

# Do protected areas work in the tropics?

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December 18, 2017



Written by Shreya Dasgupta, research by Annika Schlemm & Zuzana Burivalova by [Shreya Dasgupta](#) on 18 December 2017 |  
Mongabay Series: [Conservation Effectiveness](#)

- *To find out if terrestrial protected areas are effective in achieving their environmental and socioeconomic goals, we read 56 scientific studies. (See the interactive infographic below.)*
- *Overall, protected areas do appear to reduce forest cover loss. But other ecological outcomes of protected areas, like biodiversity or illegal hunting, remain extremely understudied.*
- *The evidence on socioeconomic impacts is very thin. What limited rigorous research exists shows that protected areas do not exacerbate poverty generally, but anecdotal studies suggest that protected areas could be making other aspects of people's well-being worse off.*
- *This is part of a special Mongabay series on "Conservation Effectiveness".*

In 1986, Patricia Wright, then a budding primatologist, spent weeks combing the rainforests of eastern Madagascar in search of the greater bamboo lemur (*Prolemur simus*), a five-pound bamboo-eating primate that was feared extinct. It was only once she stopped over at a hotel in a small village for a night that her luck changed.

Behind the hotel was a river, and across the river was a majestic rainforest where Wright spotted not only the greater bamboo lemur, but another species of bamboo lemur that was unknown to Western science.

The discoveries were exciting. But droves of loggers were moving into the rainforest with axes to cut down the grand old trees and ship the wood to Europe — legally, it appeared.

Worried that her beloved lemur-filled forest would soon be gone, Wright approached the director of what is now the Ministry of Environment, Ecology and Forests and pleaded her case. “The director told me that when he gave the timber concessions he didn’t know there was a new species to science and a rediscovered species in the forest,” Wright, now at Stony Brook University in New York, U.S., told Mongabay. “But now I was there to tell him that this forest is very special and should be protected.”

To her surprise, the director suggested turning the forest into a national park, but only if Wright arranged the funds for it and did most of the legwork herself. Over the next five years, Wright raised more than \$5 million and carved out the boundary of what would soon become Ranomafana National Park in consultation with people who lived around the forest. Finally, on May 31, 1991, the park was officially inaugurated with elders from 57 nearby villages attending the ceremony.

Wright had gone in search of a lemur, but she had helped create a protected area. Twenty-five years later, Ranomafana National Park looks like an island of dense green being choked by waves of deforestation from all sides. “I know for sure that the rainforest wouldn’t exist today had it not been for the national park,” Wright said. “The north of the park, for instance, was all forest when we started. It’s all gone now.”

National parks like Ranomafana and other protected areas have long been considered the one-stop solution to conserving terrestrial biodiversity and forests. They are seen as conservation success stories. But what happens *after* you create a protected area? Does establishing a protected area on paper really “protect” a forest? Do a park’s plants and animals thrive because of their forest home’s new legal status? And what happens to the people living in and around the park? We tried to find out by reviewing some of the scientific literature that looks at the effects of this popular conservation strategy.

Patricia Wright and colleagues discovered the golden bamboo lemur (*Hapalemur aureus*) in what later became Ranomafana National Park. Photo by Rhett A. Butler.

## Why protected areas?

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Modern-day protected areas on land, such as national parks and nature reserves, were originally conceived in the late 19<sup>th</sup> century to preserve vast stretches of wilderness in their unspoiled, untouched form. The goal was simple: to keep nature safe from people.

This goal has evolved over time. Tourism within parks became an important industry for many developing countries in the middle of the 20<sup>th</sup> century. People also began to see forest protected areas as as the key to reducing deforestation and forest degradation, and preventing extinction of threatened species. This recognition sparked off a rapid expansion of protected areas across the world in the 1970s. Even today, biodiversity conservation remains a major motivation for protecting forests.

“Protected areas are a cornerstone of biodiversity conservation now,” said William F. Laurance, a tropical ecologist at James Cook University in Australia and member of Mongabay’s advisory board. “It isn’t the only conservation strategy around, but it is clear that it will be one of the most important things in our array of conservational strategies. There’s just no doubt about that.”

In 2010, the world’s governments (not including the United States) committed to conserving 17 percent of land by 2020 through well-connected systems of protected areas. This goal is on its way to being achieved. As of 2016, governments have legally created more than 202,000 terrestrial protected areas covering 19.8 million square kilometers, or about 15 percent of the earth’s land surface.

Many conservationists have celebrated this expansion of protected areas. But critics fear that parks are being added at the cost of local people.

In 2004, anthropologist Mac Chapin of the University of Colorado in Boulder, U.S., alleged that three of the biggest international conservation NGOs — WWF, the Nature Conservancy and Conservation International — were creating large protected areas in Latin America by infringing upon the rights of local communities and indigenous peoples. “Sometimes the indigenous people are evicted, and the conservationists frequently seem to be behind the evictions,” Chapin wrote. “On other occasions, traditional uses of the land have been declared ‘illegal,’ resulting in prosecution of the inhabitants by government authorities.”

Others, like historian Ramchandra Guha, have bemoaned the practice of transplanting the U.S. system of national parks onto other countries without considering the needs of the local population.

These conflicts remain, but the tide is turning. Many conservationists and groups are now working with local people, trying to understand how conservation efforts affect them. Some are even designing conservation projects to help improve local people’s lives. “The line of thinking has progressed from, ‘Protected areas should at least do no socioeconomic harm,’

to ‘Protected areas can be targeted for both environmental and socioeconomic outcomes,’” said Merlin Hanauer, a professor of economics at Sonoma State University in California, U.S.

In fact, one of the objectives of the World Commission on Protected Areas of the International Union for Conservation of Nature (IUCN) for 2017 through 2020 is to “recognize and mainstream protected areas as natural solutions to global challenges, such as climate change, land degradation, food and water security, health and well-being.” Protected areas are also being seen as tools to help meet the targets of the U.N.’s Sustainable Development Goals (SDGs), such as poverty alleviation, food and water security, health, and disaster risk reduction.

Still, protected areas remain controversial and fierce debates about whether or not they actually work rage on. Do protected areas really protect forests and conserve biodiversity? Do protected areas make local people poorer? We reviewed the scientific literature about the effects of protected areas on both nature and people to see where this debate now stands.

Aerial view of the Amazon Rainforest near Manaus, the capital of the Brazilian state of Amazonas. Photo by Neil Palmer (CIAT) via Flickr (CC BY-SA 2.0).

## State of science on protected areas

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More than 145 years have passed since the establishment of the world’s first modern-day protected area, Yellowstone National Park in the U.S. You would imagine that by now we would know whether protected areas are effective, but there is still a lot we don’t yet know.

A major challenge is the lack of baseline ecological and social data from before the parks were created, especially for protected areas established several decades ago. Without this ability to peer into the past, scientists are often unable to say whether or not the parks have made things better.

Then there are methodological issues. To see if parks work, many studies compare the conditions inside protected areas with those outside. This comparison would be valid if protected areas were located randomly. But that is almost never the case.

Governments often decide where to designate a protected area based on political and logistical considerations, and not necessarily on where the richest or most threatened biodiversity exists. For instance, governments might find it easier and less expensive to create strictly protected national parks in remote areas that have relatively unproductive lands and fewer people, than in forests that have good agricultural or mining potential. Without controlling for the factors that determine where protected areas are placed, simple inside-outside comparisons tend to overestimate the effects.



Many studies also focus on trends: changes in forest cover or species populations over time. Again, such trends provide useful information about where forests and species stand today when compared to previous years. But they tell us little about what the trends might have been in the absence of the protected areas, especially when baseline data are missing. Would the study showing a decline in a species' populations have shown a steeper decline in the absence of the protected area? Could the study showing a positive trend have shown a similar upward trend even if the protected area didn't exist?

“Too much investment goes into measuring the status and trends of ecological indicators, and not too much goes into drawing conclusions about what's affecting that status or trends,” said Paul Ferraro, a professor at Johns Hopkins University in Maryland, U.S., whose research focuses on the design and evaluation of environmental programs. “There is often a mistaken impression in the conservation community that those same indicators can be used to draw conclusions about whether what we're doing is working or not.”



Burned land inside Tesso Nilo National Park in Indonesia. Photo by Rhett A. Butler.

To draw stronger conclusions, scientists need more carefully designed, rigorous studies, experts say, ones that try to eliminate all possible rival explanations for the patterns they detect. Such studies typically compare protected forests with unprotected forests that have very similar baseline characteristics and try to answer this question: What would the outcomes have been in the absence of protection?

These kinds of studies are on the rise, though. “A few years ago, we started writing our papers because there wasn’t much literature on the effectiveness of protected areas,” Stuart Pimm, a conservation ecologist at Duke University in North Carolina, U.S., told Mongabay. “Now, there are a lot of careful studies being done around the world.”

But as with most other forest conservation strategies, studies on the effectiveness of protected areas focus on deforestation or forest degradation. This is because forest cover has become relatively easy to measure with the availability of good satellite images. Other ecological outcomes of protected areas remain harder to detect and therefore extremely understudied. In short, striking gaps in the data remain.

The science on the socioeconomic impacts of protected areas is also limited. And the handful of rigorously designed socioeconomic studies have focused on just a few, but different, aspects of human welfare or poverty, making it hard to discern any general patterns.

Also, protected areas are not all the same. Some strictly prohibit all human activity. Others allow local people to extract certain forest resources under strict regulations. Each park followed a different path to being designated, which then shapes its management. Larger-scale studies often fail to account for these differences.

## How we reviewed available evidence

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For our analysis we focused on protected areas that seek to protect forests. We restricted our analysis to the more strictly protected parks that are usually government-controlled or sometimes co-managed with conservation NGOs. These include national parks, wildlife sanctuaries and strict nature reserves — any park that comes under IUCN categories I-IV. These categories of parks typically have biodiversity conservation or landscape protection as their primary goal, and strictly control human use. We also included only English-language studies of countries located, at least in part, in the tropics.

Overall, we found 56 relevant peer-reviewed scientific studies on Google Scholar, including three meta-analyses. (Read more about our methodology [here](#); you can access all 56 studies we reviewed [here](#). Additional studies have been added to the infographic since this story was first published.)

The quality of research varied widely. Most of the studies, 38, did not tease out whether the patterns they showed were truly caused by protected areas. Some of these studies were “case reports” that only tried to document changes, mostly socioeconomic, inside protected areas, typically through interviews. Others compared protected areas with unprotected areas, but considered only a few, if any, alternate explanations for the patterns they detected.

We also found 18 well-designed studies that rigorously compared protected with unprotected areas that were selected to account for multiple rival explanations. (These studies are called “Study III” in the “Select type of evidence” pull-down menu of the infographic below.)

While not exhaustive, we consider our review to represent a reasonably good sampling of the existing literature.

## The scientific evidence on terrestrial protected areas

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*Use the drop down menus to select data from your country of choice or to view data for a particular type of evidence. Click on the name of an outcome (such as deforestation and degradation, or economic benefit) to display data specific to it. Click on a square to see what evidence the outcome is based on. Download data for the original 56 studies [here](#). Additional studies have been added to the infographic since this story was first published. You can find this and other infographics in our Conservation Effectiveness series at [ConservationEffectiveness.org](http://ConservationEffectiveness.org). Data visualization by [GreenInfo Network](#).*

## Are protected areas good for forests?

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Yes, but we can only say this with confidence for forest cover.

In countries that are at least partly in the tropics, studies suggest that strictly protected forests generally have lower levels of forest clearing or degradation than unprotected forests.

But here’s a caveat: more than half of the 39 studies that looked at the effects of protected areas on forest cover relied on subjective perceptions, simple comparisons or trends, without showing a definitive cause-and-effect relationship between the creation of the protected area and the changes they detected.

For instance, a widely cited study published in the high-profile journal *Science* in 2001 interviewed park managers, researchers and NGO staff across 93 protected areas, and concluded that tropical parks have been “surprisingly effective at protecting the ecosystems and species within their borders.” Another [study](#) measured changes in forest cover across 48 East African protected areas between 2001 and 2009 and compared it to rates of deforestation within 10 kilometers of the parks. The researchers concluded that about half of the parks were effective (that is, they were gaining or maintaining forest cover), while the rest were ineffective, or losing forest cover. But without accounting for what the likely rates of forest loss would have been in the absence of protection, the study could not determine whether the parks were truly effective or not.



Even so, 15 of the studies used more rigorous designs and their results also suggest that protecting forests reduces deforestation.

A [2015 study](#) from Brazil found that strictly protected areas in the notorious arc of deforestation, where most forest clearing in the Amazon occurs, had considerably lower deforestation rates than unprotected areas with similar characteristics. Another [study, from Thailand](#), found that creating protected areas increased forest cover in general. Yet another well-designed [global analysis](#) of protected areas across 147 countries found that protected areas were, on average, less likely to be cleared than control unprotected areas.

There was a common thread across these rigorous studies. They found that going the conventional route, comparing forest cover change inside protected areas with that outside, tended to overestimate the positive effect of parks.



Gold mining is a major threat to the forests and biodiversity of the Peruvian Amazon, including protected areas. Photo by Rhett A. Butler.

The impacts of protected areas also vary depending on when and where you look.

Take Mexico, for example. Between 1993 and 2000, most protected areas in the country were essentially “paper parks,” researchers wrote in a [2015 study](#): that is, the parks had minimal management, funding, staffing, planning and enforcement. Such parks, on average, seemed to have no effect in reducing forest cover loss compared to similar, unprotected forests. However, between 2000 and 2005, a period of substantial increase in parks funding



and management, protected areas did lower forest cover loss considerably, a 2016 study found. On the surface, this suggests that management and funding of parks affects their “effectiveness.” But the study did not probe this, so we cannot say if it is indeed the case.

The effects of protected areas can also vary based on forest type. In China, for instance, a protected area in northwest Yunnan province failed to reduce overall forest loss, but it did reduce the loss of old-growth forests, researchers found. From a conservation point of view, at least, this might seem like a good outcome because old-growth forests are known to harbor high levels of endemic and threatened species.

The results of the meta-analyses — one that included 34 studies, and another that looked at 20 studies — found generally positive results. But again, these papers based their conclusions on studies that compared deforestation rates inside protected areas with those outside, which could be overestimating the parks’ effectiveness.

Also, by looking only at forest cover, the available research gives only a bird’s-eye view of the health of a forest. The studies do not reveal what’s going on deeper inside. “You may have a protected area with good forest cover but it may also have a lot of hunting that may be eliminating bird populations. This is the kind of damage that you cannot see from space,” Duke University’s Pimm said.

In Madagascar, for example, poachers go deep into national parks to illegally hunt animals, including lemurs. “So even though you’re protecting the trees, you have an empty forest,” Stony Brook University’s Wright said. “And that’s a shame.”

We did not find any credible evidence on the impacts of protected areas on illegal hunting, however.



The great hornbill is sometimes hunted for its beak and flesh. Photo via [Wikimedia Commons](#) (CC BY-SA 4.0).

Rigorous studies looking into the impacts of protected areas on biodiversity also seem to be rare — a glaring gap considering that biodiversity conservation is a key goal of protected areas. There are a number of case reports that try to measure populations of wild mammals, birds, reptiles or insects over time inside protected forests. And a few even compare the species' population trends with what's been observed outside the protected areas.

A [meta-analysis published in 2014](#) summarized findings from 86 such studies. The researchers found that protected areas generally had higher diversity and abundance of individual species than surrounding areas. But whether these patterns are a consequence of the protected areas, the analysis cannot show.

While not ideal, this paucity of species data is understandable, experts say. To study how protected areas affect the species inside them you need rigorous field-based monitoring, they say, which in turn needs funding, resources and support that is often severely lacking. In India, for example, park authorities often don't even allow researchers into protected areas.

“It is very difficult to get permits to work inside parks,” Harini Nagendra, a professor of sustainability at Azim Premji University in Bangalore, India, told Mongabay. “And then donors also don't want to support the kind of money and people it takes to do field

monitoring.”

Researchers run into other problems in trying to learn how protected areas affect species. For example, if an endangered species occurs only in a few places, and governments have created protected areas around that habitat, it’s entirely possible there simply are no suitable areas to serve as a basis for comparison. “In such cases, you can’t do any kind of detailed attribution of impact because those species occur only in those few places and there is no control site,” said E.J. Milner-Gulland, a professor of biodiversity at Oxford University, U.K. “In that case, you can look at trends in those species populations.”

In a global analysis, William Laurance and his team tried to look at this kind of trend. By tapping into the expert opinions of more than 260 field biologists, they collated data on the changes in status of about 30 groups of species over the past 20 to 30 years for 60 protected areas across the world’s tropical forests. Their results were disheartening: nearly half of the parks they surveyed showed serious declines in biodiversity. Top predators and large mammals, such as tigers or rhinos, seemed to be doing especially poorly, as did amphibians and old-growth trees.

Although the study does not attempt to determine what the trends might have been in the absence of protected areas, it does tell us about the state of biodiversity within those protected areas. It also gives people an idea about whether conservation efforts are pushing those trends in the direction they desire or not.

Getting this data was extremely hard, Laurance said. “I think we tried to initially do this in 18 months and it ended up being like four years,” he said. What the study also revealed was that there were glaring data gaps for many groups of species, he added. While larger mammals, bigger birds and some reptiles had lots of data points, other taxonomic groups were extremely data-poor.

“What you’d really like to have across all of your protected areas is some kind of basic sampling, something that was done in the same way over roughly the same period of time,” Laurance said. “But what you’ll find is that somebody here has been monitoring elephants for 30 years, and somebody there has been monitoring ground-nesting birds. So it’s really difficult to make some kind of broad inferences. Some kind of data standardization is really important.”



The critically endangered golden mantella (*Mantella aurantiaca*) is one of Madagascar's most threatened amphibian species. Photo by Rhett A. Butler.

## **Are protected areas socioeconomically beneficial for local people?**

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There is not enough evidence to say.

A common charge is that protected areas make people poorer, especially in developing countries. But the link between protected areas and poverty is complicated.

Regions of rich biodiversity often overlap with areas of extreme poverty. And protected areas are frequently created in places that have some of the poorest people to begin with, often because these places are remote or have low economic potential. Robust evaluations that can tell us whether the poverty is caused by protected areas or simply by pre-existing conditions are only now beginning to emerge.

The five rigorous studies we found, of 15 studies in total, concluded that the protected areas either reduced poverty levels among local people, compared to people living near similar, unprotected forests, or at least did not worsen them. But these effects were not universal.

Take for example two protected areas — Kulen Promtep Wildlife Sanctuary and Preah Vihear Protected Forest — located in remote parts of Cambodia. These protected areas contain 16 villages that have existed in those forests for years. The people living in those



villages are typically subsistence farmers who grow rice, researchers write in a [study published in 2014](#), and earn some extra income by selling tree resins used to make varnish, cheap soap, leather, and sealing wax.

The study found that villages inside the parks were overall much better off than similar villages in control sites, suggesting that the two protected areas generally reduced poverty levels. But that doesn't mean protected areas benefited everybody within the study area.

“The overall trend disguised relative differences for sub-groups of the population,” explained lead author Tom Clements of the Wildlife Conservation Society. “Protected areas secured land and forest resources against grabs by outsiders. This benefited people within the protected areas who depended upon forest resources and agriculture for their livelihoods, because they were permitted by the protected area authorities to continue to use these resources. By contrast, people outside protected areas experienced widespread land-use change and external resource grabs. At the same time, people inside protected areas who had no land or forest user rights, or who wanted to grow cash crops that the protected areas strictly restricted, had much more limited opportunities to increase their wellbeing.”



Farmers planting rice in Cambodia. Photo by Brad Collis via Wikimedia Commons (CC BY 2.0).

Another [study](#) found that communities living near protected areas in Costa Rica and Thailand were overall better off than similar communities living in unprotected areas. Parks in both countries were also generally effective in reducing deforestation.

Again, this might sound like a win-win outcome, but it isn't, Ferraro at Johns Hopkins and Hanauer at Sonoma State reported in a 2011 [study](#). The two researchers dug deeper into the data from Costa Rica and found that the effects of parks on people and forests vary depending on where they are placed.

Protected areas created on land that is highly suitable for agriculture, for example, avoided the highest amounts of forest loss: that is, deforestation rates would have been very high in the absence of those protected areas. The same protected areas also worsened poverty, possibly because the cost of losing access to valuable agricultural land is high. In contrast, protected areas placed on land with lower agricultural potential showed the least avoided deforestation, likely because those areas weren't very threatened to begin with. Protected areas in these places also reduced poverty the most. There were some protected areas that were in between: they offered both modest reductions in forest loss and poverty.

But the researchers caution against reading too much into these results. This is because poverty is a vague word, Ferraro said, one that can mean different things to different people. Some researchers look at household incomes or assets as measures of human welfare or poverty. Others look at infrastructure development, indicators of health, food security or country-specific poverty indices. "There is also the problem that we could be missing dimensions and not measuring all the relevant dimensions because we're limited by the data," Ferraro said. "Someone could be measuring two to three dimensions of human welfare and conclude that protected areas don't hurt people. That's a strong leap."

Moreover, socioeconomic effects of protected areas change over time, but very few studies have looked at these shifting effects.

Hard data on some other socioeconomic effects of protected areas (such as conflict between people and park authorities or between people and wildlife; impacts on people's land rights, access to forest resources or employment opportunities) are also limited. There are some scattered case reports, largely based on interview surveys and anecdotes, that suggest that protected areas might be making people worse-off. But those tell us little about the extent to which protected areas drive these perceptions compared to other sociopolitical factors.



Tracking elephant-caused damages to a residential colony in southern India. Photo by Ganesh Raghunathan, NCF, via [Wikimedia Commons \(CC BY-SA 4.0\)](#).

A couple of case reports show, for instance, that protected areas can create multiple employment opportunities for local people. Around Kibale National Park in Uganda, over 800 local people found jobs in 2010 as research assistants, in tourist facilities, or in forest management activities like planting trees, a study published in 2012 found. While overall the people took home annual salaries totaling \$570,839, the benefits were not equitably distributed. Wealthier households and people living closer to the protected area captured most of the jobs, the authors wrote.

Experts said they had observed similar trends elsewhere.

Madagascar's Ranomafana National Park, Wright said, has led to an economic boom in the region. She has yet to calculate the latest figures, but as of 2009, tourism and research in the park — which she says would not occur without the park — had brought over \$1.8 million into the region. People from area villages got jobs in hotels, restaurants and health and education centers, or as tourist guides or research assistants. Here, too, people living closer to the park and its main roads tended to claim most of the benefits.

Overall, though, the evidence of the socioeconomic effects of protected areas is extremely thin and mixed, a finding that concurs with a systematic review published in 2013.

(There are studies that look specifically at how tourism or ecotourism affect people around protected areas. But that was not the focus of our review, and we are unable to comment on those findings.)

## Verdict

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It came as a surprise to find so few rigorous studies for a strategy as popular and well-established as protected areas.

What scientific literature does exist suggests that terrestrial protected areas help reduce deforestation, but to varying degrees. In some places, parks avoid high rates of forest loss; in others, the effects are modest to negligible. But finer details about the health of protected forests (the status of biodiversity, levels of hunting or logging) are harder to get.

The evidence for how protected areas affect local people is also extremely limited. There are only a handful of rigorous studies, and these suggest that parks do not generally exacerbate poverty. That does not mean that parks are universally good, though. The studies looked at only a few parks, in a few countries, and may have missed aspects of human welfare that could be more relevant for some people than the ones they measured.

“What I find demoralizing is not that we don’t know as much as we ought to, but that we are still dragging our feet in investing in knowing,” said Ferraro.

And not knowing whether parks work generally will make it harder to determine what makes some parks successful and others not. That, experts say, is likely to be the most useful to decision makers.

“These protected area networks will exist,” Ferraro said. “We are not going to degazette them en masse. So we need to look at how we can make them most effective on both environmental and social outcomes: Should we put more investment into enforcement? Should we put more investment into bringing in local communities? Should we make the rules stricter or allow more resource use? These are internal arguments within the conservation community for which we have almost no empirical evidence.”

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*This is part five in the Mongabay series Conservation Effectiveness. Read the other stories in the series [here](#).*



*Disclaimer: William F. Laurance is on Mongabay's advisory board. He does not have editorial input regarding the content of Mongabay stories.*

*Banner image: An owl monkey. Photo by Rhett A. Butler.*

*Editor's note: Reviews conducted for this series are not exhaustive, and we encourage authors of research that is relevant to post links to their study in the comments section under each article. We are currently working on a strategy to maintain and update the database periodically.*

*Editor's note 5/13/21: We have updated this story to reflect the fact that additional studies have been added to the infographic since this story was originally published.*

Article published by Shreya Dasgupta



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