Three decades of deforestation from artisenal gold mining in the Peruvian Amazon

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RESEARCH BRIEF

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THREE DECADES OF DEFORESTATION FROM ARTISANAL GOLD MINING IN THE PERUVIAN AMAZON

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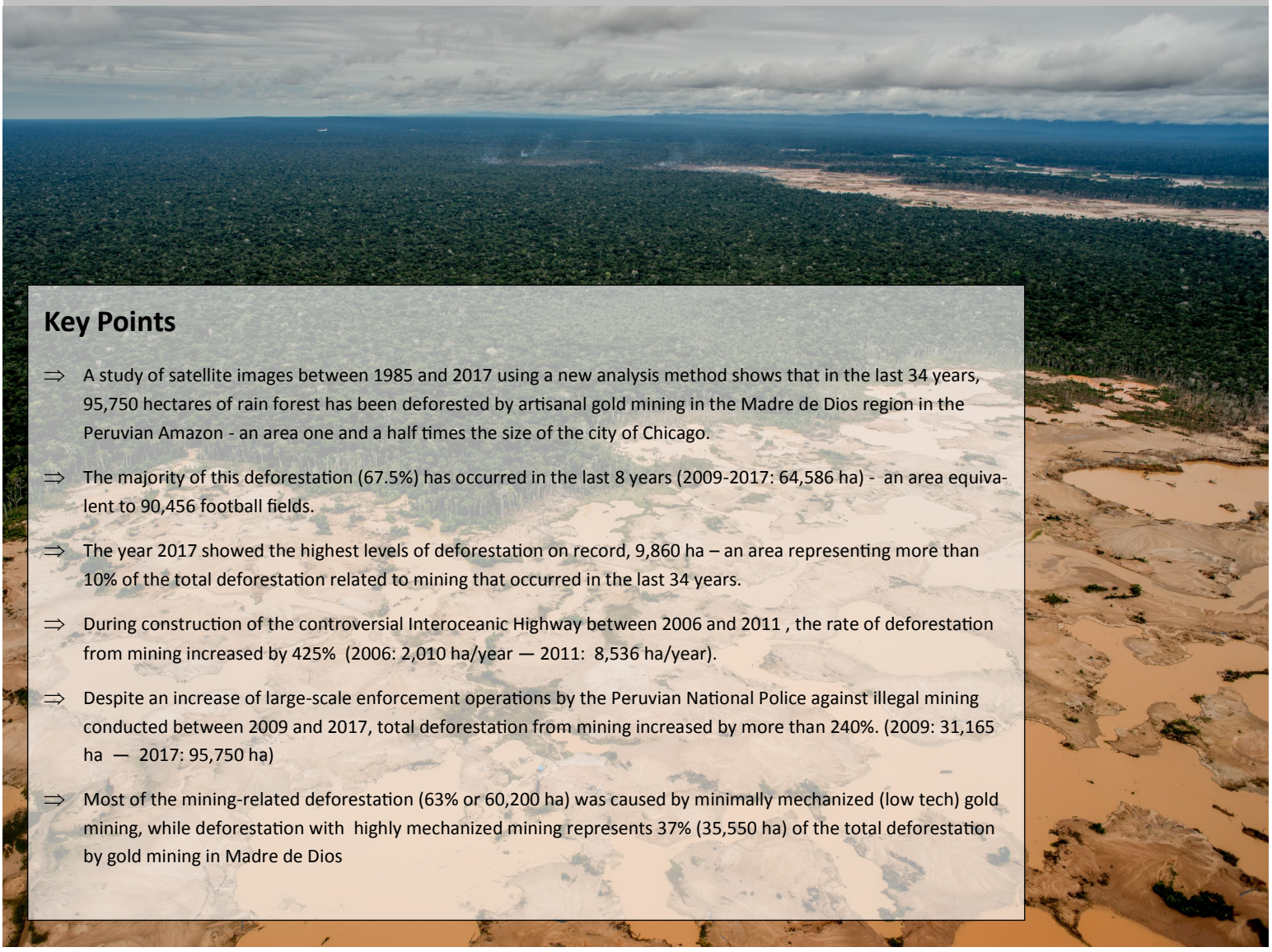
Keywords: deforestation, gold mining, Madre de Dios, Peru



Key Points

⇒ A study of satellite images between 1985 and 2017 using a new analysis method shows that in the last 34 years, 95,750 hectares of rain forest has been deforested by artisanal gold mining in the Madre de Dios region in the Peruvian Amazon - an area one and a half times the size of the city of Chicago.

⇒ The majority of this deforestation (67.5%) has occurred in the last 8 years (2009-2017: 64,586 ha) - an area equivalent to 90,456 football fields.

⇒ The year 2017 showed the highest levels of deforestation on record, 9,860 ha – an area representing more than 10% of the total deforestation related to mining that occurred in the last 34 years.

⇒ During construction of the controversial Interoceanic Highway between 2006 and 2011 , the rate of deforestation from mining increased by 425% (2006: 2,010 ha/year — 2011: 8,536 ha/year).

⇒ Despite an increase of large-scale enforcement operations by the Peruvian National Police against illegal mining conducted between 2009 and 2017, total deforestation from mining increased by more than 240%. (2009: 31,165 ha — 2017: 95,750 ha)

⇒ Most of the mining-related deforestation (63% or 60,200 ha) was caused by minimally mechanized (low tech) gold mining, while deforestation with highly mechanized mining represents 37% (35,550 ha) of the total deforestation by gold mining in Madre de Dios

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INTRODUCTION

Gold is a highly valued and globally traded commodity metal with significant markets in jewelry, electronics, manufacturing and financial sectors. Starting in the early 2000's, the price of gold has rapidly increased, particularly after the global economic crisis of 2008 where it had risen from a low of $200 per ounce to a record high of $1,905 per ounce in 2011.

In response to high gold prices, a modern-day gold rush has occurred in more than 70 countries including those in the Amazon Basin, a region with large alluvial gold deposits. Peru has experienced the highest increase of artisanal and small-scale gold mining (ASGM) in the Amazon region, with Peru's department of Madre de Dios considered the epicenter of ASGM in South America (Alvarez & Aide 2015).

The region of Madre de Dios is also considered one of the hottest of the global biodiversity hot spots (Myers et al. 2000) and is home to some of the last "uncontacted" human populations (more formally known as "peoples living in voluntary isolation"). Because most of the gold production has occurred outside the formal economy, limited economic benefits have been offset by significant social and environmental costs (Swenson et al., 2011).

Although global attention has recently started to focus on the environmental and social costs of artisanal mining in Peru, there have been very few studies detailing the patterns and trends of deforestation caused by gold mining over the last three decades. The analysis of historical deforestation is however needed to identify drivers of forest loss and is critical for understanding how the forests naturally regenerate in these degraded areas. This information will provide essential information to the development of new methods of reforestation and restoration of former mining area.

This research brief outlines ongoing research conducted by Wake Forest University's Center for Amazonian Scientific Innovation (CINCIA) which analyzed more than three decades of mining related deforestation in Madre de Dios using a new and novel image analysis method, and categorizes this deforestation by year of occurrence and by the type of mining that caused the forest loss. .

Figure 1 Types of artisanal scale gold mining and resulting patterns in post-mining landscapes in Madre de Dios

METHODOLOGY

The study team compiled 68 cloud-free Landsat 5/7/8 satellite images of the Madre de Dios mining zone dating from 1984 to 2017. We used two image analysis methodologies to detect mining-related deforestation in the study area:

i. 1985-2000: Image analysis was based on the methodology developed by Asner et al. (2013) using the CLASlite v.3.3 software.

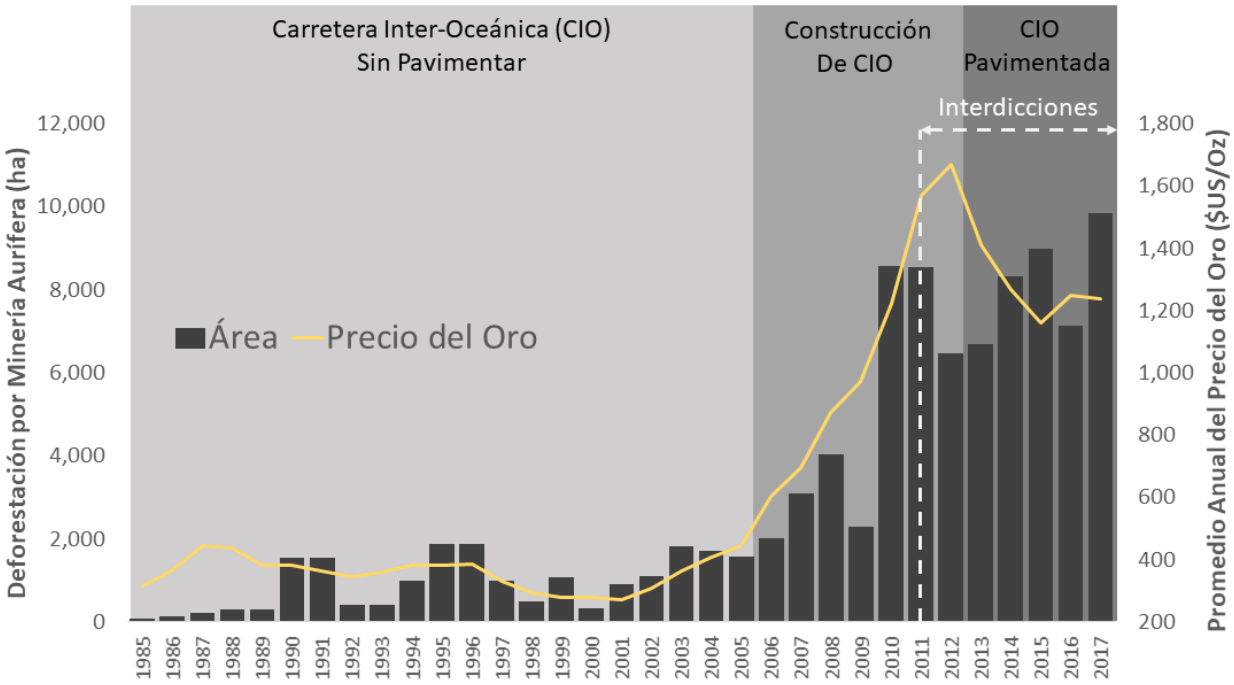
ii. 2000-2017: To improve deforestation detection rates, CINCIA developed a new methodology that fuses data from Asner (2013)'s methods with data from Hanson (2013)'s Global Forest Change methods.

High resolution satellite images (e.g. Planet and DigitalGlobe WorldView-3) were used to verify that deforestation due to other causes, such as agriculture, livestock and logging was excluded from our classification.

The use of high-resolution satellite data also allowed for the identification of the type of mining that caused the deforestation. Two general classes were used in this study: a) minimally mechanized mining: simple technologies such as diesel-powered high pressure water cannons and suction pumps, and b) highly mechanized mining: heavy machinery, bulldozers, backhoes, excavators (fig. 1). The ability to distinguish between these two types of mining was important for understanding differences in the impact of mining on the landscape and its potential for natural and human mediated reforestation and restoration.

The image classification was validated with high-resolution satellite images and drone images of the study area captured by optical sensors mounted on fixed-wing unmanned aerial vehicles developed by Wake Forest University's Small Unmanned Aerial Systems (SUAS) Laboratory located in Winston-Salem, North Carolina, USA.

Figure 2 Deforestation due to gold mining in Madre de Dios and the gold spot price, 1985 to 2017. Construction stages of the Inter-oceanic Highway are shown by grey shading and the period of increased enforcement is shown by the dotted white line.



KEY RESULTS

Historical Deforestation

95,750 ha were deforested by gold mining in Madre de Dios between 1985 and 2017

Deforestation accelerated after the increase of gold prices in response to the global economic recession of 2008, and the start of construction of the Interoceanic Highway . In total, 95,750 hectares of forests were lost (fig. 2).

The year 2017 was the highest year on record for deforestation due to gold mining

9,860 hectares, or more than 10% of the total mining related deforestation that occurred in the last 34 years, were deforested in 2017 (fig. 2).

Mining related deforestation rates increased 425% during the construction period of a large highway infrastructure project through the region

The construction of the Inter-Oceanic Highway seems to have played an important role in the increase of deforestation. In the year when construction started, the rate of deforestation by mining was 2,000 ha/year. By the end of construction, the rate of deforestation had increased to 8,400 ha/year - an increase of 425% (fig. 2).

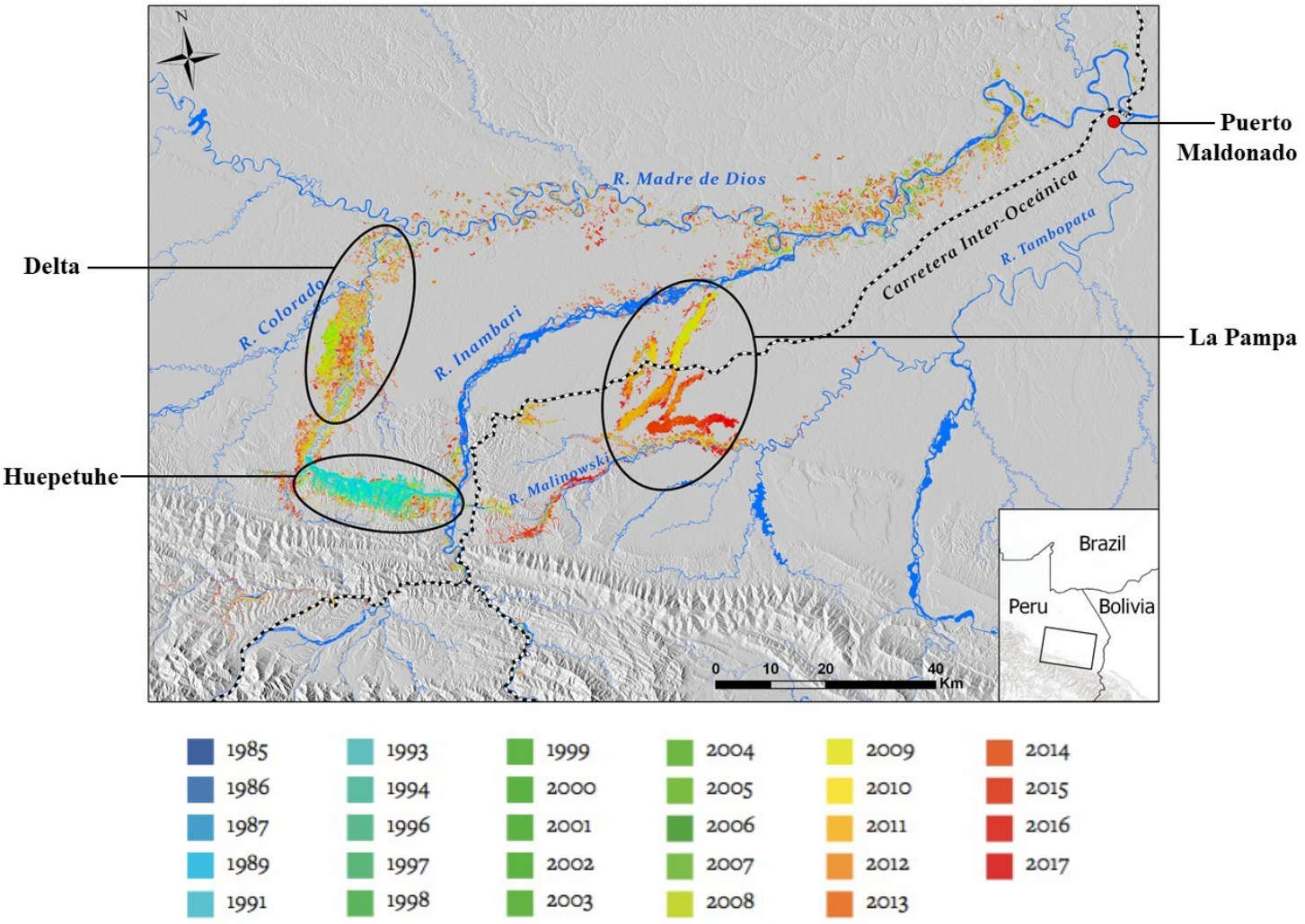
Despite large scale enforcement actions by the Peruvian government, deforestation by gold mining increased by 240%.

Large scale enforcement campaigns against illegal mining conducted by the Peruvian National Police began in 2009 when deforestation totaled 31,165 ha. By the end of 2017, mining related deforestation had increased to 95,750 ha, an increase of more than 240% (fig. 2).

Deforestation and gold prices appear to be closely linked…. until 2012

Annual deforestation and the gold spot price appear to be closely linked from 1985-2011. However, deforestation and gold prices appear to have become decoupled between 2012 and 2017. Even though the price of gold decreased by 26% between 2012 and 2017, deforestation in 2017 increased by 53% (fig. 2). The reasons for this opposite trend between deforestation rate and gold prices are unclear but weak policies of the mining-friendly regional government in place between 2013 and 2017 may have been an important factor.

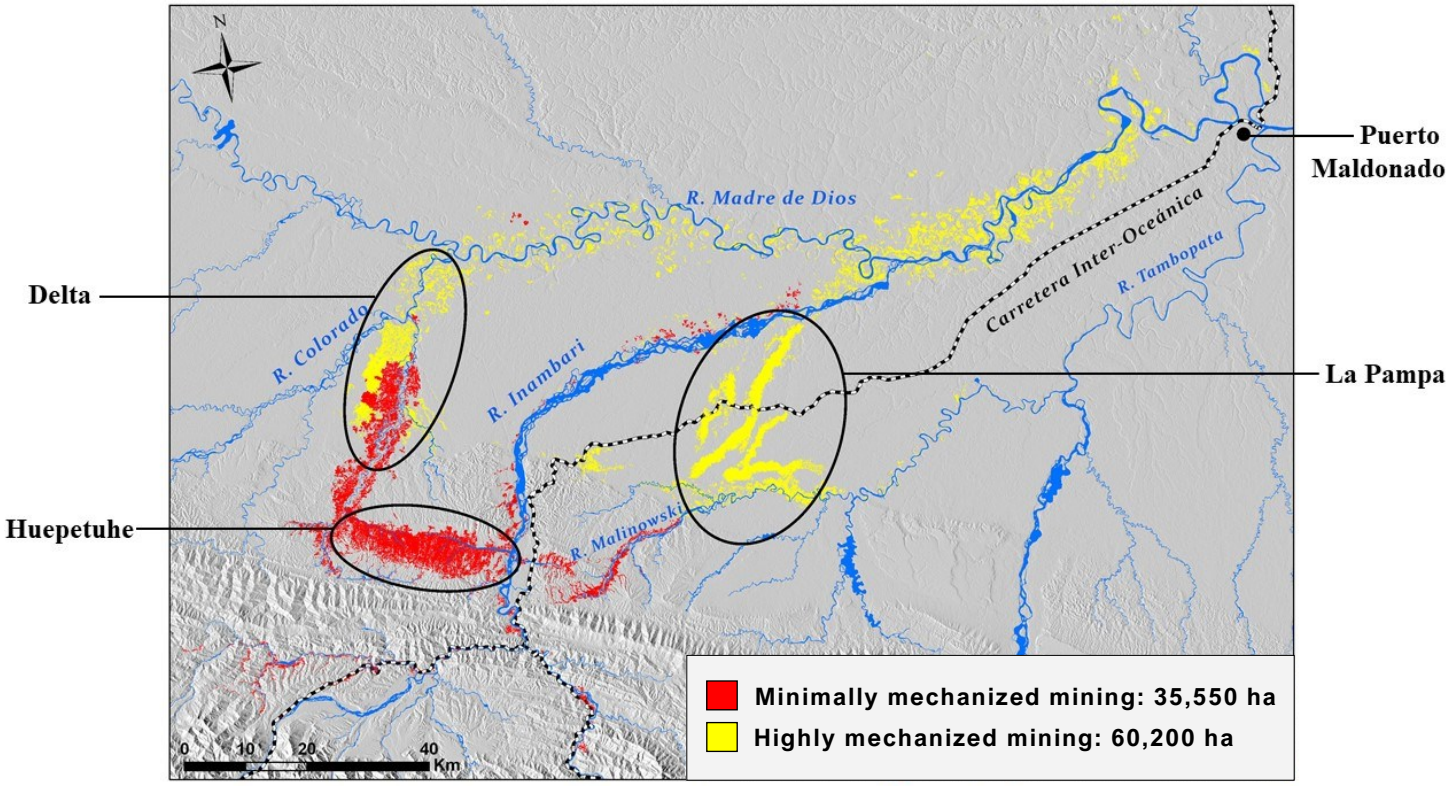
Figure 3 **Deforestation due to gold mining in Madre de Dios by year, 1985-2017**



"In the last 34 years, 95,750 hectares of rain forest have been deforested by gold mining in the southeastern Peruvian Amazon - an area 1.5 times larger than the city of Chicago. "

"Most of this deforestation (67.5% or 64,586 ha) occurred in the last 8 years (2009-2017), clearing an area equivalent to 90,456 football fields. "

Figure 4 **Deforestation due to gold mining in Madre de Dios classified by mining type, 2017**



Deforestation by Mining Type

Highly mechanized mining was responsible for most of the deforestation between 1985 and 2000 and causing 37% of mining related deforestation by 2017

Most of the deforestation during the 80's and 90's was due to highly mechanized mining. Initially concentrated in the Huepetuhe mining district, this type of mining started to expand to the Delta, Camanti, and Malinowski River mining districts after 2009 (fig. 4). In 2017, deforestation due to gold mining with heavy machinery covered 37% (35,550 ha) of the total area deforested.

Minimally mechanized mining was responsible for most of the mining related deforestation from 2000 to the present, causing 63% of the total mining related deforestation by 2017

Starting in 2000, the dominant type of mining in Madre de Dios switched to a more primitive and minimally mechanized type of mining, especially for alluvial mining on the Madre de Dios River. In 2006, the massive illegal mining zone now known as "La Pampa" began near the Inambari River and quickly spread to the Interoceanic Highway and into the Tambopata National Reserve protected area network. (Fig. 4). By 2017, deforestation by mining using minimally mechanized technology caused 63%(60,202 ha) of the total area deforested by mining.

The type of mining used to deforest landscapes has an important effect on the potential for natural regeneration and human assiated reforestation.

The two different types of mining used in Madre de Dios result in very different degraded landscapes. The use of heavy machineries results in partially forested strips 15 to 30 meters wide and up to 500 meters long, while the more recent minimally mechanized mining results in mounds of gravel of more than 100 meters diameter and interspersed with mercury contaminated mining pits. These two patterns create different conditions for regrowth of forests, and influence the potential for restoration of biodiversity in areas degraded by gold mining.

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REFERENCES

Alvarez-Berríos, N.L., Aide, T.M. 2015. Global demand for gold is another threat for tropical forests. Environ. Res. Lett. 10, 014006.

Asner, G.P., et al. 2013. Elevated rates of gold mining in the Amazon revealed through high-resolution monitoring. PNAS 110, 18454–18459.

Finer, M., et al. 2018. Deforestation Hotspots in the Peruvian Amazon, 2017. MAAP 78. URL:http://maaproject.org/2018/hotspots-peru2017/.

Global Forest Change. https://earthenginepartners. appspot.com /science-2013-global-forest

Hansen, M.C., et al. 2013. High-Resolution global maps of 21st-century forest cover change. Science 342: 850–853.

Myers, N., Mittermeier R.A., Mittermeier C.G., da Fonseca G.A., Kent J. 2000. Biodiversity hotspots for conservation priorities. Nature. 403(6772):853-8.

Swenson, J.J., et al. 2011. Gold mining in the Peruvian Amazon: global prices, deforestation, and mercury imports. PLOS ONE 6(4): e18875.

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The Centro de Innovación Cientifica Amazonica (Center for Amazonian Scientific Innovation, or CINCIA) was created in 2016 by Wake Forest University in partnership with USAID with the aim of generating scientific capacity to identify, recover and mitigate threats to ecosystems, biodiversity and public health in the Peruvian Amazon. CINCIA aims to strengthen research capacity in Amazonian institutions and improve the application of scientific knowledge to solve current and future environmental problems in the Amazon basin.

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For more information, see our StoryMap about mining in the Peruvian Amazonia

Gold Mining in the Amazon: http://arcg.is/2eXSx2x

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