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Research Article

Volume and Geographical Distribution of Ecological Research in the Andes and the Amazon, 1995-2008

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Abstract
The Andes range and the Amazon basin represent the most diverse biological community on earth and the largest tropical forest on earth, respectively, but they are historically understudied by biologists. In this paper we provide the first quantitative description of the volume and geographical distribution of ecological research in these regions. We compiled a dataset of all articles based on the Andes and Amazon regions published in two prominent international tropical ecology journals between 1995 and 2008. During this period, the number of scientific articles based on research in the Amazon was half that based on research in Central America, while the Andes scored among the least-studied of all tropical regions. Brazil was the leading base for Amazonian studies and Ecuador the primary location for Andean studies, but Ecuador led both categories and Brazil came last when research effort was standardized by area. Most Amazonian research took place in three regions—Manaus, southeastern Peru, and eastern Ecuador—with ~31 percent of all papers coming from four field stations in those regions. Andean research focused overwhelmingly on the northern Andes. Research in the Andes range and the Amazon basin remains scattered, patchy, and far below its potential. We propose steps that funding agencies can take to increase research output and reduce geographical bias in the study of South America's richest ecosystems.

Key words: biogeography, Brazil, capacity-building, Ecuador, field stations, Peru, scientific journals, tropical

Resumen
La cordillera andina y la cuenca amazónica representan la comunidad biológica más diversa de la Tierra y el bosque tropical más extensa de la Tierra, respectivamente, pero históricamente han sido poco estudiados por los biólogos. En este artículo se ofrece la primera descripción cuantitativa del volumen y distribución geográfica de la investigación ecológica en estas regiones. Se compiló una base de datos de todos los estudios basados en las regiones andinas y amazónicas publicados en dos importantes revistas internacionales de la ecología tropical entre 1995 y 2008. Durante este período, fueron publicados dos veces más artículos científicos basados en investigación en América Central de que en toda la Amazonía, mientras la región andina fue una de las menos estudiadas de todos los trópicos. Brasil fue el principal local para estudios amazónicos y Ecuador el principal local para estudios andinos, pero cuando el esfuerzo de investigación fue estandarizado por área Ecuador ocupó el primer lugar y Brasil el último. La mayoría de la investigación amazónica se llevó a cabo en tres regiones—Manaos, el sudeste del Perú, y el este de Ecuador—y el 41% de los artículos amazónicos provinieron de cuatro estaciones científicas en esas regiones. La investigación andina fue muy enfocada en la región norte de la cordillera. Concluimos que la investigación científica en los Andes y la Amazonía sigue siendo dispersa y muy por debajo de su potencial. Proponemos políticas que las agencias donantes podrían implementar para aumentar el volumen de investigación y reducir los sesgos geográficos en los estudios de los ecosistemas más ricos de Sudamérica.

Palabras clave: biogeografía, Brasil, capacitación, Ecuador, estaciones de campo, Perú, revistas cientificas, tropical

Introduction

The forests along South America's longest river and on its largest mountain range have been patchily explored by biologists. For instance, the largest stand of white-sand forest in western Amazonia was first visited by scientists in 2004 [1]. The bamboo thickets of southwestern Amazonia, which cover an area larger than the United Kingdom, remain essentially unexamined [2]. The same is true for the swamps and wetlands that cover 6-8 percent of the Amazon basin, aquatic ecosystems across the continent, and most of the eastern slopes of the Andes [3]. Given the haphazard character of on-the-ground exploration to date, it is no surprise that hundreds of large archaeological sites have been discovered in the Amazon over the last decade alone [4-5].

Maps of biological inventories carried out in tropical South America typically show clusters around roads, towns, and rivers interspersed with vast empty spaces [6-8]. Pronounced geographical bias is also typical of research effort in the region. For example, while field work in Peru's Madre de Dios watershed has produced more than 800 articles in peer-reviewed biology journals to date, the corresponding number for the neighboring and similarly-sized Alto Purús watershed is nine [9-10].

A working understanding of South America's tropical forests does not require that biologists visit every last creek and hilltop, or study every watershed with equal intensity, but it does require that they have a clear picture of the biases that derive from the patchwork exploration of the landscape [6, 11]. Considering how markedly climate, geology, vegetation, animal communities, and human impacts vary across the South American tropics [3, 12], it is important to know which ecoregions [13] are commonly depicted in the ecological literature, and which ones need more attention.

The significant resources being invested in training young biologists and improving academic infrastructure in tropical South America [14-15] have the potential to finally overturn Central America's long dominance of the tropical biological literature [16-18]. But they also risk exchanging one kind of provincialism for another, by shifting the focus from a handful of well-studied sites in Mexico, Costa Rica, and Panama to a handful of well-studied sites in South America. Ensuring that these investments are well-directed will require both close monitoring of results and a careful reading of the current situation on the ground [19-20].

Our primary question in this paper was: Where is field research in ecology being carried out in Amazonia and the Andes? We then asked: (1) which countries and individual field sites in the Andes-Amazon region generate the most scientific publications in ecology?; (2) how does the region's productivity compare to regions elsewhere in the tropics?; (3) how has the volume of publications varied over the last 15 years?; and (4) what proportion of the region's ecological literature is written by research teams based there?

These questions would ideally be answered with a dataset that encompassed the full range of publications about Andean and Amazonian biology: books, theses, journals, unpublished reports, and other gray literature in the three principal languages used by scientists in the regions. Here, as a first approximation, we provide answers from the two most prominent scientific journals of tropical ecology: *Biotropica* and *Journal of Tropical Ecology*. While our dataset represents a small subset of work over the last 15 years and is biased towards developed-world research teams [10, 18, 21], we believe that it is sufficient to provide valuable insights into the way biological research is carried out in the two richest regions of South America.

Stocks et al. [18] recently addressed some of these same questions using a similar dataset, but they focused on country-level patterns. Here we complement their analysis by examining trends in research effort at smaller spatial scales (individual research sites) and at larger ones (ecoregions).

Methods

We searched the 1995-2008 volumes of *Biotropica* and *Journal of Tropical Ecology* for all articles based on field work in the Amazon or tropical Andes. For each article we recorded: (1) the countries in which field work was carried out; (2) the geographic coordinates of every Amazonian or Andean field site; (3) the name of any field station hosting field work; (4) the year of publication; and (5) the country of the first author's institutional affiliation. This last element is not a proxy for the first authors' nationalities but rather an indicator of where they were based at the time of the study.

For the purposes of this study we defined the Amazon basin as that river's watershed <500 masl, plus the Tocantins watershed [see 3], and excluding Guyana, Suriname, and French Guiana. We defined a field station as permanent infrastructure that: (1) is primarily used for research and training; (2) is backed to some degree by an organization (e.g., university, NGO, government agency) committed to a long-term presence at the site; and (3) maintains at least one staff member. Protected areas per se (e.g., national parks, extractive reserves) and ecotourism lodges were assumed not to be field stations unless they had separate infrastructure that satisfied the first condition. We used the Internet and correspondence with researchers to determine whether or not certain sites qualified as field stations.

To compare Andes-Amazon research productivity with that of other tropical regions, we used a truncated version of our dataset so that it would be equivalent to the tropics-wide dataset compiled by Stocks et al. [18] for the 1995-2004 volumes of *Biotropica* and *Journal of Tropical Ecology.*

We used Google Maps and figures in the papers to approximate the geographical location of sites that did not include coordinates. Papers that mentioned a study region rather than a study site were represented in the database by a single central point. For simplicity, we collapsed clusters of coordinates associated with an individual site (e.g., a biological station) to a single standard coordinate. When mapping and analyzing study sites, we omitted the 15 papers that mentioned >20 sites so that they would not swamp geographic patterns (one paper contained 316 study sites, nearly as many as all the others combined). Terrestrial ecoregion analyses were based on the map of Olson et al. [13].

To determine what proportion of the Amazonian biological literature was represented by our dataset, we searched ISI Web of Science for all articles published in 2006 containing the string "Amazon*". In the resulting list of references we then counted the number of articles that reported on biological research in the Amazon basin (including both ecology and all other subfields of biology), and compared this to the number of articles published in *Biotropica* and *Journal of Tropical Ecology* in the same year.

Results

In the 1995-2008 volumes of *Biotropica* and *Journal of Tropical Ecology* we found 296 articles based on field work in the Amazon and 77 articles based on field work in the tropical Andes. We estimate that this dataset represents ~5 percent of all biological studies published in the ISI-indexed scientific literature during those years from the two regions. In the period 1995-2004, the total number of Amazonian studies was high relative to individual tropical countries, while the total number of Andean studies was low (Fig. 1). Central America accounted for twice as many papers as the Amazon basin, and for nearly eight times more papers than the entire Andean range.

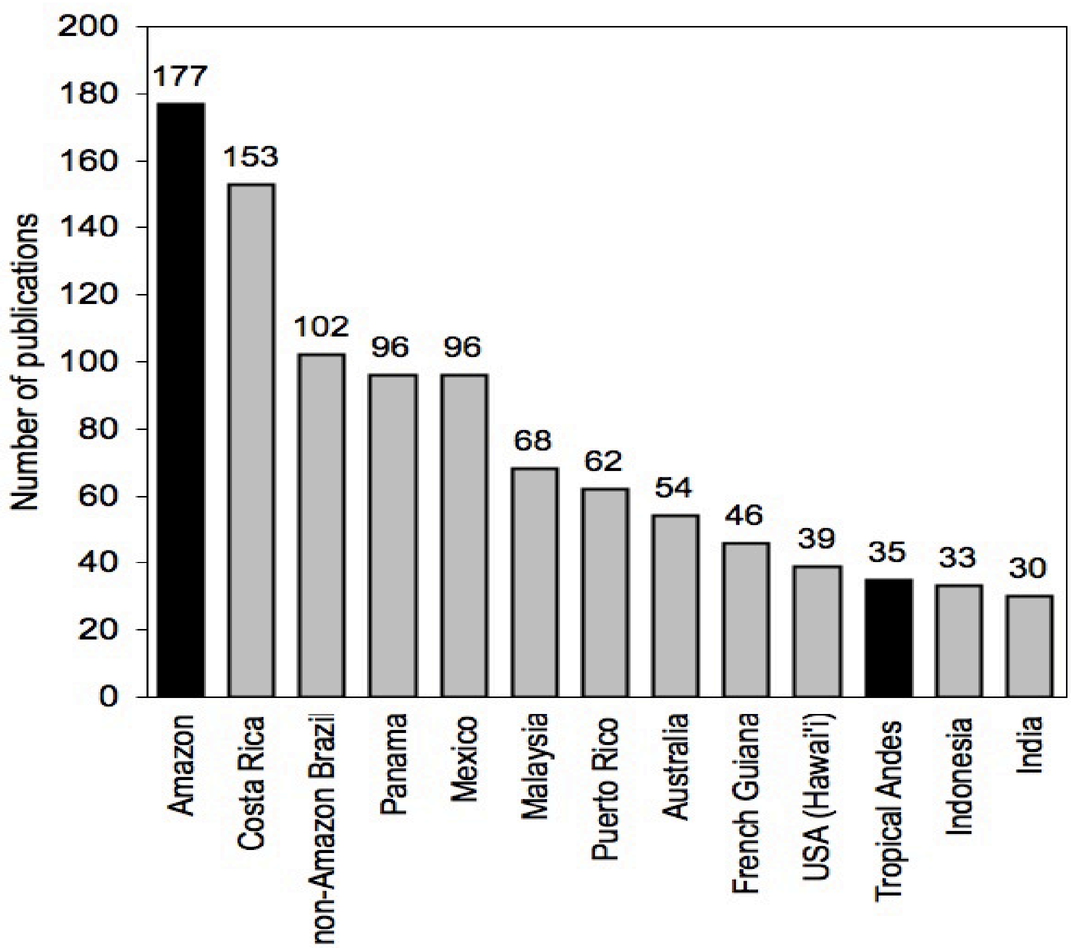

Fig. 1. The number of publications based on field work in the most-studied tropical countries in the 1995-2004 volumes of *Biotropica* and *Journal of Tropical Ecology* (gray bars), with the corresponding values for the Amazon and tropical Andes (black bars). Individual Andean and Amazonian countries are not included.

Brazil was the most common base for Amazonian studies (49.0% of the total), followed by Peru (18.9%) and Ecuador (12.5%; Table 1). Ecuador was the leading country for tropical Andean studies (40.3% of the total), followed by Colombia (27.3%) and Venezuela (18.2%). When the number of articles per country was standardized by the size of each country's Andean or Amazonian territories, Ecuador emerged as the most productive country for both regions (Fig. 2).

The articles yielded 185 unique field sites in the Amazon and 93 unique sites in the Andes. In both regions, sites were clumped around cities (especially Manaus, Iquitos, and Quito), along large rivers and roads, and around field stations (Fig. 3). Research effort was absent from country-sized areas, especially in Peru and Brazil (Amazon region) and Peru and Bolivia (Andean region). When we overlaid the study areas with a grid of 1-degree cells, 87.1 percent of cells had no field sites in them.

Site density was highest in terrestrial ecoregions of the northern Andes (e.g., northern Andean paramo, Cauca Valley montane forests, and eastern Cordillera Real montane forests). No studies were recorded in large ecoregions of the central and southern Andes (e.g., central Andean dry puna, central Andean puna, Peruvian yungas). With the exception of the Uatumã-Trombetas moist forests north and northeast of Manaus, terrestrial ecoregions of central and eastern Amazonia were less visited by biologists than those of western Amazonia.

Table 1. Number of articles based on field work in the Andes-Amazon region published in *Biotropica* and *Journal of Tropical Ecology* in the period 1995-2008, sorted by country where the field work was done.

Country	No. studies in Amazonia	Percent of all Amazon studies	No. studies in Andes	Percent of all Andean studies	Total no. Andes-Amazon studies
Bolivia	30	10.1	7	9.1	37
Brazil	145	49	0	0	145
Colombia	23	7.8	21	27.3	44
Ecuador	37	12.5	31	40.3	68
Peru	56	18.9	4	5.2	60
Venezuela	5	1.7	14	18.2	19
Totals	296		77		373

Most Amazonian field work was done at field stations (57.4%), but most tropical Andean field work was not (32.5%). Just four field stations—the Biological Dynamics of Forest Fragments Project (Brazil), Cocha Cashu Biological Station (Peru), Yasuní Scientific Station (Ecuador), and the Adolpho Ducke Forest Reserve (Brazil)—accounted for 31.4 percent of all Amazonian publications (Appendix 1). The most productive field station in the tropical Andes, Ecuador's San Francisco Scientific Station, accounted for 14.3 percent of all Andean studies (Appendix 2).

Trends over time

The number of Amazonian and tropical Andean articles in *Biotropica* and *Journal of Tropical Ecology* increased in the period 1995-2008 at a rate of about one article per year (Fig. 4). Most of this increase was due to a jump in Amazonian publications, with a weaker upwards trend for the tropical Andes.

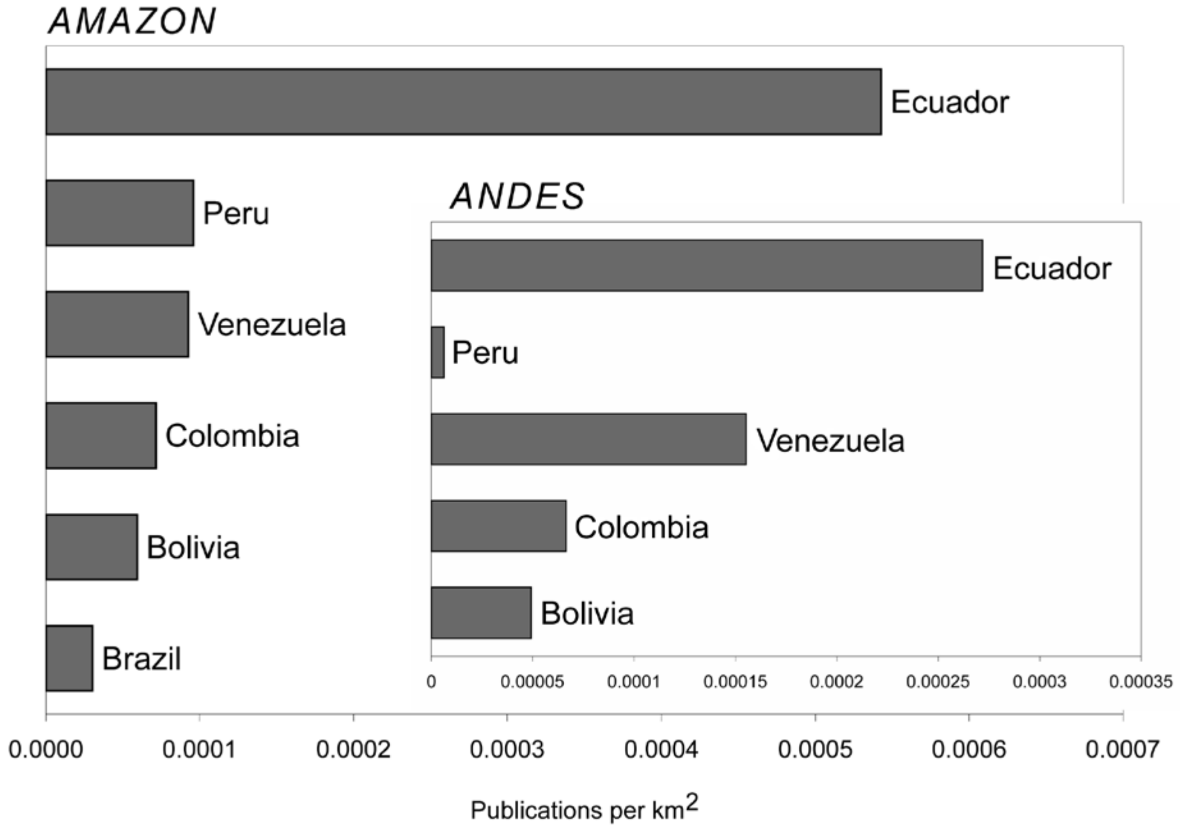

Fig. 2. The number of studies based on work in six Amazonian countries published in *Biotropica* and *Journal of Tropical Ecology* in 1995-2008, standardized by the size of each country's Amazonian territory. The inset shows the same figures for the Andean region.

Provenance of research teams

European and especially German-based research teams dominated publications about the tropical Andes (55.2 and 31.0% of the total, respectively), accounting for more articles than all Andean-based research teams combined (24.1%). Amazonian publications were dominated by research teams based in the United States (35.7% of the total), Europe (27.1%) and Brazil (23.7%). Research teams based in Amazonian countries other than Brazil wrote just 6.8 percent of Amazonian publications. Authors based in Brazil wrote 45 percent of articles on the Brazilian Amazon; the comparable number for the extra-Brazilian Amazon is 13 percent.

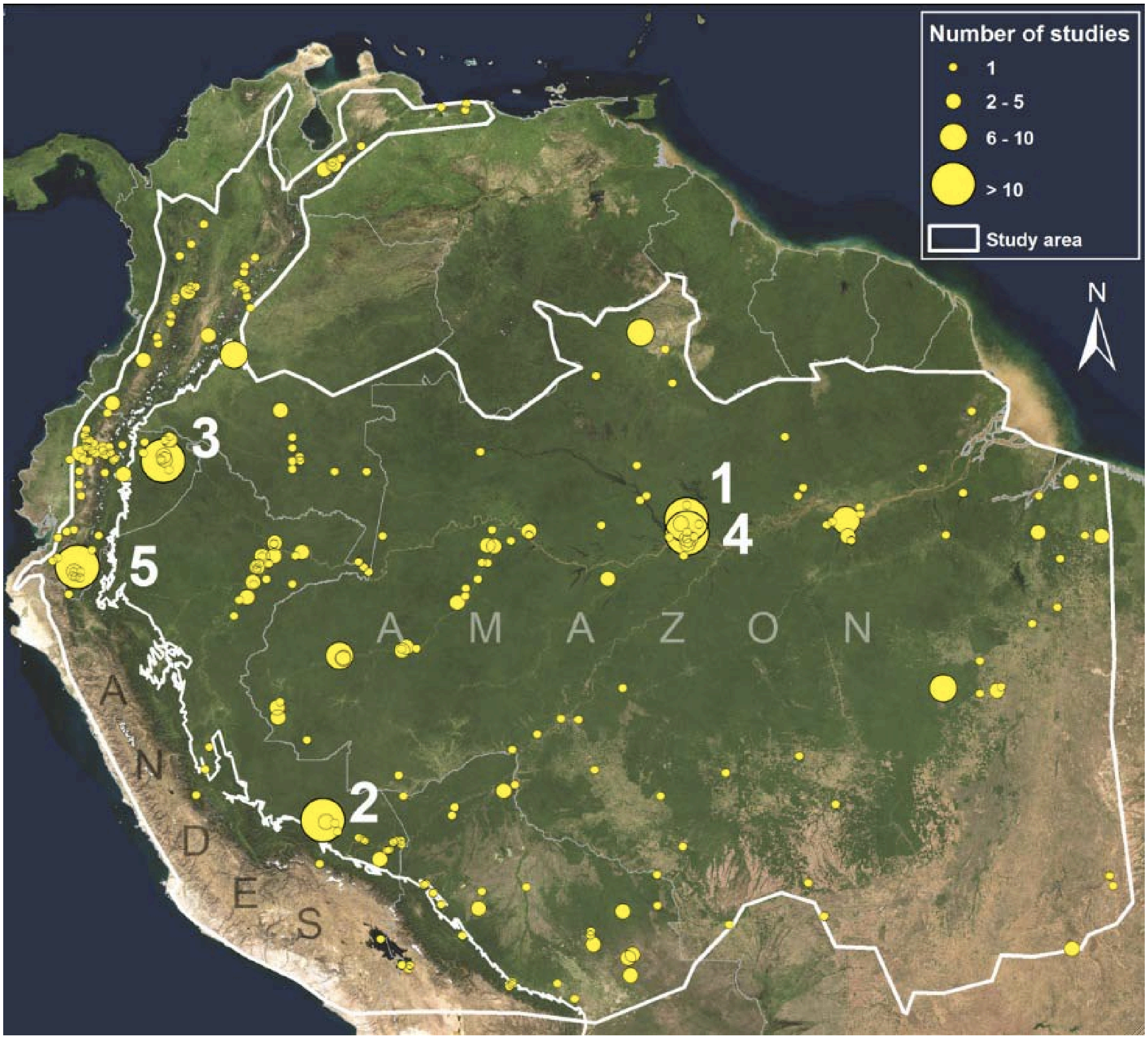

Fig. 3. A map of field work sites in the Andes and Amazon regions of South America. Yellow dots indicate sites where field work was carried out for studies published in the 1995-2008 volumes of *Biotropica* and *Journal of Tropical Ecology*. The five most productive field stations in the region, ranked in order of decreasing productivity, are indicated by numbers: 1 = Biological Dynamics of Forest Fragments Project (Manaus, Brazil), 2 = Cocha Cashu Biological Station (Manu National Park, Peru), 3 = Yasuní Scientific Station (Yasuní National Park, Ecuador), 4 = Adolpho Ducke Forest Reserve (Manaus, Brazil), 5 = San Francisco Scientific Station (Podocarpus National Park, Ecuador). International borders are shown as thin gray lines. See text for details.

Discussion

Central America remains the best-studied and most scientifically productive region in tropical ecology. The Amazon basin occupies a distant second place, followed closely by Southeast Asia and Africa. The Andean range—the undisputed epicenter of global biodiversity and endemism [22]—remains one of the least-studied tropical regions on the planet, trailing even tiny Puerto Rico in number of publications. Although the number of papers from the Andes and Amazon increased from 1995 to 2008 while the number of papers from Central America remained stable, Central America is unlikely to be overtaken in the short term. At the rates of growth measured in our dataset, it will take the Andes-Amazon region ~120 years to reach the current productivity of Central America.

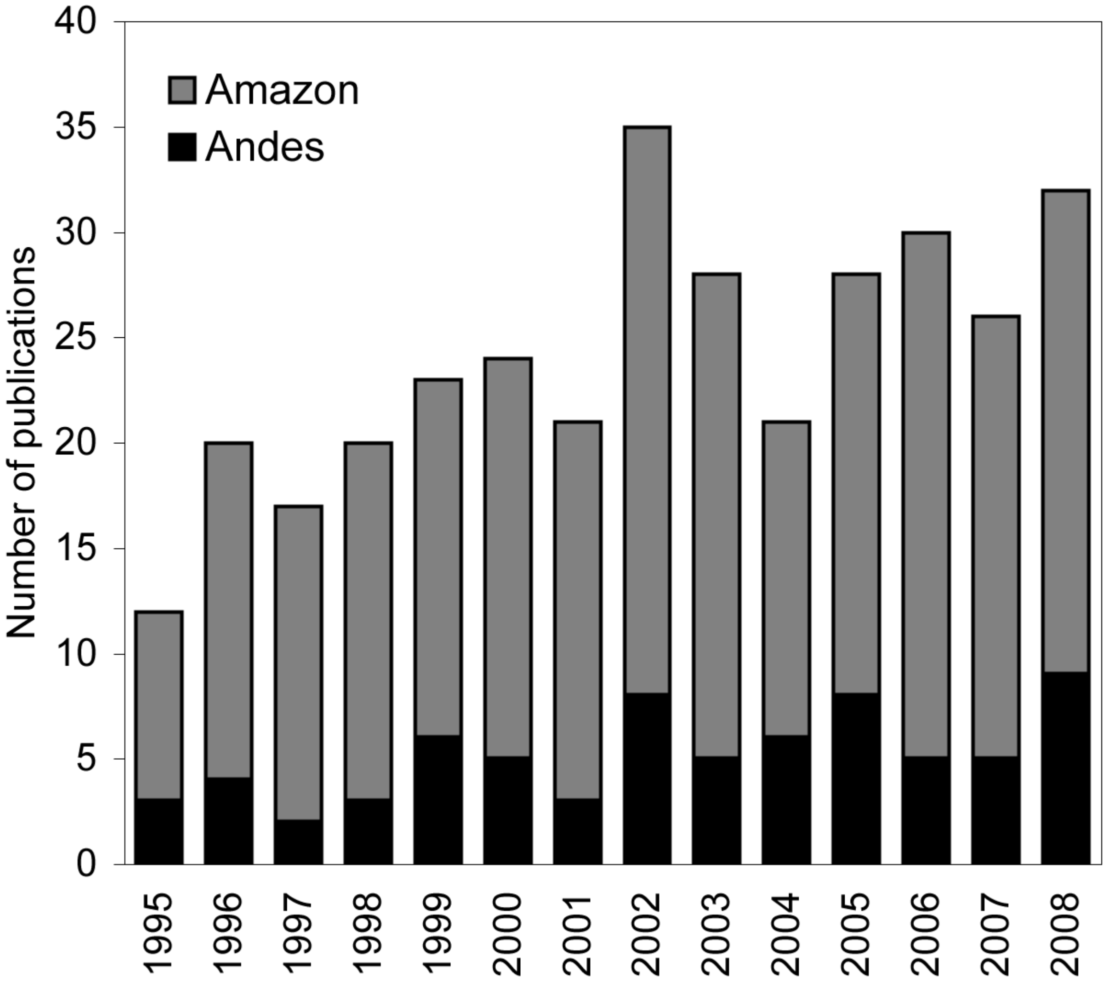

Fig. 4. Number of publications based on field work in the Andes and the Amazon published in *Biotropica* and *Journal of Tropical Ecology* in the period 1995-2008.

Patterns in Amazonian research effort

Three countries—Brazil, Ecuador, and Peru—accounted for 80.4 percent of all Amazonian research. While Brazil produced far more publications than any other Amazonian country, its dominance is tempered by two considerations. First, there is rough parity between Brazil's scientific output (comprising central and eastern Amazonia) and that of the other Amazonian countries combined (comprising a much smaller area in western Amazonia). Second, when productivity was measured by publications per square kilometer, Brazil emerged as the least productive country in the basin (Fig. 2). While Brazil's scientific leadership in the Amazon region and impact in the scientific literature remain undisputed, its efficiency in this sense lags far behind that of its Amazonian neighbors. Had Brazil's scientific output per square kilometer matched that of Ecuador, it would have produced more than twice as many articles as all other tropical countries in the world combined in the period 1995-2004. Considering Brazil's burgeoning scientific community, matching Ecuador's production per square kilometer is a goal within its reach.

But Amazonian research is not just concentrated in Brazil, Peru, and Ecuador—it is concentrated in three small regions of those countries. Research carried out near Manaus (Brazil), in and around Yasuní National Park (eastern Ecuador) and in the department of Madre de Dios (southeastern Peru) accounts for more than half of the published studies we examined. Like their counterparts in Central America, these Amazonian research hotspots are places where long-term investments and research activity have reached a critical mass. In Manaus, the defining factor is the presence of Brazil's large National Institute of Amazonian Research (INPA) and the Federal University of Amazonas (UFAM). In eastern Ecuador and southeastern Peru, the infrastructure backbone consists of >10 scientific stations backed by universities, non-governmental organizations, and researchers with a long history of work in the regions. A similar number of ecotourism lodges that offer subsidized fees for scientists have also hosted a significant proportion of research effort in these two regions.

Considering the Brazilian government's large investments in research and conservation, there is no doubt that Manaus will remain an epicenter of Amazonian research for decades. The same cannot be said for the research hotspots in Ecuador and Peru. Although scientists in those regions have so far managed to compete with Manaus in terms of productivity, their research infrastructure relies almost entirely on uncertain funding from private universities and conservation groups. When one considers the additional threats of habitat destruction, political instability, distance from major cities, and weak local universities, the Amazonian research hotspots in Ecuador and Peru start to seem remarkably fragile [23-26]. Thus, while the primary challenge in Brazil is to replicate in other areas of the Brazilian Amazon the factors that have made Manaus productive, the challenge in Ecuador and Peru is to keep existing research infrastructure alive. We outline recommendations for both regions in the last section of the discussion.

Separated from each other by >1000 km, the three principal research sites in the Amazon offer three distinct permutations of climate, soil fertility, species composition, river chemistry, hydrology, anthropogenic impacts, and other factors [3, 27-30]. While this landscape diversity helps reduce the scientific bias caused by researchers' focus on these sites, it would be useful to know what proportion of the Amazon basin, and which specific parts of the Amazon basin, share the landscape features of eastern Ecuador, southeastern Peru, and central Brazil, and thus to what degree results at these sites can be extrapolated to the larger surroundings. For example, while tree communities in the Peruvian hotspot are very similar to those in a large neighboring watershed [31], tree communities in the

Ecuadorean hotspot can be strikingly different from those a short distance across the border in northern Peru [32].

Patterns in Andean research effort

Biologists working in the Andes have focused to a remarkable degree on the northern portion of the range. Venezuela, Colombia, and Ecuador account for 85.7 percent of all Andean studies. In comparison, the Peruvian and Bolivian Andes are severely understudied. There is a nearly 1000-km stretch of the Peruvian Andes with no studies at all, and it includes the biogeographically important Huancabamba Depression [33].

The best-studied country in the Andes, both in number of publications and in publications/km^2, is Ecuador. Just as the small countries of Costa Rica and Panama make a disproportionate contribution to ecological research in Central America, so Ecuador plays the same role in the Andean and Amazon regions (its per capita publication rate even exceeds that of Costa Rica [18]). While some of this is explained by Ecuador's comparatively peaceful history and its easily accessible, extremely diverse [30], and well-collected forests, the structural and historical reasons for its prominence merit more investigation. For example, Ecuador received more biodiversity-related donations from international sources in 1990-1997 than any other Latin American country, per square kilometer [34], and possesses the highest density of botanical collections of any tropical country [35].

The fact that Andean research sites in Ecuador are clumped around field stations and trans-Andean roads may help explain the paucity of Andean research in Peru and Bolivia, where both are much rarer. However, it is worth observing that Ecuador's prominence in Andean research rests largely on the contribution of a single field site, the San Francisco Scientific Station, which was established relatively recently (1996). Indeed, it is a mark of the incipient state of Andean research that all 11 papers from the leading field station in the entire cordillera date from 2004 or later.

Implications for conservation and recommendations

Our study suggests that the Amazon and the Andes produce much less published science than they should, given their status as the largest tropical region and the most biologically diverse region on the planet [22], and given the impressive economic growth of Amazonian and Andean countries over the last 10 years. To achieve the prominent position that they merit in tropical biology, both regions should aim for a significant boost in overall research effort and a more equitable geographical coverage in field research.

The entities best positioned to make these changes are likely international funding agencies and national-level institutions like universities, museums, government science agencies, and non-governmental organizations [34]. For example, the San Francisco Scientific Station's productivity is largely due to a long-term partnership between the German Research Foundation (DFG) and an Ecuadorean NGO. Because the cause-and-effect relationship between scientific investments and the productivity of scientists working in the Andes-Amazon region is poorly documented, however, it is difficult to offer evidence-based recommendations for improving the present situation [36]. For example, we found no relationship between the volume of international biodiversity-related donations to Andean and Amazonian countries in 1991-1997 and the number of articles based on work in those countries published in 1995-2008, even when these were standardized by area [34]. In the absence of hard data, we suggest a few actions based on personal experience. These are:

1. *Strengthen local institutions that employ biologists and operate research infrastructure in the Andes-Amazon region*. Our map of research effort shows a clear connection between research effort and the presence of field stations, universities, research agencies, and long-term research projects. Many of these institutions are underfunded and operating below their potential. In the southern Peruvian hotspot alone, at least four field stations have ceased to exist in the last 20 years; most others operate below capacity and on shoestring budgets (N. Pitman, personal observation). In the long term, the most cost-effective way to maintain the scientific productivity of these field stations, and field stations elsewhere in the Andes-Amazon region, is via endowments or grant programs that subsidize their operating expenses for long periods [37]. Similarly, endowing chairs or biology programs at a small number of Andean and Amazonian universities could have a large impact on scientific productivity, by allowing top-notch researchers and their research teams to live close to their study sites year-round.

Another option is to underwrite the cost of permanent, long-term research programs (e.g., the Center for Tropical Forest Science's large-scale forest dynamics plots in Brazil, Colombia, and Ecuador, or the Biological Dynamics of Forest Fragments Project in Manaus). Most of these investments will come from governments and funding agencies, but significant funding is also available from large companies on both sides of the debate over accelerating development in the Amazon [38]. At least two field stations listed in Appendix 1, for example, were underwritten by large oil companies working in the Amazon, while the best-studied site in the Amazon currently benefits from a partnership with a Brazilian beachwear company (N. Pitman, personal observation). Whatever the mechanism, the goal is long-term institutional support for Andean and Amazonian researchers and their projects.

2. *Invest in local talent: Train more in-country scientists and provide more resources for established ones.* Most of the institution-level support described in the previous recommendation can and should be implemented in a way that broadens training opportunities for undergraduate and graduate-level scientists in the Andes-Amazon region, and provides incentives for the best of those scientists to work at in-country institutions once they are established researchers. Likewise, visiting foreign researchers can do more to boost training opportunities for young South American biologists by designing collaborative research programs, offering training courses, and ensuring that young in-country collaborators take an active role in data analysis and manuscript preparation, not just field work [18, 39].

3. *Facilitate responsible research by foreigners*. The majority of studies in our dataset were carried out by foreign-based research teams, which suggests that lowering the barriers to such teams might be the quickest and most inexpensive way to boost research effort in the Andes-Amazon region. Applying for research permits in many South American countries is a long and difficult process—especially so for foreigners who are visiting for the first time, do not speak the local language, and do not have an in-country partner willing to help in the time-intensive procedure. We know of several colleagues who, intimidated by the application requirements in South America, have chosen to work in Central America instead, where long-established science organizations facilitate the permit process. In advocating lower barriers we do not mean making the application process any less rigorous, but rather more streamlined and user-friendly (e.g., putting the application process online, allowing researchers to submit research proposals in English, hiring more staff to process applications). Streamlining applications for research visas could also help facilitate scientific collaborations in many South American countries.

4. *Offer grants for field research specifically in the Andes and the Amazon*. Some international funding agencies (e.g., the Gordon and Betty Moore Foundation [15], the Critical Ecosystem Partnership Fund, and their institutional grantees) already offer grants that target projects in the Andes-Amazon region. The total number of institutions offering such grants, though, remains small in relation to the regions' biological importance. National-level science agencies in particular could offer stronger incentives for research in poorly studied areas of their national territory, for both established and beginning researchers. Brazil already offers financial incentives for that country's scientists to work in poorly studied regions of the country. Considering their remarkable competitiveness in Amazonian research, it is time for the Peruvian and Ecuadorean science agencies to make similar investments.

5. *Carry out landscape studies and comparative studies of research hotspots*. The Ecuadorean and Peruvian Amazon hotspots remain remarkably data-poor in regards to basic abiotic features like climate and soils, and this represents a significant obstacle for researchers there. Another research priority is comparative studies of the three best-studied Amazonian landscapes (see Gentry [27] and volume 36, issue 1, special section of the journal *Biotropica* for examples).

6. *Continue to monitor volume and geographic distribution of scientific publications from the Andes-Amazon region*. This is important for two reasons. First, over the last decade a single foundation (the U.S.-based Gordon and Betty Moore Foundation) has invested ~US$200 million in conservation and research projects in the Andes-Amazon region, nearly twice as much as that invested by all foundations combined in the previous decade [34]. Because most of the Moore Foundation's investment is too recent to be reflected in the dataset we studied, and because much of it specifically addresses the recommendations made here, we expect a sharp increase in both regions' publication rates over the next 5 years. Second, the dataset we used is strongly biased towards foreign-based research teams and towards ecology. It may also be constrained by geographical quotas or preferences that are consciously or unconsciously imposed by the editors of these two journals. While Stocks et al. [18] found similar patterns when comparing the two journals we studied with four other prominent biology and conservation journals, repeating these analyses with a broader range of scientific publications (e.g., foreign-language journals and journals focusing on particular subfields of biology) will likely reveal patterns that are not apparent here.

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Appendix 1. Amazonian field stations hosting work published in *Biotropica* and *Journal of Tropical Ecology* in 1995-2008, sorted by number of publications. Field stations now defunct are marked with an asterisk.

Field stations	Country	No.
Biological Dynamics of Forest Fragments Project	Brazil	33
Cocha Cashu Biological Station	Peru	30
Yasuní Scientific Station	Ecuador	15
Adolpho Ducke Forest Reserve	Brazil	14
La Macarena Center for Ecological Research	Colombia	8
Jatun Sacha Biological Station	Ecuador	6
Pinkaití Research Station	Brazil	6
Tiputini Biodiversity Station	Ecuador	6
Maracá Island Ecological Station	Brazil	5
Tapajós National Forest	Brazil	5
Tropical Silviculture Experimental Station & Campina Biological Reserve	Brazil	5
Beni Biological Station	Bolivia	4
El Tigre Forest Reserve	Bolivia	4
Surumoni Crane Project*	Venezuela	4
Jenaro Herrera Research Center	Peru	3
Mamirauá Sustainable Development Reserve	Brazil	3
Fazenda Agua Limpa	Brazil	2
Lago Uauaçu Research Station	Brazil	2
Los Amigos Biological Station	Peru	2
Madre Selva Biological Station	Peru	2
Pakitza Biological Station*	Peru	2
Quebrada Blanco Biological Station	Peru	2
Universidade Federal Rural da Amazonia Station	Brazil	2
Ferreira Penna Scientific Station	Brazil	1
Panguana Biological Station	Peru	1
Madre Selva II Biological Station	Peru	1
Onkone Gare Station*	Ecuador	1

Appendix 2. Andean field stations hosting work published in *Biotropica* and *Journal of Tropical Ecology* in 1995-2008, sorted by number of publications.

Field site	Country	No.
San Francisco Scientific Station	Ecuador	11
La Mucuy Bird Observatory	Venezuela	3
Reserva Natural La Planada	Colombia	3
Otun-Quimbaya Flora and Fauna Sanctuary	Colombia	3
Reserva Maquipucuna	Ecuador	2
Yanayacu Biological Station	Ecuador	1
Bosque Integral Otonga	Ecuador	1
Reserva Florística Ecológica Río Guajalito	Ecuador	1