint areas of occurrence in Peru and Colombia, and shows its presence in peatland forest, another forest type on nutrient-poor soils. Additionally, we report the presence of other poor-soil specialist bird species that were previously registered in peatlands. Together with the new record of *C. duidae*, these bird records provide evidence of the diversity of poor-soil specialists in peatland forests.

Enlace: <https://doi.org/10.1590/1809-4392201901531>

Historical biogeography identifies a possible role of Miocene wetlands in the diversification of the Amazonian rocket frogs (*Aromobatidae: Allobates*)

Alejandro Réjaud, Miguel T. Rodrigues, Andrew J. Crawford, Santiago Castroviejo-Fisher, Andrés F. Jaramillo, Juan C. Chaparro, Frank Glaw, Giuseppe Gagliardi-Urrutia, Jirí Moravec, Ignacio J. De la Riva, Pedro Perez, Albertina P. Lima, Fernanda P. Werneck, Tomas Hrbek, Santiago R. Ron, Raffael Ernst, Phillipe J.R. Kok, Amy Driskell, Jerome Chave, Antoine Fouquet

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Abstract

Aim: We investigate the spatiotemporal context of the diversification of *Allobates*, a widespread genus of Amazonian frogs with high species diversity particularly in western Amazonia. We tested if that diversity originated in situ or through repeated dispersals from other Amazonian areas and if this diversification took place during or after the Pebas system, a vast lacustrine system occupying most western Amazonia between 23 and 10 million years ago (Mya).

Enlace: <https://doi.org/10.1111/jbi.13937>

Individual selection in a genetic test with 43 advanced progenies of camu-camu *Myrciaria dubia* Kunth (McVaugh) in floodable plot near Iquitos, Peruvian Amazon

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Abstract

The research summarized and validated the individual selection of camu-camu (*Myrciaria dubia* (Kunth) McVaugh) plants. 43 progenies, previously selected in genetic tests and fields of producers of flood areas, were evaluated. Each progeny was installed in a row of 10 half-sister plants, with a space of 3x2 m. Using the SELEGEN (Reml / Blup) Model 63 program, four crops were analyzed, and individuals were selected for each of the 16 descriptors evaluated. For fruit yield, the Tipishca-Río Tigre population stood out, occupying 5 of the first 10 places. The individuals TT0725-4 (Tigre-Tipishca) turned out to be a natural recombinant for fruit yield / weight. And individual 64-8 turned out to be triple recombinant (yield / fruit weight / ascorbic acid). The descriptors with the highest genetic control with $r \geq 0.30$ were: average fruit weight, brix degrees, plant height, number of basal branches and petiole length. The criteria of similarity of the morphological markers with the fruit yield are proposed as predictive indexes of productivity. The plant height at two years of age was the most important.

Enlace: <https://doi.org/10.17268/sci.agropecu.2020.03.06>

Isolation, identification, and gene expression analysis of the main digestive enzymes during ontogeny of the Neotropical catfish *Pseudoplatystoma punctifer* (Castelnau, 1855)

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Abstract

The ontogeny of the digestive capacities in fish is species-specific and its knowledge is essential for understanding the nutritional requirements of fish larvae. While the Amazon basin contains the world's highest fish biodiversity, the molecular basis of the early digestive physiology has not yet been reported in any Amazonian fish species. In order to increase basic knowledge on the molecular ontogeny of the digestive system of a commercially important Amazonian fish species, six digestive enzyme genes (α -amylase, phospholipase A2, lipoprotein lipase, trypsin, chymotrypsin, and pepsin) were isolated and identified, and their expression analyzed from 3 to 24 days post fertilization (dpf) in *Pseudoplatystoma punctifer*, a catfish species with high potential for aquaculture diversification. The present results, together with those previously obtained on the development of the digestive enzyme activity, showed that gene expression and enzymatic activities are synchronized and that the enzymatic machinery of *P. punctifer* was completely prepared for the onset of exogenous feeding (4 dpf, 6 mm total length, TL) and had reached its maturity between 10 and 13 dpf (11–14 mm TL). This indicated that the transition from the larval to the juvenile mode of digestion had been completed and they were suitable for weaning under culture conditions. Furthermore, the gene expression analyses suggest that this species displays an omnivorous behavior with a preference towards carnivory during early development. The present study provides the first comprehensive ontogenetic analysis of the digestive function from a molecular point of view of a species of the genus *Pseudoplatystoma* and contributes to the development of feeding strategies in the context of South American aquaculture diversification.

Enlace: <https://doi.org/10.1016/j.aquaculture.2021.737031>

Lista actualizada de los anfibios del departamento de Loreto

Updated checklist of the amphibians from Loreto Department

César A. Aguilar, Omar Rojas-Padilla, Ehiko J. Rios-Alva, Marco M. Odicio-Iglesias, Ramón Aguilar-Manihuari, Giuseppe Gagliardi-Urrutia

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Resumen

En este trabajo se presenta una lista actualizada de los anfibios distribuidos en el departamento de Loreto, Perú, incluyendo información sobre el estado de conservación a nivel internacional y nacional, el endemismo y zonas con vacíos de información. Se utilizó literatura herpetológica, bases de datos y especímenes de la colección del Departamento de Herpetología del Museo de Historia Natural de la Universidad Nacional Mayor de San Marcos para la elaboración de esta lista. Se registraron un total de 232 especies, con los anuros (sapos y ranas) representando el 96% del total de anfibios en Loreto. Dieciocho especies son endémicas de Loreto mientras que la gran mayoría (208 especies) tienen una distribución altitudinal por debajo de los 500 m. Diez especies están en categorías de amenaza y cuatro son consideradas casi amenazadas según criterios internacionales, mientras que cuatro están consideradas como amenazadas y seis como casi amenazadas en el listado nacional. Se observa mayor vacío de información en áreas cercanas a las fronteras con Brasil y Colombia.

Abstract

This paper presents an updated list of the amphibians occurring in the department of Loreto, Peru, including information on conservation status, endemic species and areas with information gaps. Herpetological literature, databases and the collection of the Department of Herpetology of the Natural History Museum of the National University of San Marcos were used to update the species list. A total of 232 species were recorded, with anurans (toads and frogs) representing 96% of amphibians in Loreto. eighteen species are endemic to Loreto while the vast majority (208 species) have an altitudinal distribution below 500 m. Ten species are in threatened categories and four are near threatened according to international criteria; while four are considered as threatened and six as near threatened according the national list. Mayor information gaps are observed in areas near the borders with Brazil and Colombia.

Enlace: <https://doi.org/10.15381/RPB.V28IESPECIAL.21912>

Lista actualizada de los reptiles del departamento de Loreto

Updated checklist of the reptiles from Loreto Department

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Resumen

En este trabajo se presenta una lista actualizada de los reptiles distribuidos en el departamento de Loreto, Perú, incluyendo información sobre el estado de conservación a nivel internacional y nacional, endemismo y zonas con vacíos de información. Para la elaboración de esta lista se utilizó literatura herpetológica, bases de datos y especímenes de la colección del Departamento de Herpetología del Museo de Historia Natural de la Universidad Nacional Mayor de San Marcos. Se registraron un total de 182 especies de reptiles, con los escamosos (lagartijas y serpientes) representando el 90% del total. La serpiente *Helicops yacu* es la única especie endémica de Loreto y la culebra *Dipsas peruana* es la única especie con una distribución altitudinal por encima de los 500 m. Seis especies están en la categoría de Vulnerables según la IUCN; mientras que seis están consideradas como amenazadas y dos como casi amenazadas en el listado nacional. Se observa mayor vacío de información en áreas cercanas a las fronteras con Brasil y Colombia.

Abstract

This paper presents an updated list of the reptiles occurring in the Department of Loreto, Perú including information on conservation status, endemic species, and areas with information gaps. Herpetological literature, databases and the collection of the Department of Herpetology of the Natural History Museum of the National University of San Marcos were used to update the species list. A total of 182 species were recorded, with squamates (lizards and snakes) representing 90% of reptiles in Loreto. Only one species, *Helicops yacu*, is endemic to Loreto and *Dipsas peruana* is the only species with an altitudinal distribution above 500 m. Six species are in IUCN threatened categories. Six and four species are in threatened and near threatened national categories respectively. Mayor information gaps are observed in areas near the borders with Brazil and Colombia.

Enlace: <https://doi.org/10.15381/RPB.V28IESPECIAL.21913>

Mestizo Farmers' Knowledge of Entomofauna Is Reflected in Their Management Practices: A Case Study in the Andean-Amazon Foothills of Peru

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Abstract

Local knowledge of entomofauna can influence environmental actions, particularly crop management practices, which can be sustainable or unsustainable. A farmer's decision-making is associated with their knowledge of beneficial insects and pests. This study aimed to assess local knowledge of entomofauna in relation to associated management practices, within a context of socio-cultural and environmental change. The research was carried out in Santa Lucía, a small mestizo village located in the deforestation frontier of the Peruvian Amazon. Mestizos are migrants, or descendants of migrants, from non-Amazonian regions of Peru. First, freelistings were conducted with a group of 19 female and 25 male farmers to evaluate their theoretical knowledge of insects, and to select the most salient insects associated with cassava, maize, and plantain. Second, two focus groups (which separated women and men) evaluated the practical knowledge of management practices for the most salient insects in the context of climate change. The most salient insects were collected and identified to the minimum possible taxonomic level. The results showed that farmers have a negative perception of entomofauna associated with cassava, maize, and plantain, as they considered insects to be harmful to their staple crops. Most farmers are not aware of the importance of beneficial insects such as pollinators and natural enemies. The findings of the study further showed that mestizo farmers did not have any management practices to preserve beneficial entomofauna, half of the insects they regarded as pests did not present any associated management practices, and the other half applied both sustainable (preventive and curative) and unsustainable practices (e.g., use of pesticides). The paper further discusses the dynamics of mestizo local knowledge on entomofauna in a changing environment and concludes that local capacities should be built to enrich knowledge about the recognition, biology, and ecological role of entomofauna (e.g., pollination, natural predation), and associated management practices (e.g., agroecological preventive practices that decrease pest incidence and protect pollinators, instead of curative practices) as an adaptation strategy to climate change.

Enlace: <https://doi.org/10.3389/fsufs.2020.539611>

Molecular evidence for three genetic species of *Dipteryx* in the Peruvian Amazon

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Abstract

There is a high international demand for timber from the genus *Dipteryx*, or “shihuahuaco” as it is known in Peru. Developing tools that allow the identification and discrimination of *Dipteryx* species is therefore important for supporting management of natural populations and to underpin legal trade of its timber. The objective of this study was the molecular characterization of *Dipteryx* species in the Peruvian Amazonia. Two plastid regions (cpDNA: trnH-psbA and matK) were sequenced and 11 microsatellite markers (nDNA) were genotyped for 32 individuals identified as *Dipteryx charapilla*, *D. micrantha* morphotype 1 and *D. micrantha* morphotype 2. Using the concatenated sequences of the plastid genes, we identified ten haplotypes that were not shared between the species or between the *D. micrantha* morphotypes. Haplotypic diversity was greater in *D. micrantha* morphotype 2 and *D. charapilla* than in *D. micrantha* morphotype 1, which presented only one haplotype with a wide distribution in Peru. The microsatellites allowed the discrimination of the same three clades and identified diagnostic alleles for each clade. These results allowed us to demonstrate that the two morphotypes of *D. micrantha* are different at both the plastid and nuclear markers, which supports the existence of three genetically distinct species in Peru. This study provides information for the genetic discrimination of *Dipteryx* species and emphasises the importance of conserving the genetic variability of this genus in the Peruvian Amazonia.

Enlace: <https://doi.org/10.1007/s10709-019-00082-2>

Multiplicación clonal del árbol de la quina (*Cinchona officinalis* L.): una alternativa para conservar el árbol nacional de Perú

Clonal multiplication of the cinchona tree (*Cinchona officinalis* L.): An alternative to conserve the national tree of Perú

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Abstract

The cinchona tree (*Cinchona officinalis*), an emblematic species of Peru, has for many years been threatened with extinction. The objective of this study was to evaluate the influence of the type of mini-stake (apical and basal) and the absorption time of indole-butyric acid (0, 2, 6, and 10 minutes) on the clonal multiplication of the cinchona tree. The shoots were collected from trees of natural populations present in the Conila-Peru montane forest, at an altitude of 2800 m. The mini-cuttings, basal and apical, were treated with indole butyric acid at 2000 mg·L⁻¹ and were left to rest for different times. The data were subjected to an analysis of variance and the means were compared with the Tukey test. After 60 days, it was found that the basal mini-cuttings presented a significantly higher rooting percentage (54.77 %) compared to the apical mini-cuttings (40.10 %), being also higher in survival (62.75 %) and size of roots (17.38 mm). The absorption times of 6 and 10 minutes turned out to be the most outstanding, while the control (0 minutes) turned out to be the lowest treatment. In conclusion, the basal mini-cuttings and the absorption times of 6 and 10 minutes turn out to be the most appropriate to guarantee the rooting of mini-cuttings of the cinchona tree.

Enlace: <https://doi.org/10.51372/bioagro333.7>

New species and records of *Anacanthorus* (Monogenoidea: Dactylogyridae) from the gills of *Brycon amazonicus* (Characiformes: Bryconidae) in the Peruvian Amazon

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Abstract

Five species belonging to *Anacanthorus* Mizelle & Price, 1965 were found parasitizing the gills of *Brycon amazonicus* (Agassiz) collected in the Peruvian Amazon: *A. spiralocirrus* Kritsky, Thatcher & Kayton, 1979, *A. femorispn.* sp., *A. kukamensisn.* sp., *A. rarusn.* sp. and *A. sabaloin.* sp. *Anacanthorus femorispn.* sp. presents a membranous accessory piece with flared tip, hooks with proximal bulbous base containing 1 translucent region; *A. kukamensisn.* sp. presents an accessory piece with two branches, one with can-opener-shaped termination and the other with denticles in the lateral margin and at both ends of the distal portion, hooks with expanded proximal bulbous base with central and elliptical translucent region; *A. rarusn.* sp. presents a MCO as a long sclerotized tube, slightly sinuous, with folds in its middle region, with proximal region with circular opening and distal region with rough termination. The accessory piece is small and curved, hooks with expanded proximal bulbous base with central, elliptical translucent region, elongate shank, truncate thumb, slightly curved shaft and inconspicuous point; in *A. sabaloin.* sp. the MCO is a long sclerotized reflexive tube, with membranous appearance from its middle part towards the end, with distal and proximal end with an inwardly directed fold, the accessory piece is a membranous sheath that envelops the MCO just before the reflection zone. The four new species found in this study are the second records of species of *Anacanthorus* described from a fish host from the Peruvian Amazon.

Enlace: <https://doi.org/10.1007/s11230-021-09962-8>

Nuclear and plastid SNP markers for tracing *Cedrela* timber in the tropics

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Abstract

Illegal logging and trade of timber are major worldwide concerns, resulting in biodiversity and economic losses. Tropical tree species in the genus *Cedrela*, which have historically been heavily exploited, are still often illegally traded and there is an urgent need to develop tools to verify the origin of *Cedrela* products. A set of 351 SNP loci for *Cedrela* species from Bolivia, Brazil, Costa Rica, Cuba, Ecuador, French Guiana, Mexico, and Peru was developed using restriction associated DNA sequencing (RADSeq) and low coverage MiSeq genome sequencing, and adapted for MassARRAY genotyping. After screening of 94 individuals covering most of the distribution of *Cedrela*, a final set of 136 SNP loci which included 92 nuclear SNPs, 22 chloroplast markers (20 SNPs and 2 INDELS), and 22 mitochondrial markers (19 SNPs and 3 INDELS) was selected and tested for potential to verify *Cedrela* timber origin.

Enlace: <https://doi.org/10.1007/s12686-019-01110-1>

PLANTAS USADAS PARA COMBATIR LA PANDEMIA DEL COVID-19 EN UNA COMUNIDAD INDÍGENA URARINA DEL DEPARTAMENTO DE LORETO, PERÚ

PLANTS USED TO COMBAT THE COVID-19 PANDEMIC IN AN INDIGENOUS URARINA COMMUNITY IN THE DEPARTMENT OF LORETO, PERU

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Resumen

El artículo presenta las plantas usadas para combatir la pandemia del COVID-19 en una comunidad del pueblo indígena urarina, en la región Loreto, Perú. Se realizaron entrevistas semi estructuradas a promotores de salud, sabios, sabias, dirigentes y docentes de la comunidad durante la primera y segunda ola de la pandemia, de mayo del 2020 a junio del 2021. Al no poderse realizar viajes a la comunidad durante la primera ola de contagios, las entrevistas fueron realizadas vía telefónica o a través de aplicaciones de mensajería como WhatsApp o Messenger. Durante la segunda ola se realizó trabajo de campo, complementando la información con entrevistas directas a pobladores de la comunidad y grupos focales sobre el uso de las plantas. Se realizó la colecta de las plantas usadas de los lugares identificados en las entrevistas y en los diferentes grupos focales. Se identificaron 16 especies vegetales usadas específicamente en la pandemia. Cuatro de ellas fueron introducidas en América a partir del siglo XVI y son usadas comúnmente de manera integrada con especies que son de uso tradicional en la comunidad. Se identificaron también cuatro especies que han sido usadas para fortalecer el cuerpo y el espíritu frente a la enfermedad del COVID-19.

Abstract

We report the plants used to combat the COVID-19 pandemic in a community of the Urarina indigenous people, in Loreto, Peru. Semi-structured interviews were conducted with health promoters, wise men, leaders and teachers of the community during the first and second waves of the pandemic, from May 2020 to June 2021. It was not possible to make trips to the community during the first wave of infections, so the interviews were carried out by telephone or through messaging applications such as WhatsApp or Messenger. During the second wave, field work was carried out, complementing the information with direct interviews with community residents and focus groups about the use of the plants. The plants used were collected from the places identified in the interviews and in the different focus groups. 16 plant species used specifically in the pandemic were identified. Four of them were introduced in America from the 16th century and are commonly used in an integrated way with species that are traditionally used in the community. Four species were also identified that have been used to strengthen the body and spirit against the COVID-19 disease.

Enlace: <https://doi.org/10.24841/fa.v30i1.542>

Predicting the geographic origin of Spanish Cedar (*Cedrela odorata* L.) based on DNA variation

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Abstract

The legality of wood products often depends on their origin, creating a need for forensic tools that verify claims of provenance for wood products. The neotropical tree species *Cedrela odorata* (Spanish cedar) is economically valuable for its wood and faces threats of overexploitation. We developed a 140 SNP assay for geographic localization of *C. odorata* specimens. Target capture and short-read sequencing of 46 *C. odorata* specimens allowed us to identify 140 spatially informative SNPs that differentiate *C. odorata* specimens by latitude, temperature, and precipitation. We assessed the broad applicability of these SNPs on 356 specimens from eight *Cedrela* species, three tissue types, and a range of DNA mass inputs. Origin prediction error was evaluated with discrete and continuous spatial assignment methods focusing on *C. odorata* specimens. Discrete classification with random forests readily differentiated specimens originating in Central America versus South America (5.8% error), while uncertainty increased as specimens were divided into smaller regions. Continuous spatial prediction with SPASIBA showed a median prediction error of 188.7 km. Our results demonstrate that array SNPs and resulting genotypes accurately validate *C. odorata* geographic origin at the continental scale and show promise for country-level verification, but that finer-scale assignment likely requires denser spatial sampling. Our study underscores the important role of herbaria for developing genomic resources, and joins a growing list of studies that highlight the role of genomic tools for conservation of threatened species.

Enlace: <https://doi.org/10.1007/s10592-020-01282-6>

**REGISTRO PRELIMINAR DE MICROPLÁSTICOS EN FECAS DEL LEÓN MARINO
SUDAMERICANO (*Otaria Byronia* [De Blainville 1820]) RECOLECTADAS EN
PUNTA SAN JUAN, PERÚ**

Revista Internacional de Contaminación Ambiental

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Servicio Nacional de Áreas Naturales Protegidas por el Estado

Resumen

Los residuos plásticos han sido identificados en excretas de otáridos alrededor del mundo. No obstante, en el Perú los reportes previos de estos contaminantes en *Otaria byronia* no han sido evaluados. En el presente trabajo se reporta la presencia y forma de microplásticos (MP) en las heces de esta especie, recolectadas dentro de un área natural protegida al sur del Perú. Se logró identificar un total de 47 partículas plásticas clasificadas como fibras y fragmentos, cuya media longitudinal fue de 3.02 y 1.19 mm, respectivamente. La procedencia de estas partículas plásticas milimétricas en las fecas de *O. byronia* se desconoce; sin embargo, otros estudios han asociado la incidencia de MP en la dieta de los animales. Se sugiere mejorar las técnicas de detección de MP en futuros estudios para continuar los esfuerzos de investigación de contaminantes en animales silvestres marinos.

Enlace: <http://dx.doi.org/10.20937/RICA.53745>

Saberes tradicionales sobre el uso de plantas medicinales para la salud femenina reproductiva en comunidades indígenas amazónicas de la zona fronteriza Perú – Colombia

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Resumen

El cuidado de la salud femenina reproductiva se ha basado principalmente en las prácticas de atención de la medicina tradicional, especialmente en áreas rurales de la Amazonia. Los conocimientos tradicionales transfronterizos siguen vigentes gracias al constante intercambio de saberes entre las comunidades peruanas y colombianas, lo cual lleva a un consenso sobre el uso de las plantas medicinales. Con el propósito de contribuir con información sobre los saberes tradicionales asociados al uso de plantas medicinales para la salud femenina reproductiva de las poblaciones indígenas en zona de frontera, se realizaron entrevistas a los agentes del sistema médico tradicional de cuatro comunidades nativas amazónicas. Un total de 59 especies fueron registradas para el manejo de procesos pre-concepcionales, de la salud materna y perinatal y de las alteraciones del sistema reproductivo. Se evidenció que *Spondias mombin* y *Gossypium herbaceum* son las especies con mayor valor de uso medicinal para las comunidades del estudio, especialmente en el parto y posparto. Asimismo, la hoja preparada por decocción y administrada vía oral es la forma más empleada para el tratamiento de las afecciones. Se espera que estos saberes tradicionales aporten elementos adicionales sobre nuevas prácticas de atención a la salud femenina reproductiva en comunidades peruanas, y adicionalmente, contribuyan a los procesos de manejo de la cultura y los ecosistemas amazónicos.

Enlace: <http://dx.doi.org/10.18542/ethnoscientia.v6i3.10662>

SNP Markers as a Successful Molecular Tool for Assessing Species Identity and Geographic Origin of Trees in the Economically Important South American Legume Genus *Dipteryx*

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Abstract

Dipteryx timber has been heavily exploited in South America since 2000s due to the increasing international demand for hardwood. Developing tools for the genetic identification of *Dipteryx* species and their geographical origin can help to promote legal trading of timber. A collection of 800 individual trees, belonging to 6 different *Dipteryx* species, was genotyped based on 171 molecular markers. After the exclusion of markers out of Hardy–Weinberg equilibrium or with no polymorphism or low amplification, 83 nuclear, 29 chloroplast, 13 mitochondrial single nucleotide polymorphisms (SNPs), and 2 chloroplast and 5 mitochondrial INDELS remained. Six genetic groups were identified using Bayesian Structure analyses of the nuclear SNPs, which corresponded to the different *Dipteryx* species collected in the field. Seventeen highly informative markers were identified as suitable for species identification and obtained self-assignment success rates to species level of 78–96%. An additional set of 15 molecular markers was selected to determine the different genetic clusters found in *Dipteryx odorata* and *Dipteryx ferrea*, obtaining self-assignment success rates of 91–100%. The success to assign samples to the correct country of origin using all or only the informative markers improved when using the nearest neighbor approach (69–92%) compared to the Bayesian approach (33–80%). While nuclear and chloroplast SNPs were more suitable for differentiating the different *Dipteryx* species, mitochondrial SNPs were ideal for determining the genetic clusters of *D. odorata* and *D. ferrea*. These 32 selected SNPs will be invaluable genetic tools for the accurate identification of species and country of origin of *Dipteryx* timber.

Enlace: <https://doi.org/10.1093/jhered/esaa011>

Taxonomic diversity of *Cebuella* in the western Amazon: Molecular, morphological and pelage diversity of museum and free-ranging specimens

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Abstract

We investigated the diversity of the pygmy marmoset, *Cebuella pygmaea*, by comparing genetic, morphological and pelage traits of animals from Peru and Ecuador. **Materials and Methods:** We extracted DNA from museum specimen osteocrusts and from fecal samples collected from free-ranging individuals. We sequenced the mtDNA cytochrome b gene and the control region from samples collected at 13 different sites and used Bayesian inference and Maximum Likelihood to identify distinct clades. We took measurements of the crania of a subset of these specimens (n = 26) and ran a logistic regression to determine if any of the cranial measurements (n = 22) could predict a specimen's clade. In addition, we examined the pelage patterns of the museum specimens and photographs taken of free-ranging individuals and divided them into pelage types based on coloration of the underbelly. **Results:** We identified two divergent clades, and two distinct groups with clear geographic boundaries within one of those clades. Two measurements of the zygomatic bone perfectly predicted a given individual's mtDNA clade. We found four distinct pelage patterns in our samples, but these patterns are variable within clades and among individuals within the same population. **Conclusion:** These analyses indicate that the two recognized subspecies of pygmy marmoset should be elevated to the species level (*C. pygmaea* and *C. niveiventris*) based on molecular and cranial differences but not on pelage patterns. We provide evidence on the geographic limits of the two clades and identify regions where additional sampling is required to better define the geographic distribution of the two clades.

Enlace: <https://doi.org/10.1002/ajpa.24266>

Taxonomic status of the Neotropical salamanders *Bolitoglossa altamazonica* and *Bolitoglossa peruviana* (Amphibia: Caudata: Plethodontidae), with the description of a new species from Northern Peru

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Abstract

We examine the phylogenetic relationships among salamanders of the genus *Bolitoglossa* (*Eladinea*) distributed in the Amazonian basin of northern Peru and southern Ecuador and assess species diversity based on morphological and phylogenetic analyses. We infer a molecular phylogeny using sequences from two mitochondrial (Cytb, 16S) and two nuclear genes (RAG-1, POMC). We find two well-supported subclades, one including [*B. altamazonica* + *B. peruviana*] + *B. awajun* sp. n., and the other including *Bolitoglossa* sp. Ituxi + *Bolitoglossa* sp. Jurúa. Ecuadorian lineages form divergent clades from the Peruvian lineages. Accordingly, Ecuadorian populations previously assigned to *Bolitoglossa peruviana* sensu lato are treated as members of a *Bolitoglossa equatoriana* species complex. A newly defined *Bolitoglossa altamazonica* species complex contains only populations from the Amazonian rainforest of Peru. Maximum likelihood and Bayesian Inference analyses confirm the phylogenetic placement of *B. altamazonica* and *B. peruviana*, and support recognition of a related new species of *Bolitoglossa*. The uncorrected genetic distances between the new species and *B. altamazonica* are 6.5% for Cytb and 4.9% for 16S; and the uncorrected genetic distances between the new species and *B. peruviana* are 8.0% for Cytb and 3.9% for 16S. Additionally, analyses of nuclear gene sequences show no haplotype sharing between the new species and closely related species. The new species is distinguished from its congeners by a combination of the following morphological characters: (1) Standard length mean 37.7 mm in males (range 32.0–42.2; n=5) and 41.4 mm in females (range 34.9–48.2; n=6); (2) in life, dorsal coloration uniformly brown with a dark brown triangular marking between the eyes or some irregular light cream spots or patches on the head, back and flanks; (3) iris pale golden; (4) in preservative, dark brown venter with cream mottlings or moderate-sized blotches on the gular region, belly, cloacal region and tail; (5) tips of third finger and third toe protuberant and pointed with nearly complete webbing on the hands and feet; (6) 11–26 maxillary teeth and 8–24 vomerine teeth. Given that the syntypes of *B. altamazonica* are lost, we designate a neotype for *B. altamazonica* from Allpahuayo Mishana National Reserve, Loreto department, Peru. Newly collected specimens from ~30 km NE from Moyobamba (type locality of *B. peruviana*) provide a better understanding of *B. peruviana* and enable us to show that it is the sister taxon of *B. altamazonica*. The new species is known from pre-montane forests in Cordillera Escalera Regional Conservation Area, Cordillera Azul National Park and Shucshuyacu, San Martin department, Peru at 485–1311 m elevation, ~75 km SE from Moyobamba. *Bolitoglossa awajun* sp. n. is the fourth endemic species of salamander from Peru.

Enlace: <https://doi.org/10.11646/zootaxa.4834.3.3>

Threatened fish spawning area revealed by specific metabarcoding identification of eggs and larvae in the Beni River, upper Amazon

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Abstract

Identifying fish spawning areas is of great ecological and conservation importance as fishes are suffering increasing threat levels from anthropogenic activities. However, to date very few studies have done so in the Amazon basin. In the Beni River located in the upper Madeira basin, fishers reported that a particular ecotone near the town of Rurrenabaque was a fish reproduction area. To test the importance of this zone as a spawning site, we conducted an ichthyoplankton survey during the month when reproduction is most likely to occur. The specific identification of larvae and eggs was made with a metabarcoding analysis. With this approach 13 different fish species of high importance for regional and local fisheries were identified, including the long-distance migratory gilded catfish (*Brachyplatystoma rousseauxii*), considered as endangered in the upper Madeira. Combining the development time of morula-gastrula egg stages with the integrated current velocity of the river, we identified a spawning area that ranges between the last gravel beaches close to Altamarani community and the San Miguel del Bala community on top of Suse strait, the last foothill of the Andes. This spawning area further extends upstream in the Madidi and Pilon Lajas protected areas and Tacana and T'simane indigenous communities, when considering eggs in final embryo stage. This portion of the Beni River, at the Andean foothills, is heavily impacted by anthropogenic activities, ranging from unmanaged fisheries to contamination coming from the extraction of fluvial aggregates, upstream gold mining, deforestation associated with a sugar cane mill, an existing downstream dam, and projected upstream dam projects. Some urgent solutions for the conservation of this already impacted area are proposed. Confirming fish spawning zones, although difficult, is crucial to inform the definition of priority areas for conservation and management measures, in particular when these sites host endangered species.

Enlace: <https://doi.org/10.1016/j.gecco.2020.e01309>

The global abundance of tree palms

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Abstract

Aim: Palms are an iconic, diverse and often abundant component of tropical ecosystems that provide many ecosystem services. Being monocots, tree palms are evolutionarily, morphologically and physiologically distinct from other trees, and these differences have important consequences for ecosystem services (e.g., carbon sequestration and storage) and in terms of responses to climate change. We quantified global patterns of tree palm relative abundance to help improve understanding of tropical forests and reduce uncertainty about these ecosystems under climate change.

Location: Tropical and subtropical moist forests.

Time period: Current.

Major taxa studied: Palms (Arecaceae).

Methods: We assembled a pantropical dataset of 2,548 forest plots (covering 1,191 ha) and quantified tree palm (i.e., ≥ 10 cm diameter at breast height) abundance relative to co-occurring non-palm trees. We compared the relative abundance of tree palms across biogeographical realms and tested for associations with palaeoclimate stability, current climate, edaphic conditions and metrics of forest structure.

Results: On average, the relative abundance of tree palms was more than five times larger between Neotropical locations and other biogeographical realms. Tree palms were absent in most locations outside the Neotropics but present in $>80\%$ of Neotropical locations. The relative abundance of tree palms was more strongly associated with local conditions (e.g., higher mean annual precipitation, lower soil fertility, shallower water table and lower plot mean wood density) than metrics of long-term climate stability. Life-form diversity also influenced the patterns; palm assemblages outside the Neotropics comprise many non-tree (e.g., climbing) palms. Finally, we show that tree palms can influence estimates of above-ground biomass, but the magnitude and direction of the effect require additional work.

Conclusions: Tree palms are not only quintessentially tropical, but they are also overwhelmingly Neotropical. Future work to understand the contributions of tree palms to biomass estimates and carbon cycling will be particularly crucial in Neotropical forests.

Enlace: <https://doi.org/10.1111/geb.13123>

The Amazonian dwarf cichlid *Apistogramma agassizii* (Steindachner, 1875) is a geographic mosaic of potentially tens of species: Conservation implications

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Abstract

Assessing biodiversity and understanding how it works is a prerequisite for species conservation. The Amazon basin is one of the main biodiversity hotspots where fish are heavily exploited for ornamental purposes.

The ornamental trade heavily exploits the genus *Apistogramma*, which is one of the most species-rich among Neotropical cichlids with 94 formally described species. This number is certainly underestimated owing to the limitations of conventional taxonomy, which is still too often based solely on morphological criteria and sometimes on few individuals.

Most species of this genus have a high degree of endemism and are highly prized on the ornamental market, which could put them at risk. A few species are supposed to have extensive distributions, and in particular *Apistogramma agassizii*, present from the Amazon estuary up to the Ucayali and Marañón rivers in Peru.

This study assessed the taxonomic status of 1,151 specimens of *A. agassizii* collected from 35 sites around Iquitos in the Peruvian Amazon. On the basis of molecular analyses (nuclear and mitochondrial DNA) and mate choice experiments, at least three biological species within the nominal *A. agassizii* were evidenced in the sampling area, which is extremely small compared with the known distribution of the species as initially described.

According to the molecular calibrations, these three species would have diverged during the Plio-Pleistocene. Two of them seem to be endemic from small sub-basins, one from the Nanay River and the other from the Apayacu/Ampiyacu systems. A possible scenario that may explain the evolutionary history of these species is proposed.

The conservation implications of these results on the estimation of the diversity of *A. agassizii*, of *Apistogramma* species in general, and of other Amazonian cichlids are discussed.

Enlace: <https://doi.org/10.1002/aqc.3373>

Three new species of *Philocorydoras Suriano*, (Monogenoidea: Dactylogyridae) infecting the gills of *callichthyids* (Actinopterygii: Callichthyidae) from the Peruvian Amazonia

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Abstract

During a research on gill ectoparasites of callichthyids fishes from the Peruvian Amazonia, the following monogenoideans were found: *Philocorydoras peruensis* n. sp. from *Corydoras splendens* (Castelnau); *Philocorydoras multiradiatus* n. sp. and *Philocorydoras jumboin* n. sp. from *Brochis multiradiatus* (Orcés, V.). All new species described herein are mainly differentiated from their congeners based on the morphology of the copulatory complex. In *P. peruensis* n. sp. the cirrus is "J"-like shaped tube slightly tilted to one side, while in *P. jumboin* n. sp. is "J"-like shaped tube in a straight position and in *P. multiradiatus* n. sp. the cirrus is an arced tube with inflated base and distally narrow. *Brochis* (Orcés, V.) represents a new genus hosting species of *Philocorydoras*. All new species presented in this work represent the first species of *Philocorydoras* reported for Peru.

Enlace: <https://doi.org/10.1007/s11230-021-09992-2>

The Silent Threat of Non-native Fish in the Amazon: ANNF Database and Review

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Abstract

Non-native fish (NNF) can threaten megadiverse aquatic ecosystems throughout the planet, but limited information is available for the Amazon Region. In this study we review NNF data in the Amazonian macroregion using spatiotemporal records on the occurrence and the richness of NNF from a collaborative network of 35 regional experts, establishing the Amazon NNF database (ANNF). The NNF species richness was analyzed by river basin and by country, as well as the policies for each geopolitical division for the Amazon. The analysis included six countries (Brazil, Peru, Bolivia, Ecuador, Venezuela, and Colombia), together comprising more than 80% of the Amazon Region. A total of 1314 NNF occurrence records were gathered. The first record of NNF in this region was in 1939 and there has been a marked increase in the last 20 years (2000–2020), during which 75% of the records were observed. The highest number of localities with NNF occurrence records was observed for Colombia, followed by Brazil and Bolivia. The NNF records include 9 orders, 17 families and 41 species. Most of the NNF species are also used in aquaculture (12 species) and in the aquarium trade (12 species). The most frequent NNF detected were *Arapaima gigas*, *Poecilia reticulata* and *Oreochromis niloticus*. The current data highlight that there are few documented cases on NNF in the Amazon, their negative impacts and management strategies adopted. The occurrence of NNF in the Amazon Region represents a threat to native biodiversity that has been increasing “silently” due to the difficulties of large-scale sampling and low number of NNF species reported when compared to other South American regions. The adoption of effective management measures by decision-makers is urgently needed and their enforcement needed to change this alarming trend and help protect the Amazon’s native fish diversity.

Enlace: <https://doi.org/10.3389/fevo.2021.646702>

The digestive function of *Pseudoplatystoma punctifer* early juveniles is differentially modulated by dietary protein, lipid and carbohydrate content and their ratios

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Abstract

Pseudoplatystoma punctifer is an Amazonian catfish highly appreciated for its high flesh quality, size, and commercial value. Its aquaculture is pursued to satisfy the demands of an increasing population in the region. However, knowledge of the nutritional needs during the early life stages is necessary for improving growth and reducing the incidence of cannibalism, factors that limit the success of its commercial farming. This study aimed at evaluating the influence of four diets containing different protein and lipid levels (30:15, 30:10, 45:15, or 45:10 in %) in the digestive physiology and performance of early juveniles. The results showed that the dietary protein: lipid as well as carbohydrate levels and ratios influenced differently the whole-body proximate composition, the digestive physiology and development, and hence growth and survival. The 45:15 diet promoted the best growth, survival, and the most rapid development of the digestive system, as shown at histological (higher number of hepatocytes, goblet cells in the anterior intestine and enterocytes in all intestinal portions, and longer folds in the posterior intestine), molecular (highest amylase, lipoprotein lipase, phospholipase, trypsinogen, and pepsinogen gene expression), and biochemical (highest lipase and pepsin activities and higher alkaline phosphatase:leucine alanine peptidase activity ratio) levels. Lipids were favored over carbohydrates as source of energy, with lipids promoting a protein-sparing effect at adequate energy:protein ratio. Carbohydrate content higher than 25% was excessive for this species, leading to unbalanced lipid metabolism and fat deposition in the liver.

Enlace: <https://doi.org/10.3390/ani11020369>

Unmasking continental natal homing in goliath catfish from the upper Amazon

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Abstract

Amazonian goliath catfishes are widespread in the Amazon Basin. Recently, otolith $^{87}\text{Sr}:^{86}\text{Sr}$ analyses using laser ablation–multi-collector–inductively coupled plasma mass spectrometry (LA-MC-ICPMS) revealed a >8,000 km trans-Amazonian natal homing in *Brachyplatystoma rousseauxii* among fish caught and hatched in the largest Amazon River tributary, the upper Madeira basin. Although also suspected for fish in the upper Amazon, homing could not be demonstrated owing to less distinct environmental $^{87}\text{Sr}:^{86}\text{Sr}$ gradients along the Amazon mainstem. Using scanning X-ray fluorescence microscopy (SXFm), a separate study provided evidence that Se:Ca and Sr:Ca are useful markers for identifying migration into Andean headwaters and the estuarine environment. We analysed otoliths of known $^{87}\text{Sr}:^{86}\text{Sr}$ profiles using SXFM mapping to test if Sr:Ca and Se:Ca patterns could demonstrate natal homing for three fish caught in the upper Amazon, using as reference two individuals that were natal homers and two forced residents (hatched after the construction of hydroelectric dams on the Madeira River) from the upper Madeira River. As hypothesised, although the Sr isotope profiles of the upper Amazon individuals were uninformative, two of them presented similar alternating mirror patterns of Sr:Ca and Se:Ca to those of the upper Madeira natal homers, indicating migrations out of the Andean region and into the estuary area. Both were therefore natal homers from the upper Amazon. The third individual from the upper Amazon presented similar Sr:Ca and Se:Ca patterns to those of the upper Madeira residents, suggesting it was a natural resident from the upper Amazon. By combining the results of $^{87}\text{Sr}:^{86}\text{Sr}$ analyses (LA-MC-ICPMS) and Sr:Ca and Se:Ca mappings (SXFm) that are completely independent of one another, we demonstrated that *B. rousseauxii* also performs natal homing in the upper Amazon. Our results indicate that the life cycle of *B. rousseauxii* is more complex than previous literature hypothesised, with the existence of partial migration, even in absence of physical barriers. Quantifying the relative importance of these different life-history strategies will have important implications for fisheries management. Our results also lay the groundwork for conservation efforts in the context of hydropower development in the Amazon Basin and set testable hypotheses of the potential impacts of the Madeira River dams.

Enlace: <https://doi.org/10.1111/fwb.13427>

Variability of *Myrciaria dubia* genotypes (Myrtaceae) in native populations of Roraima state

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Abstract

Camu – camu, *Myrciaria dubia* (Myrtaceae) is a native species of the Amazon Rainforest that has been attracting attention worldwide and arousing great interest in the food and pharmacological industries due to the high concentrations of ascorbic acid in its fruit, which is exported to several countries. Characterizing different materials of *M. dubia* by means of molecular markers allows integration of agronomic and molecular information to aid in the search for more promising varieties. We examined the genetic variability of 11 populations of this species distributed along the Branco River hydrographic basin in state of Roraima in northern Brazil. The populations were defined taking into account the origin of the subsample. The 55 sub-samples present in the Embrapa Roraima Germplasm Collection were evaluated using five ISSR initiators (UBC 811, UBC 812, UBC 817, UBC 868 and UBC 880). The five primers tested generated 64 fragments, with a 98% polymorphism rate. The greatest genetic variation was expressed within the populations (66.6%), while the lowest divergence was determined among the populations (33.4%) of the collection. There was a significant correlation between genetic and geographical distances (Mantel test, $r = 0.3\%$, $P < 0.01$). Analysis with the UPGMA method gave four subgroups showing that various individuals are genetically divergent and can be used in genetic breeding programs.

Enlace: <https://doi.org/10.4238/gmr18418>

Vastly underestimated species richness of *Amazonian salamanders* (Plethodontidae: *Bolitoglossa*) and implications about plethodontid diversification

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Abstract

We present data showing that the number of salamander species in Amazonia is vastly underestimated. We used DNA sequences of up to five genes (3 mitochondrial and 2 nuclear) of 366 specimens, 189 corresponding to 89 non-Amazonian nominal species and 177 Amazonian specimens, including types or topotypes, of eight of the nine recognized species in the region. By including representatives of all known species of Amazonian *Bolitoglossa*, except for one, and 73% of the currently recognized species of the genus, our dataset represents the broadest sample of *Bolitoglossa* species, specimens, and geographic localities studied to date. We performed phylogenetic analyses using parsimony with tree-alignment and maximum likelihood (ML) with similarity alignment, with indels as binary characters. Our optimal topologies were used to delimit lineages that we assigned to nominal species and candidate new species following criteria that maximize the consistency of the current species taxonomy, monophyly, gaps in branch lengths, genetic distances, and geographic distribution. We contrasted the results of our species-delimitation protocol with those of Automated Barcode Gap Discovery (ABGD) and multi-rate Poisson Tree Processes (mPTP). Finally, we inferred the historical biogeography of South American salamanders by dating the trees and using dispersal-vicariance analysis (DIVA). Our results revealed a clade including almost all Amazonian salamanders, with a topology incompatible with just the currently recognized nine species. Following our species-delimitation criteria, we identified 44 putative species in Amazonia. Both ABGD and mPTP inferred more species than currently recognized, but their numbers (23–49) and limits vary. Our biogeographic analysis suggested a stepping-stone colonization of the Amazonian lowlands from Central America through the Chocó and the Andes, with several late dispersals from Amazonia back into the Andes. These biogeographic events are temporally concordant with an early land bridge between Central and South America (~10–15 MYA) and major landscape changes in Amazonia during the late Miocene and Pliocene, such as the drainage of the Pebas system, the establishment of the Amazon River, and the major orogeny of the northern Andes.

Enlace: <https://doi.org/10.1016/j.ympcv.2020.106841>

III. DEFORESTACIÓN Y DEGRADACIÓN



Amazon tree dominance across forest strata

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Abstract

The forests of Amazonia are among the most biodiverse plant communities on Earth. Given the immediate threats posed by climate and land-use change, an improved understanding of how this extraordinary biodiversity is spatially organized is urgently required to develop effective conservation strategies. Most Amazonian tree species are extremely rare but a few are common across the region. Indeed, just 227 'hyperdominant' species account for >50% of all individuals >10 cm diameter at 1.3 m in height. Yet, the degree to which the phenomenon of hyperdominance is sensitive to tree size, the extent to which the composition of dominant species changes with size class and how evolutionary history constrains tree hyperdominance, all remain unknown. Here, we use a large floristic dataset to show that, while hyperdominance is a universal phenomenon across forest strata, different species dominate the forest understory, midstory and canopy. We further find that, although species belonging to a range of phylogenetically dispersed lineages have become hyperdominant in small size classes, hyperdominants in large size classes are restricted to a few lineages. Our results demonstrate that it is essential to consider all forest strata to understand regional patterns of dominance and composition in Amazonia. More generally, through the lens of 654 hyperdominant species, we outline a tractable pathway for understanding the functioning of half of Amazonian forests across vertical strata and geographical locations.

Enlace: <https://doi.org/10.1038/s41559-021-01418-y>

Detecting vulnerability of humid tropical forests to multiple stressors

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Abstract

Humid tropical forests play a dominant role in the functioning of Earth but are under increasing threat from changes in land use and climate. How forest vulnerability varies across space and time and what level of stress forests can tolerate before facing a tipping point are poorly understood. Here, we develop a tropical forest vulnerability index (TFVI) to detect and evaluate the vulnerability of global tropical forests to threats across space and time. We show that climate change together with land-use change have slowed the recovery rate of forest carbon cycling. Temporal autocorrelation, as an indicator of this slow recovery, increases substantially for above-ground biomass, gross primary production, and evapotranspiration when climate stress reaches a critical level. Forests in the Americas exhibit extensive vulnerability to these stressors, while in Africa, forests show relative resilience to climate, and in Asia reveal more vulnerability to land use and fragmentation. TFVI can systematically track the response of tropical forests to multiple stressors and provide early-warning signals for regions undergoing critical transitions.

Enlace: <https://doi.org/10.1016/j.oneear.2021.06.002>

Fine root dynamics across pantropical rainforest ecosystems

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Abstract

Fine roots constitute a significant component of the net primary productivity (NPP) of forest ecosystems but are much less studied than aboveground NPP. Comparisons across sites and regions are also hampered by inconsistent methodologies, especially in tropical areas. Here, we present a novel dataset of fine root biomass, productivity, residence time, and allocation in tropical old-growth rainforest sites worldwide, measured using consistent methods, and examine how these variables are related to consistently determined soil and climatic characteristics. Our pantropical dataset spans intensive monitoring plots in lowland (wet, semi-deciduous, and deciduous) and montane tropical forests in South America, Africa, and Southeast Asia ($n = 47$). Large spatial variation in fine root dynamics was observed across montane and lowland forest types. In lowland forests, we found a strong positive linear relationship between fine root productivity and sand content, this relationship was even stronger when we considered the fractional allocation of total NPP to fine roots, demonstrating that understanding allocation adds explanatory power to understanding fine root productivity and total NPP. Fine root residence time was a function of multiple factors: soil sand content, soil pH, and maximum water deficit, with longest residence times in acidic, sandy, and water-stressed soils. In tropical montane forests, on the other hand, a different set of relationships prevailed, highlighting the very different nature of montane and lowland forest biomes. Root productivity was a strong positive linear function of mean annual temperature, root residence time was a strong positive function of soil nitrogen content in montane forests, and lastly decreasing soil P content increased allocation of productivity to fine roots. In contrast to the lowlands, environmental conditions were a better predictor for fine root productivity than for fractional allocation of total NPP to fine roots, suggesting that root productivity is a particularly strong driver of NPP allocation in tropical mountain regions.

Enlace: <https://doi.org/10.1111/gcb.15677>

Gradiente altitudinal y su influencia en las características edafoclimáticas de los bosques tropicales

Altitudinal gradient and its influence on the edofoclimatic characteristics of tropical forests

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Resumen

Los gradientes altitudinales pueden generar límites ambientales, influyendo en el crecimiento y desarrollo de las especies vegetales. Se tuvo por objetivo identificar las variaciones edafoclimáticas en gradientes altitudinales y su influencia en los bosques tropicales. Se buscaron artículos de investigación con ámbito geográfico entre 27° N y 27° S de latitud, con influencia de gradientes altitudinales entre 0 m y 5000 m. Se sistematizó la información, organizándose en temáticas del clima, en las propiedades fisicoquímicas y biológicas del suelo, y en el comportamiento de las especies forestales. Se determinó que la temperatura media anual (TMA) disminuye conforme aumenta la altitud; y la precipitación anual (PA) presenta máximos pluviales en altitudes medias. Los valores del pH del suelo disminuyen hasta 3000 m, aumentando sobre esta altitud; sin embargo, la materia orgánica, carbono orgánico, carbono total (CT), nitrógeno total (NT) y la relación C/N del suelo aumentan hasta 3000 m; sobre esta altitud los valores disminuyen. El potasio (K), el calcio (Ca), el magnesio (Mg), el fierro (Fe), y el aluminio (Al) del suelo disminuyen con el aumento de la altitud por influencia de las bajas temperaturas y humedad del suelo (HS). La variación edafoclimática en los gradientes altitudinales interactúa con las especies forestales, afectando las respuestas fisiológicas, disminuyendo su crecimiento y altura con el aumento de la altitud; del mismo modo disminuye su densidad y diversidad con el aumento de la altitud. Las especies forestales de los trópicos prosperan en amplios o estrechos límites altitudinales y edafoclimáticos, por lo que identificar estos límites es fundamental no solo en términos ecológicos, sino también políticos y económicos, para diseñar políticas efectivas de uso de la tierra y de conservación.

Abstract

Altitudinal gradients can generate environmental limits, influencing the growth and development of plant species. The aim was to understand the edaphoclimatic variation in altitudinal gradients, and its influence on tropical forests. Research articles with a geographic scope between 27° N and 27° S latitude were searched, with influence of altitudinal gradients between 0 m and 5000 m; The information was systematized, organizing it in climatic issues, in physicochemical and biological properties of the soil, and in the behavior of forest species. It was determined that the mean annual temperature (TMA) decreases as the altitude increases, and the annual precipitation (PA) presents maximum pluvial at mid altitudes; soil pH values decrease up to 3000 m, increasing above this altitude; however, organic matter, organic carbon, total carbon (TC), total nitrogen (NT) and the C/N ratio of the soil increase up to 3000 m a.s.l., above this altitude the values decrease; potassium (K), calcium (Ca), magnesium (Mg), iron (Fe), and aluminum (Al) in the soil decrease with increasing altitude due to the influence of low temperatures and soil moisture (HS). The edaphoclimatic variation in the altitudinal gradients interacts with the forest

species, affecting the physiological responses, decreasing their growth and height with increasing altitude; in the same way its density and diversity decreases with increasing altitude. The forest species of the tropics thrive in wide or narrow elevational and edaphoclimatic limits, so identifying these limits is essential not only in ecological terms, but also in political and economic terms, to design effective land use and conservation policies.

Enlace: <https://doi.org/10.21829/myb.2021.2732271>

Habitat Quality Differentiation and Consequences for Ecosystem Service Provision of an Amazonian Hyperdominant Tree Species

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Abstract

Ecosystem services of Amazonian forests are disproportionately produced by a limited set of hyperdominant tree species. Yet the spatial variation in the delivery of ecosystem services by individual hyperdominant species across their distribution ranges and corresponding environmental gradients is poorly understood. Here, we use the concept of habitat quality to unravel the effect of environmental gradients on seed production and aboveground biomass (AGB) of the Brazil nut, one of Amazonia's largest and most long-lived hyperdominants. We find that a range of climate and soil gradients create trade-offs between density and fitness of Brazil nut trees. Density responses to environmental gradients were in line with predictions under the Janzen–Connell and Herms–Mattson hypotheses, whereas tree fitness responses were in line with resource requirements of trees over their life cycle. These trade-offs resulted in divergent responses in area-based seed production and AGB. While seed production and AGB of individual trees (i.e., fitness) responded similarly to most environmental gradients, they showed opposite tendencies to tree density for almost half of the gradients. However, for gradients creating opposite fitness-density responses, area-based seed production was invariable, while trends in area-based AGB tended to mirror the response of tree density. We conclude that while the relation between environmental gradients and tree density is generally indicative of the response of AGB accumulation in a given area of forest, this is not necessarily the case for fruit production.

Enlace: <https://doi.org/10.3389/fpls.2021.621064>

Heavy metals in alluvial gold mine spoils in the peruvian Amazon

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Abstract

Alluvial gold mining in the Peruvian Amazon has become a key driver of land degradation and deforestation. The associated release of mercury in the environment poses direct human health risks and is likely to engender cascading effects throughout local food chains. We carried out research in an alluvial gold mine concession in the Madre de Dios region to compare the degree of soil-borne pollution of heavy metals in areas where mining operations were abandoned more and less recently (1–5 and 6–8 years ago, respectively) with non-impacted old-growth forest areas. All heavy metals were below permissible levels according to Peruvian and Canadian environmental quality standards. Mean As, Ba, Pb, Cu, Cr, Ni, V and Zn concentrations in impacted areas were 1.90 ± 1.51 , 29.80 ± 22.87 , 4.60 ± 2.55 , 12.68 ± 8.13 , 7.90 ± 3.98 , 7.93 ± 3.89 , 12.67 ± 6.62 , and 26.65 ± 13.53 mg kg⁻¹ dry matter (DM), respectively. Heavy metal concentrations were higher in non-impacted old growth forest soils than in mining spoils and tended to increase with time since abandonment of mining operations. Hg was not detected in any of the sites. Low heavy metal concentrations in mine spoils might be explained because of intense volatilization, reduced metal retention capacity due to the low clay and organic matter content, and leaching processes related with soil rinsing which is part of the mining operations combined with intense rainfall. Our findings suggest that heavy metal concentrations in mining spoils should not be considered to constrain forest restoration efforts or the development of similar land uses as in comparable non-impacted high forest soils.

Enlace: <https://doi.org/10.1016/j.catena.2020.104454>

Mercury in soils impacted by alluvial gold mining in the Peruvian Amazon

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Abstract

Gold mining is the largest source of mercury (Hg) pollution worldwide. The discharge of mercury in the environment bears direct human health risks and is likely to increase cascading effects throughout local food chains. In the Peruvian Amazon the mining process consists of slashing and burning trees, followed by extraction of gold-bearing sediment, amalgamation with Hg and gold recovery, leading each year to the degradation of 6,000-10,000 ha and the release of 180 metric tons of Hg per year to the environment. The purpose of this study was to determine soil Hg levels in soils of abandoned alluvial gold mine spoils and undisturbed forest in the Madre de Dios region, the epicenter of alluvial gold mining in Peru. We selected gold mine spoils of the two most important technologies locally applied for gold extraction, i.e., Minimally Mechanized Mining (MMM) and Highly Mechanized Mining (HMM), in the native communities of Laberinto and Kotzimba, respectively. We collected 127 and 35 soil samples (0-20cm depth) from potentially contaminated sites and undisturbed forest, respectively. Physicochemical analysis and determination of Hg levels were determined for all soil samples. None of the samples had Hg concentrations above Peruvian, Canadian and British Environmental Quality Standards for Agricultural Soil (6.6mg/kg). Hg levels in MMM and HMM were not significantly different between the two areas. The main variables explaining variation of soil Hg concentrations were the vegetation cover, soil organic matter, soil pH and clay particle content, which explained up to 80% of data set variation. Surprisingly, highest Hg concentrations were found in untouched old-growth forest bordering the mine spoils, but there was also a trend of increasing Hg concentrations with the regenerating vegetation. Our findings suggest that Hg concentrations in old mine spoils are low and shouldn't stand in the way of efforts to restore soil conditions and develop sustainable land uses. However, it is urgent to end the use of Hg in mining operation to decrease human and environmental risks.

Enlace: <https://doi.org/10.1016/j.jenvman.2021.112364>

Regional Mapping and Spatial Distribution Analysis of Canopy Palms in an Amazon Forest Using Deep Learning and VHR Images

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Abstract

Mapping plant species at the regional scale to provide information for ecologists and forest managers is a challenge for the remote sensing community. Here, we use a deep learning algorithm called U-net and very high-resolution multispectral images (0.5 m) from GeoEye satellite to identify, segment and map canopy palms over ~ 3000 km² of Amazonian Forest. The map was used to analyse the spatial distribution of canopy palm trees and its relation to human disturbance and edaphic conditions. The overall accuracy of the map was 95.5% and the F1-score was 0.7. Canopy palm trees covered 6.4% of the forest canopy and were distributed in more than two million patches that can represent one or more individuals. The density of canopy palms is affected by human disturbance. The post-disturbance density in secondary forests seems to be related to the type of disturbance, being higher in abandoned pasture areas and lower in forests that have been cut once and abandoned. Additionally, analysis of palm trees' distribution shows that their abundance is controlled naturally by local soil water content, avoiding both flooded and waterlogged areas near rivers and dry areas on the top of the hills. They show two preferential habitats, in the low elevation above the large rivers, and in the slope directly below the hill tops. Overall, their distribution over the region indicates a relatively pristine landscape, albeit within a forest that is critically endangered because of its location between two deforestation fronts and because of illegal cutting. New tree species distribution data, such as the map of all adult canopy palms produced in this work, are urgently needed to support Amazon species inventory and to understand their distribution and diversity.

Enlace: <https://doi.org/10.3390/rs12142225>

Soil recovery of alluvial gold mine spoils in the Peruvian Amazon using *Stylosanthes guianensis*, a promising cover crop

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Abstract

The Amazon is an important reservoir of biodiversity and carbon but it is under pressure by multiple threats such as artisanal and small-scale gold mining (ASGM). In Peru ASGM has degraded 90,000 ha of old-growth forest since the eighties, leaving vast areas as wastelands. As most ASGM in the region is illegal, efforts to recover degraded areas have been scant. Here we assessed the potential of *Stylosanthes guianensis* to recover soil health as a first step in the restoration of gold mine spoils in a Native community and a mining concession in Madre de Dios, Peru. We evaluated plant growth and analyzed changes in physical, chemical, and biological soil parameters. After 470 days from sowing, the average plant height was 46.7 cm with a survival rate >50% and yields of 23.9 t ha⁻¹ and 450 kg ha⁻¹ of dry biomass and nitrogen, respectively. Multiple soil parameters increased significantly, including cationic exchange capacity (3.3 to 4.0 cmol [+] kg⁻¹), soil organic matter (0.03% to 0.39%), soil respiration (0.02 to 0.06 mg CO₂ g⁻¹ d⁻¹) and biomass (0.03 to 0.15 mg C g⁻¹). Soil macrofauna increased from 2 to 11 taxonomic groups, including ants, considered as soil engineers. Furthermore, *S. guianensis* increased soil carbon sequestration of impacted areas from 0.004 t C ha⁻¹ by more than 1650%, up to 0.07 t C ha⁻¹. These promising findings clearly illustrate *S. guianensis* potential to kick-start natural succession of Amazonian forests after degradation by ASGM and hence help to achieve the Sustainable Development Goals.

Enlace: <https://doi.org/10.1002/ldr.4118>

Survival and early growth of 51 tropical tree species in areas degraded by artisanal gold mining in the Peruvian Amazon

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Abstract

Artisanal gold mining in Amazon forests and rivers has been reported in all Amazonian countries. Amazon mining has a wide range of negative effects and severe environmental and social consequences. Given that the activity in the region is mostly illegal, there are few studies published in the scientific literature on recovery of areas degraded by gold mining. This study conducts an experimental reforestation project aimed to evaluate soil degradation and explore the seedling survivorship and early growth of 51 tropical tree species in gold mined areas at 5 study sites distributed across the Madre de Dios region, in the Peruvian Amazon. The study evaluates the effect of biochar amendments on the survivorship and growth of 51 tropical species. The study also analyzes the influence of species wood density on seedling performance one year after planting. In order to inform further restoration plantation strategies, species were chosen with the end goals of timber production, biodiversity enhancement, and soil restoration. Site degradation, soil properties and mercury levels were analyzed in degraded areas and paired reference forest patches. Soils after gold mining are found to be highly degraded, with soil C being nearly absent, cation content greatly decreased, and loss of fine sediment. Soil mercury levels were found below national and international environmental quality standards. A positive correlation and a statistically significant relationship were found between survivorship and wood density. This reveals that the higher the wood density of the species, the higher the survival percentage. Growth and overall performance of mid, and especially low wood density species were significantly increased by biochar additions, while no effect was recorded on high wood density species growth. The study provides guidance on the post-ASGM restoration potential for 51 common and useful tree species and gives practitioners recommendations for combinations of species and fertilization treatments to optimize restoration designs.

Enlace: <https://doi.org/10.1016/j.ecoleng.2020.106097>

Taking the pulse of Earth's tropical forests using networks of highly distributed plots

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Abstract

Tropical forests are the most diverse and productive ecosystems on Earth. While better understanding of these forests is critical for our collective future, until quite recently efforts to measure and monitor them have been largely disconnected. Networking is essential to discover the answers to questions that transcend borders and the horizons of funding agencies. Here we show how a global community is responding to the challenges of tropical ecosystem research with diverse teams measuring forests tree-by-tree in thousands of long-term plots. We review the major scientific discoveries of this work and show how this process is changing tropical forest science. Our core approach involves linking long-term grassroots initiatives with standardized protocols and data management to generate robust scaled-up results. By connecting tropical researchers and elevating their status, our Social Research Network model recognises the key role of the data originator in scientific discovery. Conceived in 1999 with RAINFOR (South America), our permanent plot networks have been adapted to Africa (AfriTRON) and Southeast Asia (T-FORCES) and widely emulated worldwide. Now these multiple initiatives are integrated via ForestPlots.net cyber-infrastructure, linking colleagues from 54 countries across 24 plot networks. Collectively these are transforming understanding of tropical forests and their biospheric role. Together we have discovered how, where and why forest carbon and biodiversity are responding to climate change, and how they feedback on it. This long-term pan-tropical collaboration has revealed a large long-term carbon sink and its trends, as well as making clear which drivers are most important, which forest processes are affected, where they are changing, what the lags are, and the likely future responses of tropical forests as the climate continues to change. By leveraging a remarkably old technology, plot networks are sparking a very modern revolution in tropical forest science. In the future, humanity can benefit greatly by nurturing the grassroots communities now collectively capable of generating unique, long-term understanding of Earth's most precious forests.

Enlace: <https://doi.org/10.1016/j.biocon.2020.108849>

Tree mode of death and mortality risk factors across Amazon forests

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Abstract

The carbon sink capacity of tropical forests is substantially affected by tree mortality. However, the main drivers of tropical tree death remain largely unknown. Here we present a pan-Amazonian assessment of how and why trees die, analysing over 120,000 trees representing > 3800 species from 189 long-term RAINFOR forest plots. While tree mortality rates vary greatly Amazon-wide, on average trees are as likely to die standing as they are broken or uprooted—modes of death with different ecological consequences. Species-level growth rate is the single most important predictor of tree death in Amazonia, with faster-growing species being at higher risk. Within species, however, the slowest-growing trees are at greatest risk while the effect of tree size varies across the basin. In the driest Amazonian region species-level bioclimatic distributional patterns also predict the risk of death, suggesting that these forests are experiencing climatic conditions beyond their adaptative limits. These results provide not only a holistic pan-Amazonian picture of tree death but large-scale evidence for the overarching importance of the growth–survival trade-off in driving tropical tree mortality.

Enlace: <https://doi.org/10.1038/s41467-020-18996-3>

IV. ECONOMÍA CIRCULAR Y CADENAS PRODUCTIVAS SOSTENIBLES



Actividad Ecoturística de los emprendimientos locales en la sostenibilidad del Santuario Histórico Bosque de Pómac

Rosse Marie Esparza Huamanchumo, Carla Ethel Gamarra Flores, Daysy Angeles Barrantes

Servicio Nacional de Áreas Naturales Protegidas por el Estado

Resumen

El Santuario Histórico Bosque de Pómac (SHBP) es un Área Natural Protegida (ANP), que se ubica en el departamento de Lambayeque – Perú, guarda gran riqueza cultural porque es cuna de la Cultura Sicán, y natural porque conserva y protege la más densa formación de algarrobos del planeta. El SHBP se ha posicionado como destino ideal para el desarrollo de la actividad turística como eje articulador entre los diferentes actores del sector público, privado, academia y comunidad local. mejora de la calidad de vida de los pobladores del área; así como generar acciones de conservación y preservación de los recursos naturales y culturales del ANP.

Actualmente en la zona de amortiguamiento de esta ANP nacen emprendimientos locales vinculados a la actividad turística y ecoturística, por lo que el objetivo del presente artículo es describir la situación de los emprendimientos locales con la finalidad de determinar los impactos que genera el turismo en la zona y como aportan a la sostenibilidad del SHBP.

Con base en la metodología cualitativa se realizaron visitas de campo y entrevistas semiestructuradas que indaga sobre las características y condiciones de la actividad turística en los ejes claves de la sostenibilidad.

El resultado es mostrar cómo se encuentran los emprendimientos locales a partir del desarrollo del ecoturismo en un ANP, asimismo proponer estrategias que permitan integrar a los emprendimientos locales y potenciar los beneficios que conduzcan a una mejora de la calidad de vida de los pobladores del área; así como generar acciones de conservación y preservación de los recursos naturales y culturales del ANP.

Enlace: <http://sis.sernanp.gob.pe/biblioteca/?publicacion=2079>

<http://www.jthr.es/index.php/journal/article/view/216>

Antihyperlipidemic and antioxidant capacities, nutritional analysis and uhlplc-pda-ms characterization of cocona fruits (*Solanum sessiliflorum* dunal) from the peruvian amazon

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Abstract

Cocona fruits are a popular food and medicinal fruit used mainly in the Amazon and several countries of South America for the preparation of several food products such as drinks, jams and milk shakes. In this study five ecotypes of cocona native to Peru have been studied regarding their nutritional and antioxidants values plus antihyperlipidemic activities. Seventy bioactive compounds have been detected in Peruvian cocona ecotypes including several phenolic acids, aminoacids and flavonoids; of those six were spermidines, (peaks 1, 2, 25, 26, 38 and 39), thirteen were aminoacids, (peaks 3,-9, 11-13, 16, 17, 22-24), eighteen flavonoids (peaks 28, 30-32 45,46, 48-53 56, 57, 61 and 64-66), twelve were phenolics (peaks 19, 21, 27, 29, 34, 35, 36, 42, 43, 44, 54, and 59), two carotenoids, (peak 62 and 63), eight were lipid derivatives (peaks 37, 55, 58, 60 and 67-70), one sugar (peak 47), four terpenes (peaks 33, 40, 41 and 47), two amides, (peaks 10 and 18), one aldehyde, (peak 15), and three saturated organic acids, (peaks 4, 5 and 20). Hypercholesterolemic rats administered with pulp of the ecotypes CTR and SRN9 showed the lowest cholesterol and triglyceride levels after treatment (126.74 ± 6.63 ; 102.11 ± 9.47 ; 58.16 ± 6.64 ; 61.05 ± 4.00 mg/dL, for cholesterol, triglycerides, high-density lipoprotein and low-density lipoprotein respectively, for the group treated with SRN9 pulp, and 130.09 ± 8.55 ; 108.51 ± 10.04 ; 57.30 ± 5.72 ; and 65.41 ± 7.68 mg/dL, for cholesterol, triglycerides, HDL and LDL lipoproteins respectively for the group treated with CTR pulp). The ecotypes proved to be good sources of natural antioxidants and their consumption represent an alternative for the prevention of atherosclerosis.

Enlace: <https://doi.org/10.3390/antiox10101566>

Asociación entre abejas sin aguijón (*Hymenoptera: Apidae: Meliponini*) y camu camu (*Myrciaria dubia: Myrtaceae*) en la Amazonía peruana

Association between stingless bees (*Hymenoptera: Apidae: Meliponini*) and camu camu (*Myrciaria dubia: Myrtaceae*), in the Peruvian Amazon

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Resumen

La polinización es un servicio ecosistémico de gran importancia para el mantenimiento de los bosques y la provisión de alimentos en el mundo. El estudio se realizó entre septiembre y noviembre del 2018, con los objetivos de evaluar la diversidad de abejas sin aguijón asociadas al camu camu (*Myrciaria dubia*) y del incremento en la formación de frutos por polinizadores naturales, principalmente abejas sin aguijón. Se muestrearon seis parcelas cultivadas de camu camu en dos comunidades del bajo río Ucayali, provincia de Requena, departamento de Loreto en Perú. Se registraron nueve especies nativas de abejas sin aguijón y la especie exótica *Apis mellifera* Linnaeus asociados al camu camu. Las dos especies más abundantes fueron *Apis mellifera* con 26.5%, y *Melipona eburnea* Friese con 19.2%. Los insectos, principalmente abejas incrementaron hasta en 44% la producción de los frutos de camu camu.

Abstract

Pollination is an ecosystem service of great importance for forest maintenance and food security in the world. This study was conducted between September and November 2018 to evaluate the diversity of stingless bees associated with camu camu (*Myrciaria dubia*) and the increase in fruit formation through the presence of pollinators, chiefly stingless bees. Six cultivated plots of camu camu were sampled in two communities of the lower Ucayali River, Requena Province, Loreto Department in Peru. Nine species of stingless bees and the exotic *Apis mellifera* were recorded associated with camu camu. The two most abundant species were *A. mellifera* Linnaeus with 26.5%, *Melipona eburnea* Friese with 19.2%. Insects, mainly bees, contribute up to 44% increase in the production of camu camu fruits.

Enlace: <http://www.lrrd.org/lrrd32/8/cdelga32129.html>

COMPORTAMIENTO AGRONÓMICO DE *Oryza sativa* L. (ARROZ) Y *Manihot esculenta* Crantz (YUCA) EN DOS LOCALIDADES DE SIEMBRA EN LORETO, PERÚ

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Resumen

En la región Loreto, se han realizado muchos esfuerzos para alcanzar altos rendimientos de la yuca y el arroz, los cuales poseen moderados potenciales de rendimiento; siendo estos cultivos, una garantía en la alimentación de la población, ya que son de mucha demanda por la población rural amazónica. El objetivo del estudio fue determinar el comportamiento de *Oryza sativa* L. variedad "INIA 509 la esperanza" y *Manihot esculenta* crantz variedad "señorita" en dos localidades de siembra en la región Loreto. Fueron sembradas bajo un sistema de *Bactris gasipaes* H.B.K "pijuayo" en las localidades El dorado y el Bolloquito ubicadas en el eje de la carretera Iquitos-Nauta en la Amazonía peruana. El cultivo del arroz mostró significancia estadística ($p < 0.01$) en las características agronómicas con mayores promedios en El dorado para altura de planta (81,61 cm), cantidad de matas (21,55), cantidad de panojas (21,55), peso de granos por mata (0,08 kg) y rendimiento de grano (2656,14 k/ha). En el cultivo de la yuca mostraron significancia estadística ($p < 0.01$) en las características agronómicas con mayores promedios en el Bolloquito como altura de planta (255,55 cm) y altura de la primera ramificación (130,22 cm), mientras en El dorado mostraron significancia estadística ($p < 0.05$) para peso de raíz por planta (2,59 kg) y rendimiento de raíces (19689,07 kg/ha), los cultivos se comportan según las localidades de siembra, expresando mejores características agronómicas y rendimientos de manera específica.

Enlace: <https://doi.org/10.24841/fa.v29i2.526>

Contenido de nutrientes en plantas de *Myrciaria dubia* en función de dosis de potasio aplicadas por fertirrigación

Nutritional contents in *Myrciaria dubia* plants in function of in Potassium doses applied through fertigation

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Resumen

El objetivo en este estudio fue determinar el contenido de nutrientes en plantas de *Myrciaria dubia* (Camu-camu) como respuesta a la aplicación de cinco dosis de K₂O (0; 40; 80; 120 e 160 kg ha⁻¹) aplicadas por fertirrigación. Se evaluaron los contenidos de materia seca de hoja (MSH), materia seca total (MST) y el contenido de nutrientes en las hojas. La MSH y la MST fueron mayores en plantas fertilizadas con la dosis de 160 kg ha⁻¹ de K₂O, con 52.44 g y 302.69 g, respectivamente. Los contenidos de N y K fueron de 22.15 y 9.48 g kg⁻¹ en respuesta a la dosis de 160 kg ha⁻¹ de K₂O. Los contenidos medios de P, Ca y S fueron de 1.6, 17.89 y 1.61 g kg⁻¹, respectivamente, y el contenido de Mg²⁺ disminuyó desde 5.62 hasta 2.74 g kg⁻¹ en la dosis de 0 y 160 kg ha⁻¹ de K₂O, respectivamente. Los contenidos de B, Mn y Fe disminuyeron de 136.5 a 100.0, de 346.24 a 248, y de 142.06 a 97.35 mg kg⁻¹ en la dosis de 0 y 160 kg ha⁻¹ de K₂O, respectivamente. Los contenidos medios de Cu y Zn fueron 3,81 y 40,54 mg kg⁻¹, respectivamente, en todas las dosis de K₂O. El contenido de nutrientes determinado en las hojas de *M. dubia* fueron adecuados para el desarrollo de la especie en el primer año de cultivo, presentando el siguiente orden decreciente: N > Ca > K > Mg > P = S > Mn > B > Fe > Zn > Cu.

Abstract

The objective in this study was to determine the nutrient contents in *Myrciaria dubia* plants in function of five K₂O doses (0, 40, 80, 120 and 160 kg ha⁻¹) applied through fertigation. Leaf dry matter (LDM), total dry matter (TDM), and leaf nutrient contents were evaluated. The LDM and TDM were higher in plants subjected to the dose of 160 kg ha⁻¹ of K₂O, with 52.44 g and 302.69 g, respectively. Leaf N and K contents were 22.15 and 9.48 g kg⁻¹ in response to 160 kg ha⁻¹ of K₂O. The mean P, Ca and S contents were 1.6, 17.89 and 1.61 g kg⁻¹, respectively, and the content of Mg²⁺ decreased from 5.62 to 2.74 g kg⁻¹ at the dose of 0 and 160 kg ha⁻¹ of K₂O, respectively. The B, Mn and Fe contents decreased from 136.5 to 100.0, 346.24 to 248, and from 142.06 to 97.35 mg kg⁻¹ at the dose of 0 and 160 kg ha⁻¹ of K₂O, respectively. The mean Cu and Zn contents were 3.81 and 40,54 mg kg⁻¹, respectively, at the K₂O doses. The nutrient content determined in the leaves of *M. dubia* were adequate for the development of the species in the first year of cultivation, presenting the following decreasing order: N > Ca > K > Mg > P = S > Mn > B > Fe > Zn > Cu.

Enlace: <https://doi.org/10.15446/ACAG.V68N4.76882>

Diversity bears fruit: Evaluating the economic potential of undervalued fruits for an agroecological restoration approach in the peruvian amazon

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Abstract

Agroforestry systems with a range of native and often neglected and underutilized tree species (NUS) are increasingly recognized for their potential role in restoration, simultaneously providing ecological and livelihood benefits. Successful adoption of these systems requires knowledge about beneficial species, system-level potential profitability, and barriers faced by farmers. Such information is essential but lacking for most NUS. We analyzed the economic potential of NUS in diverse smallholder-managed agroforestry systems in the Peruvian Amazon. Through semistructured surveys with local stakeholders (n = 40), we identified 10 native Amazonian NUS fruit with ecological, nutritious and commercial benefits. We then simulated the potential revenue per species and system-level profit of an agroforestry system designed with the 10 NUS. Our projections suggest that a diverse NUS-based agroforestry system can outcompete most alternative land-uses in the region on a per hectare profit basis. This shows that including NUS in restoration efforts could provide economic benefits for smallholders. To realize this potential, we recommend adapted interventions, e.g., increased farmer access to planting material, technical support for production and capacity building with a focus on high-potential NUS.

Enlace: <https://doi.org/10.3390/su13084582>

Efecto de los factores climáticos en las fases fenológicas de *Mauritia flexuosa* Lf. en plantaciones de terraza baja en Ucayali, Perú

Effect of climatic factors on the phenological phases of *Mauritia flexuosa* Lf. In low terrace plantations in Ucayali, Peru

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Resumen

El objetivo en este estudio fue determinar la influencia de la temperatura del aire y la precipitación pluvial en el desarrollo fenológico de *Mauritia flexuosa* en plantaciones ubicadas en Ucayali, Perú. Para ello, durante un periodo de 24 meses, se evaluaron 191 palmeras de 19 años, distribuidas en tres plantaciones establecidas en suelos de terraza baja. Los resultados mostraron que el 45% de palmeras no manifestaron su madurez sexual, no obstante, fue verificado 42% y 13% de individuos con sexo masculino y femenino, respectivamente. Fue constatado que el ciclo fenológico fue bianual, con superposición de fenofases y eventos escalonados. En individuos femeninos se observó máxima floración en fenofase FLA1 (4-5%) de setiembre a noviembre de 2018 y máxima fructificación FRM1 (4-6%) de octubre 2018 a enero de 2019; en individuos masculinos la fenofase de floración FLA2 se presenta en dos periodos entre setiembre de 2018 y febrero de 2020, entre tanto, la fenofase de flores abiertas de ambos sexos, es sincrónica en mayor proporción entre setiembre y noviembre. Fue determinado que la precipitación pluvial y la temperatura del aire (máxima y mínima) no presentaron correlación ($p \leq 0,05$) con las fenofases productivas de *Mauritia flexuosa*. La precipitación pluvial, la temperatura máxima y temperatura mínima del aire presentaron asociación nula con cada una de las fases fenológicas de las palmeras de *Mauritia flexuosa* durante el periodo de evaluación. Con la finalidad de obtener información para la planificación de actividades de manejo silvicultural para su conservación de la especie, se recomienda evaluar por más años la influencia de los elementos climáticos sobre el desarrollo productivo de *Mauritia flexuosa*.

Abstract

The aim of this study was to determine the influence of air temperature and rainfall on the phenological development of *Mauritia flexuosa* in plantations located in Ucayali, Peru. For this, during a 24-month period, 191 19-year-old palm trees were evaluated, distributed in three plantations established on low terrace soils. The results showed that the 45% of palm trees did not manifest their sexual maturity, meanwhile, 42% and 13% of individuals with male and female sex, respectively, were verified. It was found that the phenological cycle was biannual, with overlapping phenophases and staggered events. In female individuals, maximum flowering was observed in phenophase FLA1 (4-5%) from September to November 2018 and maximum fruiting FRM1 (4-6%) from October 2018 to January 2019; In male individuals, the FLA2 flowering phenophase occurs in two periods between September 2018 and February 2020, meanwhile, the open flower phenophase of both sexes is synchronous in a higher proportion between September and November. It was determined that pluvial precipitation and air temperature (maximum and minimum) did not show correlation ($p = 0.05$) with the productive phenophases of *Mauritia flexuosa*.

The pluvial precipitation, the maximum temperature and the minimum air temperature showed null association with each one of the phenological phases of the *Mauritia flexuosa* palm trees during the evaluation period. In order to obtain information for the planning of silvicultural management activities for the conservation of the species, it is recommended to evaluate for more years the influence of climatic elements on the productive development of *Mauritia flexuosa*.

Enlace: <https://doi.org/10.17268/SCI.AGROPECU.2021.024>

El ecoturismo como reactivador de los emprendimientos locales en áreas naturales protegidas

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Resumen

El ecoturismo es una modalidad de viaje responsable con el medio ambiente que en los últimos años ha tomado auge por ser una forma de turismo naturalista que promueve que la población receptora obtenga ingresos económicos durante el proceso y al mismo tiempo estimula el cuidado de los espacios ambientales y el mejoramiento de calidad de vida de los vinculados. Por ello se propone El Santuario Histórico Bosque de Pomac Área Natural Protegida con riqueza cultural y natural, para ser investigada como fuente de desarrollo turístico y emprendimiento locales vinculados a la actividad ecoturística, los que enfrentan una serie de desafíos que limitan su crecimiento y sostenibilidad. Esta investigación tiene una base metodológica cualitativa realizándose revisiones bibliográficas, visitas de campo exploratorias y aplicación de entrevistas semiestructuradas a los representantes de los emprendimientos locales. Los resultados muestran la caracterización de los emprendimientos locales vinculados a la actividad ecoturística y se presenta un análisis en base a los tres pilares del desarrollo sostenible.

Enlace: <http://sis.sernanp.gob.pe/biblioteca/?publicacion=2081>

<https://rus.ucf.edu.cu/index.php/rus/article/view/1666>

Establishment success of Brazil nut trees in smallholder Amazon forest restoration depends on site conditions and management

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Abstract

1. Forest landscape restoration (FLR) has gained momentum globally and guidance is needed to identify those species, sites and planting methods that increase restoration success. Incorporating native Non-Timber Forest Product (NTFP) species in FLR approaches provides an opportunity to simultaneously deliver ecological and economic benefits. The Brazil nut tree is one of the most valuable Amazonian NTFP species and could fulfil a cornerstone role in Amazon FLR. However, the factors defining establishment success within Brazil nut restoration activities remain unknown.

2. Here, we evaluate the effect of management practices, restoration site (pastures, agroforestry, secondary forest and canopy gaps in old growth forest) and environmental conditions on the establishment success (tree growth, survival and fruit production) of Brazil nut restoration projects implemented by smallholders in the Peruvian Amazon. We performed a field study at 25 restoration sites of 1–38 years in age, where we conducted measurements on 481 trees and interviewed 21 smallholders. We used mixed effect models to identify drivers of performance.

3. Twenty years after planting, diameter growth in secondary forests was 38%, 34%, and 24% higher than in canopy gaps, pastures, and agroforestry sites, respectively. Survival rate was similar for trees planted in pastures and secondary forests, but 15–20% higher there than trees planted in agroforestry sites, and 7–12% higher than in canopy gaps. Fruit production was 262% higher for reproductive trees in secondary forest sites compared to pastures, but production probability did not differ between restoration sites. These results show that secondary forests are the most suitable sites for planting Brazil nut trees.

4. In addition to restoration site effects, we also found significant effects of management practices. Survival rate increased with application of fire for clearing and weeding and economic investments and decreased with potentially inefficient herbivore protection. Fruit production was lower for trees planted further away from smallholders' homes. These results show that smallholders' management has a substantial effect on establishment success.

5. Our findings suggest a significant importance of post-planting maintenance of trees to increase success of FLR projects. Further, our study shows that evaluation of past restoration activities can guide future forest restoration in tropical landscapes.

Enlace: <https://doi.org/10.1016/j.foreco.2021.119575>

Estimación de la cantidad de guano de aves marinas acumulado en islas y puntas de Perú mediante un método geoestadístico en SIG

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Servicio Nacional de Áreas Naturales Protegidas por el Estado

Resumen

El 'guano de las islas' en Perú es el excremento de cormoranes, piqueros y pelícanos (aves guaneras), acumulado en grandes depósitos en islas y puntas. Este guano es extraído y comercializado por la agencia gubernamental AGRORURAL para satisfacer las demandas de la agricultura orgánica local. Como parte de sus planes de gestión y comercialización, AGRORURAL estima la cantidad total de guano acumulado en las colonias de aves marinas utilizando un método volumétrico. El objetivo de esta investigación fue proponer un método geoestadístico alternativo que utiliza la recopilación de datos volumétricos como línea de base, pero incorpora la pendiente del terreno y hace estimaciones de la cantidad total y la distribución de guano utilizando un modelo de cuadrícula de interpolación en un Sistema de Información Geográfica (SIG). Los datos de la pendiente del terreno, profundidad de la corteza de guano, la densidad del guano y la proporción de guano/roca de puntos de muestreo georreferenciados (tomados con un GPS de mano) sobre la superficie de la isla/punta fueron usados para interpolar la cantidad de guano total usando un modelo ráster kriging, de tal forma que cada celda contuviera una cantidad estimada de guano. Para este estudio se visitaron seis colonias entre junio de 2014 y febrero de 2018. Según el método geoestadístico, la cantidad total de guano estimada varió entre 10921 t en Isla Mazorca y 26142 t en Isla Guañape Sur. Los mapas de cuadrícula SIG mostraron que la cantidad de depósitos de guano no se distribuía uniformemente sobre la superficie de la isla/punta. Cuando las estimaciones de cantidad total de guano basadas en el método geoestadístico se validaron con la cantidad de guano extraído, el error de estimación fue inferior al 18%. Este error debería disminuir con el uso de un GPS submétrico, un radar de penetración del suelo y barrenas. Un método preciso de cuantificación del volumen de guano en las islas y puntas es crucial para la planificación presupuestaria, logística y de mercadeo del guano de las islas guaneras y puntas del Perú.

Enlace: <https://doi.org/10.25260/EA.20.30.3.0.1108>

Fertilización orgánica para introducir el cultivo de camote (*Ipomoea batatas* L.) en suelos de la sabana

Organic fertilization for the beginning of sweet potato (*Ipomoea batatas* L.) cultivation in savanna soils

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Abstract

Due to limited information on sweet potato (*Ipomoea batatas* L.) cultivation in uncultivated savanna areas, the objective of this research was to determine the ideal dose and type of organic fertilizer for sweet potato cultivation in savanna soils with no history of use. In four experiments, the following fertilizer doses were tested: Cattle manure (0, 10, 20, 30, and 40 t-ha⁻¹), poultry manure (0, 5, 10, 15, and 20 t-ha⁻¹), compost A (0, 0.75, 1.5, 2.25, and 3.0 t-ha⁻¹), and compost B (0, 0.75, 1.5, 2.25, and 3.0 t-ha⁻¹). The fifth experiment consisted of an organic fertilizer efficiency test using applications already recommended for sweet potato crops, which resulted in six treatments: Control (without organic fertilization), cattle manure (20 t-ha⁻¹), poultry manure (10 t-ha⁻¹), compost A (1.5 t-ha⁻¹), compost B (1.5 t-ha⁻¹), and compost C (0.375 t-ha⁻¹). In the first four experiments, the products and their recommended doses were defined in order of production efficiency, as follows: Poultry manure (doses between 13 and 20 t-ha⁻¹) > cattle manure (doses between 30 and 40 t-ha⁻¹) > compost B (doses between 0.75 and 2.25 t-ha⁻¹) = compost A (doses between 2.25 and 3.00 t-ha⁻¹). The fifth experiment concluded that: 1) poultry manure was the most suitable starting point for sweet potato cultivation in savanna soils and 2) sweet potato yield was directly linked to the commercial root mass, number of commercial roots, and branch productivity, which, in turn, were maximized by an increase in organic matter and satisfactory amounts of phosphorus in the soil.

Enlace: <https://doi.org/10.5154/R.RCHSH.2020.05.011>

Forest Degradation and Inter-annual Tree Level Brazil Nut Production in the Peruvian Amazon

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Abstract

Brazil nuts are an economically important non-timber forest product throughout the Amazon Basin, but the forests in which they grow are under threat of severe degradation by logging, road building, agricultural expansion, and forest fires. As a result, many Brazil nut trees grow within a mosaic of young secondary forest, primary forest remnants and agricultural fields. Little is known about the reproductive ecology and fruit production of Brazil nut in such degraded landscapes. Previous studies on Brazil nut productivity did not explicitly address forest degradation as a factor. In this study, we analyzed the extent to which Brazil nut fruit production is affected by the level of forest degradation. We collected 3 years of fruit production data of 126 Brazil nut trees occurring in degraded forest (the above-mentioned mosaics) and closed canopy (i.e., undegraded) forest in and around the Tambopata National Reserve in Madre de Dios, Peru. We analyzed the effect of forest degradation at two different levels: at the site type (i.e., degraded vs. undegraded forest) and the individual tree level (quantified as stand basal area and stem density around the individual Brazil nut trees). Stand basal area around the individual Brazil nut trees significantly positively influenced tree fruit production in all 3 years and stem density in year 2 and 3, with strongest effects in the 3rd year, and weakest effect in the 1st year, coinciding with an El Niño year. Trees in undegraded forest produced more fruits in the 2nd and 3rd year than trees in degraded forest (29.4% and 35.8% more, respectively), but not in the 1st year in which trees in undegraded forest produced 31.7% less fruits than trees in degraded forest. These within year effects were not significant, although the effects significantly differed between years. Our results show that forest degradation can affect Brazil nut fruit production, and suggest that the strength (and possibly the sign) of this effect might be different in (extreme) El Niño years. This illustrates the potential importance of restoring degraded forest to enhance resilience and protect the livelihoods of people depending on the Brazil nut trade.

Enlace: <https://doi.org/10.3389/ffgc.2020.525533>

Genetic threats to the Forest Giants of the Amazon: Habitat degradation effects on the socio-economically important Brazil nut tree (*Bertholletia excelsa*)

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Instituto de Investigaciones de la Amazonía Peruana

Abstract

Ecosystem degradation in the Amazon drives this biodiverse rainforest toward an ecological tipping point. Sustainable management and restoration of degraded rainforest therein are central to counteract this crisis. One hyperdominant, keystone species of high ecological and socio-economic value, the Brazil nut tree, offers additional benefits as a major carbon sink and a nutritional source of the most prominent globally traded non-timber forest product. Despite Brazil nut trees being protected by conservation regulation, forest degradation threatens sufficient gene-flow among Brazil nut tree populations. This has impacts on the reproductive success, genetic diversity, and consequently on the resilience of this species to environmental change. We used 13 microsatellite loci to explore the consequences of forest degradation on the reduction in genetic diversity of Brazil nut populations. We examined the clustering of genetically related individuals as fine-scale genetic structure (FSGS) and the variation in genetic diversity and inbreeding across adult trees and seedlings along a categorized forest-degradation gradient ranging from conserved to degraded areas. In addition, we applied direct and indirect approaches to estimate contemporary pollen-mediated gene flow. We found significant levels of FSGS, comparable to other similar tropical tree species. Brazil nut seedlings had consistently lower genetic diversity and higher inbreeding than adults, significantly associated with the degree of forest degradation of their origin. We observed limited pollen dispersal, differential patterns in pollen heterogeneity, and disproportionate paternal-assignment rates from few individuals shaping the effective population size in our dataset. We discuss how this evidence for reproduction vulnerability may affect the genetic resources and undermine the resilience of this ecological and socio-economic system in Peru.

Enlace: <https://doi.org/10.1002/ppp3.10166>

Growth of the native cladocero *Ceriodaphnia sp* with chlorophytes (*Scenedesmus sp* and *Chlorella sp*) under laboratory conditions

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Resumen

Se presentan los resultados del efecto de las clorofitas *Scenedesmus sp* y *Chlorella sp* utilizadas como alimento sobre el desarrollo del cladócero nativo *Ceriodaphnia sp*. Se emplearon tres tratamientos con tres repeticiones para cada clorofita, T1= 5 ml.L-1 (25 x 106 cel), T2= 10 ml.L-1 (50 x 106 cel) y T3=15 ml.L-1 (75 x 106 cel). Las características físicas y químicas del agua de los recipientes variaron entre 28.4 y 28.6 °C, pH entre 6.57 y 7.36 y el oxígeno disuelto entre 6.34 y 6.66 mg/l entre tratamientos. Los resultados mostraron que *Ceriodaphnia sp* tiene preferencia por la microalga *Chlorella sp*, donde las dietas con la concentración de 10 ml.l-1 (50 x 106 cel) fueron superiores a las otras dietas.

Abstract

The effect of the chlorophytes *Scenedesmus sp* and *Chlorella sp* used as feed on the growth of the native cladoceran *Ceriodaphnia sp* were studied. Three treatments with three repetitions for each chlorophyte were used: T1 = 5 ml.L-1 (25 x 106 cells), T2 = 10 ml.L-1 (50 x 106 cells) and T3 = 15 ml.L-1 (75 x 106 cel). The physical and chemical characteristics of the water in the containers varied between 28.4 and 28.6 °C, pH between 6.57 and 7.36 and the dissolved oxygen between 6.34 and 6.66 mg/l between treatments. The results showed that *Ceriodaphnia sp* prefers the *Chlorella sp* microalgae, where diets with a concentration of 10 ml.l-1 (50 x 106 cells) were better than the other diets.

Enlace: <https://revistasinvestigacion.unmsm.edu.pe/index.php/veterinaria/article/view/17555>

<https://doi.org/10.15381/rivep.v31i1.17555>

Identifying and quantifying the abundance of economically important palms in tropical moist forest using UAV imagery

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Abstract

Sustainable management of non-timber forest products such as palm fruits is crucial for the long-term conservation of intact forest. A major limitation to expanding sustainable management of palms has been the need for precise information about the resources at scales of tens to hundreds of hectares, while typical ground-based surveys only sample small areas. In recent years, small unmanned aerial vehicles (UAVs) have become an important tool for mapping forest areas as they are cheap and easy to transport, and they provide high spatial resolution imagery of remote areas. We developed an object-based classification workflow for RGB UAV imagery which aims to identify and delineate palm tree crowns in the tropical rainforest by combining image processing and GIS functionalities using color and textural information in an integrative way to show one of the potential uses of UAVs in tropical forests. Ten permanent forest plots with 1170 reference palm trees were assessed from October to December 2017. The results indicate that palm tree crowns could be clearly identified and, in some cases, quantified following the workflow. The best results were obtained using the random forest classifier with an 85% overall accuracy and 0.82 kappa index.

Enlace: <https://doi.org/10.3390/RS12010009>

Management practices and honey characteristics of *Melipona eburnea* in the peruvian amazon

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Abstract

Meliponiculture and associated honey production are activities with a great potential for general use and commercialization in the Peruvian Amazon. Lack of management techniques and limited knowledge of honey quality are two factors which may hinder the implementation of meliponiculture. The present study was conducted in three communities in the Peruvian Amazon where the production and physicochemical and microbiological characteristics of honey from *Melipona eburnea* were evaluated at 90 days following transfer from natural to rational hives. Honey from *M. eburnea* was also compared with the 90-day-old honey from *Melipona grandis*, *Melipona illota*, and *Melipona titania*. In addition, 180-day-old honey from *M. eburnea* was sampled and compared with the younger 90-day-old honey. The production of honey varied from 900 to 1400 mL/colony/3 months for *M. eburnea*. When moisture and total sugars among the different species of *Melipona* were compared, no significant differences were observed. Neither were there significant differences between the *M. eburnea* honey at 90 and 180 days of maturation. Microbiological analyses for both treatments had values <0.3/g most probable number (MPN) of coliforms and organisms of fecal origin. Stingless bee honey can therefore be harvested after 3 months, by which time its physicochemical characteristics are stable and it is microbiologically suitable for human consumption.

Enlace: <https://doi.org/10.1590/0103-8478cr20190697>

Modelos alométricos de biomasa de árboles de *Guazuma crinita* Mart en plantaciones forestales de Ucayali, Perú

Allometric model of biomass of white bolaina (*Guazuma crinita* Mart.) trees in forest plantations of Ucayali, Peru

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Resumen

La bolaina blanca (*Guazuma crinita* Mart, Meliaceae) es una de las especies más importantes de la región Ucayali por su rápido crecimiento y creciente valor en el mercado, convirtiéndola en una especie competitiva al momento de elegir especies para un programa de producción de bienes y servicios sostenible, por ello la determinación de la cantidad de biomasa cumple un papel clave para este fin; en este contexto, fueron evaluados 38 árboles de *G. crinita* de 31 meses de edad, con diámetro promedio a la altura de la base de 13,33 cm, con un valor máximo y mínimo de 17,4 y 10,2 cm, respectivamente, con desviación estándar de 1,80 cm y un coeficiente de variabilidad de 13%, para una biomasa total promedio de 28,76 Kg, con una desviación estándar de 10,07 y un coeficiente de variabilidad del 35%; se determinó que en la cuenca del río Aguaytia existe una alta relación entre la variable independiente diámetro a la altura de la base (dab) y la biomasa total aérea de los árboles de acuerdo al modelo biomasa $\sim a \cdot dab^b$, lo que resultó que es previsible con la siguiente fórmula $Bma_{dab} = 0,04253 \cdot dab^{2,5027}$ con $R^2 = 0,9397$.

Abstract

The white ball (*Guazuma crinita* Mart, Meliaceae) as one of the most important species in the Ucayali region due to its rapid growth and increasing market value, makes it a competitive species when choosing species for a program of production of goods and sustainable services, therefore determining the amount of biomass plays a key role for this purpose; In this purpose, the 38 trees of *G. crinita* at 31 months of age, with an average diameter at the height of the base of 13.33 cm, with a maximum and minimum value of 17.4 and 10.2 cm, respectively, with a standard deviation of 1.80 cm and a variability coefficient of 13%, for an average total biomass of 28.76 Kg, with a standard deviation of 10.07 and a variability coefficient of 35%; It was determined that there is a high relationship between the independent variable diameter at the height of the base (dab) and the total aerial biomass of the trees in the Aguaytia river basin according to the biomass model - $adab$, which resulted which is predictable with the following formula $Bmadab = 0.04253 \cdot Dab^{2.5027}$ with $R^2 = 0.9397$.

Enlace: <https://doi.org/10.17268/sci.agropecu.2021.062>

Modelos alométricos para estimar el volumen de madera de *Guazuma crinita* en plantaciones forestales

Allometric models to estimate the volume of *Guazuma crinita* in forest plantations

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Resumen

El uso de ecuaciones alométricas en la estimación del volumen comercial de madera permite planificar el manejo silvicultural. En ese sentido, el objetivo en este trabajo fue seleccionar los mejores modelos alométricos para estimar el volumen de madera en árboles de *G. crinita*, para ello, fueron utilizados árboles entre 13,09 m de altura y 10,58 cm de DAP en media. Para la determinación del mejor modelo fueron considerados el mayor coeficiente de determinación R^2 ajustado ($> R^2_{Aj}$), menor coeficiente de variabilidad ($< CV\%$) y menor índice de Furnival, (IF). De los 17 modelos alométricos existentes para especies forestales, dos fueron adecuados, el modelo: $\ln(V) = a + b \ln(D)$ ($R^2 = 0,93$, $CV = 11,93\%$, $IF = 0,003444$) y el modelo que utiliza la variable combinada Log: $\ln(V) = a + b \ln(D^2 * H)$ ($R^2 = 0,91$, $CV = 11,93\%$, $IF = 0,003444$), así mismo, un tercer modelo propuesto en este estudio: $\ln(V) = a + b \ln(D^2) + c \ln(D * H) - d \ln(D^2 * H)$ ($R^2 = 0,98$, $CV = 11,93\%$, $IF = 0,003444$), también presentó el mejor ajuste para estimar el volumen comercial de *G. crinita* a los 31 meses de edad. Con todo, se recomienda el uso del modelo de Husch, por ser de fácil aplicación, puesto que utiliza apenas el diámetro a la altura del pecho (DAP) como variable independiente.

Abstract

The use of allometric equations in the estimation of the commercial volume of wood allows to plan the management Forestry In that sense, the objective in this work was to select the best allometric models to estimate the volume of wood in *G. crinita* trees, for this, trees between 13.09 m high and 10.58 cm DAP were used on average. For the determination of the best model, the highest adjusted coefficient of determination R^2 ($> R^2_{Aj}$), lower coefficient of variability ($< CV\%$) and lower Furnival index (IF) were considered. Of the 17 existing allometric models for forest species, two were suitable, the model: $\ln(V) = a + b \ln(D)$ ($R^2 = 0.93$, $CV = 11.93\%$, $IF = 0.003444$) and the model that uses the combined variable Log: $\ln(V) = a + b \ln(D^2 * H)$ ($R^2 = 0.91$, $CV = 11.93\%$, $IF = 0.003444$), likewise, a third model proposed in this study: $\ln(V) = a + b \ln(D^2) + c \ln(D * H) - d \ln(D^2 * H)$ ($R^2 = 0.98$, $CV = 11.93\%$, $IF = 0.003444$), also presented the best fit to estimate the commercial volume of *G. crinita* at 31 months of age. However, the use of the Husch model is recommended, as it is easy to apply, since it only uses the diameter at chest height (DBH) as an independent variable.

Enlace: <https://doi.org/10.17268/SCI.AGROPECU.2021.003>

MORTALIDAD DE BANDA NEGRA *Myloplus Schomburgkii* DEBIDO A LA POBRE CALIDAD DEL AGUA ASOCIADA CON LA SOBREPoblACIÓN DE LENTEJAS DE AGUA EN UN ESTANQUE DE CRIANZA EN LA AMAZONÍA PERUANA

MORTALITY OF BLACK-BAND MYLEUS *Myloplus Schomburgkii* DUE TO POOR WATER QUALITY ASSOCIATED WITH OVERPOPULATION OF DUCKWEEDS IN A CULTURE POND IN THE PERUVIAN AMAZONIA

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Resumen

Los estanques cubiertos de lentejas de agua liberan nutrientes de forma rápida causando problemas de eutrofización del agua que pueden reducir la transparencia y perjudicar su calidad, creando una "zona mortal" hipóxica o anóxica que carece de oxígeno suficiente para mantener a la mayoría de los organismos. En el presente estudio se observó la mortalidad del pez "banda negra" *Myloplus schomburgkii* Jardine, 1841, lo que motivó a investigar los factores que causaron la muerte de los ejemplares registrados en un estanque de peces en la Amazonía peruana. Tras el recuento de los peces muertos, se reveló que sesenta individuos (75% de la población total) de *M. schomburgkii* murieron. La identificación taxonómica reveló la presencia de la planta acuática *Lemna minor* denominadas localmente en Perú como "lentejas de agua" distribuida por todo el estanque. Los parámetros físicos y químicos del agua revelaron bajos niveles de oxígeno, agua ácida y altos niveles de nitrato y fosfato. Dado que la lenteja de agua no puede eliminarse por completo del agua, que favorece su desarrollo, hay que cosecharlas periódicamente para evitar que aumenten desmedidamente. Las estrategias de manejo son fundamentales para garantizar la buena calidad del agua del estanque y evitar mortalidades debido a desequilibrio de parámetros físicos y químicos del agua.

Abstract

Ponds covered with duckweeds release nutrients rapidly causing problems of eutrophication of the water that can reduce water clarity and harm water quality, creating a hypoxic or anoxic 'dead zone' lacking sufficient oxygen to support most organisms. In the present study, mortality of black-band myleus *Myloplus schomburgkii* Jardine, 1841 was suddenly perceived, motivating to investigate the factors that caused the death of the specimens registered in a fish pond in the Peruvian Amazon. After the counting of death fish, it was revealed that sixty individuals (75% of the total population) of *M. schomburgkii* died. The taxonomic identification of the aquatic plant revealed the presence of "duckweeds" locally named in Peru as "lenteja de agua" *Lemna minor* distributed throughout the pond. Physical and chemical water parameters revealed low levels of oxygen, acid water, and high levels of nitrate and phosphate. Since duckweeds cannot be completely eliminated from waters, which are conducive to its growth and have to be harvested periodically to prevent matting, proper management strategies therefore become critical to

guarantee good quality of water in the pond and avoid deaths due to imbalances in physical and chemical parameters.

Enlace: <https://doi.org/10.24841/fa.v30i1.543>



Measuring sustainability of smallholder livestock farming in Yurimaguas, Peruvian Amazon

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Abstract

Sustainability measurement addresses the social, economic, and environmental aspects in order to support policy and decision-making. In the Peruvian Amazon, some smallholder livestock farmers have subsisted through time, partially preserving the ecosystems and demonstrating in practice a certain degree of sustainability. In this regard, this study aims at measuring the sustainability of smallholder livestock farming in the Peruvian Amazon. Sustainability was measured using a multi-criteria method, through the construction of sustainability indicators based on information obtained from field surveys, and soil and macrofauna sampling in the pastures. For this purpose, economic, environmental, and socio-cultural indicators were considered, with a rating scale from 0 to 4, where 0 is the least sustainable category and 4 is the most sustainable one. Smallholder livestock farming was considered sustainable if the general sustainability index (GenSI) was equal to or greater than 2 and, at the same time, if none of the three indicators had a value lower than 2. The socio-cultural indicator was within the sustainability threshold, but the economic and environmental indicators did not fulfill the necessary requirements to consider smallholder livestock farming a sustainable activity in the city of Yurimaguas, Peru. The critical points affecting the sustainability of smallholder livestock farming in Yurimaguas were as follows: degraded soils, lack of silvopastoral systems, inefficient transport system, low annual income, and low levels of associativity. The results suggest the need for mitigating these limitations, as well as promoting associativity and implementing silvopastoral systems for the improvement of the welfare of smallholder livestock farmers.

Enlace: <https://doi.org/10.1002/fes3.242>

Mycorrhizal science outreach: Scope of action and available resources in the face of global change

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Abstract

Mycorrhizal associations are acknowledged as key components of global ecosystem functioning. This is especially relevant in the context of global change, since they contribute to the amelioration of adverse soil conditions and play crucial roles in agriculture. Generally speaking, the lay public is uninformed on the importance of mycorrhizal fungi and symbiosis to our planet. Therefore, mycorrhizal scientific outreach activities are of paramount importance in order to bridge the aforementioned gap. We think that informing people about the benefits of mycorrhizal fungi and symbiosis in the face of global change, will raise general awareness of relevant research and aid conservation efforts. Summary: Science outreach has become a particularly important duty in shortening the knowledge gap between scientists and the public, in order to strengthen societal decision-making power in the global change crisis. Mycorrhizal fungi and mycorrhizal symbioses are key components of terrestrial ecosystems that contribute significantly to endure and reduce certain negative global change effects. Their importance has been gaining recognition in academic circles, but not among the general public. The aim of this article is to encourage as many mycorrhizal fungi researchers around the world as possible to build, through science outreach, a bridge between their scientific work and public interest. To this end, we conducted a review and discussed the relationship between global change and the mycorrhizal symbiosis. We highlight potential audiences, tools, resources, activities, outreach models, pros and cons, as well as the quantification potential for the outreach activities success. We extend an invitation to all mycorrhizologists around the world to contribute with mycorrhizal outreach material. Contributions will become available on the South American Mycorrhizal Research Network website for individuals or organizations interested in starting or innovating in mycorrhizal science outreach activities. Finally, the hashtag #mycorrhizalscienceoutreach is proposed to be used whenever a mycorrhizal fungi-related science outreach activity is shared in social media.

Enlace: <https://doi.org/10.1002/ppp3.10213>

Nuevos agentes de biorremediación de cadmio: Especies de *Trichoderma* nativas de la rizósfera de árboles de cacao

New cadmium bioremediation agents: *Trichoderma* species native to the rhizosphere of cacao trees

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Resumen

La absorción de cadmio (Cd) por la planta de cacao y la mayor acumulación en granos, representa un problema para las exportaciones y la industria chocolatera. *Trichoderma spp.* nativas con capacidad de remoción y tolerancia a Cd, colectadas del suelo rizosférico de árboles de cacao. *in vitro* fueron inoculadas 10 cepas *Trichoderma spp.* nativas en medio de cultivo papa dextrosa agar (PDA) contaminado con tres concentraciones de Cd (25 ppm, 100 ppm y 250 ppm) y en medio de cultivo papa dextrosa (PD) contaminado con 5 ppm de Cd. Con los datos de ritmo de crecimiento (RC) de la colonia del hongo en presencia de Cd y porcentaje de remoción de Cd (RCd), se realizaron el análisis de varianza y las medias se compararon con la prueba de Scott-knott ($p = 0,05$). *Trichoderma spp.* fueron sensibles a la presencia de Cd y capaces de remover Cd. Entre las cepas con alta capacidad de remoción significativa ($p < 0,05$) de Cd fueron *T. brevicompactum* M43D (83,1%), *T. harzianum* M1P (67,0%) y *T. spirale* M55SM (65,8%). Mientras, las cepas más tolerantes fueron *T. harzianum* M1P y *T. koningiopsis* M3B, en comparación al tratamiento control sin Cd. Por lo tanto, *T. brevicompactum* M43D y *T. spirale* M55SM se suman a la lista de especies de *Trichoderma* como nuevos agentes potenciales de biorremediación de Cd que pueden ser explorados.

Abstract

The cadmium absorption by cacao plant and increased in beans accumulation, represents a problem for the exports of cacao beans and chocolate industry. In this study, native strains of *Trichoderma spp.* were evaluated for their capacity of tolerate and removal to Cd, collected from rhizospheric soil of cacao trees. In order to evaluate such capacities under *in vitro* conditions, 10 native strains of *Trichoderma spp.* were inoculated in potato dextrose agar (PDA) culture medium contaminated with three concentrations of Cd (25 ppm, 100 ppm and 250 ppm) and in potato dextrose (PD) culture medium contaminated with 5 ppm Cd. With data of growth rhythm (RC) of the fungus colony in Cd presence and percentage of Cd removal (RCd), the analysis of variance was performed, and the means were compared with Scott-knott test ($p = 0.05$). The results showed that, *Trichoderma spp.* were sensitive to Cd presence and capable of Cd removing. Among the strains with high significant removal Cd capacity ($p < 0.05$) were *T. brevicompactum* M43D (83.1%), *T. harzianum* M1P (67.0%) and *T. spirale* M55SM (65.8%). While the most tolerant strains were *T. harzianum* M1P and *T. koningiopsis* M3B, in comparison to the control treatment without Cd. Therefore, *T. brevicompactum* M43D and *T. spirale* M55SM unite to the list of *Trichoderma* species as potential new Cd bioremediation agents that can be explored.

Enlace: <https://doi.org/10.17268/SCI.AGROPECU.2021.017>



Nutritional evaluation and human health-promoting potential of compounds biosynthesized by native microalgae from the Peruvian Amazon

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Abstract

A plausible strategy to mitigate socioeconomic problems in the Peruvian Amazon is through the sustainable exploitation of biodiversity resources, such as native microalgae. Several studies worldwide affirm that these microorganisms are excellent sources of higher value products for human nutrition and possess health-promoting biochemicals, but these attributes are unknown for the native microalgae of Peru. Therefore, the aim of this investigation was to evaluate the nutritional and human health-promoting potential of compounds biosynthesized by native microalgae from the Peruvian Amazon. Ten native microalgae strains of the groups cyanobacteria and chlorophyta were cultured in BG-11 medium and their biomass harvested and dried. Standardized methods were then used to determine proximate composition, fatty acids and amino acids composition, antioxidant activity, and total phenolic content. All ten microalgae strains produce primary nutrients, the entire spectrum of essential amino acids, essential fatty acids, and 3 of the 10 microalgae strains produced eicosapentaenoic acid. Additionally, all microalgae strains exhibited antioxidant activities and contained phenolic compounds. In conclusion, native microalgae strains from the Peruvian Amazon analyzed in this study possess the ability to biosynthesize and accumulate several nutrients and compounds with human health-promoting potential.

Enlace: <https://doi.org/10.1007/s11274-020-02896-1>

Propagation of Rust-Tolerant *Coffea arabica* L. Plants by Sprout Rooting in Microtunnels

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Abstract

Small Peruvian coffee producers face low yields per hectare, caused mainly by recent rust outbreaks and by natural crossing of coffee varieties, which are sown without specific order. Coffee rust has drastically reduced areas of susceptible but high-quality cup varieties as caturra, pache, and nacional, which have been replaced by others with high grain weight, but low-quality cup. This study aimed to determine the rooting capacity of sprouts subjected to different concentrations of indole-3-butyric acid (AIB) in three varieties of *Coffea arabica*, in the San Martín region, Peru. The most appropriate sprout rooting characteristics allowing to propagate rust-tolerant *C. arabica* plants were evaluated, under the effect of four doses of AIB (0, 1000, 2000, and 3000 ppm) in three coffee varieties (caturre, pache, and nacional), using microtunnels as rooting environments. A completely randomized design, consisting of three repetitions per treatment and six sprouts per repetition, was used. At the end of 50 days, the best rooting result (89%) was obtained with a dose of 2000 ppm of AIB in the caturra variety. The overall results are successful, since there is a conversion rate of sprouts into useful seedlings of more than 85%, if proper handling conditions are implemented. This method of propagation of rust-tolerant *C. arabica* sprouts by microtunnels enables a mass production of seedlings. The validation of these results could lead to the establishment of entire rust-tolerant coffee farms.

Enlace: <https://doi.org/10.1007/s42729-020-00180-7>

Plantas medicinales con valor comercial en la ciudad de Iquitos, Perú

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Resumen

En la Amazonía peruana se registran más de 1,000 especies de plantas con propiedades medicinales. El objetivo de este trabajo fue documentar las especies vegetales de mayor consumo y comercialización en la ciudad de Iquitos, Perú. Se realizaron entrevistas con los responsables de los puestos de venta de plantas medicinales del Pasaje Paquito, donde se verificó y corroboró en su registro las especies vegetales de mayor venta. Se tomaron datos del nombre común, parte utilizada de la planta, tipo de dolencia en la que se utiliza y forma de preparación. Se reporta 38 especies de plantas medicinales con valor comercial, siendo la uña de gato, sangre de grado, guanábana y copaiba las más citadas. Con estos datos se contribuye con información de plantas que tienen un buen mercado a nivel regional, nacional e internacional, y que puede servir como propuesta de implementación de programas de cultivo en la región de Loreto, Perú.

Enlace: <https://repositorio.iiap.gob.pe/handle/20.500.12921/569>

Pharmacological validation of *Solanum mammosum* L. as an anti-infective agent: Role of solamargine

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Abstract

Ethnopharmacological relevance: Fungal and bacterial infections remain a major problem worldwide, requiring the development of effective therapeutic strategies. *Solanum mammosum* L. (Solanaceae) (“teta de vaca”) is used in traditional medicine in Peru to treat fungal infections and respiratory disorders via topical application. However, the mechanism of action remains unknown, particularly in light of its chemical composition. Materials and methods: The antifungal activity of TDV was determined against Trichophyton mentagrophytes and Candida albicans using bioautography-TLC-HRMS to rapidly identify the active compounds. Then, the minimum inhibitory concentration (MIC) of the fruit crude extract and the active compound was determined to precisely evaluate the antifungal activity. Additionally, the effects of the most active compound on the formation of Pseudomonas aeruginosa biofilms and pyocyanin production were evaluated. Finally, a LC-HRMS profile and a molecular network of TDV extract were created to characterize the metabolites in the fruits' ethanolic extract. Results: Bioautography-TLC-HRMS followed by isolation and confirmation of the structure of the active compound by 1D and 2D NMR allowed the identification solamargine as the main compound responsible for the anti-Trichophyton mentagrophytes (MIC = 64 $\mu\text{g mL}^{-1}$) and anti-Candida albicans (MIC = 64 $\mu\text{g mL}^{-1}$) activities. In addition, solamargine led to a significant reduction of about 20% of the Pseudomonas aeruginosa biofilm formation. This effect was observed at a very low concentration (1.6 $\mu\text{g mL}^{-1}$) and remained fairly consistent regardless of the concentration. In addition, solamargine reduced pyocyanin production by about 20% at concentrations of 12.5 and 50 $\mu\text{g mL}^{-1}$. Furthermore, the LC-HRMS profiling of TDV allowed us to annotate seven known compounds that were analyzed through a molecular network. Conclusions: Solamargine has been shown to be the most active compound against *T. mentagrophytes* and *C. albicans* in vitro. In addition, our data show that this compound affects significantly *P. aeruginosa* pyocyanin production and biofilm formation in our conditions. Altogether, these results might explain the traditional use of *S. mammosum* fruits to treat a variety of fungal infections and respiratory disorders.

Enlace: <https://doi.org/10.1016/j.jep.2021.114473>

REPORTE PRELIMINAR SOBRE EL CRECIMIENTO INICIAL DE *Calycophyllum spruceanum* (Benth) Hook. F. ex K. Schum. A PARTIR DEL MÉTODO DE SIEMBRA DE SEMILLAS AL VOLEO

PRELIMINARY REPORT ON THE INITIAL GROWTH OF *Calycophyllum spruceanum* (Benth) Hook. F. ex K. Schum. FROM BROADCAST SEEDS SOWING METHOD

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Resumen

Se presentan los resultados preliminares del crecimiento inicial de capirona *Calycophyllum spruceanum*, a partir de la siembra de semillas al voleo, para ello, primero se mezcló las semillas junto con arena blanca y se esparció manualmente en un área de 40 m². Posterior a la germinación, se realizaron mediciones biométricas trimestralmente a los individuos seleccionados. En 18 meses de evaluación se alcanzó un promedio en altura de 3,75 m ($\pm 0,65$) y en diámetro de fuste de 3,44 cm ($\pm 1,46$). Este experimento buscó comprobar la eficacia del método de siembra al voleo para capirona, una especie forestal maderable de gran valor, que hoy en día se encuentra en riesgo de desaparición debido a que sus poblaciones naturales vienen siendo afectadas por la sobreexplotación. Las cifras de crecimiento obtenidas fueron satisfactorias, lo que demuestra que este método de siembra es viable, convirtiéndose en una nueva alternativa de propagación para la especie.

Abstract

We present the preliminary results of the initial growth of capirona *Calycophyllum spruceanum* from a broadcast seed sowing in which the seeds were first mixed together with white sand and manually spread over an area of 40m². After germination, biometric measurements were recorded every three months for selected individuals. In 18 months of evaluation, an average height of 3.75m (± 0.65) and stem diameter of 3.44cm (± 1.46) were reached. This experiment sought to verify the efficacy of the broadcast seed sowing for capirona, a highly valuable timber forest species, which today is at risk of disappearance due to the fact that its natural populations are being affected by overexploitation. The growth figures obtained were satisfactory, which shows that this sowing method is viable in becoming a new propagation alternative for the species.

Enlace: <https://doi.org/10.24841/fa.v30i1.544>

Safety of oral administration of high doses of ivermectin by means of biocompatible polyelectrolytes formulation

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Abstract

The FDA-approved drug ivermectin is applied for treatments of onchocerciasis and lymphatic filariasis. The anti-cancer and anti-viral activities have been demonstrated stressing possibilities for the drug repurposing and therefore new information on high dosage safety is on demand. We analyzed in vivo tissue responses for high doses of ivermectin using *Corydoras* fish as animal model. We made intestinal histology and hematologic assays after oral administration of ivermectin transported with polyelectrolytes formulation. Histology showed any apparent damage of intestinal tissues at 0.22–170 mg of ivermectin/kg body weight. Immunofluorescence evidenced delocalization of Myosin-Vb at enterocytes only for the higher dose. Hematology parameters showed random variations after 7 days from administration, but a later apparent recover after 14 and 21 days. The study evaluated the potential of high doses of oral administration of ivermectin formulation, which could be an alternative with benefits in high compliance therapies.

Enlace: <https://doi.org/10.1016/j.heliyon.2020.e05820>

Selection of soybean genotypes for yield, size, and oil and protein contents

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Abstract

A set of experiments was developed involving a randomized block design with three replications to evaluate 17 soybean genotypes for yield, size, and oil and protein contents. Soybean genotypes Conquista, CD 223 AP, Elite, Garantia, Bioagro, M-Soy 8400, M-soy 8001, Nambu, Sambaíba, Esplendor, UFVS 2006, UFVS 2005, UFVTN 102, UVF 18, UVF 16, Valiosa RR, and Vencedora were tested. The genotypes were compared and correlated with the following variables: plant height (PH), first pod height (FPH), yield, and oil and protein contents. The genotypes with the highest PH and FPH were Sambaíba, UVF 18, and Garantia, which, together with M-Soy 8001, also had the highest grain oil contents of 20.93, 21.16, 21.02, and 21.95, respectively. Genotype Bioagro had the highest grain protein content, and the genotypes Elite and Nambu were the most productive. Oil content had a negative correlation with protein content, and yield had a positive correlation with plant size in the evaluated soybean genotypes. Soybean (*Glycine max* (L.) Merrill) is one of the main oilseeds produced in the world, and is being used in the production of oils, cosmetics, and human and animal feed, making the plant highly important for the economic development of producing and consuming countries. In Brazil, soybean development has occurred effectively through genetic breeding programs, which have increased yield through the selection of genotypes adapted to the edaphoclimatic conditions of each region (Vasconcelos et al., 2015; Finoto et al., 2017).

Enlace: <https://doi.org/10.21475/ajcs.21.15.01.2390>

SILVICULTURA DE UN RODAL DE REGENERACIÓN NATURAL DE *Calycophyllum spruceanum* (Benth.) Hook. f. ex K. Schum (RUBIACEAE) EN LA LLANURA ALUVIAL INUNDABLE DE IQUITOS, AMAZONÍA PERUANA

SILVICULTURE OF NATURAL REGENERATION STAND OF *Calycophyllum spruceanum* (Benth.) Hook. f. ex K. Schum (RUBIACEAE) IN ALLUVIAL FLOODPLAIN OF IQUITOS, PERUVIAN AMAZON

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Resumen

Los rodales de *Calycophyllum spruceanum* (Benth.) Hook. f. ex K. Schum., conocidos localmente como capironales, ocurren naturalmente en la planicie de inundación de los ríos principales de la Amazonía baja peruana. En el presente estudio, se caracterizó la estructura horizontal y se analizó la condición silvicultural de un rodal de capirona ubicado en el distrito de Belén, departamento de Loreto. Se realizó un inventario forestal y se midieron los parámetros sobre la condición silvicultural de las plantas según categorías de tamaño. El rodal tiene 8 años y presenta 961 individuos, 7,68 m² de área basal y un volumen de 25,68 m³. La condición silvicultural según iluminación de copas muestra que el 40,48% de la población se encuentra en condiciones deficientes de luz y pertenecen al grupo de latizales, esta situación también afecta la forma de las copas, ya que dentro de este grupo el 33,51% corresponden a la categoría tolerable con medio círculo de copa y un 22,27 son copas pobres a muy pobres. En cuanto a la calidad de fuste el 30,07% de individuos presentan fustes bien rectos y cilíndricos y 25,7% con fuste recto en la mayor parte de su longitud. El análisis silvicultural del rodal muestra que existe un alto número de plantas con deficiente iluminación y forma de copas, por lo que se considera que el tratamiento silvicultural adecuado es un raleo de tipo selectivo-elegido con fin de regular el distanciamiento entre las plantas mejor conformadas y vigorosas y mejorar las condiciones para su desarrollo.

Abstract

Horizontal structure and silvicultural conditions of a naturally-regenerated *Calycophyllum spruceanum* (known in Peru as "Capirona") stand in an alluvial floodplain were assessed. A forestry inventory was carried out and silvicultural conditions parameters were measured according their size categories. *C. spruceanum* stand has 961 individuals, 7.68m² of basal area and 25.68m³ of volume. Silvicultural condition by crown lighting indicated that 40.48% of total population has deficient lighting and belongs to the latizales class. This deficient lighting also affected the crown shape because 33.51% of the stand belong to the "tolerable" class with half-crown circle and 22.27% varies from poor to very poor crown. Regarding the stem quality, 30.07% of individuals shows well straight and cylindrical stems and 25.7% with straight stems in higher of its length. The silvicultural analysis of the stand shows that there are a high number of plants with poor lighting and crown shape, so it is considered that the appropriate silvicultural treatment is a thinning of the selective-chosen type in order to regulate the distance between the best shaped plants and vigorous and improve the conditions for their development.

Enlace: <https://doi.org/10.24841/fa.v30i1.545>



The Peruvian Amazon forestry dataset: A leaf image classification corpus

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Abstract

Forest census allows getting precise data for logging planning and elaboration of the forest management plan. Species identification blunders carry inadequate forest management plans and high risks inside forest concessions. Hence, an identification protocol prevents the exploitation of non-commercial or endangered timber species. The current Peruvian legislation allows the incorporation of non-technical experts, called “materos”, during the identification. Materos use common names given by the folklore and traditions of their communities instead of formal ones, which generally lead to misclassifications. In the real world, logging companies hire materos instead of botanists due to cost/time limitations. Given such a motivation, we explore an end-to-end software solution to automatize the species identification. This paper introduces the Peruvian Amazon Forestry Dataset, which includes 59,441 leaves samples from ten of the most profitable and endangered timber-tree species. The proposal contemplates a background removal algorithm to feed a pre-trained CNN by the ImageNet dataset. We evaluate the quantitative (accuracy metric) and qualitative (visual interpretation) impacts of each stage by ablation experiments. The results show a 96.64% training accuracy and 96.52% testing accuracy on the VGG-19 model. Furthermore, the visual interpretation of the model evidences that leaf venations have the highest correlation in the plant recognition task.

Enlace: <https://doi.org/10.1016/j.ecoinf.2021.101268>

The Role of Arbuscular Mycorrhizal Fungi Against Root-Knot Nematode Infections in Coffee Plants

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Abstract

Coffee (*Coffea arabica*) is one of the most important tropical crops in the world, and root-knot nematode (*Meloidogyne spp.*) infections are one of the main factors that negatively affect crop yields throughout the South American region. This study aimed to evaluate the role of indigenous arbuscular mycorrhizal fungi against root-knot nematode infections in coffee plants grown under different soil conditions in the Peruvian Amazon. The experimental design was a 3A × 2B × 4C factorial scheme with 24 treatments. Each experimental unit consisted of six coffee plants, with three replicates in randomized blocks, totaling 18 coffee plants per treatment. The studied factors were soil conditions (A), types of coffee propagation (B), and arbuscular mycorrhizal fungi consortia (C). The data were statistically examined by three-way analysis of variance, and the Tukey HSD test was applied for multiple comparisons of group means. Mycorrhiza-induced tolerance was confirmed against root-knot nematodes, as the severity of infection was significantly lower in mycorrhizal roots, with an average reduction of 52.5%, 38.5% and 38.3% in coffee plants inoculated with Huall-pache, Do-cat, and Mo-cat, respectively. Furthermore, the effects on plant growth and biological control vary depending on the diversity of arbuscular mycorrhizal fungi consortia, soil conditions, and type of propagation. This study therefore demonstrates that the inoculation of coffee plants with indigenous arbuscular mycorrhizal fungi prior to field establishment promotes coffee plant growth after root-knot nematode infections.

Enlace: <https://doi.org/10.1007/s42729-020-00366-z>

Trichoderma and Clonostachys as biocontrol agents against *Meloidogyne incognita* in sacha inchi

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Abstract

One of the main pathological problems for cropping sacha inchi (*Plukenetia volubilis* L.) is its susceptibility to root-knot nematodes (*Meloidogyne incognita*). In this study, fungal endophytes were explored in the stems and leaves of seven species of the *Plukenetia* genus, and also evaluated the abilities of isolates of *Trichoderma* and *Clonostachys* as biocontrol agents against damages caused by this nematode in sacha inchi. In order to evaluate such effects, seedlings were colonized with these fungal isolates, and then they were infested with root-knot nematode eggs. The results showed that the *Plukenetia* genus is rich in diversity of fungal endophytes. Their greatest diversity was found in *Plukenetia brachybotria*. Among the most efficient isolates for endophytic colonization, some of *Trichoderma* (e.g., kmd-36 and kmd-54) and others of *Clonostachys* (e.g., kmd-68 and kmd-80) provided a significant ($p < 0.05$) reduction in the number of galls induced by the nematodes, in comparison to the control treatment without endophytic colonization. In addition, these isolates allowed a better root development in the tested plants, thus revealing a good biocontrol potential against *M. incognita* in sacha inchi.

Enlace: <https://doi.org/10.1590/1983-40632020v5060890>

Widespread Use of Traditional Techniques by Local People for Hunting the Yellow-Footed Tortoise (*Chelonoidis denticulatus*) Across the Amazon

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Abstract

Understanding the repertoire of hunting techniques used by traditional peoples in tropical forests is crucial for recognizing the role of traditional knowledge in hunting activities, as well as assessing the impact of harvests on game species. We describe the hunting techniques used across Amazonia by Indigenous and non-Indigenous peoples for hunting yellow-footed tortoises (*Chelonoidis denticulatus*), one of the most consumed species in the biome. We interviewed 178 local people in 25 communities living in seven study areas in the Peruvian and Brazilian Amazon. We used a Principal Coordinate Analysis (PCoA) and Analysis of Similarity (ANOSIM) to compare the hunting techniques between ethnic groups and the ages of the interviewees. Four different techniques were reported: (1) trapping with bait (46%; n = 122); (2) hunting with dogs (35%; n = 92); (3) active searching (14 %; n = 37); and (4) visiting fruiting trees (5%; n = 14). Trapping with bait was alleged to be the most cost-effective technique by 67% of the interviewees. Among the baits used, 93% involved the use of wild species as rotten meat. Hunting with dogs was also frequently cited and involved eight different methods of training. The hunting techniques recorded were not significantly different among ethnic groups or generations. The consonance among the technique repertoire likely reflects a shared knowledge still in use across different cultural groups. There is a potential for applying the hunting techniques to large scale community-based monitoring and management programs, but the impact on additional species affected, such as species intentionally captured to be used as bait, should be considered. Local assessments and community-based management plans that incorporate traditional ecological knowledge are recommended to guarantee the maintenance of livelihoods and ensure the species' conservation in Amazonia.

Enlace: <https://doi.org/10.2993/0278-0771-40.2.268>

Wild meat trade over the last 45 years in the Peruvian Amazon

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Abstract

The trade in wild meat is an important economic component of rural people's livelihoods, but it has been perceived to be among the main causes of the decline of wildlife species. Recently, the COVID-19 pandemic has brought to light an additional concern of wildlife markets as a major human-health challenge. We analyzed data from the largest longitudinal monitoring (1973–2018) of the most important urban wild-meat markets in Iquitos, Peru, to examine the trends in and impacts of these markets on people's livelihoods. Over the last 45 years, wild meat sales increased at a rate of 6.4 t/year (SD 2.17), paralleling urban population growth. Wild meat sales were highest in 2018 (442 t), contributing US\$2.6 million (0.76%) to the regional gross domestic product. Five species of ungulates and rodents accounted for 88.5% of the amount of biomass traded. Vulnerable and Endangered species represented 7.0% and 0.4% of individuals sold, respectively. Despite growth in sales, the contribution of wild meat to overall urban diet was constant: 1–2%/year of total meat consumed. This result was due to greater availability and higher consumption of cheaper meats (e.g., in 2018, poultry was 45.8% cheaper and was the most consumed meat) coupled with the lack of economic incentives to harvest wild meat species in rural areas. Most wild meat was sold salted or smoked, reducing the likelihood of foodborne diseases. Community-based wildlife management plans and the continued trade bans on primates and threatened taxa may avoid biodiversity loss. Considering the recent COVID-19 pandemic, future management plans should include potential viral hosts and regulation and enforcement of hygiene practices in wild-meat markets.

Enlace: <https://doi.org/10.1111/cobi.13801>

V. GESTIÓN DE RIESGOS Y ADAPTACIÓN AL CAMBIO CLIMÁTICO



Action needed for staple crops in the Andean-Amazon foothills because of climate change

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Abstract

The Andean-Amazon foothills region, shaped by Andean moist forests and Amazon forests in southwestern Colombia, Napo province in Ecuador, and Ucayali Province and Napo Basin in Peru, provides local and global ecosystem services as food, water, world climate regulation, water purification, and carbon absorption. However, it faces major problems of land-use change that are exacerbated by climate change that affects these ecosystem services. For instance, conventional agriculture contribute to deforestation, soil degradation, and biodiversity loss, which might be further aggravated by climate change-induced droughts, thus reducing staple crop production and, consequently, food security. Cassava (*Manihot esculenta* Crantz), maize (*Zea mays* L.), and plantain (*Musa paradisiaca* L.) are major staple crops in the region. They play a key role for food security and local farmers' income but are highly exposed to climate risks. This article aims to quantify the level of exposure to climate change (measured as climatic suitability) of these crops in the Andean-Amazon foothills by using the EcoCrop model by the 2030s, 2050s, and 2080s under Representative Concentration Pathway 2.6, 4.5, and 8.5 scenarios. EcoCrop results showed that, whereas cassava will not lose climatic suitability, maize will lose more than half of its current suitable area, and plantain will gain and lose area, which would affect local food security. Globally, these results are important in highlighting adaptive and cost-effective strategies in agriculture and suggest that agricultural crop diversification may improve resilience by promoting the use of local crops varieties.

Enlace: <https://link.springer.com/article/10.1007/s11027-020-09923-4>

<https://doi.org/10.1007/s11027-020-09923-4>

A combined view on precipitation and temperature climatology and trends in the southern Andes of Peru

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Abstract

In the southern Peruvian Andes, communities are highly dependent on climatic conditions due to the mainly rain-fed agriculture and the importance of glaciers and snow melt as a freshwater resource. Longer-term trends and year-to-year variability of precipitation or temperature severely affect living conditions. This study evaluates seasonal precipitation and temperature climatologies and trends in the period 1965/66–2017/18 for the southern Peruvian Andes using quality-controlled and homogenized station data and new observational gridded data. In this region, precipitation exhibits a strong annual cycle with very dry winter months and most of the precipitation falling from spring to autumn. Spatially, a northeast–southwest gradient in austral spring is observed, related to an earlier start of the rainy season in the northeastern part of the study area. Seasonal variations of maximum temperature are weak with an annual maximum in austral spring, which is related to reduced cloud cover in austral spring compared to summer. On the contrary, minimum temperatures show larger seasonal variations, possibly enhanced through changes in longwave incoming radiation following the precipitation cycle. Precipitation trends since 1965 exhibit low spatial consistency except for austral summer, when in most of the study area increasing precipitation is observed, and in austral spring, when stations in the central-western region of the study area register decreasing precipitation. All seasonal and annual trends in maximum temperature are larger than trends in minimum temperature. Maximum temperature exhibits strong trends in austral winter and spring, whereas minimum temperature trends are strongest in austral winter. We hypothesize, that these trends are related to precipitation changes, as decreasing (increasing) precipitation in spring (summer) may enhance maximum (minimum) temperature trends through changes in cloud cover. El Niño Southern Oscillation (ENSO), however, has modifying effects onto precipitation and temperature, and thereby leads to larger trends in maximum temperatures.

Enlace: <https://repositorio.senamhi.gob.pe/handle/20.500.12542/425?show=full>

<https://doi.org/10.1002/joc.6645>

An Estimation of Past and Present Air Temperature Conditions, Water Equivalent, and Surface Velocity of Rock Glaciers in Cordillera Volcanic, Peru

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Abstract

Rock glaciers (RG) are one of the most important geomorphological features in the Peruvian Andes. However, the local characteristics of RG have barely been studied or remain unknown. The aim of this research was to characterize past and present conditions of the RG located in Cordillera Volcanic in the southern of Peru. For this purpose, an inventory of RG was carried out and modern and past regional mean air annual temperatures (MAATs) were calculated. We estimate the water equivalent of RG to assess their importance as possible storage of frozen water for past and present conditions using an empirical rule. In addition, the local surface velocity of RG was obtained from Landsat 8 imagery. Within the study area, 187 RG were identified (surface area of 8.3 km²). Of these, 63 were classified as inactive, 39 as active and 85 as relict forms. The altitudinal distribution of RG ranges between 4616 to 5551 m a.s.l. (meter above sea level) where modern MAAT is 0.9°C. In the current conditions, relict RG are located in positive MAAT levels around 1.4°C, however, for the past conditions, relict RG were located in negative MAAT levels around -5°C. The amount of water stored in intact RG range between 28 and 64 million m³. Meanwhile, for past conditions (paleo-WVE), we estimated that volume stored within rock relict RG was between 16 and 35 million m³ (we assume an ice-rich layer of RG permafrost has between 20–45%). On the other hand, the average surface velocities of the active RG have been estimated between 1 to 10 cm/month. The finding of this research contributes to increasing knowledge about RG in the Peruvian Andes, however, further research is needed to understand the importance of RG as stores of frozen water during the past and present conditions.

Enlace: <https://ascelibrary.org/doi/abs/10.1061/9780784483589.010>

A multi-objective approach to select hydrological models and constrain structural uncertainties for climate impact assessments

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Resumen

En este artículo, probamos un marco simple para seleccionar un conjunto de estructuras de modelos hidrológicos calibrados en cuencas donde se han observado condiciones climáticas contrastantes. Comenzamos considerando 78 estructuras modelo producidas con el marco de modelado modular FUSE y nos basamos en un esquema de Pareto para seleccionar estructuras modelo que maximizan la eficiencia del modelo tanto en períodos húmedos como secos. La aplicación de este enfoque en tres cuencas de estudio de caso en Perú permite la identificación de estructuras con buena robustez, pero también con buen desempeño de acuerdo con las firmas hidrológicas no utilizadas para la selección del modelo. También destacamos que algunas estructuras modelo que funcionan bien de acuerdo con las métricas de eficiencia tradicionales tienen un rendimiento bajo en climas contrastantes o estados y flujos internos sospechosos. Es importante destacar que el enfoque de selección del modelo seguido aquí ayuda a reducir la dispersión de las elasticidades de precipitación y las sensibilidades a la temperatura, proporcionando una imagen más clara de los cambios hidrológicos futuros.

Abstract

The assessment of climate change impacts on water resources and flood risk is typically underpinned by hydrological models calibrated and selected based on observed streamflow records. Yet, changes in climate are rarely accounted for when selecting hydrological models, which compromises their ability to robustly represent future changes in catchment hydrology. In this paper, we test a simple framework for selecting an ensemble of calibrated hydrological model structures in catchments where contrasting climatic conditions have been observed. We start by considering 78 model structures produced with the FUSE modular modelling framework and rely on a Pareto scheme to select model structures maximizing model efficiency in both wet and dry periods. The application of this approach in three case study basins in Peru enables the identification of structures with good robustness, but also good performance according to hydrological signatures not used for model selection. We also highlight that some model structures that perform well according to traditional efficiency metrics have low performance in contrasting climates or suspicious internal states and fluxes. Importantly, the model selection approach followed here helps to reduce the spread in precipitation elasticities and temperature sensitivities, providing a clearer picture of future hydrological changes. Overall, this work demonstrates the potential of using contrasting climatic conditions in a multi-objective framework to produce robust and credible simulations, and to constrain structural uncertainties in hydrological projections.

Enlace: <https://onlinelibrary.wiley.com/doi/abs/10.1002/hyp.14446>

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Analysis of extreme meteorological events in the central Andes of Peru using a set of specialized instruments

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Abstract

A set of instruments to measure several physical, microphysical, and radiative properties of the atmosphere and clouds are essential to identify, understand and, subsequently, forecast and prevent the effects of extreme meteorological events, such as severe rainfall, hailstorms, frost events and high pollution events, that can occur with some regularity in the central Andes of Peru. However, like many other Latin American countries, Peru lacks an adequate network of meteorological stations to identify and analyze extreme meteorological events. To partially remedy this deficiency, the Geophysical Institute of Peru has installed a set of specialized sensors (LAMAR) on the Huancayo observatory (12.04° S, 75.32° W, 3350 m ASL), located in the Mantaro river basin, which is a part of the central Andes of Peru, especially in agricultural areas. LAMAR consists of a set of sensors that are used to measure the main atmosphere and soil variables located in a 30-meter-high tower. It also has a set of high-quality radiation sensors (BSRN station) that helps measure the components of short-wave (SW) (global, diffuse, direct and reflected) and long-wave (LW) (emitted and incident) irradiance mounted in a 6-meter-high tower. Moreover, to analyze the microphysics properties of clouds and rainfall, LAMAR includes a set of profiler radars: A Ka-band cloud profiler (MIRA-35c), a UHF wind profiler (CLAIRE), and a VHF wind profiler (BLTR), along with two disdrometers (PARSIVEL2) and two rain gauges pluviometers. The present study performs a detailed dynamic and energetic analysis of two extreme rainfall events, two intense frost events, and three high-pollution events occurring on the Huancayo observatory between 2018 and 2019. The results show that the rainfall events are similar to the 1965–2019 climatological 90th percentile of the daily accumulated rainfall. The results also highlighted the patterns of reflectivity in function of height for both events, which is measured by highlighting the presence of convective and stratiform rainfall types for both events. The first intense rainfall event was associated with strong easterly circulations at high levels of the atmosphere, and the second one was associated with the presence of strong westerly circulations and the absence of BH-NL system around the central Andes. The first frost event was mainly associated with continuous clear sky conditions in the few previous days, corresponding to a radiative frost event. The second one was mainly associated with the intrusion of cold surges from extra-tropical South America. For both events, the energy budget components were strong-lower in comparison to the mean monthly values during early morning hours. Finally, for the high pollution events, the study identified that the main source of aerosols were the forest fires that took place in Peru with certain contributions from the fires in the northern area of Bolivia.

Enlace: <https://repositorio.igp.gob.pe/handle/20.500.12816/4936>

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A Novel High-Resolution Gridded Precipitation Dataset for Peruvian and Ecuadorian Watersheds: Development and Hydrological Evaluation

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Resumen

Aquí se desarrolla un enfoque novedoso para estimar los patrones de precipitación y se aplica para generar un nuevo conjunto de datos de precipitación diaria corregido hidrológicamente, denominado RAIN4PE (Lluvia para Perú y Ecuador), con una resolución espacial de 0,1° para el período 1981–2015 que cubre Perú y Ecuador. Se basa en la aplicación de 1) el método de bosque aleatorio para fusionar las estimaciones de precipitación de múltiples fuentes (pluviómetro, satélite y reanálisis) con la elevación del terreno, y 2) datos de caudal observados y modelados para detectar primero sesgos y luego ajustar la precipitación cuadriculada por inversamente aplicando los resultados simulados del modelo ecohidrológico SWAT (Soil and Water Assessment Tool).

Abstract

A novel approach for estimating precipitation patterns is developed here and applied to generate a new hydrologically corrected daily precipitation dataset, called RAIN4PE (Rain for Peru and Ecuador), at 0.1° spatial resolution for the period 1981–2015 covering Peru and Ecuador. It is based on the application of 1) the random forest method to merge multisource precipitation estimates (gauge, satellite, and reanalysis) with terrain elevation, and 2) observed and modeled streamflow data to first detect biases and second further adjust gridded precipitation by inversely applying the simulated results of the ecohydrological model SWAT (Soil and Water Assessment Tool). Hydrological results using RAIN4PE as input for the Peruvian and Ecuadorian catchments were compared against the ones when feeding other uncorrected (CHIRP and ERA5) and gauge-corrected (CHIRPS, MSWEP, and PISCO) precipitation datasets into the model. For that, SWAT was calibrated and validated at 72 river sections for each dataset using a range of performance metrics, including hydrograph goodness of fit and flow duration curve signatures. Results showed that gauge-corrected precipitation datasets outperformed uncorrected ones for streamflow simulation. However, CHIRPS, MSWEP, and PISCO showed limitations for streamflow simulation in several catchments draining into the Pacific Ocean and the Amazon River. RAIN4PE provided the best overall performance for streamflow simulation, including flow variability (low, high, and peak flows) and water budget closure. The overall good performance of RAIN4PE as input for hydrological modeling provides a valuable criterion of its applicability for robust countrywide hydrometeorological applications, including hydroclimatic extremes such as droughts and floods.

Enlace: <https://journals.ametsoc.org/view/journals/hydr/23/3/JHM-D-20-0285.1.xml>

<https://doi.org/10.1175/JHM-D-20-0285.1>

Assessing Near Real-Time Satellite Precipitation Products for Flood Simulations at Sub-Daily Scales in a Sparsely Gauged Watershed in Peruvian Andes

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Resumen

Este estudio investiga la aplicabilidad de los Productos Satelitales de Precipitación (SPP) casi en tiempo real para la simulación de la escorrentía subdiaria en la cuenca del río Vilcanota, ubicada en los Andes del sureste de Perú. Los datos de las estaciones de pluviómetros se utilizan para evaluar la calidad de las recuperaciones multisatélite integradas para GPM–Early (IMERG-E), el mapeo satelital global de la precipitación–casi en tiempo real (GSMaP-NRT), el método de transformación del centro de predicción climática (CMORPH) e HydroEstimator (HE) a nivel de estación de píxel; y estos SPP se utilizan como entradas meteorológicas para el modelado hidrológico horario. El modelo GR4H se calibra con la estación hidrométrica de mayor registro y también se verifican las simulaciones del modelo en una estación aguas arriba y dos estaciones aguas abajo del punto de calibración.

Abstract

This study investigates the applicability of Satellite Precipitation Products (SPPs) in near real-time for the simulation of sub-daily runoff in the Vilcanota River basin, located in the southeastern Andes of Peru. The data from rain gauge stations are used to evaluate the quality of Integrated Multi-satellite Retrievals for GPM–Early (IMERG-E), Global Satellite Mapping of Precipitation– Near Real-Time (GSMaP-NRT), Climate Prediction Center Morphing Method (CMORPH), and HydroEstimator (HE) at the pixel-station level; and these SPPs are used as meteorological inputs for the hourly hydrological modeling. The GR4H model is calibrated with the hydrometric station of the longest record, and model simulations are also verified at one station upstream and two stations downstream of the calibration point. Comparing the sub-daily precipitation data observed, the results show that the IMERG-E product generally presents higher quality, followed by GSMaP-NRT, CMORPH, and HE. Although the SPPs present positive and negative biases, ranging from mild to moderate, they do represent the diurnal and seasonal variability of the hourly precipitation in the study area. In terms of the average of Kling-Gupta metric (KGE), the GR4H_GSMaP-NRT' yielded the best representation of hourly discharges (0.686), followed by GR4H_IMERG-E' (0.623), GR4H_Ensemble-Mean (0.617) and GR4H_CMORPH' (0.606), and GR4H_HE' (0.516). Finally, the SPPs showed a high potential for monitoring floods in the Vilcanota basin in near real-time at the operational level. The results obtained in this research are very useful for implementing flood early warning systems in the Vilcanota basin and will allow the monitoring and short-term hydrological forecasting of floods by the Peruvian National Weather and Hydrological Service.

Enlace: <https://repositorio.senamhi.gob.pe/handle/20.500.12542/826>

<https://doi.org/10.3390/rs13040826>

Assessment of ECMWF SEAS5 seasonal forecast performance over South America

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Abstract

Seasonal predictions have a great socioeconomic potential if they are reliable and skillful. In this study, we assess the prediction performance of SEAS5, version 5 of the seasonal prediction system of the European Centre for Medium-Range Weather Forecasts (ECMWF), over South America against homogenized station data. For temperature, we find the highest prediction performances in the tropics during austral summer, where the probability that the predictions correctly discriminate different observed outcomes is 70%. In regions lying to the east of the Andes, the predictions of maximum and minimum temperature still exhibit considerable performance, while farther to the south in Chile and Argentina the temperature prediction performance is low. Generally, the prediction performance of minimum temperature is slightly lower than for maximum temperature. The prediction performance of precipitation is generally lower and spatially and temporally more variable than for temperature. The highest prediction performance is observed at the coast and over the highlands of Colombia and Ecuador, over the northeastern part of Brazil, and over an isolated region to the north of Uruguay during DJF. In general, Niño-3.4 has a strong influence on both air temperature and precipitation in the regions where ECMWF SEAS5 shows high performance, in some regions through teleconnections (e.g., to the north of Uruguay). However, we show that SEAS5 outperforms a simple empirical prediction based on Niño-3.4 in most regions where the prediction performance of the dynamical model is high, thereby supporting the potential benefit of using a dynamical model instead of statistical relationships for predictions at the seasonal scale.

Enlace: <https://repositorio.senamhi.gob.pe/handle/20.500.12542/424>

<https://doi.org/10.1175/WAF-D-19-0106.1>

Assessment of CMIP6 Performance and Projected Temperature and Precipitation Changes Over South America

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Abstract

We evaluate the performance of a large ensemble of Global Climate Models (GCMs) from the Coupled Model Intercomparison Project Phase 6 (CMIP6) over South America for a recent past reference period and examine their projections of twenty-first century precipitation and temperature changes. The future changes are computed for two time slices (2040–2059 and 2080–2099) relative to the reference period (1995–2014) under four Shared Socioeconomic Pathways (SSPs, SSP1–2.6, SSP2–4.5, SSP3–7.0 and SSP5–8.5). The CMIP6 GCMs successfully capture the main climate characteristics across South America. However, they exhibit varying skill in the spatiotemporal distribution of precipitation and temperature at the sub-regional scale, particularly over high latitudes and altitudes. Future precipitation exhibits a decrease over the east of the northern Andes in tropical South America and the southern Andes in Chile and Amazonia, and an increase over southeastern South America and the northern Andes—a result generally consistent with earlier CMIP (3 and 5) projections. However, most of these changes remain within the range of variability of the reference period. In contrast, temperature increases are robust in terms of magnitude even under the SSP1–2.6. Future changes mostly progress monotonically from the weakest to the strongest forcing scenario, and from the mid-century to late-century projection period. There is an increase in the seasonality of the intra-annual precipitation distribution, as the wetter part of the year contributes relatively more to the annual total. Furthermore, an increasingly heavy-tailed precipitation distribution and a rightward shifted temperature distribution provide strong indications of a more intense hydrological cycle as greenhouse gas emissions increase. The relative distance of an individual GCM from the ensemble mean does not substantially vary across different scenarios. We found no clear systematic linkage between model spread about the mean in the reference period and the magnitude of simulated sub-regional climate change in the future period. Overall, these results could be useful for regional climate change impact assessments across South America.

Enlace: <https://link.springer.com/article/10.1007/s41748-021-00233-6>

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Behavior of ITCZ' second band near the Peruvian coast during the 2017 coastal El Niño

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Abstract

The behavior of the second band of the Intertropical Convergence Zone (ITCZ), near the Peruvian coast during early 2017, is studied, using precipitation, surface winds, sea surface temperature (SST) and atmospheric variables in different isobaric levels. The proposal of a daily index (**Ia**) to identify, opportunely, the formation of this band and the Lorenz energy terms in the region is also considered.

This band was present from late January to early April 2017, associated with an anomalous dipole of sea level pressure between the east and west Oriental Equatorial Pacific, that configured anomalously northerly surface winds and relaxation of southeasterly trade winds near Peru. In medium levels, a zonally-oriented positive mixing ratio anomaly is observed in early March over the ITCZ's second band, associated with heavy rain systems over the northern Peruvian coastal region. In the same period, positive anomalies of divergence in high tropospheric levels are observed.

The daily **Ia** index allowed an effective detection of the ITCZ's second band with 11 days prior the maximum coastal precipitation, and the Lorenz energy terms showed kinetic eddies energy (KE) peaks in January and February and a contribution of barotropic instability in equatorial regions.

Enlace: <https://www.revistascca.unam.mx/atm/index.php/atm/article/view/53017>

<https://doi.org/10.20937/ATM.53017>

Carbon storage estimation of *Lessonia trabeculata* kelp beds in Southern Peru: an analysis from the San Juan de Marcona region

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Abstract

Carbon storage is one of the most important ecosystem services provided by kelp beds. Laminarialean kelps are widely harvested along the Warm Temperate South-eastern Pacific coast, a marine province shared by Chile and Peru. Carbon storage assessments of kelps in Peru are lacking. From a blue economy and sustainable management perspectives, information on the carbon storage of kelps is important. We conduct the first carbon storage assessment of *Lessonia trabeculata* in Peru and contribute to the development of biomass estimation models in order to monitor kelps using the least destructive methodologies. We chose three commonly harvested sites in San Juan de Marcona to haphazardly extract *Lessonia trabeculata* sporophytes using transects. Sporophyte height (m), wet biomass (kg), maximum (D) and minimum (d) holdfast disk widths (cm) were measured in the field. In the laboratory, C content was measured to calculate the best-fitting coefficients for future estimations by using allometric equations. Individual biomass was best estimated from sporophyte height through a rational model, while holdfast area (ellipse in cm^2) was a good proxy of biomass with a sinusoidal model. The southernmost, least accessible, and most exposed site (Elefante) had significantly higher values of stored carbon. We estimated a carbon standing stock (from sporophytes only) of 2044 t C in these kelp beds. Nevertheless, additional and more detailed measurements will likely produce more accurate estimates both in time and space. We provide allometric equations for future carbon assessments. Our results highlight the importance carbon assessment for kelp management and blue carbon estimates and the need to develop science-based marine planning strategies.

Enlace: <http://sis.sernanp.gob.pe/biblioteca/?publicacion=2080>

<https://doi.org/10.1080/17583004.2020.1808765>

Carbon stocks and the use of shade trees in different coffee growing systems in the Peruvian Amazon

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Abstract

Agroforestry systems can play an important role in mitigating the effects of climate change given their capacity to increase tree diversity and to store more carbon than conventional farming. This study aims at assessing carbon stocks and the use of shade trees in different coffee growing systems in the Northeast Peruvian Amazon. Carbon stocks in trees were estimated by field-based measurements and allometric equations. Carbon stocks in dead wood, litter and soil (upper 60 cm) were determined using field sampling and laboratory analysis. The diversity analysis drew on the Shannon–Weiner diversity index, and focus groups were used to obtain information about the local use of shade trees. The total carbon stock in the polyculture-shaded coffee system was 189 t C/ha, while the *Inga*-shaded and unshaded systems totalled 146 and 113 t C/ha, respectively. The soil compartment contributed the largest carbon stock in the coffee growing systems and contained 67, 82 and 96% of the total carbon stock in the polyculture-shaded, *Inga*-shaded and unshaded coffee systems, respectively. The Shannon–Weiner index and tree species richness values were highest for the polyculture-shaded coffee system, with a total of 18 tree species identified as important sources of fodder, food, wood, firewood and medicine. Therefore, coffee agroforestry systems play a significant role in carbon storage, while promoting conservation of useful trees in agricultural landscapes in the Peruvian Amazon.

Enlace:

<https://www.cambridge.org/core/journals/journal-of-agricultural-science/article/abs/carbon-stocks-and-the-use-of-shade-trees-in-different-coffee-growing-systems-in-the-peruvian-amazon/EFBC4767DB3C355403F162F6286E2373>

<https://doi.org/10.1017/S002185962000074X>

Change of the Rainfall Seasonality Over Central Peruvian Andes: Onset, End, Duration and Its Relationship With Large-Scale Atmospheric Circulation

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Resumen

Los cambios en las fechas de inicio, fechas de finalización y duración de la temporada de lluvias en los Andes centrales peruanos (cuenca del río Mantaro, CRM) podrían afectar gravemente la gestión de los recursos hídricos y las principales actividades económicas (por ejemplo, agricultura de secano, ganadería, entre otros). Sin embargo, estos cambios no se han documentado para los Andes tropicales. Para evaluar eso, utilizamos conjuntos de datos diarios de lluvia observada durante el período 1965-2013. Para este período, la fecha promedio de inicio (finalización) de la temporada de lluvias durante el MRB ocurre en la pentada 17 (19-23 de septiembre) [pentad 57 (7-11 de abril)]. La duración de la temporada de lluvias está modulada principalmente por las fechas de inicio debido a que tiene una mayor variabilidad que las fechas de finalización. Hay una reducción de 3 días/década en la duración de la estación húmeda en la CRM durante las últimas cuatro décadas debido al retraso de los días de inicio. Además, El Niño favorece el inicio tardío y el final temprano de la temporada de lluvias; mientras que, La Niña favorece el inicio temprano y el final tardío de la temporada de lluvias en la CRM. Las fechas de inicio están relacionadas con la propagación de la región convectiva del Sistema de Monzones de América del Sur (SAMS), desde la región del Caribe hacia la cuenca central del Amazonas. Los días de inicio temprano (tardío) están asociados con un desplazamiento hacia el sur (norte) de la Zona de Convergencia del Atlántico Sur (SACZ) y una convección débil (fuerte) sobre el Atlántico ecuatorial que induce la propagación más meridional (desplazamiento hacia el este) del SAMS.

Abstract

Changes of the onset dates, end dates, and duration of the rainy season over central Peruvian Andes (Mantaro river basin, MRB) could severely affect water resources management and the main economic activities (e.g., rainfed agriculture, raising cattle, among others). Nonetheless, these changes have not been documented for the Tropical Andes. To assess that, we used daily datasets of observed rainfall during the 1965–2013 period. For this period, the average onset (end) date of the rainy season over the MRB occurs in the pentad 17 (19–23 September) [pentad 57 (7–11 April)]. The duration of the rainy season mainly is modulated by the onset dates due to it has higher variability than end dates. There is a reduction of 3 days/decade in the duration of wet season over the MRB for the last four decades due to the delay of the onset days. Furthermore, El Niño favors late-onset and early end of the rainy season, while La Niña favors early onset and late end of the rainy season in the MRB. Onset dates are related to the propagation of the convective region of the South American Monsoon System (SAMS), from the Caribbean region toward the central Amazon basin. Early (late)-onset days are associated with a southward (northward) shift of the South Atlantic Convergence Zone (SACZ) and weak (strong) convection over equatorial Atlantic that induces the southernmost propagation (eastward shift) of the SAMS.

Enlace: <https://repositorio.igp.gob.pe/handle/IGP/4750>

<https://doi.org/10.3390/cli8020023>



Climate change impact on cultivated and wild cacao in Peru and the search of climate change-tolerant genotypes

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Abstract

Aim: Cacao (*Theobroma cacao* L.) is expected to be vulnerable to climate change. The objectives of this study were to (a) assess the future impact of climate change on cacao in Peru and (b) identify areas where climate change-tolerant genotypes are potentially present.

Location: Peru

Methods: Drawing on 19,700 and 1,200 presence points of cultivated and wild cacao, respectively, we modelled their suitability distributions using multiple ensemble models constructed based on both random and target group selection of pseudo-absence points and different resolutions of spatial filtering. To estimate the uncertainty of future predictions, we generated future projections for all the ensemble models. We investigated the potential emergence of novel climates, determined expected changes in ecogeographical zones (zones representative for particular sets of growth conditions) and carried out an outlier analysis based on the environmental variables most relevant for climate change adaptation to identify areas where climate change-tolerant genotypes are potentially present.

Results: We found that the best modelling approaches differed between cultivated and wild cacao and that the resolution of spatial filtering had a strong impact on future suitability predictions, calling for careful evaluation of the effect of model selection on modelling results. Overall, our models foresee a contraction of suitable area for cultivated cacao while predicting a more positive future for wild cacao in Peru. Ecogeographical zones are expected to change in 8%–16% of the distribution of cultivated and wild cacao. We identified several areas where climate change-tolerant genotypes may be present in Peru.

Main conclusions: Our results indicate that tolerant genotypes will be required to facilitate the adaptation of cacao cultivation under climate change. The identified cacao populations will be target of collection missions.

Enlace: <http://sis.sernanp.gob.pe/biblioteca/?publicacion=2569>

<https://doi.org/10.1111/ddi.13294>

Comparative analysis of climate change impacts on meteorological, hydrological, and agricultural droughts in the lake Titicaca basin

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Abstract

The impact of climate change on droughts in the Lake Titicaca, Desaguadero River, and Lake Poopo basins (TDPS system) within the Altiplano region was evaluated by comparing projected 2034–2064 and observed 1984–2014 hydroclimate time series. The study used bias-corrected monthly climate projections from the fifth phase of the Coupled Model Intercomparison Project (CMIP5), under the Representative Concentration Pathway 8.5 (RCP8.5) emission scenarios. Meteorological, agricultural, and hydrological droughts were analyzed from the standardized precipitation, standardized soil moisture, and standardized runoff indices, respectively, the latter two estimated from a hydrological model. Under scenarios of mean temperature increases up to 3 °C and spatially diverse precipitation changes, our results indicate that meteorological, agricultural, and hydrological droughts will become more intense, frequent, and prolonged in most of the TDPS. A significant increase in the frequency of short-term agricultural and hydrological droughts (duration of 1–2 months) is also projected. The expected decline in annual rainfall and the larger evapotranspiration increase in the southern TDPS combine to yield larger projected rises in the frequency and intensity of agricultural and hydrological droughts in this region.

Enlace: <https://repositorio.igp.gob.pe/handle/20.500.12816/4902>

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Contemporary glacial lakes in the Peruvian Andes

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Abstract

Glacier recession in response to climate warming has resulted in an increase in the size and number of glacial lakes. Glacial lakes are an important focus for research as they impact water resources, glacier mass balance, and some produce catastrophic glacial lake outburst floods (GLOFs). Glaciers in Peru have retreated and thinned in recent decades, prompting the need for monitoring of ice- and water-bodies across the cordilleras. These monitoring efforts have been greatly facilitated by the availability of satellite imagery. However, knowledge gaps remain, particularly in relation to the formation, temporal evolution, and catastrophic drainage of glacial lakes. In this paper we address this gap by producing the most current and detailed glacial lake inventory in Peru and provide a set of reproducible methods that can be applied consistently for different time periods, and for other mountainous regions.

The new lake inventory presented includes a total of 4557 glacial lakes covering a total area of 328.85 km². In addition to detailing lake distribution and extent, the inventory includes other metrics, such as dam type and volume, which are important for GLOF hazard assessments. Analysis of these metrics showed that the majority of glacial lakes are detached from current glaciers (97%) and are classified as either embedded (i.e. bedrock dammed; ~64% of all lakes) or (moraine) dammed (~28% of all lakes) lakes. We also found that lake size varies with dam type; with dammed lakes tending to have larger areas than embedded lakes. The inventory presented provides an unparalleled view of the current state of glacial lakes in Peru and represents an important first step towards (1) improved understanding of glacial lakes and their topographic and morphological characteristics and (2) assessing risk associated with GLOFs.

Enlace: <https://www.sciencedirect.com/science/article/abs/pii/S0921818121001594?via%3Dihub>

<https://doi.org/10.1016/j.gloplacha.2021.103574>

Cutoff low over the southeastern Pacific Ocean: a case study

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Abstract

Cutoff lows (COLs) are infrequent events in the tropics that can cause extreme rainfall, flash flooding and landslides in arid areas, such as western South America. In this study, the life cycle of a COL in the southeastern Pacific at the beginning of April 2012 was analysed using the ERA-Interim reanalysis dataset. This paper examines: (1) the precursor flow evolution prior to the COL, its development and dissipation by applying the quasi-geostrophic and vorticity equations; and (2) the influence of the COL in the heavy precipitation events over the western Peruvian Andes. During April 2012, the highest amount of precipitation was recorded in Chosica (850 masl) with 37 mm on 5 April. Days prior to the formation of the COL, a subtropical trough deepened by the amplification of a ridge over the tropical Pacific and the incursion of cold air from medium and low levels into the trough. The strong cyclonic vorticity advection was intensified by a short-wave trough embedded inside a long-wave one that strengthened the system on 5 April 2012. In the dissipation stage, warm vertical advection predominated, resulting in the reabsorption of the COL by a new trough. Understanding the behaviour COL systems is important for reducing the impact of these extreme weather events on lives and infrastructure in densely populated areas.

Enlace: <https://repositorio.senamhi.gob.pe/handle/20.500.12542/905>

<https://www.publish.csiro.au/es/pdf/ES19051>

<https://doi.org/10.1071/ES19051>

Dataset on the first weather radar campaign over Lima, Peru

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Abstract

The first weather radar campaign over Lima, the capital of Peru, a deserty area on the western side of the Peruvian Andes, was carried out to study the occurrence of rain events in summer 2018. The weather radar was installed strategically and was able to overlook three river basins: Rimac, Chill3n, and Lurin. An X-band radar (PX-1000) was used, which operates at 9.55 GHz. PX-1000 was built by the Advanced Radar Research Center (ARRC) at the University of Oklahoma (U.S.A.). The radar operated from January 26th to April 1st, 2018, at Cerro Suche located 2910 m ASL and 55 km from the city of Lima. The PX-1000 performed plan-position-indicators (PPI) for elevations starting at 0° up to 20°. The data presented here were obtained using a three-dimensional constant-altitude plan-position-indicator (3D CAPPI), which was generated by high resolution (250 m) nearest point algorithm.

Enlace: <https://repositorio.igp.gob.pe/handle/20.500.12816/4940>

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Dataset on raindrop size distribution, raindrop fall velocity and precipitation data measured by disdrometers and rain gauges over Peruvian central Andes (12.0°S)

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Resumen

Describimos nuestra base de datos sobre tamaños y velocidades de gotas de lluvia colectadas con varios instrumentos en simultáneo desde 2018. La información es potencialmente útil para estudios de microfísica de lluvias orográficas, validación de modelos atmosféricos y algoritmos de estimación de la precipitación, en la compleja topografía de los Andes tropicales. Junto con la base de datos también se desarrolló una librería para la manipulación de los datos en Matlab.

Abstract

This dataset includes data obtained at the Atmospheric Microphysics and Radiation Laboratory (LAMAR) of the Huancayo Observatory (12.04° S, 75.32° W, 3313 m ASL). Two Parsivel2 and two tipping bucket rain gauges are used in this dataset which are operating together since 2018. Data is given in NetCDF format, including two types of files, one NetCDF for precipitation totals and another which contains Parsivel2 data. This data set was collected in the complex topography conditions of the tropical Andes, and its potential use is to study the microphysics of orographic rainfall, atmospheric models and rainfall estimation algorithms.

Enlace: <https://repositorio.igp.gob.pe/handle/IGP/4772>

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Design, Development and Implementation of a Low Cost Weather Station for high mountains

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Abstract

This research is based on the need to have a measurement tool to carry out different studies that require meteorological information in high mountain areas, therefore, a low-cost weather station based on open source is designed and implemented. The design process considered the inclusion of the directives of the World Meteorological Organization and the place of installation. Then we continued with the assembly and installations in conjunction with a Campbell Scientific station (3800 m) and a HOBO station (5000 m), in order to compare their records. The Arduino Mega 2560 controller used as a datalogger responded adequately, the data captured when compared are very similar to those of the stations. The average difference between the low-cost station and the other two is in temperature 0.193 °C, humidity 1.3% RH, atmospheric pressure 0.14 mbar, solar radiation 5.8%, soil temperature 0.127 °C, wind speed 0.485 m/s and wind direction 1.33°. The cost benefit is 4 to 18 times compared to purchasing a commercial station and certified instrumentation.

Enlace: <https://ieeexplore.ieee.org/document/9532835>

DOI: 10.1109/INTERCON52678.2021.9532835

Empirical–Statistical Downscaling of austral summer precipitation over South America, with a focus on the central Peruvian Andes and the equatorial Amazon basin

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Abstract

Precipitation is one of the most difficult variables to estimate using large scale predictors. Over South America (SA), this task is even more challenging, given the complex topography of the Andes. Empirical Statistical Downscaling (ESD) models can be used for this purpose, but such models, applicable for all of SA, have not yet been developed. To address this issue, we construct an ESD model based on multiple linear regression techniques for the period 1982-2016 that is based on large-scale circulation indices representing tropical Pacific, Atlantic, and South American climate variability, to estimate austral summer (DJF) precipitation over SA. Statistical analyses show that the ESD model can reproduce observed precipitation anomalies over the tropical Andes (Ecuador, Colombia, Peru, and Bolivia), the eastern equatorial Amazon basin, and the central part of the western Argentinian Andes. On a smaller scale, the ESD model also shows good results over the western Cordillera of the Peruvian Andes. The ESD model reproduces anomalously dry conditions over the eastern equatorial Amazon and the wet conditions over Southeastern South America (SESA) during the three extreme El Niño's 1982/83, 1997/98, and 2015/16. However, it overestimates the observed intensities over SESA. For the central Peruvian Andes as a case study, results further show that the ESD model can correctly reproduce DJF precipitation anomalies over the entire Mantaro basin during the three extreme El Niño episodes. Moreover, multiple experiments with varying predictor combinations of the ESD model corroborate the hypothesis that the interaction between the South Atlantic Convergence Zone (SACZ) and the equatorial Atlantic Ocean provoked the Amazon drought in 2015/16.

Enlace: <https://repositorio.igp.gob.pe/handle/20.500.12816/4909>

<https://doi.org/10.1175/JAMC-D-20-0066.1>

Evaluation of GPM Dual-Frequency Precipitation Radar Algorithms to Estimate Drop Size Distribution Parameters, Using Ground-Based Measurement over the Central Andes of Peru

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Abstract

The raindrop size distribution (DSD) parameters, which consists of the mass-weighted average diameter (D_m) and the scaling parameter for the concentration (N_w) are essential to estimate precipitation in numerical modelling and other research areas such as the Global Precipitation Measurement (GPM) core satellite. In the present work, we used the GPM Dual-Frequency Precipitation Radar algorithms (GPM-DPR), single (SF) and dual (DF) frequency, and in situ observations to derive the DSD parameters and evaluate the performance of algorithms under the complex orography and climate regime of the central Andes. We used data from optical disdrometer and Ka-band profiler radar over Huancayo Observatory during the austral summer monsoon. Our results indicate that the GPM-DPR algorithms have problems to correctly estimate the DSD parameters of convective rains due to the high variability in time and space of this type of rain and is the result of fixing the shape parameter (μ). The estimation of DSD parameters in stratiform rains, which are very common in the central Andes, is strongly affected by the limitation of the DF algorithm in light rain rates caused by its inability to estimate $D_m < 1$ mm.

Enlace: <https://repositorio.igp.gob.pe/handle/20.500.12816/5004>

<https://doi.org/10.1007/s41748-021-00242-5>

Evidence of nonlinear Walker circulation feedbacks on extreme El Niño Pacific diversity: observations and CMIP5 models

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Abstract

The Walker circulation (WC) is essential for the formation and diversity of El Niño events. However, the nonlinear WC feedback during extreme Central and Eastern El Niño episodes (C and E episodes, respectively) has received little attention. This study used observational datasets and the Atmospheric Model Intercomparison Project (AMIP) and historical simulations from the Coupled Model Intercomparison Project Phase 5 (CMIP5). Eight out of 21 historical models that simulate the El Niño-Southern Oscillation (ENSO) nonlinearity also simulate the nonlinear Bjerknes feedback in C and E episodes. The opposite does not necessarily occur. However, the underestimation of E might limit the empirical determination. Moreover, few historical models simulate the shallow conditional instability of the second kind (CISK) mechanism. Positive C episodes feature an eastward shift in the ascending branch of the Pacific Walker cell (PWC), while shallow convection prevails over the far eastern Pacific (FEP). Positive E events feature two anomalous ascending branches located over the central-western Pacific (170°W) and FEP (80°W). Positive anomalies in sea surface temperature over the FEP induce the second ascending branch. The positive stratification anomaly in the central Pacific Ocean, which is associated with overestimated Ekman feedback, limits the eastward displacement of the first ascending branch of the PWC. The net surface heat flux determines the duration of growth of the two ascending branches of the PWC during C and E events. Because of their coarse resolution, the historical models underestimate the positive stratification anomaly in the FEP, causing the quick demise of the second ascending branch.

Enlace: <https://repositorio.igp.gob.pe/handle/20.500.12816/4908>

<https://doi.org/10.1002/joc.6998>

First record of OSL-dated fluvial sands in a tropical Andean cave reveals rapid late Quaternary tectonic uplift

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Abstract

We present the first results of OSL-dated fluvial sands extracted from a riverside cave in the tropical Andes. The excellent agreement between the ages of the various samples allowed the calculation of a late Quaternary valley incision rate forced by ongoing uplift of an active Subandean fault-propagation fold in NE Peru. A structural cross-section was constructed to understand the relationship between the geometry of the fault-propagation fold, historical damaging earthquakes and the cave system. The calculated uplift rate is 2.3 to 2.6 mm a⁻¹ over the past 70 ka and can be directly linked to active propagation of west-verging basement thrusts. It is similar to uplift rates calculated from fluvial terraces in the Subandes of Colombia and Venezuela. The results will help to better assess the seismic hazard and confirm that OSL dating of fluvial sands in caves is a powerful tool to quantify uplift rates of active mountain fronts.

Enlace: <https://repositorio.igp.gob.pe/handle/20.500.12816/4924>

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Impacts of topography and land use changes on the air surface temperature and precipitation over the central Peruvian Andes

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Resumen

Este artículo se enfoca en la representación de la temperatura de la superficie del aire y la precipitación usando simulaciones espaciotemporales altas (3km – 1h) del modelo WRF3.7.1 en el área central peruana. Cubre, de este a oeste, la zona costera, la vertiente occidental de los Andes, la cuenca andina del Mantaro (500-5000 msnm) y la región de transición de los Andes al Amazonas en los Andes orientales. El estudio cubre los meses de enero de 2004 a 2008. Se llevaron a cabo tres experimentos utilizando diferentes fuentes de datos de topografía y uso del suelo: (1) una simulación de control utilizando los conjuntos de datos de uso de suelo y topografía WRF predeterminados del Servicio Geológico de los Estados Unidos (USGS); (2) una simulación que cambia solo la topografía utilizando el conjunto de datos de topografía SRTM; y (3) una simulación que cambia los datos de uso de la tierra de (2) por un nuevo conjunto de datos adaptado de Eva et al. (2004) La topografía SRTM funcionó mejor que la simulación de control para representar las altitudes reales de 57 estaciones meteorológicas que se utilizaron para datos de precipitación y temperatura de la superficie del aire. Como resultado, las simulaciones de los experimentos (2) y (3) produjeron valores de sesgo más bajos que los de (1). El cambio de topografía (experimento (2)) mostró mejoras en el sesgo de temperatura que se asociaron directamente con modificaciones lineales de -5.6 y -6.7 °C·km⁻¹ en temperatura mínima y máxima, respectivamente. El aumento (disminución) de la precipitación con la topografía o el cambio en el uso de la tierra fue claramente controlado por los cambios en los patrones de flujo de humedad y su convergencia (divergencia) en la transición de los Andes al Amazonas. En la ladera occidental, el aumento de la precipitación podría estar asociado con el aumento del flujo hacia el este por las altitudes más pequeñas de las montañas de los Andes en la topografía SRTM y al aumentar la evaporación con el nuevo uso de la tierra. Dentro de la cuenca del Mantaro, el flujo de humedad de bajo nivel parece controlar los cambios de lluvia. En general, los cambios relativos (positivos o negativos) en la precipitación debido a la topografía o al cambio en el uso del suelo podrían alcanzar valores superiores al 25% resultado, las simulaciones de los experimentos (2) y (3) produjeron valores de sesgo más bajos que los de (1). El cambio de topografía (experimento (2)) mostró mejoras en el sesgo de temperatura que se asociaron directamente con modificaciones lineales de -5.6 y -6.7 °C·km⁻¹ en temperatura mínima y máxima, respectivamente. El aumento (disminución) de la precipitación con la topografía o el cambio en el uso de la tierra fue claramente controlado por los cambios en los patrones de flujo de humedad y su convergencia (divergencia) en la transición de los Andes al Amazonas. En la ladera occidental, el aumento de la precipitación podría estar asociado con el aumento del flujo hacia el este por las altitudes más pequeñas de las montañas de los Andes en la topografía SRTM y al aumentar la evaporación con el nuevo uso de la tierra. Dentro de la cuenca del Mantaro, el flujo de humedad de bajo nivel parece controlar los cambios de lluvia. En general, los cambios relativos (positivos o negativos) en la precipitación debido a la topografía o al cambio en el uso del suelo podrían alcanzar valores superiores al 25%.

Abstract

This paper focuses on the representation of the air surface temperature and precipitation using high spatiotemporal simulations (3 km–1 h) of the WRF3.7.1 model in the central Peruvian area. It covers, from east to west, the coastal zone, the western slope of the Andes, the Andean Mantaro basin (500–5000 masl), and the Andes-Amazon transition region in the eastern Andes. The study covers the January months from 2004 to 2008. Three experiments were conducted using different topography and land use data sources: (1) a control simulation using the default WRF topography and land use datasets from the United States Geological Survey (USGS); (2) a simulation changing only the topography by using the SRTM topography dataset; and (3) a simulation changing the land use data of (2) by a new dataset adapted from Eva et al. (2004). SRTM topography performed better than the control simulation for representing the actual altitudes of 57 meteorological stations that were used for precipitation and surface air temperature data. As a result, the simulations of experiments (2) and (3) produced lower bias values than that of (1). Topography change (experiment (2)) showed improvements in temperature bias that were directly associated with linear modifications of -5.6 and -6.7 °C·km⁻¹ in minimum and maximum temperature, respectively. Increasing (decreasing) precipitation with topography or land use change was clearly controlled by changes in the moisture flux patterns and its convergence (divergence) in the Andes-Amazon transition. On the western slope, precipitation increase could be associated with the increase in easterly flow by the smaller altitudes of the Andes mountains in SRTM topography and by increasing evaporation with new land use. Inside the Mantaro Basin, low level moisture flux seems to control the rainfall changes. Overall, relative changes (positive or negative) in precipitation due to topography or land use change could reach values above 25%.

Enlace: <https://repositorio.igp.gob.pe/handle/20.500.12816/4739>

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Influence of the Coupling South Atlantic Convergence Zone-El Niño-Southern Oscillation (SACZ-ENSO) on the projected precipitation changes over the central Andes

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Abstract

There are no studies related to the influence of the coupling between the South Atlantic Convergence Zone (SACZ) and El Niño-Southern Oscillation (ENSO) pattern variability on future changes in the austral summer (December-February, DJF) precipitation over the central Andes. Therefore, we evaluated the historical simulations (1980–2005) and projections (2070–2099) for the Representative Concentration Pathway 8.5 (RCP 8.5) scenario of 25 global climate models (GCMs) from the Coupled Model Intercomparison Project phase 5 (CMIP5). Moreover, we also consider the Regional Climate Model version 4 (RegCM4) projections nested in three CMIP5 GCMs (GFDL-ESM2M, MPI-ESM-MR, and HadGEM2-ES) under RCP 8.5. We separate the CMIP5 GCMs according to their abilities to simulate the nonlinear characteristics of ENSO and the SACZ for the historical period. We found that only three out of 25 CMIP5 GCMs (hereafter group A) simulate the nonlinear characteristics of ENSO and the SACZ during the historical period. Although most CMIP5 GCM project DJF precipitation decreases over the central Andes, group A project precipitation increases related to the projected increase in deep convection over the central Peruvian Amazon. On the regional scale, only RegGFDL (nested in a group A CMIP5 GCM) projects a statistically significant increase in DJF precipitation (~5–15%) over the northern central Andes and the central Peruvian Amazon. Conversely, all RegCM4 simulations project a decrease in DJF precipitation (~–10%) over the southern central Andes.

Enlace: <https://repositorio.igp.gob.pe/handle/20.500.12816/4943>

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Intensive field sampling increases the known extent of carbon-rich Amazonian peatland pole forests

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Abstract

Peatland pole forest is the most carbon-dense ecosystem in Amazonia, but its spatial distribution and species composition are poorly known. To address this knowledge gap, we quantified variation in the floristic composition, peat thickness, and the amount of carbon stored above and below ground of 102 forest plots and 53 transects in northern Peruvian Amazonia. This large dataset includes 571 ground reference points of peat thickness measurements across six ecosystem types. These field data were also used to generate a new land-cover classification based on multiple satellite products using a random forest classification. Peatland pole forests are floristically distinctive and dominated by thin-stemmed woody species such as *Pachira nitida* (Malvaceae), *Platycarpum loretense* (Rubiaceae), and *Hevea guianensis* (Euphorbiaceae). In contrast, palm swamps and open peatlands are dominated by *Mauritia flexuosa* (Arecaceae). Peatland pole forests have high peat thickness (274 ± 22 cm, mean \pm 95% CI, $n = 184$) similar to open peatlands (282 ± 46 cm, $n = 46$), but greater than palm swamps (161 ± 17 cm, $n = 220$) and seasonally-flooded forest, terra firme, and white-sand forest where peat is rare or absent. As a result, peatland pole forest has exceptional carbon density ($1,133 \pm 93$ Mg C ha⁻¹). The new sites expand the known distribution of peatland pole forest by 61% within the Pastaza-Maranón Foreland basin, mainly alongside the Tigre river, to cover a total of 7540 km² in northern Peruvian Amazonia. However, only 15% of the pole forest area is within a protected area, whilst an additional 26% lies within indigenous territories. The current low levels of protection and forest degradation but high threat from road paving projects makes the Tigre river basin a priority for conservation. The long-term conservation of peatland pole forests has the potential to make a large contribution towards international commitments to mitigate climate change.

Enlace: <https://iopscience.iop.org/article/10.1088/1748-9326/ac0e65>

<https://doi.org/10.1088/1748-9326/ac0e65>

Linking magmatic processes and magma chemistry during the post-glacial to recent explosive eruptions of Ubinas volcano (southern Peru)

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Abstract

Understanding the links between the magma differentiation processes, the magma plumbing system and the magma composition at arc volcanoes is of paramount importance for volcanic hazard assessment. In this work we focus on the post-glacial, Holocene, historical, and recent eruption products of Ubinas volcano (Peru), which display an overall decrease in silica content from the older, plinian (VEI 3-5), rhyolitic eruptions (69-71 wt.% SiO₂) to the historical and recent (2006-2009, 2013-2017), vulcanian (VEI 1-2) basaltic andesitic eruptions (55-57 wt.% SiO₂). Based on a comprehensive study of the major and trace elements and the Sr-Nd-Pb isotopes, we conclude that this temporal pattern reflects an evolution of the Ubinas magmas in the middle-to-upper crust by a coupled assimilation and fractional crystallization process involving a cumulate composed of plagioclase, amphibole, clinopyroxene, orthopyroxene and Fe-Ti oxides, with minor amounts of olivine and biotite at the mafic and felsic end-members, respectively. Upper crustal assimilation is limited to 5-8 vol.%, but the overall high radiogenic Sr-Nd-Pb signature of the Ubinas magmas requires a larger crustal component, which must therefore occur at middle to lower crustal depths. The petrology of the Ubinas magmas also points to an overall increase in P-T conditions: the large Holocene dacitic and rhyolitic eruptions record temperatures ranging from 800 to 850°C and pressures in the range of 200-400 MPa, whereas the historical and recent (2006-2009; 2013-2017) basaltic andesitic eruptions provide higher temperatures and pressures (900-1000°C, >400 MPa). Overall, the thermobarometry, phase equilibrium and geochemical constraints allow us to propose the existence of a middle-to-upper crust magma column composed of a highly crystalline magma mush containing batches of liquid magma, which seems to be continually recharged from deeper levels. On the basis of the petrological nature of the historical basaltic andesitic eruptions (1667 CE, 2006-2009, 2013-2017), we postulate that during the last centuries, Ubinas experienced a recharge-dominated process, with no evidence for a rejuvenation of the silica-rich reservoir that fed the large Holocene dacitic to rhyolitic eruptions. This study highlights the importance of detailed petrological studies of Holocene sequences at explosive arc volcanoes in order to constrain the magmatic processes and conditions that control large explosive eruptions.

Enlace: <https://www.sciencedirect.com/science/article/abs/pii/S0377027320302560?via%3Dihub>

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Long-term thermal sensitivity of Earth's tropical forests

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Abstract

The sensitivity of tropical forest carbon to climate is a key uncertainty in predicting global climate change. Although short-term drying and warming are known to affect forests, it is unknown if such effects translate into long-term responses. Here, we analyze 590 permanent plots measured across the tropics to derive the equilibrium climate controls on forest carbon. Maximum temperature is the most important predictor of aboveground biomass (-9.1 megagrams of carbon per hectare per degree Celsius), primarily by reducing woody productivity, and has a greater impact per °C in the hottest forests (>32.2°C). Our results nevertheless reveal greater thermal resilience than observations of short-term variation imply. To realize the long-term climate adaptation potential of tropical forests requires both protecting them and stabilizing Earth's climate.

Enlace: <https://www.science.org/doi/10.1126/science.aaw7578>

<https://doi.org/10.1126/science.aaw7578>

Loreto Intermediate Depth Earthquake of 26 May 2019 (Northeast Peru): Source Parameters by Inversion of Local to Regional Waveforms and Strong- Motion Observations

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Abstract

The Loreto earthquake of 26 May 2019 occurred below the extreme northeast part of Peru at a depth of 140 km within the subducting Nazca plate at a distance of 700 km from the trench Peru–Chile. The orientation of the seismic source was obtained from waveform inversion in the near field using velocity and strong-motion data. The rupture occurred in normal faulting corresponding to a tensional process with T axis oriented in east west direction similar to the direction of convergence between the Nazca and South America plates. The analysis of the strong-motion data shows that the levels of ground shaking are very heterogeneous with values greater than 50 Gal up to distances of 300 km; the maximum recorded acceleration of 122 Gal at a distance of 100 km from the epicenter. The Loreto earthquake is classified as a large extensional event in the descending Nazca slab in the transition from flat-slab geometry to greater dip.

Enlace: <http://hdl.handle.net/20.500.12816/4984>

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160 glacial lake outburst floods (GLOFs) across the Tropical Andes since the Little Ice Age

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Abstract

Assessing the extent to which glacial lake outburst floods (GLOFs) are increasing in frequency in modern times and whether their incidence is driven by anthropogenic climate change requires historical context. However, progress on this issue is hampered by incomplete GLOF inventories, especially in remote mountain regions. Here, we exploit high-resolution, multi-temporal satellite and aerial imagery, and documentary data to identify GLOF events across the glacierized Cordilleras of Peru and Bolivia, using a set of diagnostic geomorphic features. A total of 160 GLOFs from 151 individual sites are characterised and analysed, tripling the number of previously reported events. We provide statistics on location, magnitude, timing and characteristics of these events with implications for regional GLOF hazard identification and assessment. Furthermore, we describe several cases in detail and document a wide range of process chains associated with Andean GLOFs.

Enlace: <https://www.sciencedirect.com/science/article/pii/S0921818121003076?via%3Dihub>

<https://doi.org/10.1016/j.gloplacha.2021.103722>

Meteorological factors and childhood diarrhea in Peru, 2005–2015: a time series analysis of historic associations, with implications for climate change

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Abstract

Background: Global temperatures are projected to rise by ≥ 2 °C by the end of the century, with expected impacts on infectious disease incidence. Establishing the historic relationship between temperature and childhood diarrhea is important to inform future vulnerability under projected climate change scenarios.

Methods: We compiled a national dataset from Peruvian government data sources, including weekly diarrhea surveillance records, annual administered doses of rotavirus vaccination, annual piped water access estimates, and daily temperature estimates. We used generalized estimating equations to quantify the association between ambient temperature and childhood (< 5 years) weekly reported clinic visits for diarrhea from 2005 to 2015 in 194 of 195 Peruvian provinces. We estimated the combined effect of the mean daily high temperature lagged 1, 2, and 3 weeks, in the eras before (2005–2009) and after (2010–2015) widespread rotavirus vaccination in Peru and examined the influence of varying levels of piped water access.

Results: Nationally, an increase of 1 °C in the temperature across the three prior weeks was associated with a 3.8% higher rate of childhood clinic visits for diarrhea [incidence rate ratio (IRR): 1.04, 95% confidence interval (CI): 1.03–1.04]. Controlling for temperature, there was a significantly higher incidence rate of childhood diarrhea clinic visits during moderate/strong El Niño events (IRR: 1.03, 95% CI: 1.01–1.04) and during the dry season (IRR: 1.01, 95% CI: 1.00–1.03). Nationally, there was no evidence that the association between temperature and the childhood diarrhea rate changed between the pre- and post-rotavirus vaccine eras, or that higher levels of access to piped water mitigated the effects of temperature on the childhood diarrhea rate.

Conclusions: Higher temperatures and intensifying El Niño events that may result from climate change could increase clinic visits for childhood diarrhea in Peru. Findings underscore the importance of considering climate in assessments of childhood diarrhea in Peru and globally, and can inform regional vulnerability assessments and mitigation planning efforts.

Enlace: <https://repositorio.senamhi.gob.pe/handle/20.500.12542/857>

<https://doi.org/10.1186/s12940-021-00703-4>

Methanogens and Methanotrophs Show Nutrient-Dependent Community Assemblage Patterns Across Tropical Peatlands of the Pastaza-Marañón Basin, Peruvian Amazonia

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Instituto de Investigaciones de la Amazonía Peruana

Abstract

Tropical peatlands are globally important carbon reservoirs that play a crucial role in fluxes of atmospheric greenhouse gases. Amazon peatlands are expected to be large source of atmospheric methane (CH₄) emissions, however little is understood about the rates of CH₄ flux or the microorganisms that mediate it in these environments. Here we studied a mineral nutrient gradient across peatlands in the Pastaza-Marañón Basin, the largest tropical peatland in South America, to describe CH₄ fluxes and environmental factors that regulate species assemblages of methanogenic and methanotrophic microorganisms. Peatlands were grouped as minerotrophic, mixed and ombrotrophic categories by their general water source leading to different mineral nutrient content (rich, mixed and poor) quantified by trace elements abundance. Microbial communities clustered dependent on nutrient content (ANOSIM $p < 0.001$). Higher CH₄ flux was associated with minerotrophic communities compared to the other categories. The most dominant methanogens and methanotrophs were represented by *Methanobacteriaceae*, and *Methylocystaceae*, respectively. Weighted network analysis demonstrated tight clustering of most methanogen families with minerotrophic-associated microbial families. Populations of *Methylocystaceae* were present across all peatlands. Null model testing for species assemblage patterns and species rank distributions confirmed non-random aggregations of *Methylococcaceae* methanotroph and methanogen families ($p < 0.05$). We conclude that in studied amazon peatlands increasing mineral nutrient content provides favorable habitats for *Methanobacteriaceae*, while *Methylocystaceae* populations seem to broadly distribute independent of nutrient content.

Enlace: <https://www.frontiersin.org/articles/10.3389/fmicb.2020.00746/full>

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Monitoreo de volcanes activos en Perú por el Instituto Geofísico del Perú: Sistemas de alerta temprana, comunicación y difusión de la información

Monitoring of active volcanoes in Peru by the Instituto Geofísico del Perú: Early Warning Systems, Communication and Information Dissemination

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Instituto Geofísico del Perú

Resumen

El monitoreo volcánico en Perú es realizado por el Instituto Geofísico del Perú (IGP), a través de su Centro Vulcanológico Nacional (CENVUL). El CENVUL monitorea 12 de los 16 volcanes considerados como activos y potencialmente activos, localizados en el sur del Perú y emite boletines periódicos sobre la actividad volcánica, y dependiendo del nivel de alerta de cada volcán también emite alertas vulcanológicas de dispersión de ceniza y ocurrencia de lahares. La información generada por el CENVUL se difunde a las autoridades civiles y al público en general a través de diferentes medios de comunicación (boletines, correo electrónico, web, redes sociales, aplicativo móvil, etc.). El grupo de vulcanología del IGP se formó después de la erupción del volcán Sabancaya en 1988. Desde entonces, los estudios geofísicos y geológicos, la evaluación de peligros volcánicos y el monitoreo multidisciplinario realizado por el IGP, han permitido conocer en profundidad la actividad volcánica pasada y reciente ocurrida en Perú, para prever futuros escenarios eruptivos. Actualmente, el 80 % de los volcanes activos y potencialmente activos del Perú están equipados con redes de instrumentos multiparamétricos, siendo el monitoreo sísmico el más extendido. En este artículo, presentamos la situación actual del monitoreo volcánico en el Perú, las redes de monitoreo y las técnicas empleadas, así como los esfuerzos de educación e información al público y a las autoridades responsables del manejo de riesgo de desastres.

Abstract

Volcano monitoring in Peru is carried out by the Instituto Geofísico del Perú (IGP), through its Centro Vulcanológico Nacional (CENVUL). CENVUL monitors 12 out of 16 volcanoes considered as historically active and potentially active in southern Peru and issues bulletins about the volcanic activity and, depending on the alert-level of each volcano, also issues alerts and warning of volcanic unrest, ash dispersion, and occurrence of lahars. The information generated by CENVUL is disseminated to the civil authorities and the public through different information media (newsletters, e-mail, website social media, mobil app, etc.). The IGP volcanology team was formed after the eruption of Sabancaya volcano in 1988. Since then, geophysical and geological studies, volcanic hazards assessments, and multidisciplinary monitoring realized by the IGP. Currently, 80% of the historically active and potentially active volcanoes in Peru are equipped with network of multiparameter instruments, with the seismic monitoring being the most widely implemented. In this report, we present the situation of volcanic monitoring in Peru, the monitoring networks, the techniques employed, as well as efforts to educate and inform the public and officials responsible for disaster risk management.

Enlace: <https://www.jvolcanica.org/ojs/index.php/volcanica/article/view/88>

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Monumental Inca remains and past seismic disasters: A relational database to support archaeoseismological investigations and cultural heritage preservation in the Andes

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Abstract

As recent dramatic and numerous examples demonstrate, earthquakes still constitute a significant threat to cultural heritage (Bam 2003; L'Aquila 2009; Haiti 2010; Nepal 2015). By damaging the historical legacy, telluric phenomena affect economic and touristic incomes and alter regional identities and collective psyche. In the Andes, as in other emerging regions across the globe, deficient seismic hazard assessments, constant lack of resources, and inadequate maintenance programs are additional challenges for cultural heritage management. As part of our archaeoseismological investigation in the Cusco area (Peru), we developed a relational database, which seeks to identify, record and inventory seismic damage in pre-Columbian architecture. This work presents the main characteristics of the structure and design of the RISC ("Risque sismique, Incas et Société à Cusco") database and its contribution in supporting the fieldwork organization and facilitating the data acquisition. The collected architectural evidence constitutes the first large archaeoseismological dataset in South America and will provide valuable complementary data in Peru to regional seismic hazard studies. We here aim to demonstrate that an ergonomic and user-friendly interface has a role to play in supervising and preserving the cultural heritage in active seismic areas. By converting *ad-hoc* surveys into routine inspections, RISC could become an effective low-tech monitoring system, providing relevant support for disaster risk reduction plans in archaeological sites conservation. We stress the necessity of adopting cost-effective and easy-to-implement tools for cultural heritage monitoring in emerging countries through this case study. Our database may represent a relevant methodological background and template for further initiatives in both fields of archaeoseismology and cultural heritage protection.

Enlace: <https://www.sciencedirect.com/science/article/abs/pii/S0895981121002947?via%3Dihub>

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Mountain Permafrost in the Tropical Andes of Peru: The 0°C Isotherm as a Potential Indicator

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Abstract

In the tropical Andes of Peru very little is known about the occurrence and extent of mountain permafrost. Only recently systematic studies have been carried out on the high elevation sites of the mountain ranges (cordilleras). In the framework of the first pioneering studies, and with the objective to improve the understanding of characteristics of mountain permafrost and rock glaciers, we analyze how mountain permafrost in the Peruvian Andes is correlated with the altitude of the 0 °C isotherm (ZIA). Climate change has generated an increase in air temperature and in the ZIA in the past decades. These temperature changes could lead to impact the state of the mountain permafrost. In this research, we focus on two mountain regions: The Cordillera Central (CC) and the Cordillera Volcánica (CV), the first located in the central zone and the second in the south zone of Peru. The study used air temperature data from 20 weather stations (2002–2016) to calculate the mean annual air temperature (MAAT), interpolated using a multiple linear regression model (MLRM) and digital elevation model (MERIT DEM). Occurrence and extent of 46 intact rock glaciers (IRG) and the global model of permafrost (Permafrost Zonation Index) were used to validate the results. The MAAT of CC has a minimum value around -4.1°C ($R^2 = 0.8$) and a ZIA average of ~5152 m a.s.l. None of the IRGs are located above the ZIA. The MAAT of CV has a minimum value around of -5.5°C ($R^2 = 0.8$), a ZIA average of ~4861 m a.s.l., and 60% of the IRGs are located above of the ZIA. The results show a greater variation of the position of the ZIA in CC in comparison to CV, which could indicate a possible degradation of mountain permafrost in these mountain ranges.

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Multi-instrument rainfall-rate estimation in the Peruvian Central Andes

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Abstract

Agriculture is one of the main economic activities in the Peruvian Andes; rainwater alone irrigates more than 80% of the fields used for agriculture purposes. However, the cloud and rain generation mechanisms in the Andes still remain mostly unknown. In early 2014, the Instituto Geofísico del Perú (IGP) decided to intensify studies in the central Andes to better understand cloud microphysics; the Atmospheric Microphysics and Radiation Laboratory officially started operations in 2015 at IGP's Huancayo Observatory. In this work, a Ka-band cloud profiler [cloud and precipitation profiler (MIRA-35c)], a UHF wind profiler [Clear-Air and Rainfall Estimation (CLAIRE)], and a VHF wind profiler [Boundary Layer and Tropospheric Radar (BLTR)] are used to estimate rainfall rate at different conditions. The height dependence of the drop size diameter versus the terminal velocity, obtained by the radars, in the central Andes (3350 m MSL) was evaluated. The estimates of rainfall rate are validated to ground measurements through a disdrometer [second-generation Particle, Size, and Velocity (PARSIVEL2)] and two rain gauges. The biases in the cumulative rainfall totals for the PARSIVEL2, MIRA-35c, and CLAIRE were 18%, 23%, and -32%, respectively, and their respective absolute biases were 19%, 36%, and 63%. These results suggest that a real-time calibration of the radars, MIRA-35c and CLAIRE, is necessary for better estimation of precipitation at the ground. They also show that the correction of the raindrop terminal fall velocity, obtained by separating the vertical wind velocity (BLTR), used in the estimation the raindrop diameter is not sufficient, especially in convective conditions.

Enlace: <https://repositorio.igp.gob.pe/handle/20.500.12816/4852>

<https://doi.org/10.1175/JTECH-D-19-0105.1>

Non-structural carbohydrates mediate seasonal water stress across Amazon forests

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Abstract

Non-structural carbohydrates (NSC) are major substrates for plant metabolism and have been implicated in mediating drought-induced tree mortality. Despite their significance, NSC dynamics in tropical forests remain little studied. We present leaf and branch NSC data for 82 Amazon canopy tree species in six sites spanning a broad precipitation gradient. During the wet season, total NSC (NSC_T) concentrations in both organs were remarkably similar across communities. However, NSC_T and its soluble sugar (SS) and starch components varied much more across sites during the dry season. Notably, the proportion of leaf NSC_T in the form of SS (SS:NSC_T) increased greatly in the dry season in almost all species in the driest sites, implying an important role of SS in mediating water stress in these sites. This adjustment of leaf NSC balance was not observed in tree species less-adapted to water deficit, even under exceptionally dry conditions. Thus, leaf carbon metabolism may help to explain floristic sorting across water availability gradients in Amazonia and enable better prediction of forest responses to future climate change.

Enlace: <https://www.nature.com/articles/s41467-021-22378-8>

<https://doi.org/10.1038/s41467-021-22378-8>

On the dynamic mechanisms of intense rainfall events in the central Andes of Peru, Mantaro valley

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Abstract

The present study was aimed at analysing the main atmospheric dynamic mechanisms associated with the occurrence of intense rainfall events above the Huancayo observatory (12.05°S, 75.32°W, 3313 m asl) in the central Andes of Perú (Mantaro valley) from January 2018 to April 2019. To identify the rainfall events, we used a set of instruments from the laboratory of physics, microphysics and radiation (LAMAR) composed by in-situ pluviometric observations, satellite remote sensing data (GPM), Cloud Radar (MIRA-35c), Boundary Layer Tropospheric Radar (BLTR) and downscaling model simulations with WRF (resolutions: 18 km, 6 km and 2 km) and ARPS (0.5 km) models to analyse the dynamics of the atmosphere for the synoptic, meso and local processes that control the occurrence of these rainfall events. The results showed that all intense rainfall events are associated with the presence of thermal meso-scale circulations that transport moisture fluxes through passes with gentle slopes along both sides of the Andes. The easterly moisture fluxes come in from the South America Low Level Jet (SALLJ) and the westerly moisture fluxes from the Pacific Ocean. The arrival of these moisture flows to regions within the Mantaro valley depends on their coupling with the circulations at medium and high levels of the atmosphere. At the synoptic scale, the results show that the rainfall events can be separated into two groups: the first one associated with westerly circulations (WC) at the mid and upper levels of the atmosphere, generated by the weakening and eastern displacement of the anticyclonic Bolivian high-North east low (BH-NE) system, and the second associated with easterly circulations (EC) at the mid and upper levels of the atmosphere, generated by the intensification of the BH-NE system. The observed and simulated results showed that multicell convective systems of WC events are more extensive and deeper than EC events. This situation can be explained as the convergence of moisture fluxes from opposite directions occurred within the Mantaro basin for WC events. In contrast, for EC events, the convergence develops at the east Andes mountain range, following which the multicell storm system propagates westward, driven by easterly circulations. The EC events occur mostly in the summer months, while the WC events occur mostly in the autumn and spring months. Moreover, apparently the inertia gravity waves (IGWs) formed in the Amazon basin transport moisture and energy to the central Andes plateau and intensify the convection processes.

Enlace: <https://repositorio.igp.gob.pe/handle/20.500.12816/4831>

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Patterns and drivers of development in a west Amazonian peatland during the late Holocene

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Abstract

Amazonian peatlands sequester and store large amounts of carbon below ground and contribute to regional biodiversity. They also present an outstanding opportunity for palaeoecological research. This study uses multiple peat cores to improve our understanding of the long-term development of a peatland (Quistococha) in Peruvian Amazonia, by providing a reconstruction of the spatial patterns of vegetation change and peat accumulation over time across the site. Peat cores taken along transects totalling c. 5 km were used to establish the peat thickness and visible stratigraphy. Of 29 new peat cores, four were selected for pollen analysis, supported by 15 radiocarbon dates. These complement two existing published pollen records from the site, from a peat core and a lake sediment core. Our study shows that peat initiation occurred across the site in the form of primary mire formation between 2400 and 1900 cal yr BP. Following peat initiation, five broadly similar phases of vegetation development are recorded in all the pollen sequences: Amazon floodplain, herbaceous sedge fen, mixed angiosperm flooded forest, mixed palm swamp, *Mauritia*-dominated palm swamp. In detail, there are differences in the pattern and timing of vegetation change between the sequences. Much of this spatial variation is likely to be the result of the underlying substrate topography. In addition, we find that the difference in vegetation composition between core sites was greater during the early stages of peat accumulation at Quistococha than it is today. Such spatial and temporal variability has significant implications for computer modelling of carbon accumulation in tropical peatlands and, consequently, our understanding of their role in the global carbon cycle. Our findings highlight key challenges for numerical modelling on Holocene timescales, namely the difficulty in quantifying long-term variations in primary productivity, the variable influence of sediment input on carbon accumulation during the early stages of peatland formation, and the difficulty of modelling water tables in sites with variable underlying topography.

Enlace: <https://www.sciencedirect.com/science/article/abs/pii/S0277379119309588?via%3Dihub>

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PISCO_HyM_GR2M: A Model of Monthly Water Balance in Peru (1981–2020)

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Resumen

Este trabajo tiene como objetivo evaluar el desempeño hidrológico de un modelo de balance hídrico mensual en Perú utilizando datos de precipitación y evapotranspiración del conjunto de datos meteorológicos de alta resolución PISCO, que ha sido desarrollado por el Servicio Nacional de Meteorología e Hidrología del Perú (SENAMHI). Un enfoque de regionalización basado en la prueba de sensibilidad de amplitud de Fourier (FAST) de los índices de lluvia-escorrentía (RR) y variabilidad de la escorrentía (RV) definió 14 regiones de calibración en todo el país. A continuación, se utilizó el modelo GR2M a escala semidistribuida en 3594 subcuencas y arroyos fluviales para simular descargas mensuales desde enero de 1981 hasta marzo de 2020. El rendimiento del modelo se evaluó utilizando la eficiencia de Kling-Gupta (KGE), raíz cuadrada de Nash transferida –Métricas de eficiencia de Sutcliffe (NSEsqr) y error de balance de agua (WBE).

Abstract

Quantification of the surface water offer is crucial for its management. In Peru, the low spatial density of hydrometric stations makes this task challenging. This work aims to evaluate the hydrological performance of a monthly water balance model in Peru using precipitation and evapotranspiration data from the high-resolution meteorological PISCO dataset, which has been developed by the National Service of Meteorology and Hydrology of Peru (SENAMHI). A regionalization approach based on Fourier Amplitude Sensitivity Testing (FAST) of the rainfall-runoff (RR) and runoff variability (RV) indices defined 14 calibration regions nationwide. Next, the GR2M model was used at a semi-distributed scale in 3594 sub-basins and river streams to simulate monthly discharges from January 1981 to March 2020. Model performance was evaluated using the Kling–Gupta efficiency (KGE), square root transferred Nash–Sutcliffe efficiency (NSEsqr), and water balance error (WBE) metrics. The results show a very well representation of monthly discharges for a large portion of Peruvian sub-basins ($KGE \geq 0.75$, $NSEsqr \geq 0.65$, and $-0.29 < WBE < 0.23$). Finally, this study introduces a product of continuous monthly discharge rates in Peru, named PISCO_HyM_GR2M, to understand surface water balance in data-scarce sub-basins.

Enlace: <https://repositorio.senamhi.gob.pe/handle/20.500.12542/927>

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Pleistocene rock avalanche, damming, and secondary debris flow along the Cotahuasi river, Peru

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Abstract

Landslides are among the most frequent and dangerous mass removal processes around the globe. They can be triggered by different phenomena such as earthquakes, extraordinary rains, glacier outbursts, volcanic activity, among others. In this study, we reconstruct the origin and potential cause of a rock avalanche that occurred in the Cotahuasi canyon in southern Peru. The head-scarp is a cirque carved during the Last Glacial Maximum and is formed by Alpbamba ignimbrites and Upper Barroso Formation volcanics. Slope failure removed a minimum volume of 1.13 km^3 generating a dry rock avalanche that was immediately confined into the Cachana valley, where it traveled 11 km downstream before reaching the Cotahuasi river. There, it did run for another 3 km towards the opposite Mungui mountains with minimum speeds of 72 m/s. The transversal Mungui range forced the avalanche to laterally spread upstream and downstream along the Cotahuasi river, as well as upstream the Pampamarca tributary prior to its final stop. The resulting deposit ($H/L = 0.16$) developed hummocky topography and formed a 10 km long and ≤ 100 m high dam that impounded two temporary lakes. At their maximum capacity, these lakes could hold $\sim 1.6 \times 10^8 \text{ m}^3$ of water prior to overtopping the dam. The dam-breakout generated a catastrophic flood (massive layer forming terraces) that traveled for tens of kilometers and likely as far as the sea. The debris flow deposit could be well-documented up to a distance of 20 km from the breach with the presence of 4 to 50-m-thick terraces with a minimum volume of 0.72 km^3 . After this distance, the deposit disappears, likely due to post-emplacement erosion by the river itself. Considering the missing volume at the head-scarp cirque ($\sim 3.85 \text{ km}^3$) and the sum of the minimum volumes of the rock avalanche and debris flow deposits ($\sim 1.85 \text{ km}^3$), circa forty percent of the material must have been removed by glacial and fluvial activity since the time of its original emplacement.

Enlace: <https://repositorio.igp.gob.pe/handle/20.500.12816/4925>

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Precipitation structure during various phases the life cycle of precipitating cloud systems using geostationary satellite and space-based precipitation radar over Peru

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Abstract

The life cycle of clouds consists of mainly into three phases, namely developing, mature, and dissipating phases. The information about the vertical structure of the precipitation during different phases of development will improve their representation in the cloud models. Whether specific regimes over Peru favor the formation or decay of the cloud systems and how their intensity varies during different phases of development will provide the insight into the precipitation structure over Peru. We used two satellite-based data, namely from Global Precipitation Measurement dual Precipitation Radar (GPM-DPR) and GOES (Geostationary Operational Environmental Satellite) to expose the vertical structure of precipitation during different phases of the precipitating cloud systems (PCSs). A PCS is defined using the GPM based near surface rainfall data and then GOES based brightness temperature (BT) is used to identify a specific phase of PCS. In particular 9 hours of BT (e.g., time series of BT) data for a GPM DPR overpass is used to a specific phase of PCS. Once, all the PCSs are identified into a specific phase, their statistical properties are studied. The highest convective fraction area (~26%) and near surface rain rate (RR; 4.97 mm hr⁻¹) are observed in developing phase of PCSs. Also, the convective fraction area and near surface RR decreases as cloud matures, and, least convective fraction area and RR (~4.11 mm hr⁻¹) are observed in dissipating phase PCSs. The vertical structure of precipitation consists of more complex relation among different phases of PCSs. The vertical distributors of hydrometeors (e.g., radar reflectivity, RR, and DSD parameters) during various phases have different characteristics above and below the freezing height (~5 km). For example, convective precipitation has small concentration of higher sized hydrometeors below the freezing height, whereas mature has PCSs show different behavior. The total amount of water analysis shows that liquid and ice water amount varies during different phases and affect the rainfall characteristics. It is observed that precipitation characteristics during different phases are influenced by the Andes Mountain and developing phase PCSs have higher sized of hydrometeors with higher near surface RR at the north-eastern continent of Peru.

Enlace: <https://repositorio.igp.gob.pe/handle/20.500.12816/4905>

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Potential conditions for fire occurrence in vegetation in the Peruvian Andes

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Abstract

Fire activity in the Peruvian Andes has increased significantly in recent decades, but climatic parameters associated with drought, which may indirectly contribute to the occurrence of severe forest fires, have not yet been investigated. Because fire prevention tools are scarce, strategies for deterring burning are necessary in order to reduce impacts in regions where forest fires usually result from human activity. This study explores the conditions conducive to forest fire in the Andes of Peru. Daily precipitation and temperature observed data from the PISCO gridded dataset for the 2002–2016 period were used. In addition, MODIS satellite images (MOD09A1 product) were collected to characterise Andean vegetation using spectral indices. Analysis of daily temperature and rainfall indicates that climatic parameters such as cumulative precipitation, dry-day frequency and hot-day frequency are statistically associated with conditions that could contribute to increased forest fire occurrence. Our findings suggest that a decrease in the water content of vegetation, estimated by the Global Vegetation Moisture Index during the dry period and wet period onset, can be used to identify potential conditions for forest fire occurrence. This study suggests that forest managers should consider implementing prevention strategies that include continuous monitoring of climate and vegetation parameters.

Enlace: <https://www.publish.csiro.au/wf/WF21029>

<https://doi.org/10.1071/WF21029>

¿Qué sabemos sobre las turberas peruanas?

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Resumen

El Perú es uno de los países del trópico más ricos en turberas. Cuenta con ellas en sus tres regiones, con una preponderancia marcada en la Amazonía. Sus turberas proveen importantes servicios ecosistémicos, como el almacenamiento de inmensas cantidades de carbono, la fijación de dióxido de carbono, una biodiversidad única, la regulación hídrica a nivel local y regional, y el suministro de medios de subsistencia y valores culturales para las poblaciones locales.

Las turberas del país están siendo deterioradas por actividades antropogénicas que incluyen el desarrollo de infraestructura y la extracción de recursos (p. ej., petróleo, minerales), y usos o prácticas no sostenibles de intensidad variable (p. ej., sobrepastoreo, extracción de turba, tala de palmeras, sobrecaza) que las amenazan e incrementan su vulnerabilidad. De igual manera, los cambios climáticos comprometen su estabilidad.

El marco normativo peruano incluye normas e instrumentos para una gestión sostenible de los humedales, pero falta desarrollar regulaciones específicas para las turberas. Entre los avances recientes está la elaboración de una definición normativa nacional del término “turbera”; sin embargo, aún se requiere su inclusión explícita en políticas relativas al cambio climático, como REDD+ y las Contribuciones Nacionalmente Determinadas (NDC, por sus siglas en inglés).

Existe una falta fundamental de investigación científica sobre las turberas peruanas. En particular, se requiere cartografiarlas, inventariarlas y caracterizar sus propiedades ecológicas y sus valores económicos y sociales. También es esencial identificar y revalorar los conocimientos que las comunidades indígenas ponen en práctica para gestionarlas de manera sostenible.

Las oportunidades para la conservación y buena gestión de estos ecosistemas claves son diversas e incluyen, por ejemplo, la consolidación de los mecanismos de pago por servicios ecosistémicos, la implementación de planes de manejo sostenible de recursos por las poblaciones locales, la extensión de las áreas naturales protegidas (ANP) y el reconocimiento de los derechos de tenencia de las comunidades.

Enlace: https://repositorio.iiap.gob.pe/bitstream/20.500.12921/574/1/Lopez_documento_2020.pdf

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Rainfall control on Amazon sediment flux: synthesis from 20 years of monitoring

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Instituto Geofísico del Perú

Resumen

La biodiversidad y la productividad de la llanura de inundación del Amazonas dependen de los nutrientes y la materia orgánica transportada con sedimentos suspendidos. Sin embargo, todavía hay incógnitas fundamentales sobre cómo la variabilidad hidrológica y de las precipitaciones influyen en el flujo de sedimentos en el río Amazonas. Para abordar esta brecha, analizamos 3069 muestras de sedimentos recolectadas cada 10 días durante 1995–2014 en cinco estaciones de medición ubicadas en los ríos principales. Tenemos dos fracciones distintas de sedimentos suspendidos, finos (arcilla y limo) y gruesos (arena), que siguieron patrones contrastantes de temporada y de largo plazo. Al tener en cuenta estas dinámicas, se estimó, por primera vez, en la llanura amazónica, que el flujo de sedimentos suspendidos medía por separado aproximadamente 60% de sedimento fino y 40% de sedimento grueso. Encontramos que el flujo de sedimentos finos suspendidos está relacionado con la lluvia y el flujo de sedimentos suspendidos gruesos más altos está relacionado con la descarga. Además, este trabajo presenta el lapso de tiempo entre la lluvia y la descarga, que está relacionado con el área aguas arriba de la medición. Este resultado es una contribución importante al conocimiento de los problemas biológicos y geomorfológicos en la cuenca del Amazonas.

Abstract

The biodiversity and productivity of the Amazon floodplain depend on nutrients and organic matter transported with suspended sediments. Nevertheless, there are still fundamental unknowns about how hydrological and rainfall variability influence sediment flux in the Amazon River. To address this gap, we analyzed 3069 sediment samples collected every 10 days during 1995–2014 at five gauging stations located in the main rivers. We have two distinct fractions of suspended sediments, fine (clay and silt) and coarse (sand), which followed contrasting seasonal and long-term patterns. By taking these dynamics into account, it was estimated, for first time, in the Amazon plain, that the suspended sediment flux separately measured approximately 60% fine and 40% coarse sediment. We find that the fine suspended sediments flux is linked to rainfall and higher coarse suspended sediment flux is related with discharge. Additionally this work presents the time lag between rainfall and discharge, which is related to the upstream area of the gauging. This result is an important contribution to knowledge of biological and geomorphological issues in Amazon basin.

Enlace: <https://repositorio.igp.gob.pe/handle/20.500.12816/4790>

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Rainfall characteristics in the Mantaro basin over tropical Andes from a vertically pointed profile rain radar and in-situ field campaign

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Resumen

La información sobre la estructura vertical de la lluvia, especialmente cerca de la superficie, es importante para una estimación cuantitativa precisa de la precipitación de los radares meteorológicos y espaciales. En el presente estudio, se observan las características de lluvia, de un perfil de radar verticalmente puntiagudo en la cuenca del Mantaro (Huancayo, Perú). En resumen, la variación diurna de la precipitación cerca de la superficie y la altura de la banda brillante, los perfiles verticales promedio de la distribución del tamaño de la gota (DSD), la tasa de lluvia, la reflectividad del radar (Z_e) y el contenido de agua líquida (LWC) se investigan para derivar las características de la lluvia. La variación diurna de la tasa de lluvia y la altura de la banda brillante muestra la distribución bimodal, donde se produjo una tasa de lluvia frecuente y más alta durante la tarde y la noche, y se encontró más del 70% de altura de banda brillante entre 4,3 y 4,7 km. Los perfiles verticales promedio de Z_e muestran las características opuestas por encima y por debajo del nivel de fusión (ML) y dependen de la tasa de lluvia cercana a la superficie. Por ejemplo, los perfiles Z_e promedio tienen un gradiente negativo por encima del NM, mientras que debajo del ML, el gradiente depende de la tasa de lluvia cercana a la superficie. La tasa de lluvia y LWC muestran el comportamiento opuesto, y ambos consisten en un gradiente positivo (negativo) debajo (arriba) del NM. El crecimiento vertical de los parámetros DSD depende de la tasa de lluvia cercana a la superficie, y se observa una mayor concentración de gotas de gran tamaño para una tasa de lluvia más cercana a la superficie, sin embargo, los modos dominantes de gotas son <1 mm en toda la columna vertical. Sin embargo, la variación más significativa en el crecimiento de DSD se observa para la tasa de lluvia cercana a la superficie ≥ 20 mm/h. Estos hallazgos sugieren el uso de diferentes técnicas de recuperación para la estimación de lluvia cercana a la superficie que el resto del perfil vertical y los eventos de alta tasa de lluvia. La mejor comprensión de la precipitación de los Andes tropicales sería muy importante para evaluar la variabilidad climática y pronosticar la precipitación utilizando los modelos numéricos.

Abstract

Information on the vertical structure of rain, especially near the surface is important for accurate quantitative precipitation estimation from weather and space-borne radars. In the present study, the rainfall characteristics, from a vertically pointed profile Radar in the Mantaro basin (Huancayo, Peru) are observed. In summary, diurnal variation of near-surface rainfall and bright band height, average vertical profiles of the drop size distribution (DSD), rain rate, radar reflectivity (Z_e) and liquid water content (LWC) are investigated to derive the rainfall characteristics. Diurnal variation of rain rate and bright band height show the bimodal distribution, where frequent and higher rain rate occurred during the afternoon and nighttime, and more than 70% bright band height found between 4.3–4.7 km. The average vertical profiles of Z_e show the opposite characteristics above and below the melting level (ML) and depend on the near-surface rain rate. For example, the average Z_e profiles have a negative gradient above the ML, whereas

below, the ML, the gradient depends on the near-surface rain rate. The rain rate and LWC show the opposite behavior, and both consist of a positive (negative) gradient below (above) the ML. The vertical growth of DSD parameters depend on the near-surface rain rate, and a higher concentration of large-sized droplets are observed for higher near surface rain rate, however, the dominant modes of droplets are <1 mm throughout the vertical column. However, the most significant variation in DSD growth is observed for near-surface rain rate ≥ 20 mm/h. These findings suggest using different retrieval techniques for near surface rain estimation than the rest of the vertical profile and high rain rate events. The improved understanding of the tropical Andes precipitation would be very important for assessing climate variability and to forecast the precipitation using the numerical models.

Enlace: <https://repositorio.igp.gob.pe/handle/20.500.12816/4789>

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Regional parameter estimation of the SWAT model: methodology and application to river basins in the Peruvian Pacific drainage

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Servicio Nacional de Meteorología e Hidrología del Perú

Resumen

Este estudio presenta una metodología para la estimación de parámetros regionales del SWAT (Soil and Water Assessment Tool), con el objetivo de estimar series de caudales diarios en el Pacífico drenaje en el contexto de disponibilidad limitada de datos hidrológicos. Esta metodología ha sido diseñada para obtener los parámetros del modelo de un número limitado de cuencas (14) para finalmente regionalizar a cuencas sin datos hidrológicos basados en características físico-climáticas.

Abstract

This study presents a methodology for the regional parameters estimation of the SWAT (Soil and Water Assessment Tool) model, with the objective of estimating daily flow series in the Pacific drainage under the context of limited hydrological data availability. This methodology has been designed to obtain the model parameters from a limited number of basins (14) to finally regionalize them to basins without hydrological data based on physical-climatic characteristics. In addition, the bootstrapping method was selected to estimate the uncertainty associated with the parameters set selection in the regionalization process. In general, the regionalized parameters reduce the initial underestimation which is reflected in a better quantification of daily flows, and improve the low flows performance. Furthermore, the results show that the SWAT model correctly represents the water balance and seasonality of the hydrological cycle main components. However, the model does not correctly quantify the high flows rates during wet periods. These findings provide supporting information for studies of water balance and water management on the Peruvian Pacific drainage. The approach and methods developed can be replicated in any other region of Peru.

Enlace: <https://repositorio.senamhi.gob.pe/handle/20.500.12542/654>

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Seismic source of the earthquake of Camana Peru 2001 (Mw 8.2) from joint inversion of geodetic and tsunami data

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Abstract

On June 23, 2001 at 15:33 local time (20:33 UTC), a strong earthquake of magnitude Mw 8.2 shook the southern region of Peru, causing considerable material damage and the loss of 74 human lives. The epicenter was located in the sea near the city of Atico (Arequipa). As a coseismic effect, a local tsunami was generated, which after 15 min, caused the flood and destruction of the beach resorts of Camana and resulted in the death of 25 people and 62 missing persons. Another coseismic effect was the subsidence of the coastal zones in the source region, evidenced by geodetic observations. We have conducted a joint inversion of tsunami and geodetic data with a fault plane of variable dip to obtain the slip distribution. The main asperity (slip = 12.6 m) was located offshore Camana, this explains the great damage in this city. The seismic moment was calculated in 2.72×10^{21} Nm and the corresponding moment magnitude was Mw 8.2. The subfaults near the trench have a null slip, therefore there is a high potential for the generation of a tsunamigenic earthquake in the updip of the fault plane near the trench.

Enlace: <https://repositorio.igp.gob.pe/handle/20.500.12816/4923>

<https://doi.org/10.1007/s00024-020-02616-8>

Seismic velocity structure in the area of the 2007, Mw 8.0, Pisco-Peru earthquake: implications for the mechanics of subduction in the vicinity of the Nazca ridge

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Abstract

In this study, we present a velocity model for the area of the 2007 Pisco-Peru earthquake ($M_w = 8.0$) obtained using a double-difference tomography algorithm that considers aftershocks acquired for 6 months. The studied area is particularly interesting because it lies on the northern edge of the Nazca Ridge, in which the subduction of a large bathymetric structure is the origin of geomorphological features of the central coast of Peru. Relocated seismicity is used to infer the geometry of the subduction slab on the northern flank of the Nazca Ridge. The results prove that the geometry is continuous but convex because of the subduction of the ridge, thereby explaining the high uplift rates observed in this area. Our inferred distribution of seismicity agrees with both the coseismic and postseismic slip distributions.

Enlace: <https://repositorio.igp.gob.pe/handle/20.500.12816/4876>

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The energy and mass balance of Peruvian glaciers

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Abstract

Peruvian glaciers are important contributors to dry season runoff for agriculture and hydropower, but they are at risk of disappearing due to climate change. We applied a physically based, energy balance melt model at five on-glacier sites within the Peruvian Cordilleras Blanca and Vilcanota. Net shortwave radiation dominates the energy balance, and despite this flux being higher in the dry season, melt rates are lower due to losses from net longwave radiation and the latent heat flux. The sensible heat flux is a relatively small contributor to melt energy. At three of the sites the wet season snowpack was discontinuous, forming and melting within a daily to weekly timescale, and resulting in highly variable melt rates closely related to precipitation dynamics. Cold air temperatures due to a strong La Niña year at Shallap Glacier (Cordillera Blanca) resulted in a continuous wet season snowpack, significantly reducing wet season ablation. Sublimation was most important at the highest site in the accumulation zone of the Quelccaya Ice Cap (Cordillera Vilcanota), accounting for 81% of ablation, compared to 2%–4% for the other sites. Air temperature and precipitation inputs were perturbed to investigate the climate sensitivity of the five glaciers. At the lower sites warmer air temperatures resulted in a switch from snowfall to rain, so that ablation was increased via the decrease in albedo and increase in net shortwave radiation. At the top of Quelccaya Ice Cap warming caused melting to replace sublimation so that ablation increased nonlinearly with air temperature.

Enlace: <https://agupubs.onlinelibrary.wiley.com/doi/abs/10.1029/2021JD034911>

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Thermal Remote Sensing for Global Volcano Monitoring: Experiences From the MIROVA System

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Abstract

Volcanic activity is always accompanied by the transfer of heat from the Earth's crust to the atmosphere. This heat can be measured from space and its measurement is a very useful tool for detecting volcanic activity on a global scale. MIROVA (Middle Infrared Observation of Volcanic Activity) is an automatic volcano hot spot detection system, based on the analysis of MODIS data (Moderate Resolution Imaging Spectroradiometer). The system is able to detect, locate and quantify thermal anomalies in near real-time, by providing, on a dedicated website (www.mirovaweb.it), infrared images and thermal flux time-series on over 200 volcanoes worldwide. Thanks to its simple interface and intuitive representation of the data, MIROVA is currently used by several volcano observatories for daily monitoring activities and reporting. In this paper, we present the architecture of the system and we provide a state of the art on satellite thermal data usage for operational volcano monitoring and research. In particular, we describe the contribution that the thermal data have provided in order to detect volcanic unrest, to forecast eruptions and to depict trends and patterns during eruptive crisis. The current limits and requirements to improve the quality of the data, their distribution and interpretation are also discussed, in the light of the experience gained in recent years within the volcanological community. The results presented clearly demonstrate how the open access of satellite thermal data and the sharing of derived products allow a better understanding of ongoing volcanic phenomena, and therefore constitute an essential requirement for the assessment of volcanic hazards.

Enlace: <https://www.frontiersin.org/articles/10.3389/feart.2019.00362/full>

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Towards a more consistent eco-hydrological modelling through multi-objective calibration: a case study in the Andean Vilcanota River basin, Peru

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Resumen

Este estudio tiene como objetivo (a) desarrollar un marco integral de calibración multiobjetivo utilizando datos de vegetación de sensores remotos y firmas hidrológicas (curva de duración del flujo - FDC e índice de flujo base) además de la descarga, y (b) aplicar este marco para la calibración de la Herramienta de Evaluación de Suelos y Aguas (SWAT) en una cuenca andina típica. En general, nuestro enfoque de calibración superó las estrategias de calibración tradicionales basadas en descargas y firmas de FDC en términos de simulación de vegetación, caudal y partición del caudal.

Abstract

Most hydrological studies rely on a model calibrated using discharge alone. However, judging the model reliability based on such calibration is problematic, as it does not guarantee the correct representation of internal hydrological processes. This study aims (a) to develop a comprehensive multi-objective calibration framework using remote sensing vegetation data and hydrological signatures (flow duration curve – FDC, and baseflow index) in addition to discharge, and (b) to apply this framework for calibration of the Soil and Water Assessment Tool (SWAT) in a typical Andean catchment. Overall, our calibration approach outperformed traditional discharge-based and FDC signature-based calibration strategies in terms of vegetation, streamflow, and flow partitioning simulation. New hydrological insights for the region are the following: baseflow is the main component of the streamflow sustaining the long dry-season flow, and pasture areas offer higher water yield and baseflow than other land-cover types. The proposed approach could be used in other data-scarce regions with complex topography.

Enlace: <https://repositorio.senamhi.gob.pe/handle/20.500.12542/658>

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Trends and variability of precipitation extremes in the Peruvian Altiplano (1971-2013)

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Resumen

Este estudio se centra en el análisis de 11 índices de precipitación extrema (IPA) en el período 1971-2013. En este contexto, se aplicaron análisis estadísticos de tendencias y rupturas de uso común y se utilizó un procedimiento de descubrimiento falso para reducir el número de pruebas significativas artificiales. Además, se determinó el predominio relativo de la frecuencia y la intensidad de las precipitaciones en conjuntos de datos de precipitaciones interanuales. Finalmente, se analizó la correlación entre los EPI y seis índices oceánico-atmosféricos. Los resultados indican que no existe una tendencia global significativa hacia condiciones húmedas o secas en la AP, aunque se presenta una señal de una disminución más leve de la precipitación en la AP Sur. Además, la variabilidad interanual de la precipitación total está dominada principalmente por la frecuencia de la precipitación. La temperatura de la superficie del mar del Pacífico Tropical Central juega un papel importante en la duración máxima y promedio de los períodos húmedos, así como en la precipitación total. Este hallazgo es particularmente relevante para el suroeste de AP.

Abstract

Precipitation extremes have been investigated throughout the last decades in different regions of the Andes. However, little attention has been paid to the Altiplano region (Central Andes), especially to the Peruvian Altiplano (PA) that represents a complex area and is highly vulnerable to extreme events, such as floods and droughts, driven by the strong variability of precipitation. This study focuses on the analysis of 11 extreme precipitation indices (EPIs) in the period 1971–2013. In this context, commonly used statistical trend and break analyses were applied and a false discovery procedure was used in order to reduce the number of artificial significant tests. Additionally, the relative dominance of precipitation frequency and intensity in interannual precipitation datasets was determined. Finally, the correlation between EPIs and six oceanic-atmospheric indices were analysed. The results indicate that there is no significant global trend towards wet or dry conditions in the PA, although a signal of a more slightly decrease of precipitation is presented in the Southern PA. Additionally, interannual variability of total precipitation is mainly dominated by precipitation frequency. The Central Tropical Pacific sea surface temperature plays a major role for the maximum and average length of wet periods as well as for total precipitation. This finding is particularly relevant for the southwestern PA. Our results have important implications for risk management and adaptation planning related to extreme hydrological events in the PA.

Enlace: <https://repositorio.senamhi.gob.pe/handle/20.500.12542/427>

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Tropical peatlands and their conservation are important in the context of COVID-19 and potential future (zoonotic) disease pandemics

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Abstract

The COVID-19 pandemic has caused global disruption, with the emergence of this and other pandemics having been linked to habitat encroachment and/or wildlife exploitation. High impacts of COVID-19 are apparent in some countries with large tropical peatland areas, some of which are relatively poorly resourced to tackle disease pandemics. Despite this, no previous investigation has considered tropical peatlands in the context of emerging infectious diseases (EIDs). Here, we review: (i) the potential for future EIDs arising from tropical peatlands; (ii) potential threats to tropical peatland conservation and local communities from COVID-19; and (iii) potential steps to help mitigate these risks. We find that high biodiversity in tropical peat-swamp forests, including presence of many potential vertebrate and invertebrate vectors, combined, in places, with high levels of habitat disruption and wildlife harvesting represent suitable conditions for potential zoonotic EID (re-)emergence. Although impossible to predict precisely, we identify numerous potential threats to tropical peatland conservation and local communities from the COVID-19 pandemic. This includes impacts on public health, with the potential for haze pollution from peatland fires to increase COVID-19 susceptibility a noted concern; and on local economies, livelihoods and food security, where impacts will likely be greater in remote communities with limited/no medical facilities that depend heavily on external trade. Research, training, education, conservation and restoration activities are also being affected, particularly those involving physical groupings and international travel, some of which may result in increased habitat encroachment, wildlife harvesting or fire, and may therefore precipitate longer-term negative impacts, including those relating to disease pandemics. We conclude that sustainable management of tropical peatlands and their wildlife is important for mitigating impacts of the COVID-19 pandemic, and reducing the potential for future zoonotic EID emergence and severity, thus strengthening arguments for their conservation and restoration. To support this, we list seven specific recommendations relating to sustainable management of tropical peatlands in the context of COVID-19/disease pandemics, plus mitigating the current impacts of COVID-19 and reducing potential future zoonotic EID risk in these localities. Our discussion and many of the issues raised should also be relevant for non-tropical peatland areas and in relation to other (pandemic-related) sudden socio-economic shocks that may occur in future.

Enlace: <https://peerj.com/articles/10283/>

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Twinning SENAMHI and MeteoSwiss to co-develop climate services for the agricultural sector in Peru

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Abstract

The development and dissemination of weather and climate information is crucial to improve people's resilience and adaptability to climate variability and change. The impacts of climate variability and change are generally stronger for disadvantaged population groups due to their limited adaptive and coping capacities. For instance, smallholder farmers living in remote areas such as the southern Peruvian Andes suffer strongly from adverse weather and climatic events such as droughts or frost. The project Climandes aimed at providing high-quality climate services in support of the agricultural sector in southern Peru by implementing the guidelines of the Global Framework for Climate Services (GFCS).

In Climandes, a two-fold challenge was tackled: the co-development of climate services by building up a continuous dialogue between the information provider (in this case the Peruvian national meteorological and hydrological service (NMHS)) and potential users; and the production of climate services through international cooperation. To this end, the NMHSs of Peru (SENAMHI) and Switzerland (MeteoSwiss) worked closely together to tackle issues ranging from the treatment of climate data to ensure the provision of reliable information to establishing continuous interaction with different user groups. In this paper, we postulate that this approach of close collaboration, the so-called twinning of the two NMHSs, was key for the projects' success and contributed to strengthening the Peruvian NMHS institutionally and procedurally. This project overview guides its reader through the approach, main achievements, and conclusions regarding successes and challenges of the project, and reflects on some potential improvements for future initiatives.

Enlace: <https://repositorio.senamhi.gob.pe/handle/20.500.12542/655>

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Variable seismic anisotropy across the Peruvian flat-slab subduction zone with implications for upper plate deformation

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Abstract

We performed shear wave splitting analyses to investigate seismic anisotropy across the northern extent of the Peruvian flat-slab subduction region. We used core-mantle refracted SKS, SKKS and PKS phases from teleseismic events ($88^\circ > \Delta < 150^\circ$) recorded at 45 broadband seismic stations from the Peruvian permanent and portable seismic networks as well as from, international networks (CTBTO, RSBR-Brazil, and RENSIG-Ecuador). The results reveal a complex anisotropy pattern with distinct variations in shear wave splitting along strike. In the northernmost region, the mean delay times range between 1.0 ± 0.2 s and 1.5 ± 0.2 s with fast directions predominantly oriented ENE-WSW approximately perpendicular to the trench, parallel with the motion of the subducting Nazca plate. In the central region of Peru, the predominant fast directions change to a SE-NW orientation that is oblique with the trench. These fast splitting directions are consistent with the pattern seen previously over the southern extent of the flat-slab and correlate well with the current geodetically derived motion of the overriding forearc, the Peruvian Sliver. These characteristics suggest a fundamental change in anisotropic behavior between the northern and central portions of the Peruvian flat-slab and imply that the upper plate deformation is a controlling factor.

Enlace: <https://www.sciencedirect.com/science/article/abs/pii/S0895981120305964?via%3Dihub>

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Wild Meat Species, Climate Change, and Indigenous Amazonians

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Abstract

People throughout the world are adapting to alternative livelihoods as climate change transforms the earth. The western Amazon basin has recently gone through extreme flood levels that resulted in population declines of species used for wild meat, principally white-lipped peccary (*Tayassu pecari*), collared peccary (*Pecari tajacu*), red brocket deer (*Mazama americana*), lowland paca (*Cuniculus paca*), and black agouti (*Dasyprocta fuliginosa*). The Cocama (Kukama) people of the Samiria River have adapted to the declining wild meat populations by greatly reducing hunting and increasing their fishing activity. We evaluated the sustainability of subsistence hunting of peccaries, deer, lowland tapir (*Tapirus terrestris*), large rodents, and primates in flooded forests of the Pacaya-Samiria National Reserve using camera trap capture rates, density from distance transects, and participatory interviews with Cocama villagers from 2009 to 2018. Peccaries, deer, and large rodents are recovering from population declines that occurred during extreme floods, which suggests that hunting levels are allowing these populations to grow. The primates and lowland tapir have healthy population sizes and stable numbers, which suggests people are hunting these species at sustainable levels. Our results indicate that changes in hunting patterns by the Cocama have permitted peccary, deer, and large rodent populations to recover to varying degrees during years of normal flood levels. The Cocama people are adapting to climate change in a way that agrees with conservation goals and reinforces the importance of community-based approaches to conservation in the Amazon.

Enlace: <https://doi.org/10.2993/0278-0771-40.2.218>

VI. GESTIÓN INTEGRAL DE RESIDUOS SÓLIDOS



Primer registro de ingestión de microplásticos por un pez de importancia comercial en la ciudad de Iquitos, Amazonía peruana

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Resumen

El estudio reporta por primera vez para la Amazonía peruana la ingestión de microplásticos en un pez de importancia económica, registrados en individuos provenientes del Mercado Belén de la ciudad de Iquitos, región Loreto, Perú. De las once especies analizadas (50 individuos), sólo en seis individuos de la especie boquichico *Prochilodus nigricans* Agassiz, 1829 fueron registrados en total 17 partículas de microplásticos, con un promedio (y desviación estándar) de 0,34 ($\pm 1,19$) microplásticos por individuo. La frecuencia de ocurrencia de las partículas de microplásticos para los 50 individuos fue 12% y para *P. nigricans* fue 46,2%. Los tamaños estuvieron en un rango de 0,40 a 4,39 mm y las formas encontradas fueron los filamentos (14) y los fragmentos irregulares (3). De los colores registrados, el azul se presentó en mayor número (10 microplásticos), seguido del rojo (5 microplásticos), verde (1 microplástico) y celeste (1 microplástico). Los resultados estarían sugiriendo que algunas zonas de pesca están siendo afectadas por la mala gestión de los residuos plásticos impactando de forma negativa en los ecosistemas y la ictiofauna de la Amazonía peruana; y a través del consumo podría afectar a la salud de las personas.

Enlace: <https://revistas.iiap.gob.pe/index.php/foliaamazonica/article/view/521/563>

<https://doi.org/10.24841/fa.v29i2.521>

VII. GOBERNANZA AMBIENTAL



Convivencia negociada y gobernanza ambiental en áreas naturales protegidas del Perú

Negotiated coexistence and environmental governance in protected nature areas of Peru

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Resumen

Un elemento central en la gobernanza ambiental multiescalar y jerárquica es la legitimidad provisoria de los arreglos institucionales. Este artículo se enfoca en las estrategias desplegadas por una muestra de jefaturas de áreas naturales protegidas del Perú en su trabajo con, desde, para y a veces contra de las comunidades en la búsqueda de una convivencia negociada. En la actualidad la relación parque-comunidad en el Perú se caracteriza por un acercamiento estratégico. A partir de entrevistas y documentos gubernamentales, en el presente texto se analizan las estrategias y racionalidades de gobernanza ambiental. Se desarrolla un argumento acerca de la consolidación de un contrato social para la conservación entendido como el proceso que permite establecer el reconocimiento recíproco entre la institución de áreas protegidas y las organizaciones locales. Tres elementos destacan en las entrevistas: los legados de la conservación en ámbitos rurales, los viejos y nuevos espacios y mecanismos de participación, y la emergencia de nuevas formas de organización rural en relación con las áreas protegidas a través de la formalización de acuerdos de manejo. Se concluye que cada uno de estos elementos apunta a las condiciones para crear una legitimidad duradera en los territorios de conservación; sin embargo, estos mecanismos participativos e incluyentes también son espacios jerárquicos institucionales debido a su énfasis en la creación de incentivos.

Abstract

A central element in multi-scalar and hierarchical environmental governance is the provisional legitimacy of institutional arrangements. This article focuses on the strategies deployed by a sample of protected area managers in Peru in the work with, from, for and sometimes against communities in the search for a negotiated coexistence. Currently, the park-community relationship in Peru is characterized by a strategic approach. Based on interviews and government documents, this text analyzes the strategies and rationalities of environmental governance. An argument is developed about the consolidation of a social contract for conservation understood as the process that allows the establishment of reciprocal recognition between the protected area institution and local organizations. Three elements stand out in the interviews: the legacies of conservation in rural areas, the old and new spaces and mechanisms for participation, and the emergence of new forms of rural organization in relation to protected areas through the formalization of management agreements. It is concluded that each of these elements point to conditions for creating lasting legitimacy in conservation territories; however, these participatory and inclusive mechanisms are also hierarchical institutional spaces due to their emphasis on the creation of incentives.

Enlace: <http://sis.sernanp.gob.pe/biblioteca/?publicacion=2565>

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E-LEARNING tool for virtual capacitation in sustainable forest management of the urban and rural sector in cities of the 8 countries of the Amazon basin

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Abstract

This work includes the development and validation of a computerized e-learning platform for training in sustainable forest management and biodiversity conservation oriented to urban, rural and indigenous populations in the 8 countries of the Amazon basin. This tool has been called "Regional Platform for Information and Knowledge Exchange" - PRIC and was developed in the framework of the implementation of the Amazon Regional Observatory (ARO) promoted by ACTO, through the ITTO/CDB/ACTO project. The Amazon Basin contains considerable natural and cultural wealth, however, it has been affected by various legal and illegal economic activities among which are illegal logging and trafficking of wood, large-scale migratory and commercial agriculture, among others that are generating deforestation, water pollution and even loss of Amazon culture and language, so it is necessary to manage and handle Amazon natural resources appropriately. In this way, the development of capacities, supported by on-line computer tools, of diverse actors related to the sustainability of forest management, becomes an effective means to increase the capacity to sustainably manage the Amazon Forest and guarantee its sustainability. This work included the identification and analysis of requirements, design, development, validation and feedback of services. The platform has a hybrid virtual training mechanism that combines the typical LMS e-learning model with the MOOC mass training model, which are complemented by resources such as virtual forums, webinars, chats, etc. The socialization and validation with users from the 8 countries has been successful and through the feedback of the participants, some functional details have been adjusted.

Enlace: <https://doi.org/10.1109/LACLO50806.2020.9381180>

From plots to policy: How to ensure long-term forest plot data supports environmental management in intact tropical forest landscapes

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Abstract

Long-term data from permanent forest inventory plots have much to offer the management and conservation of intact tropical forest landscapes. Knowledge of the growth and mortality rates of economically important species, forest carbon balance, and the impact of climate change on forest composition are all central to effective management. However, this information is rarely integrated within the policymaking process. The problem reflects broader issues in using evidence to influence environmental management, and in particular, the need to engage with potential users beyond the collection and publication of high-quality data. To ensure permanent plot data are used, (a) key “policy windows”—opportunities to integrate data within policy making—need to be identified; (b) long-term relationships need to be developed between scientists and policy makers and policymaking organizations; and (c) leadership of plot networks needs to be shared among all participants, and particularly between institutions in the global north and those in tropical countries. Addressing these issues will allow permanent plot networks to make tangible contributions to ensuring that intact tropical forest persists over coming decades.

Enlace: <https://nph.onlinelibrary.wiley.com/doi/epdf/10.1002/ppp3.10154>

<https://doi.org/10.1002/ppp3.10154>

Intervención social para la ejecución articulada de proyectos de investigación en comunidades altoandinas: Caso instalación del sistema de monitoreo en tiempo real de la laguna Arhuaycocha, Cordillera Blanca

Social intervention for an articulated execution of research projects in high Andean communities: Case of installation of the real-time monitoring system of the Arhuaycocha glacier lake, Cordillera Blanca

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Resumen

En el Perú las comunidades localizadas a lo largo de la cordillera de los Andes a más de 3000 metros sobre el nivel del mar tienen un comportamiento altamente susceptible a cualquier tipo de actividad de investigación sobre las áreas de montañas, debido principalmente al mal manejo de las empresas mineras durante muchas décadas, sin un proceso de extracción mineral ecoeficiente u óptimo desde un punto de vista ambiental. El mayor problema que surge al buscar realizar actividades de investigación en dichas áreas consiste en demostrar a las comunidades que las actividades de investigación son de un gran beneficio común y no de intereses particulares. En este artículo se muestran estrategias de trabajos de sensibilización en comunidades de montaña, previos a la ejecución de un proyecto de investigación. Se tomó el caso de estudio el proyecto de instalación de un sistema de monitoreo de la laguna peligrosa de origen glaciar Arhuaycocha, en la subcuenca Río Blanco-Santa Cruz, Áncash, donde el distrito Santa Cruz se ubica en el camino aluviónico. Se realizaron actividades de sensibilización, identificación de actores, análisis situación social y de perspectivas de los pobladores para con el proyecto.

Se concluyó que en toda actividad de índole de investigación se debe de realizar con un grado alto de sentimiento de pertenencia por parte de las comunidades, mostrar beneficios directos y lograr acuerdos con las autoridades locales. Un punto clave fue la inclusión de los pobladores en las actividades del proyecto, transparentando y dejando en claro la realización de actividades de ciencia dentro de su comunidad.

Abstract

In Peru, the communities located along the Andes Mountains at more than 3000 meters above sea level, have a behavior highly susceptible to any type of research activity on the mountain areas, mainly due to the past wrong management of mountain resources by mining companies for many decades, without an eco-efficient or optimal mineral extraction process from an environmental point of view. The biggest problem in conducting research activities in these areas is demonstrating to communities that research activities are of great common benefit and not of private interest. Here are strategies for awareness-raising work in mountain communities, prior to the execution of a research project. The study case was taken on the project to install a monitoring system over high danger Arhuaycocha glacier lake at Río Blanco-Santa Cruz Sub-basin, Ancash, Peru, where the Santa Cruz district is located on the alluvial path. Awareness-raising activities were carried out, identification of actors, analysis of the social situation and

perspectives of the inhabitants for the project. It was concluded that all research activities must be carried out with a high degree of sense of belonging on the part of the communities, showing direct benefits, and reach agreements with local authorities. A key point was the inclusion of the residents in the project activities, making it transparent and making it clear that science activities are carried out within their community.

Enlace: <https://revistas.pucp.edu.pe/index.php/espacioydesarrollo/article/view/24374>

Wetland spirits and indigenous knowledge: Implications for the conservation of wetlands in the Peruvian Amazon

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Abstract

Globally, the importance of indigenous and local knowledge systems for science, policy, environmental conservation and the cultural heritage of indigenous peoples is increasingly being recognised. The Amazon region in particular is home to many indigenous peoples who have conserved their cultural traditions and knowledge, despite growing threats to the environment and traditional lifestyles and cultures. Based on insights from ethnographic research in three indigenous communities, here we present a case study on the indigenous knowledge of the Urarina people of the Chambira Basin in the Peruvian Amazon and its implications for conservation. We describe, for the first time, a series of anthropomorphic and territorial “wetland spirits”, who are associated with particular wetland ecosystems and range in character from the benign to outright aggressive. Their presence may indirectly benefit conservation of wetlands, as humans fear or respect these wetland spirits and adapt their behaviour accordingly. While benign spirits may be seen as positive models to follow, aggressive spirits may deter unsustainable harvesting of resources through fear of disease or death. However, their cultural status is not adequately captured by such rational-scientific explanations. Wetland spirits are important characters within the indigenous cosmos of humans and non-humans, which is built on a relational, rather than extractive model of connecting humans and nature. We discuss our findings in the context of wider conceptual debates on recognising relational ontologies in environmental policy and conservation, the paradigm of biocultural conservation, as well as their implications for land titling, and incorporating indigenous perspectives in local education.

Enlace: <https://www.sciencedirect.com/science/article/pii/S2666049021000839?via%3Dihub>

<https://doi.org/10.1016/j.crsust.2021.100107>

VIII. REDUCCIÓN DE EMISIONES DE GASES DE EFECTO INVERNADERO



Hydrometeorological sensitivities of net ecosystem carbon dioxide and methane exchange of an Amazonian palm swamp peatland

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Abstract

Tropical peatlands are a major, but understudied, biophysical feedback factor on the atmospheric greenhouse effect. The largest expanses of tropical peatlands are located in lowland areas of Southeast Asia and the Amazon basin. The Loreto Region of Amazonian Peru contains ~63,000 km² of peatlands. However, little is known about the biogeochemistry of these peatlands, and in particular, the cycling of carbon dioxide (CO₂) and methane (CH₄), and their responses to hydrometeorological forcings. To address these knowledge gaps, we established an eddy covariance (EC) flux tower in a natural palm (*Mauritia flexuosa* L.f.) swamp peatland near Iquitos, Peru. Here, we report ecosystem-scale CO₂ and CH₄ flux observations for this Amazonian palm swamp peatland over a two-year period in relation to hydrometeorological forcings. Seasonal and short-term variations in hydrometeorological forcing had a strong effect on CO₂ and CH₄ fluxes. High air temperature and vapor pressure deficit (VPD) exerted an important limitation on photosynthesis during the dry season, while latent heat flux appeared to be insensitive to these climate drivers. Evidence from light-response analyses and flux partitioning support that photosynthetic activity was downregulated during dry conditions, while ecosystem respiration (RE) was either inhibited or enhanced depending on water table position. The cumulative net ecosystem CO₂ exchange indicated that the peatland was a significant CO₂ sink ranging from -465 (-279 to -651) g C m⁻² y⁻¹ in 2018 to -462 (-277 to -647) g C m⁻² y⁻¹ in 2019. The forest was a CH₄ source of 22 (20 to 24) g C m⁻² y⁻¹, similar in magnitude to other tropical peatlands and larger than boreal and arctic peatlands. Thus, the annual carbon budget of this Amazonian palm swamp peatland appears to be a major carbon sink under current hydrometeorological conditions.

Enlace: <https://www.sciencedirect.com/science/article/abs/pii/S0168192320302690?via%3Dihub>

<https://doi.org/10.1016/j.agrformet.2020.108167>

Spatial and temporal variability of soil N₂O and CH₄ fluxes along a degradation gradient in a palm swamp peat forest in the Peruvian Amazon

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Abstract

Mauritia flexuosa palm swamp, the prevailing Peruvian Amazon peatland ecosystem, is extensively threatened by degradation. The unsustainable practice of cutting whole palms for fruit extraction modifies forest's structure and composition and eventually alters peat-derived greenhouse gas (GHG) emissions. We evaluated the spatiotemporal variability of soil N₂O and CH₄ fluxes and environmental controls along a palm swamp degradation gradient formed by one undegraded site (Intact), one moderately degraded site (mDeg) and one heavily degraded site (hDeg). Microscale variability differentiated hummocks supporting live or cut palms from surrounding hollows. Macroscale analysis considered structural changes in vegetation and soil microtopography as impacted by degradation. Variables were monitored monthly over 3 years to evaluate intra- and inter-annual variability. Degradation induced microscale changes in N₂O and CH₄ emission trends and controls. Site-scale average annual CH₄ emissions were similar along the degradation gradient (225.6 ± 50.7 , 160.5 ± 65.9 and 169.4 ± 20.7 kg C ha⁻¹ year⁻¹ at the Intact, mDeg and hDeg sites, respectively). Site-scale average annual N₂O emissions (kg N ha⁻¹ year⁻¹) were lower at the mDeg site (0.5 ± 0.1) than at the Intact (1.3 ± 0.6) and hDeg sites (1.1 ± 0.4), but the difference seemed linked to heterogeneous fluctuations in soil water-filled pore space (WFPS) along the forest complex rather than to degradation. Monthly and annual emissions were mainly controlled by variations in WFPS, water table level (WT) and net nitrification for N₂O; WT, air temperature and net nitrification for CH₄. Site-scale N₂O emissions remained steady over years, whereas CH₄ emissions rose exponentially with increased precipitation. While the minor impact of degradation on palm swamp peatland N₂O and CH₄ fluxes should be tested elsewhere, the evidenced large and variable CH₄ emissions and significant N₂O emissions call for improved modeling of GHG dynamics in tropical peatlands to test their response to climate changes.

Enlace: <https://onlinelibrary.wiley.com/doi/10.1111/gcb.15354>

<https://doi.org/10.1111/gcb.15354>

Thinner bark increases sensitivity of wetter Amazonian tropical forests to fire

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Abstract

Understory fires represent an accelerating threat to Amazonian tropical forests and can, during drought, affect larger area than deforestation itself. These fires kill trees at rates varying from < 10 to c. 90% depending on fire intensity, forest disturbance history and tree functional traits. Here, we examine variation in bark thickness across the Amazon. Bark can protect trees from fires, but it is often assumed to be consistently thin across tropical forests. Here, we show that investment in bark varies, with thicker bark in dry forests and thinner in wetter forests. We also show that thinner bark translated into higher fire-driven tree mortality in wetter forests, with between 0.67 and 5.86 gigatonnes CO₂ lost in Amazon understory fires between 2001 and 2010. Trait-enabled global vegetation models that explicitly include variation in bark thickness are likely to improve the predictions of fire effects on carbon cycling in tropical forests.

Enlace: <https://onlinelibrary.wiley.com/doi/10.1111/ele.13409>

<https://doi.org/10.1111/ele.13409>

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