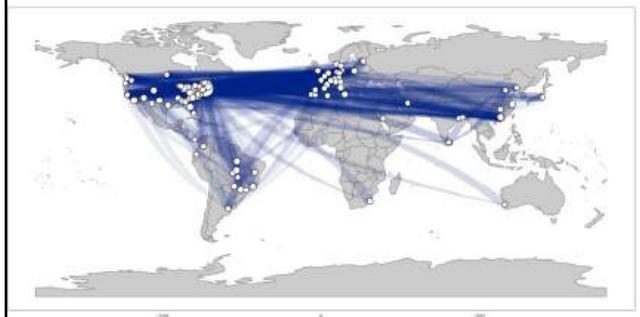
Global biases in the creation and diffusion of scientific knowledge

(and what we can do about them)



Emilio M. Bruna , University of Florida
Dept. of Wildlife Ecology & Conservation &
Center for Latin American Studies

www.BrunaLab.org

github.com/BrunaLab

1

This was a team effort.

Harrison Jones
Candice Prince
Constanza Rios
Erica Ross
Bhagatveer Sangha
Tia Tyler
Joseph Andreoli
Patrick James
Forrest Smith
Matt Boone
Auriel Fournier
Sean Bruna

Franklin Paniagua
Sebastian Palmas
Farah Carrasco-Rueda
Kristina Riemer
Kay Kastner-Wilcox
Gabriela Stocks
Audrey C. Smith
Leandra Merz
Jesse B. Borden
Chris K. Gulick
Akhil R. Kshirsagar
Ellen Bledsoe
Zachary Emberts

Mauricio M. Núñez-Regueiro
Ana Luiza Violato Espada
Jessica Hightower
Johanna Espin
Judit Ungvari-Martin
Mariana Villegas
Joan Meiners
Kirsten A. Hecht
Catherine Frock
Pablo E. Allen
Kwanmok Kim
Nathan Berkebile
Tara T. Cataldo

BRUNA LAB

THE MELLON FOUNDATION

UF Informatics

UF Center for Latin American Studies

2

Me.

3

Also me.

TCD Tropical Conservation & Development Program

4

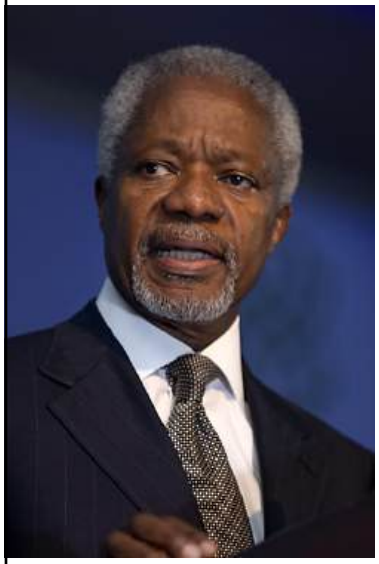
Oye Gary…
en dónde están
los Ticos?

Dr. Mario Blanco
Universidad de Costa

OTS 96-9
Tropical Plant Systematics

Dr. Gary Hartshorn
CEO, OTS

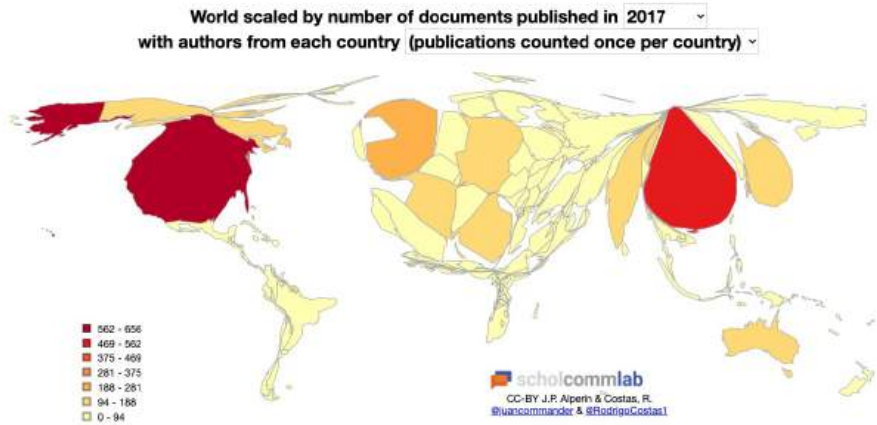
5



"95% of the new science in the world is created in the countries comprising only 1/5 of the world's population. And much of that science…neglects the problems that afflict most of the world's people.

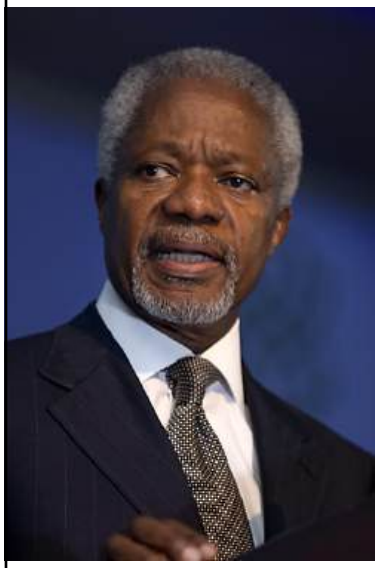
Kofi Annan (2003) Science 299: 1485

6



Source: http://scholcommlab.ca/cartogram/

7



"This unbalanced distribution of scientific activity generates serious problems not only for the scientific community in the developing countries, but for development itself.
It accelerates the disparity between advanced and developing countries, creating social and economic difficulties at both national and international levels."

Kofi Annan (2003) Science 299: 1485

8

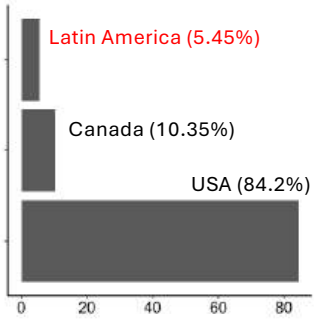
A robust national scientific community is key to socio-economic development

vs.

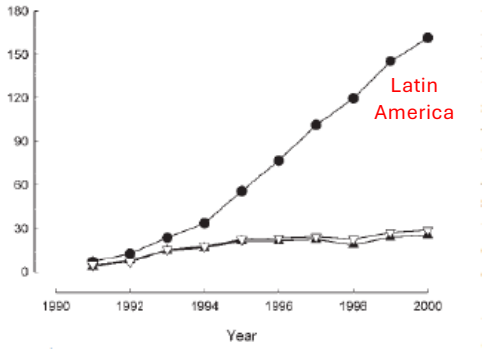
9

Milena Holmgren & Stefan A. Schnitzer: "Science on the Rise in Developing Countries" (PLoS Biology 2004)

Regional Contribution to the Scientific Literature



% Increase in Scientific Productivity (relative to 1990)



% of GDP invested in Research & Development:
USA: 2.84%, Canada: 1.5%, Latin America: 0.59%

10

"Although there may still be a long road to travel, we feel optimistic that the bridges mentioned by Mr. Annan are slowly being built."

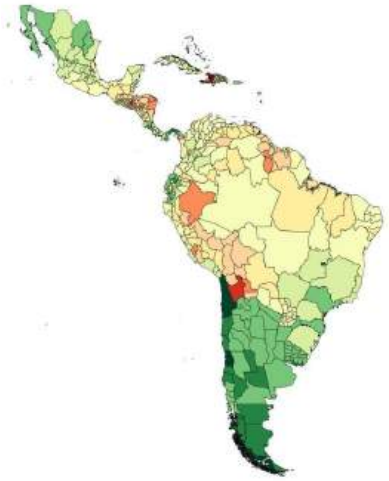
Holmgren and Schnitzer (PLoS Biology, 2004)

However…

11

"Latin America" is not a monolith

GDP per capita
(2019)



Human Development Index
(HDI)

12

1. How has scientific productivity in the Global South (= Latin America) changed over time?

2. What shapes the disparities in the creation of knowledge in Latin America?

3. What can we do to address global disparities in the production and recognition of scholarship?

13

1. How has scientific productivity in the Global South (= Latin America) changed over time?

2. What shapes the disparities in the creation of knowledge in Latin America?

3. What can we do to address global disparities in the production and recognition of scholarship?

14

Holmgren & Schnitzer redux:

Is science really on the rise in Latin America?

1) All articles, Reviews, or Data Papers published 1981-2024

...indexed in SCOPUS and

...with ≥1 author based in USA, or
Canada, or
one of 20 LatAm Countries.

2) All countries credited equally for coauthored articles
(i.e., no fractional authorship)

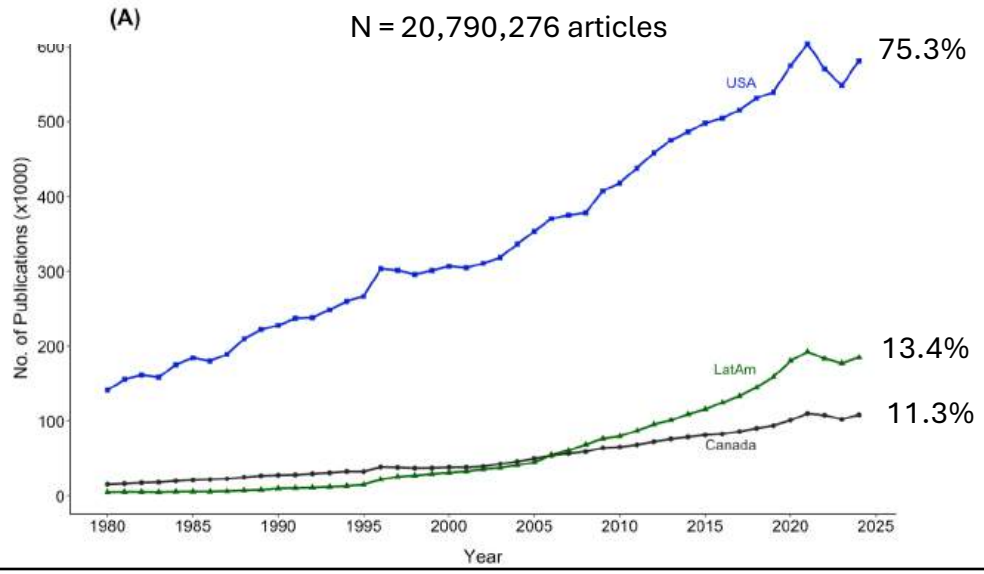
NB: A large quantity of very good & very important scholarship is not indexed in the SCOPUS during the early years surveyed (or to this day, for that matter). That's a feature of this study, not a bug.

15

N = 20,790,276

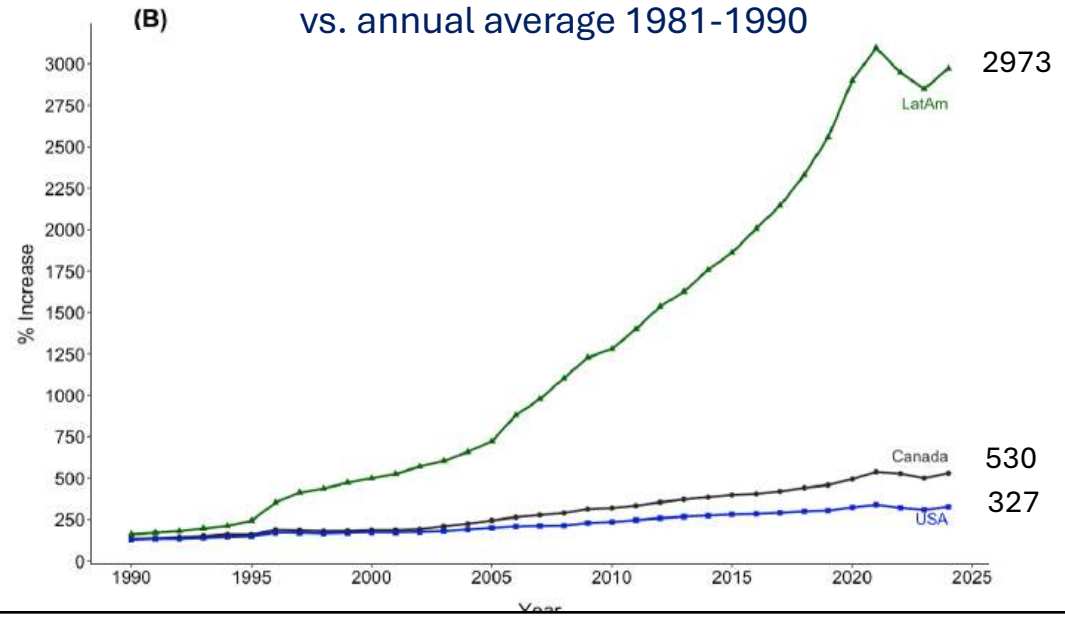
16

Disparity in Scientific Publication in the Americas 1981-2024:

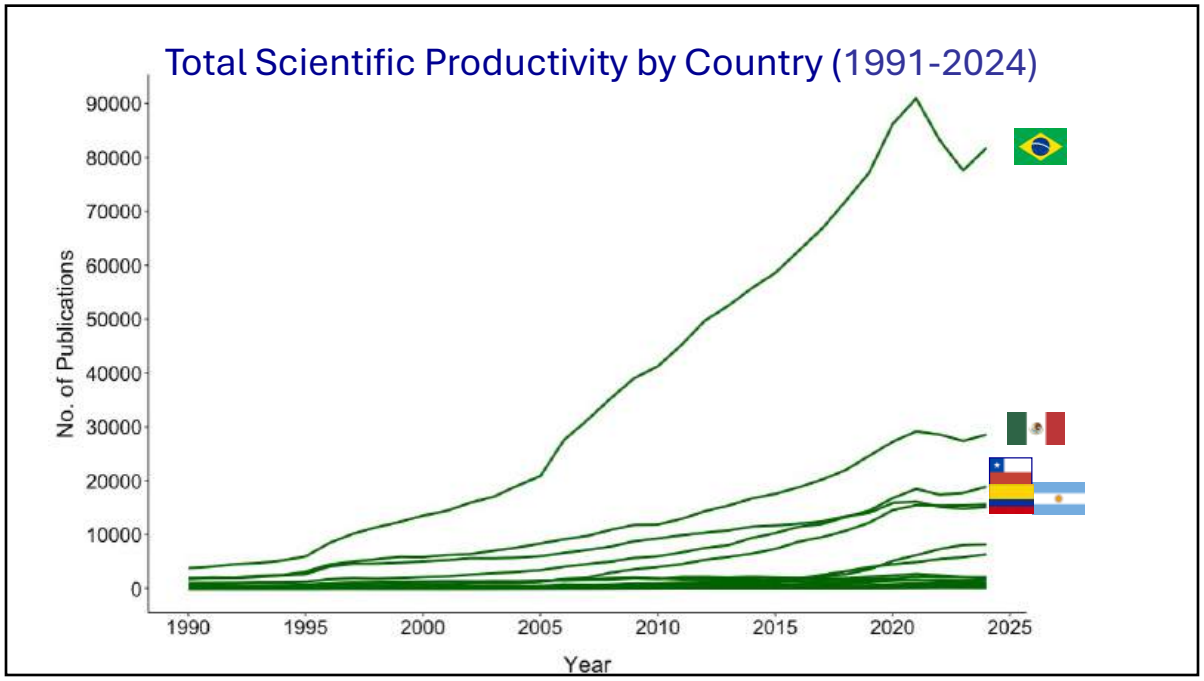


17

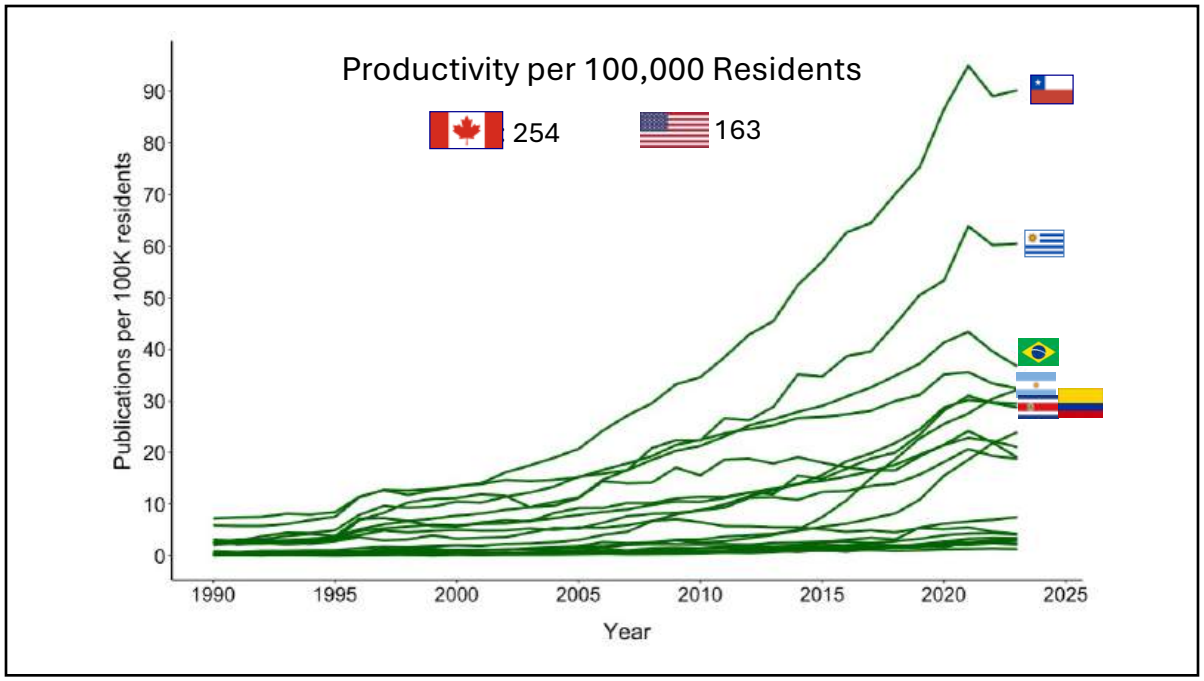
% inncrease in scientific productivity vs. annual average 1981-1990



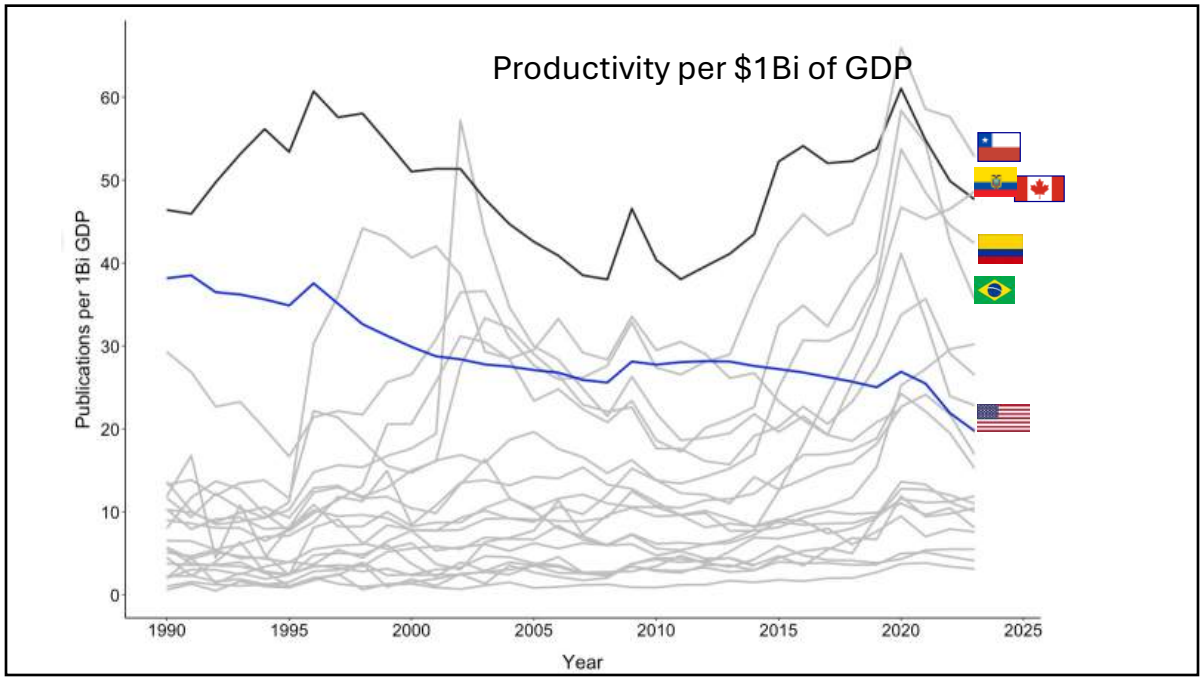
18


Total Scientific Productivity by Country (1991-2024)
No. of Publications
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
1990
1995
2000
2005
2010
2015
2020
2025
Year

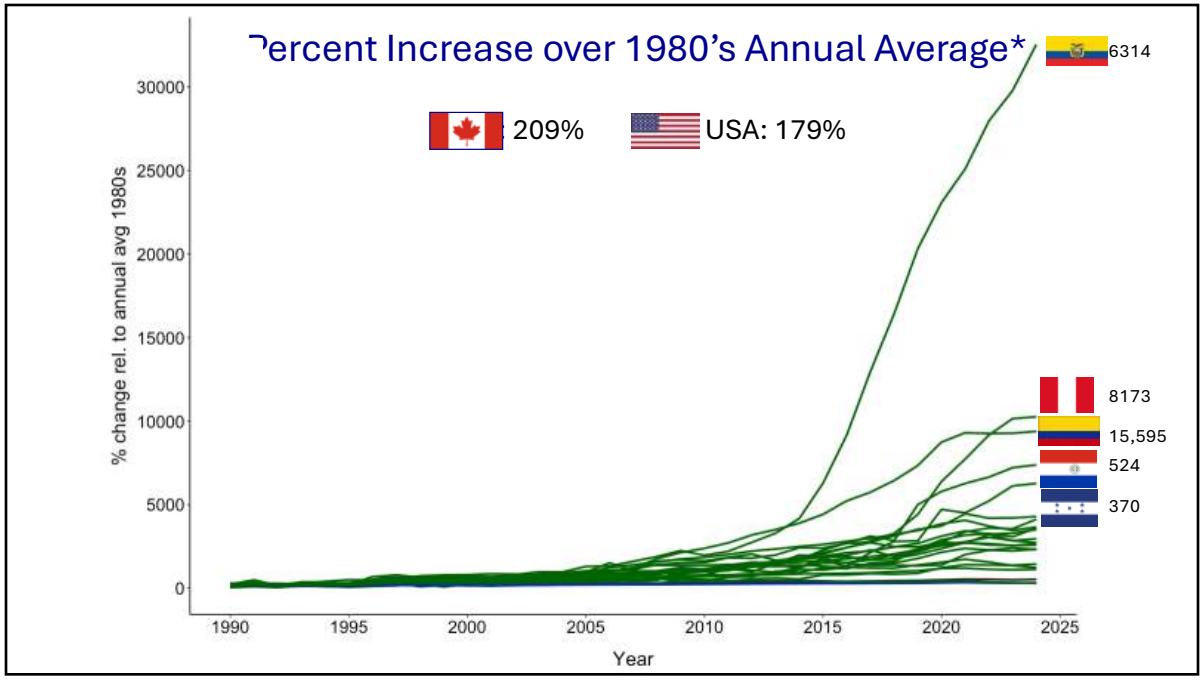
19


Productivity per 100,000 Residents
254
163
Publications per 100K residents
90
80
70
60
50
40
30
20
10
0
1990
1995
2000
2005
2010
2015
2020
2025
Year

20


Productivity per $1Bi of GDP
Publications per 1Bi GDP
0
10
20
30
40
50
60
1990
1995
2000
2005
2010
2015
2020
2025
Year

21


Percent Increase over 1980's Annual Average*
209%
USA: 179%
6314
8173
15,595
524
370
% change rel. to annual avg 1980s
0
5000
10000
15000
20000
25000
30000
1990
1995
2000
2005
2010
2015
2020
2025
Year

22

1. How has scientific productivity in the Global South (= Latin America) changed over time?

2. What shapes the disparities in the creation of knowledge in Latin America?

3. What can we do to address global disparities in the production and recognition of scholarship?

Resources
Financial Investment
Human Resources
Investment in Higher Ed

Productivity

Is Latin American Productivity On the Rise?

Preliminary Results (GAMs): For most countries, yes....

Resources: Population Size & GDP: 96% of variance in data.

This is not big news.

Chile
pop: 18 million
GDP: 277 billion

vs.

México
pop: 129 million
GDP: $1.15 trillion

25

(Stable-ish) Research Funding

CNPq Conselho Nacional de Desenvolvimento Científico e Tecnológico

CAPES

FAPESP

2015: R$ 10.7 bi
2022: R$ 3.14bi
(-70%)

2017: R$ 1.08 bi
2022: R$ 1.85 bi

26

Investment in higher education

1	Pontificia Universidad Católica de Chile (UC)	*	Chile
2	Universidade de São Paulo	*	Brazil
3	Universidade Estadual de Campinas (Unicamp)	*	Brazil
4	Universidad Nacional Autónoma de México (UNAM)	More	Mexico
5	Universidad de los Andes	More	Colombia
6	Instituto Tecnológico y de Estudios Superiores de Monterrey	More	Mexico
7	Universidad de Chile	*	Chile
8	Universidad de Buenos Aires (UBA)	*	Argentina
9	Universidade Federal do Rio de Janeiro	*	Brazil
10	Universidad Nacional de Colombia	More	Colombia
11	UNESP	*	Brazil
12	Pontifícia Universidade Católica do Rio de Janeiro	*	Brazil
13	Universidad de Santiago de Chile (USACH)	*	Chile
14	Universidad de Concepción	*	Chile
=15	Universidad de Antioquia	More	Colombia
=15	Universidade Federal de Minas Gerais	*	Brazil
17	Pontificia Universidad Javeriana	More	Colombia
18	Universidade Federal do Rio Grande Do Sul	*	Brazil
=19	Universidad de Costa Rica	More	Costa Rica
=19	Universidad de La Habana	More	Cuba

QS Latin America Rankings 2019

27

Specializing & Leveraging Circumstances

Astronomy / Astrophysics: Chile (16,774) vs. Argentina (6622)

28

Developing a national scientific workforce

29

(Access to) International collaborations

30

Resources

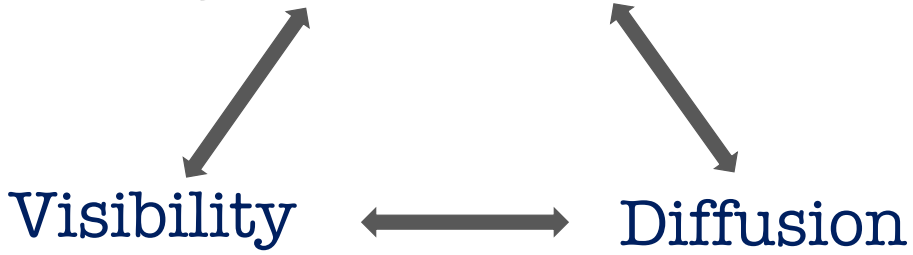
Financial Investment
Human Resources
Investment in Higher Ed
Collaborations
Serendipity

Productivity

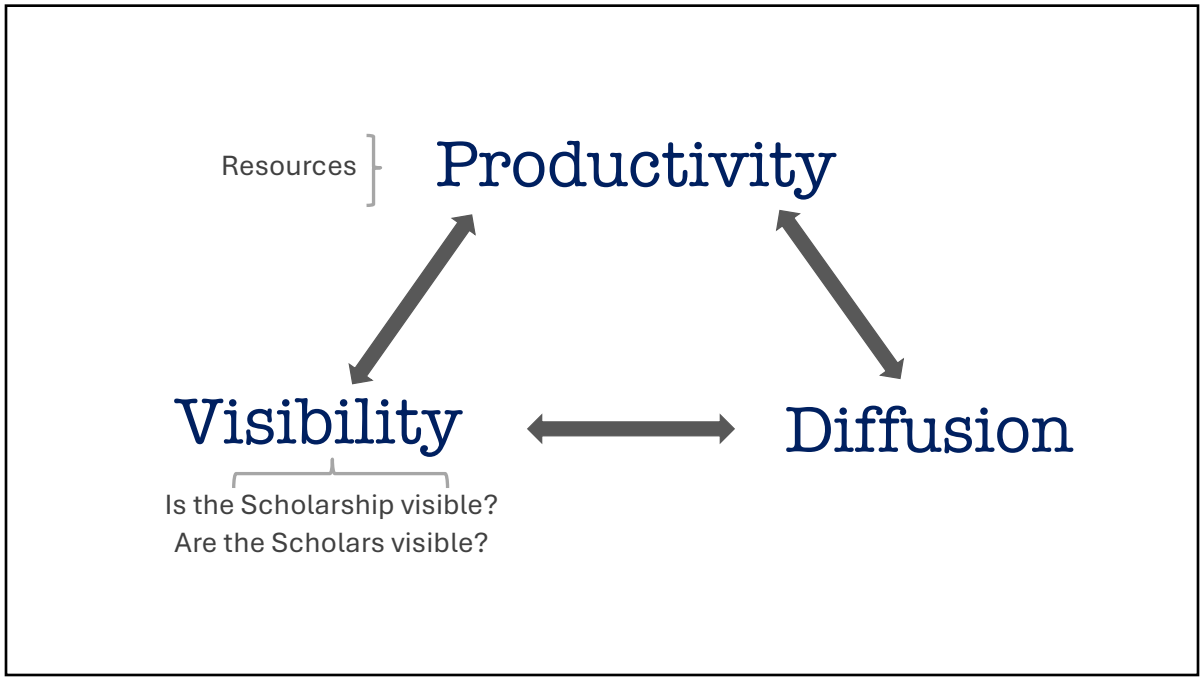
31

Resources

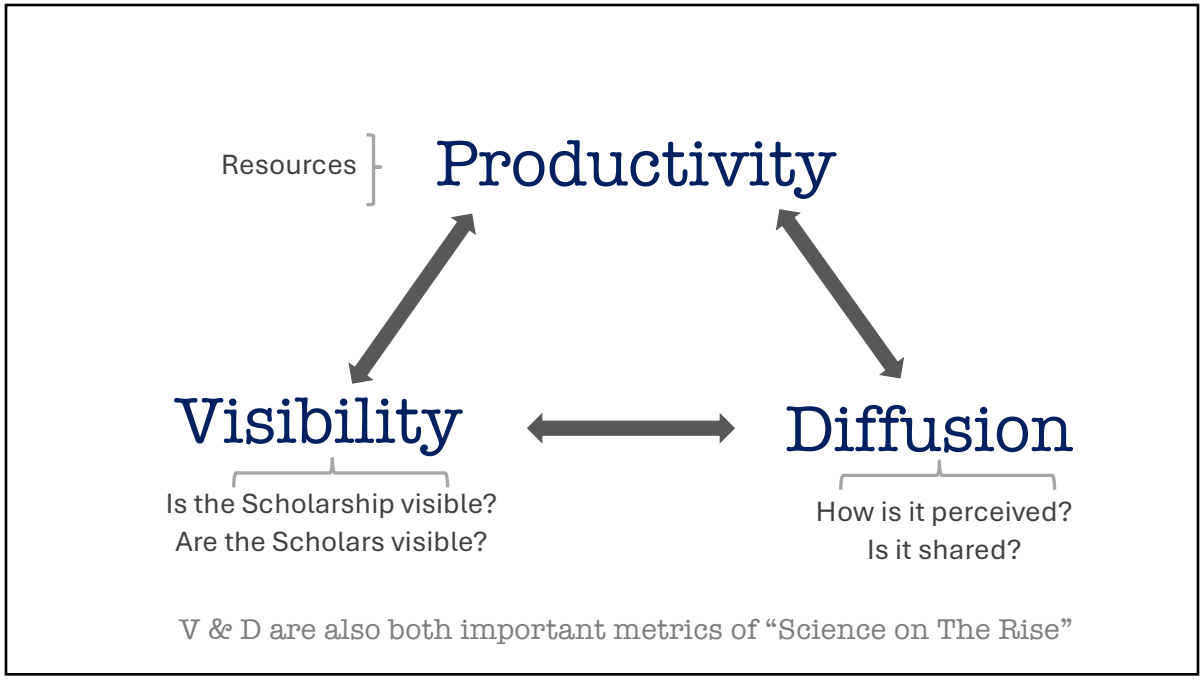
Productivity



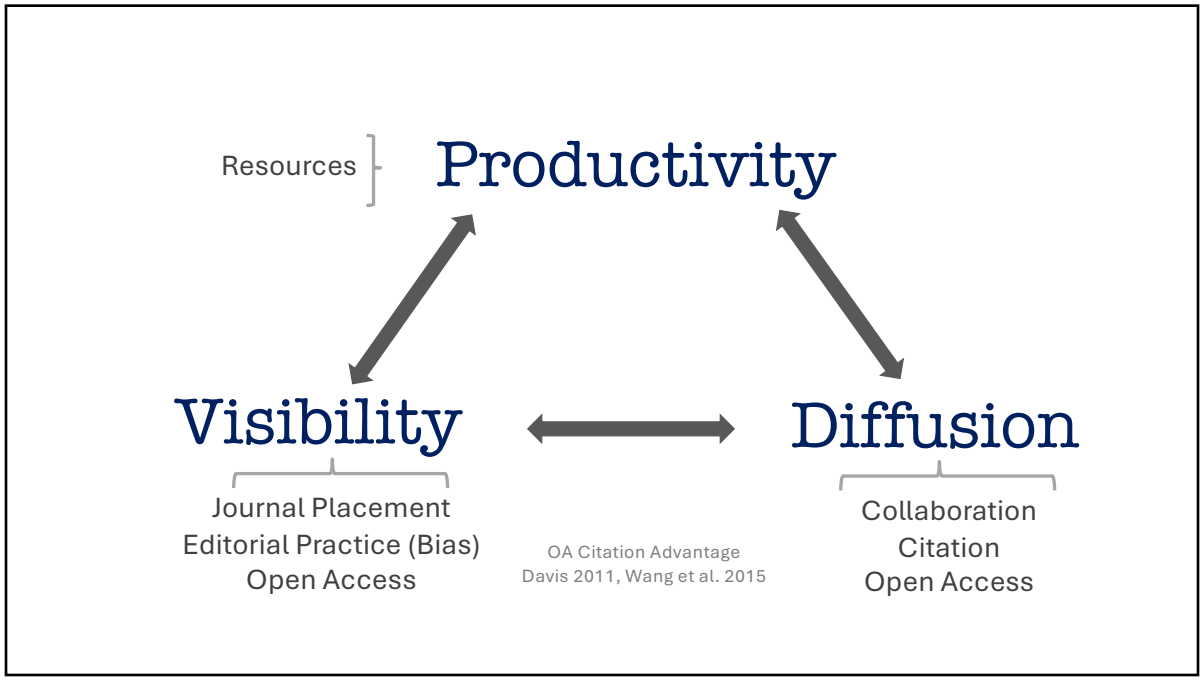
32


Resources
Productivity
Visibility
Diffusion
Is the Scholarship visible?
Are the Scholars visible?

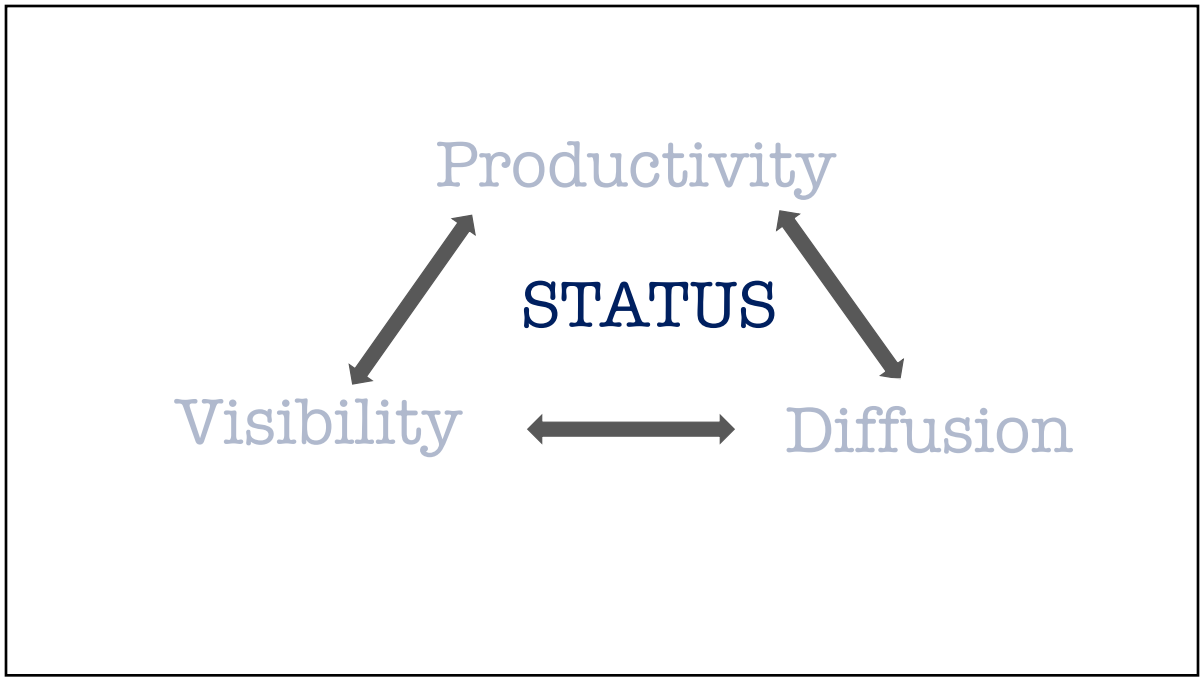
33


Resources
Productivity
Visibility
Diffusion
Is the Scholarship visible?
Are the Scholars visible?
How is it perceived?
Is it shared?
V & D are also both important metrics of "Science on The Rise"

34


Resources
Productivity
Visibility
Diffusion
Journal Placement
Editorial Practice (Bias)
Open Access
OA Citation Advantage
Davis 2011, Wang et al. 2015
Collaboration
Citation
Open Access

35


Productivity
STATUS
Visibility
Diffusion

36

GEOGRAPHJY & OPEN ACCESS

US$908

avg. APC for N = 4418 OA journals
Morrison & Singh 2019

$1500 $1760 $4500 $5380 $3750

$282 $413
MS PhD

$493 $711
MS PhD

$574 $588
MS PhD

Smith et al. 2022 *Quantitative Science Studies*: 38,906 Articles in 42 journal pairs

37

OPEN ACCESS Freely available online PLOS one

Articles by Latin American Authors in Prestigious Journals Have Fewer Citations

Rogerio Meneghini[1,2]*, Abel L. Packer[1,2], Lilian Nassi-Calò[1]

National bias: a comparison of citation practices by health professionals

By Frank M. Campbell, M.A.L.S.

Virginia Commonwealth University
Medical College of Virginia
Tompkins-McCaw Library
Box 582 MCV Station
Richmond, Virginia 23298-0582

British Library Lending Division were employed to find world journal counts. The results suggest that U.S. authors publishing in the *New England Journal of Medicine* and U.K. authors publishing in *Lancet* tend to cite material produced in their own countries more than would be warranted by the amount of material produced by these countries. In addition, these authors cited material produced in non-U.S. and non-U.K. countries far less than the amount of material produced by these countries would indicate.

Conservation Biology

Research Note | Full Access

Geographic bias in citation rates of conservation research

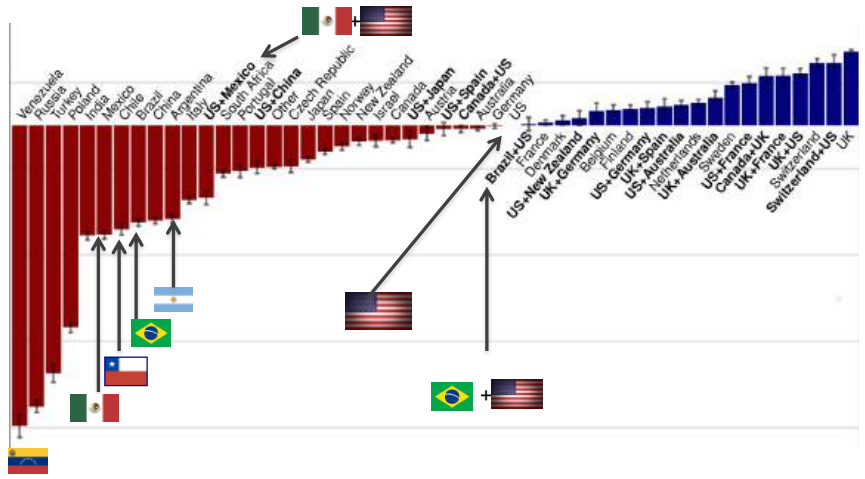
Erik Meijaard, Marcel Cardillo, Emily M. Meijaard, Hugh P. Possingham

First published: 27 March 2015 | https://doi.org/10.1111/cobi.12489 | Citations: 14

38

GEOGRAPHY & PUBLICATION

Author Home Country & Journal Placement: Ecology

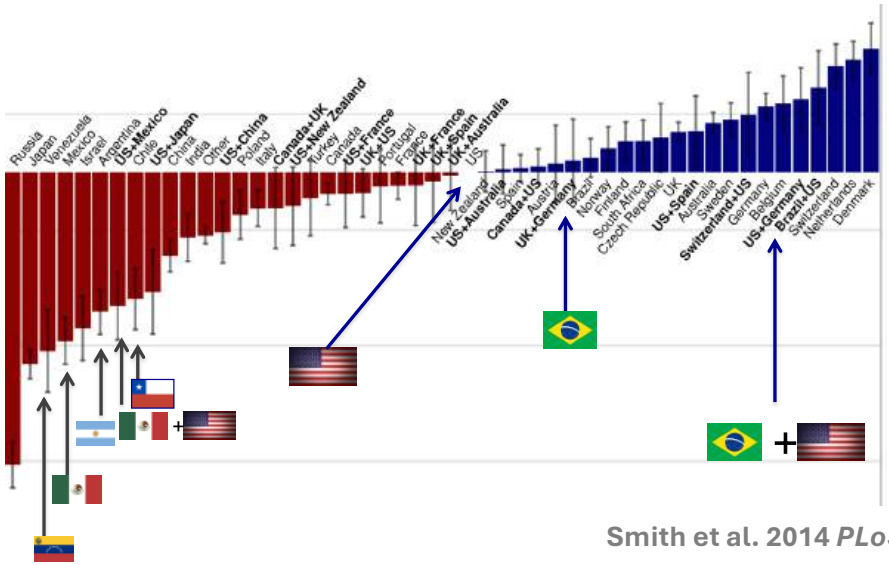


Smith et al. 2014 *PLoS ONE*: 1.25 million articles, 1996-2012, 8 subjects

39

GEOGRAPHY & CITATION

Author Home Country & Citation Performance: Ecology



Smith et al. 2014 *PLoS ONE*

40

GEOGRAPHY & COLLABORATION

536 articles with ≥2 authors

Alexandre Oliveira (USP)
Cris Jurinitz (USP)
Emilio Bruna (UF)

All authors foreign scientists 45%

All authors in-country scientists 28%

Multinational teams 27%

Stocks et al. 2008 *Biotropica*: N = 1985 'tropical' articles in 6 journals

41

Productivity

STATUS

Visibility ⟷ Diffusion

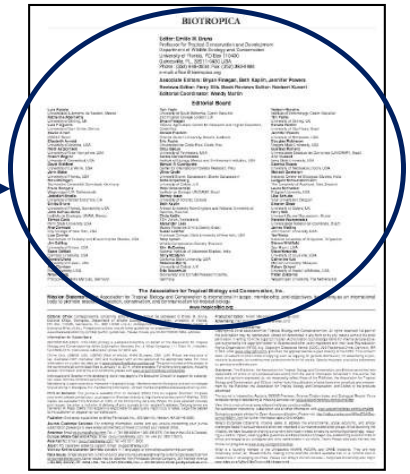
42

Crane, Diana. 1967. The gatekeepers of science: Some factors affecting the selection of articles for scientific journals. The American Sociologist. 2(4):195-201.

43

Crane, Diana (1967) The gatekeepers of science: Some factors affecting the selection of articles for scientific journals. The American Sociologist 2(4):195-201.

Editors are a very small but very influential group of scientists



44

Gatekeepers

Also Gatekeepers

45

Why are Editors such powerful gatekeepers?

Confer legitimacy on both the research & the researchers

Shape the direction of the field (topics, approaches)

Help choose new editors.
This confers status on a select group of individuals that can now benefit professionally

46

Could Editorial Board composition bias peer-review?

Board of Directors, [corporate name redacted]

M.C. Escher: Moebius Strip II (1964)

Demographically homogenous Boards might converge on narrow suite of topics & approaches 'worthy of publication'

This narrow vision could be perpetuated by editors nominating collaborators with similar perspectives or backgrounds

47

Implicit Expectation (Hypothesis):
Editorial boards that reflect increasing geographic diversity of scientific community will benefit journals *and* disciplines

48

Editors based in the region more familiar with environmental, socio-economic context & constraints

Scientists trained in different parts of world can have very different epistemological orientations.

Internationalization could reduce biases in review, publication, & citation of articles based on author 'nationality'

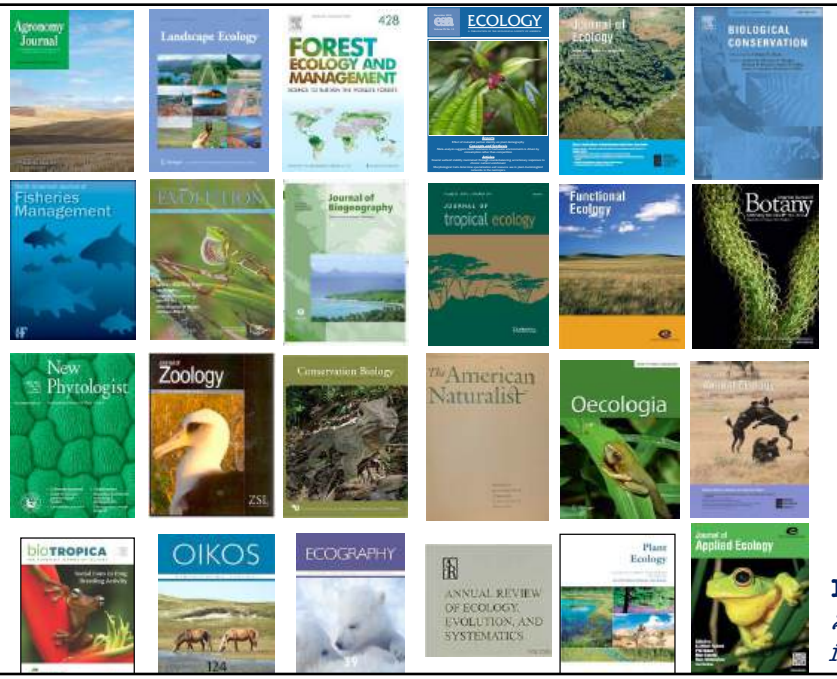
49

WHO ARE OUR GATEKEEPERS?

'our' = Ecology, Evolution, & Conservation

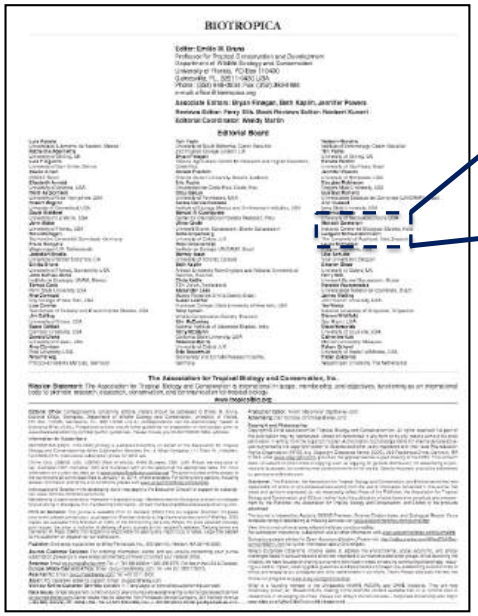
50

GEOGRAPHY & EDITORIAL BOARDS



1985-2013
2014-2024
in progress

51


BIOTROPICA

1. Issue 1 of every volume (1985-2015)

Laura Schneider
Rutgers University, USA
Lisa Schulte
Vrije Universiteit, Belgium
Luitgard Schwendenmann
The University of Auckland, New Zealand
Eleanor Slade
University of Oxford, UK
Ferry Slik
Universiti Brunei Darussalam, Brunei

2. Richness & Diversity Estimators

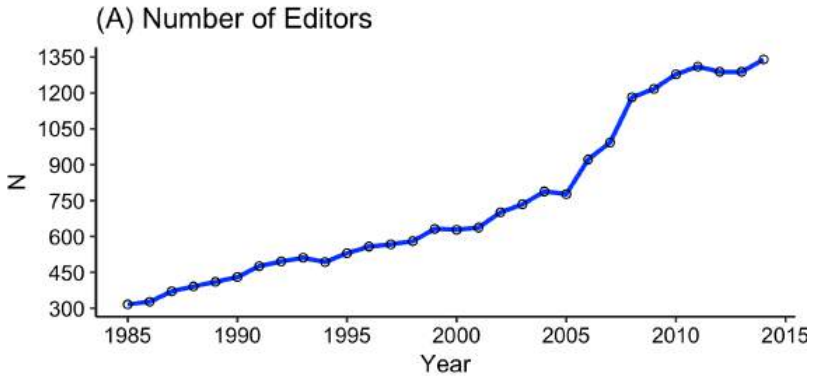
Gender: Cho et al. 2014 *PeerJ*
Geography: Espin et al. 2017 *PLOS Biology*

DRYAD

52

Geographic Distribution of Editors (1985-2013)

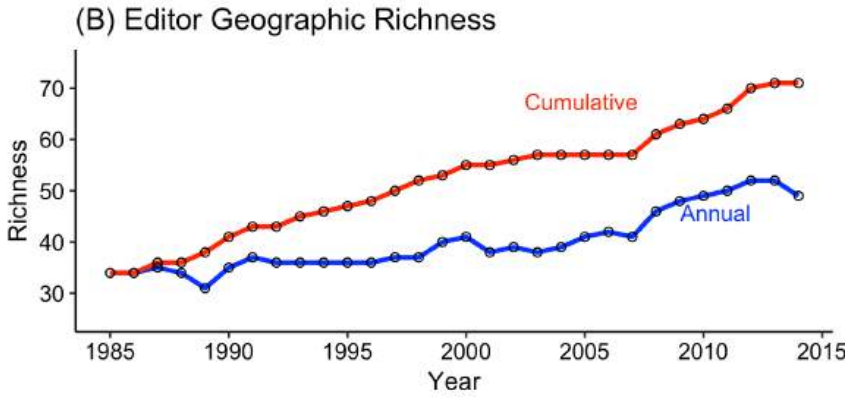
N = 3827 Editors



53

Geographic Distribution of Editors (1985-2013)

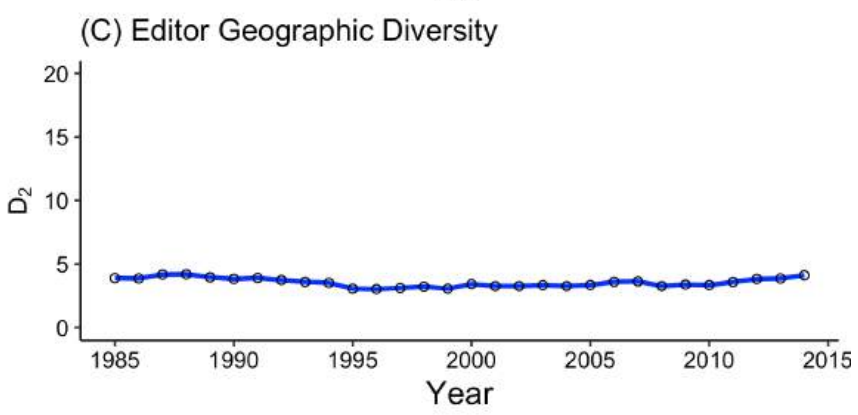
N = 3827 Editors



54

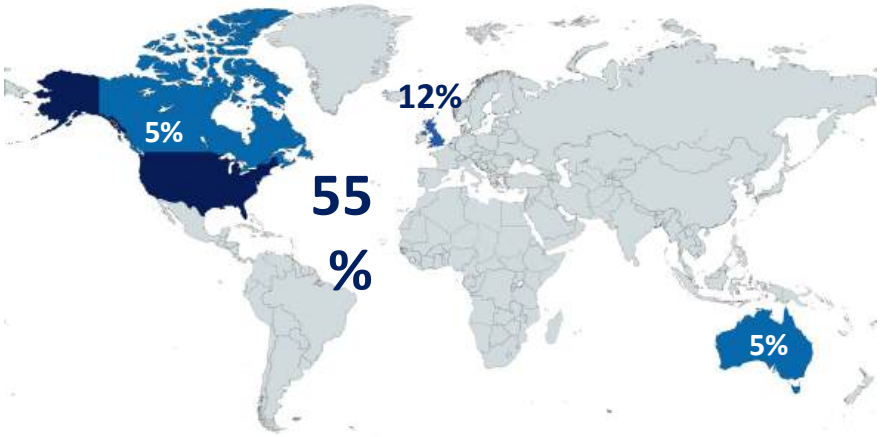
Geographic Distribution of Editors (1985-2013)

N = 3827 Editors



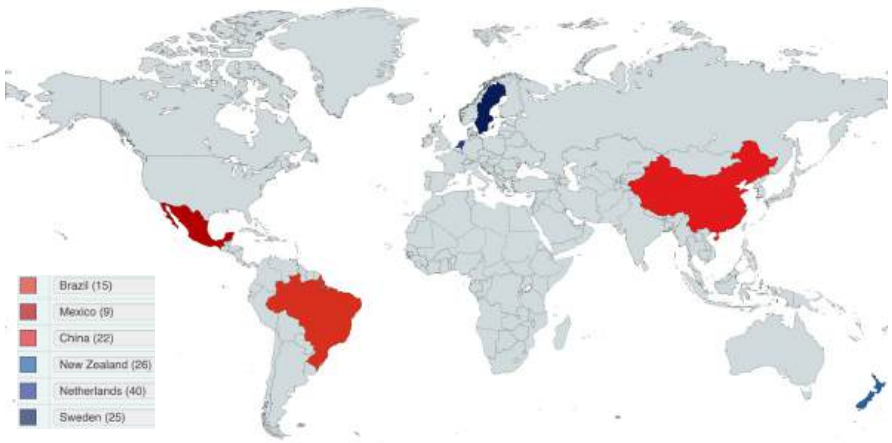
55

Geographic Distribution of Editors (1985-2013)



56

Brazil, Mexico, & China < Sweden, New Zealand, The Netherlands



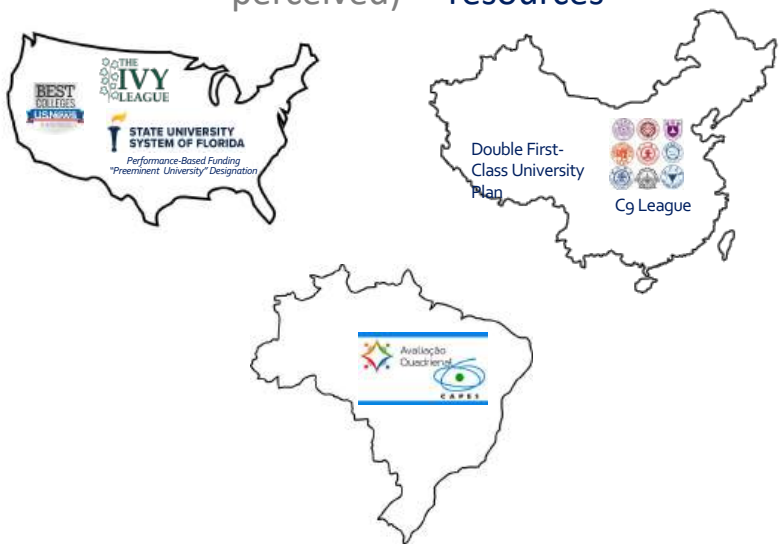
57

Individuals aren't the only ones concerned with or (that benefit from)

STATUS

58

…within-country differences in status (real or perceived) = resources



59

Institutional Status in the Outside World

THE WALL STREET JOURNAL.

Yale University Team Develops An Experimental AIDS Vaccine

The New York Times

Yale Professors Race Google and IBM to the First Quantum Computer

Harvard researchers discovered the one thing everyone needs for happier, healthier lives

Showing 131 results for:
"Yale Study"
N = 131

Showing 530 results for:
"Harvard Study"
N = 530

Showing 19 results for:
"University of Florida Study"
N = 19

60

Institutional Representation on Editorial Boards

61

Journal of Financial Economics
Volume 111, Issue 1, January 2014, Pages 251-270

Networks and productivity: Causal evidence from editor rotations ☆

Jonathan Brogaard [a 1], Joseph Engelberg [b 2], Christopher A. Parsons [b]

"During an editor's tenure, his current university colleagues publish about 100% more papers in the editor's journal, compared to years when he is not editor. In contrast to editorial nepotism, such "inside" articles have significantly higher ex post citation counts, even when same-journal and self-cites are excluded."

62

As of 2 hours ago: 23 Journals
3013 Editors from 949 Institutions
20,839 editor-years

editor_id	last_name	journal
1459	bence	ecology
16	bennett	evol
637	brown	leco
3885	chen	leco
1518	conner	evol
1518	conner	oecol
73	finley	ecology
3915	gross	oecol
715	hall	ecology
730	ian	evol
3374	kalisz	jecol
496	klausmeier	amnat
755	landis	jape
1699	lau	jecol
1699	lau	oecol
3134	lenski	amnat
3134	lenski	evol

editor_id	last_name	journal
993	litchman	oecol
1718	liu	leco
1762	messina	plantecol
1233	mittelbach	ecology
2887	ostrom	oecol
3432	peacor	oecol
1253	robertson	ecology
2738	sarnelle	ecology
858	schemske	arees
858	schemske	bitr
2085	scribner	conbio
197	shingleton	evol
2696	swenson	jecol
215	tessier	oecol
2952	werner	arees

N = 19

63

Table 2: Top Institutions (No. of Editors)

inst	country	n	rank	perc
university of california davis	usa	57	1.0	1.63
university of oxford	united kingdom	43	2.0	1.23
university of florida	usa	37	3.0	1.06
cornell university	usa	29	5.0	0.83
university of georgia	usa	29	5.0	0.83
university of washington seattle	usa	29	5.0	0.83
michigan state university	usa	28	8.0	0.80
university of sheffield	united kingdom	28	8.0	0.80
university of wisconsin madison	usa	28	8.0	0.80
oregon state university	usa	27	10.5	0.77
university of british columbia vancouver	canada	27	10.5	0.77
[illegible]				
university of michigan	usa	19	29.0	0.54

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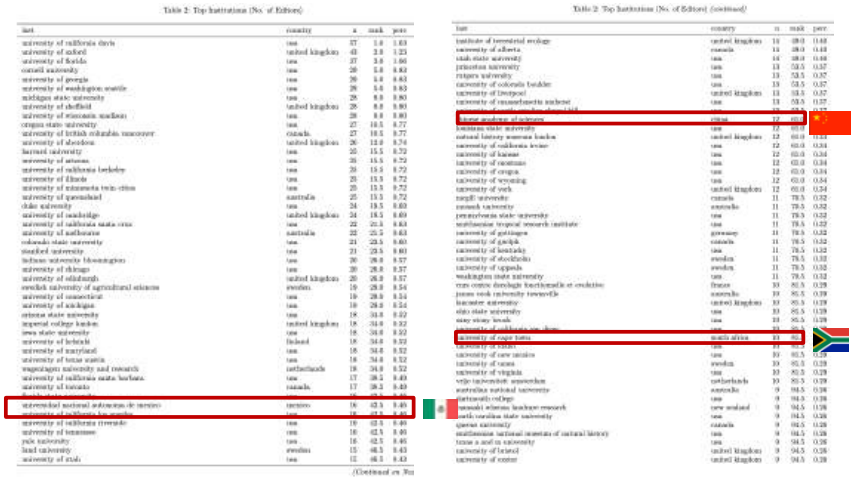
Institutions from the Global South

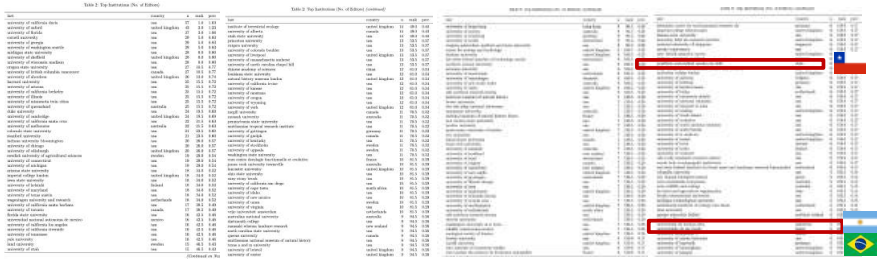


UNAM (T-42, N = 16)

Chinese Academy of Sciences (T No. 61, N = 12)

University of Capetown (T No. 81, N = 10)

65



PUC Chile (T No. 159, N=6)

Univ. Buenos Aires,
USP (T No. 192, N = 5)

66

	first_name	n
	<fct>	<int>
1	john	92
2	david	89
3	michael	66
4	peter	64
5	j	57
6	james	49
7	richard	49
8	robert	41
9	mark	38
10	william	38

Editors named Jennifer = 16

Editors named Brian = 19

william >

67

1. How has scientific productivity in Latin America changed over time, and what shapes disparities in knowledge production?

2. What influences the global diffusion of knowledge generated in Latin America?

3. What can we do to rectify global disparities in the production and recognition of scholarship?

68

Is Science on the rise in Latin America?

Yes: National increases in publication (absolute & relative); greater share of hemispheric productivity (5% -> 14%)

No: 1. Much of Latin America's research remains invisible

2. LatAm scientists publish in lower-profile journals than expected

(Hyp: Biased evaluation)

3. Research undervalued by the international community

(Hyp: Biased citation)

4. Huge financial barrier to publishing in high profile OA outlets;
Barely represented in powerful community of Scientific Gatekeepers

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Addressing Disparities in Latin American Science

Top Down:

National Science & Tech Policy
Private Sector R & D
Stem the tide of populism
Stabilize National Economies and Global Financial Markets
Reduce Inequality
Unravel the legacies of colonialism

Bottom Up:

?

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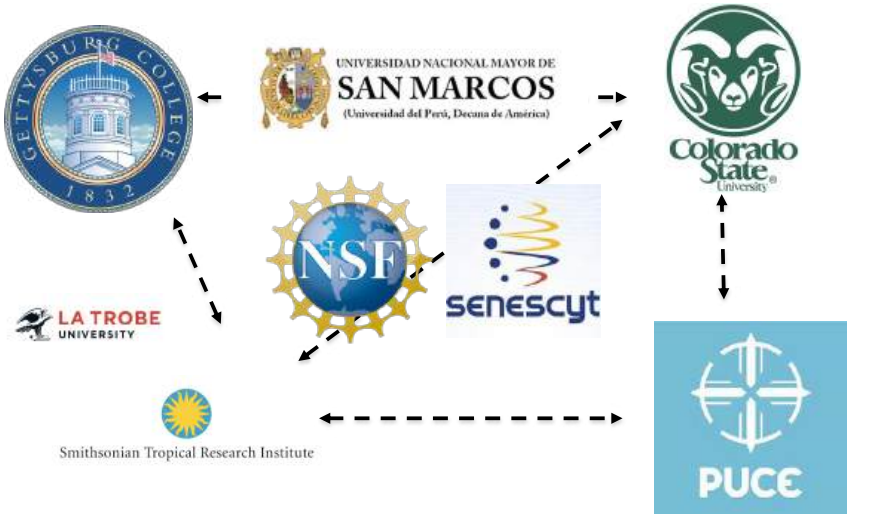
Bottom-up #1: Engage in International Collaboration – it has high ROI



Trillo et al. 2017, Plos ONE

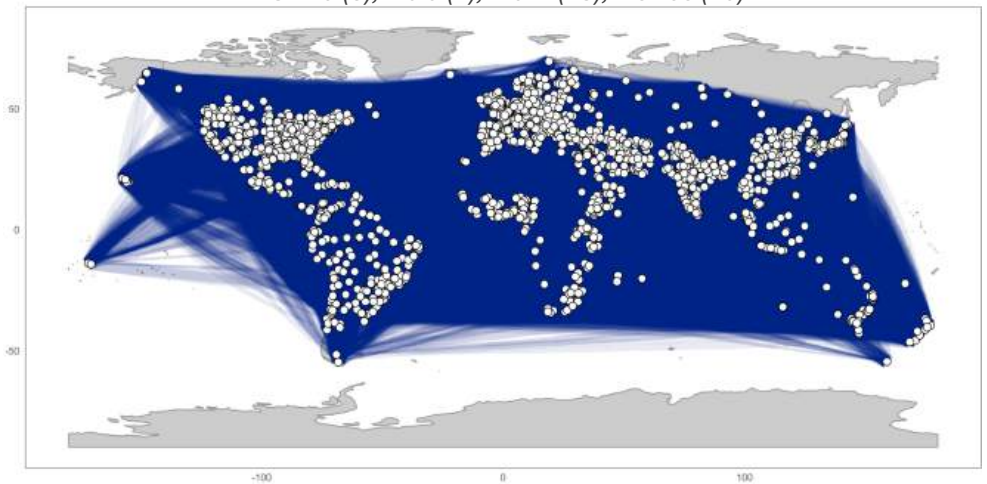
71

Yale (2024)

9713 articles *with* 471,818 authors *in* 169 countries

147 articles: >1000 authors *106 > 100 authors*

China (5), India (7), Brazil (13), Mexico (20)

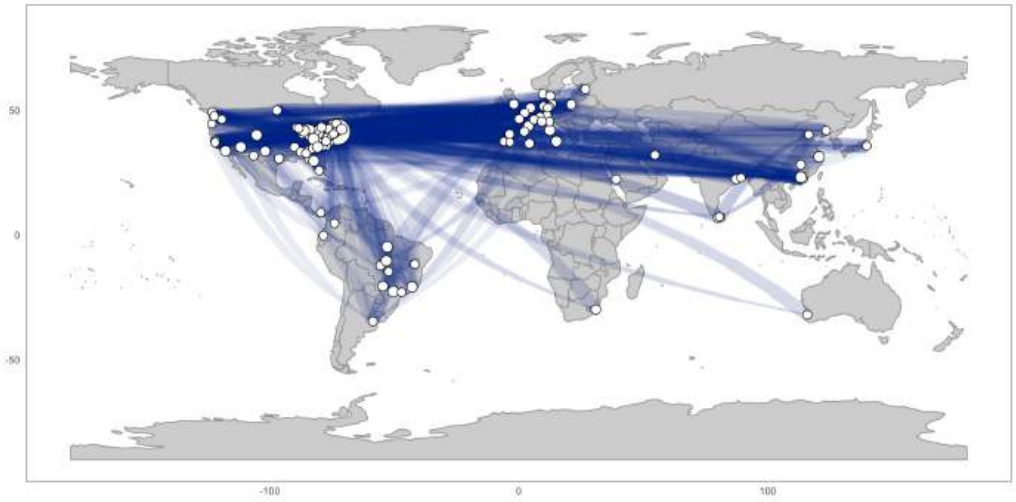


72

Yale School of the Environment (2024)

66 articles *with* 448 authors *in* 28 countries

Brazil (2), China (3), India (4), Sri Lanka (8)

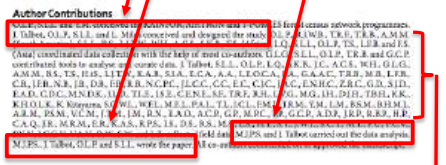


BUT…do so in a way that benefits local partners.
Coauthorship is not necessarily collaboration.


SCIENTIFIC REPORTS

OPEN Diversity and carbon storage across the tropical forest biome

5 scientists designed study (4), analyzed data (2) wrote MS (4)


Author Contributions

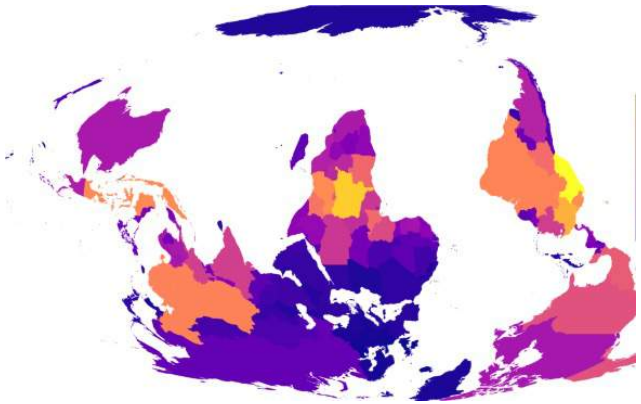
M.J.P.S. and J. Talbot carried out the data analysis.

M.J.P.S., J. Talbot, O.L.P. and S.L.L. wrote the paper.

Provided Data: 98 others

#1: Recalibrate our perspective.

Be aware of how biases could influence (i) how research is evaluated & (ii) what research is elevated

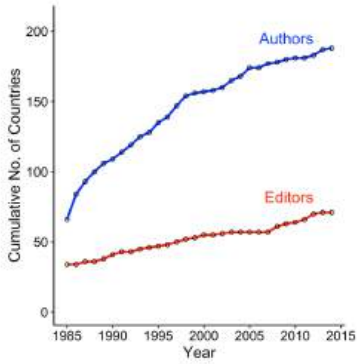


Trisos et al. 2021 *Nature Ecology & Evolution*

75

#2: Recalibrate our values.

Biases in the production, evaluation, & diffusion of scholarship can be overcome…



…but it requires planning, effort, & accountability.

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Editoral Boards should be Aspirational

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#2: Recalibrate our Values

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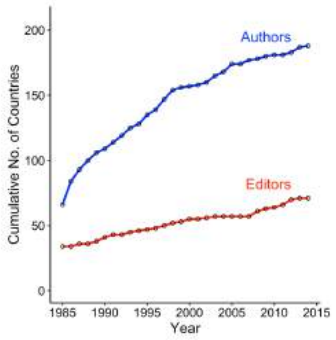
#3: Address potential biases influencing the evaluation, visibility, and diffusion of science from the Global South.

"Multi-Ethnic Team Indoors"
freedigitalphotos.net



Authors & Teachers: Citations, Readings, Speakers, Classes

Editors & Referees: planning, effort, & accountability

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Bottom-up #4:

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THE GATEKEEPER PROJECT editorial board composition across disciplines

HOME JOURNALS UNDER REVIEW HOW TO PARTICIPATE DATA & CODE TEAM MEMBERS CONTACT US

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Functional Ecology
Global Change Biology
Human Organization
International Journal of American Linguistics
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