生物多様性保全における言葉の壁：

その重要性と解決策

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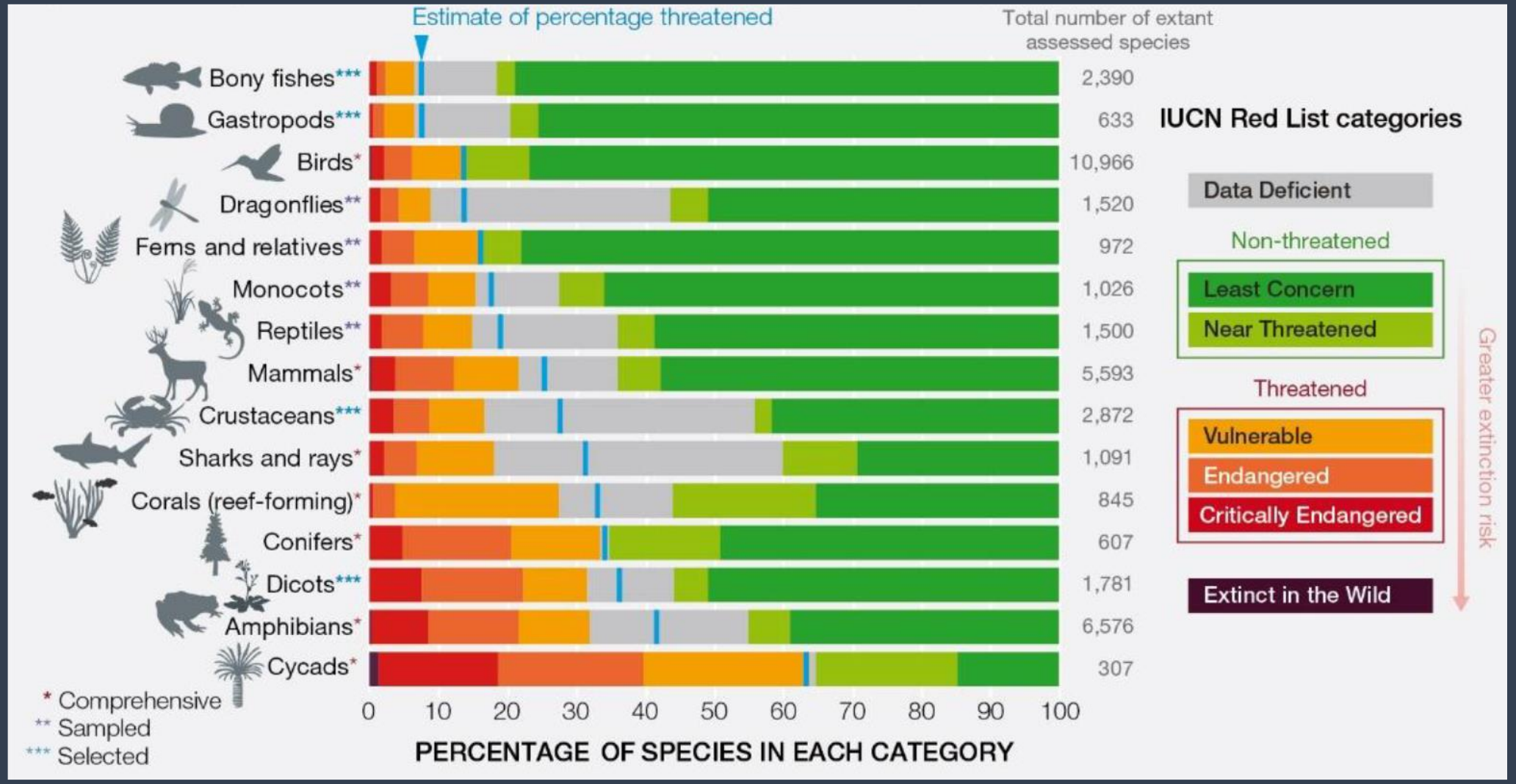
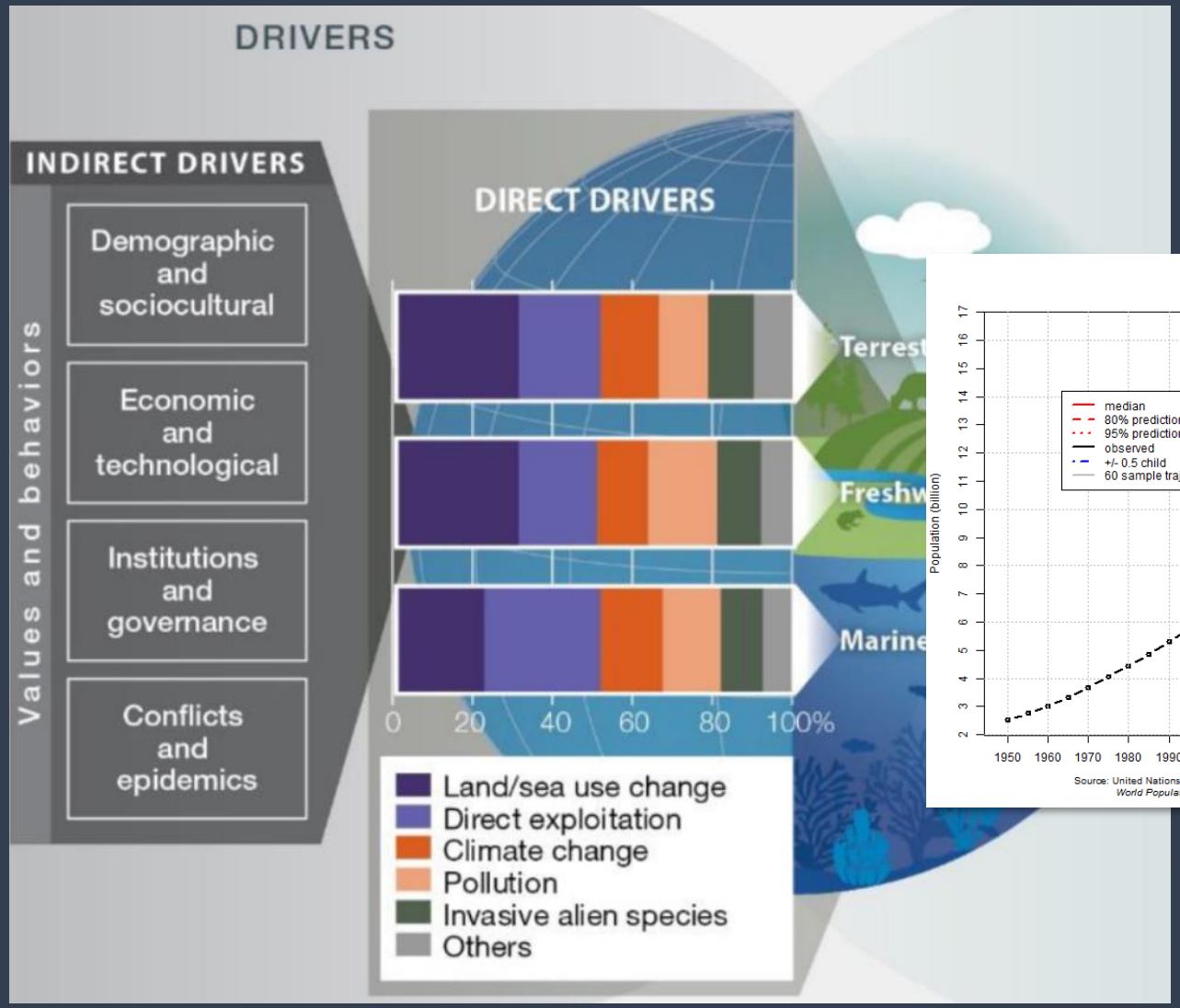
Kaizen Conservation Group
kaizenconservation.com

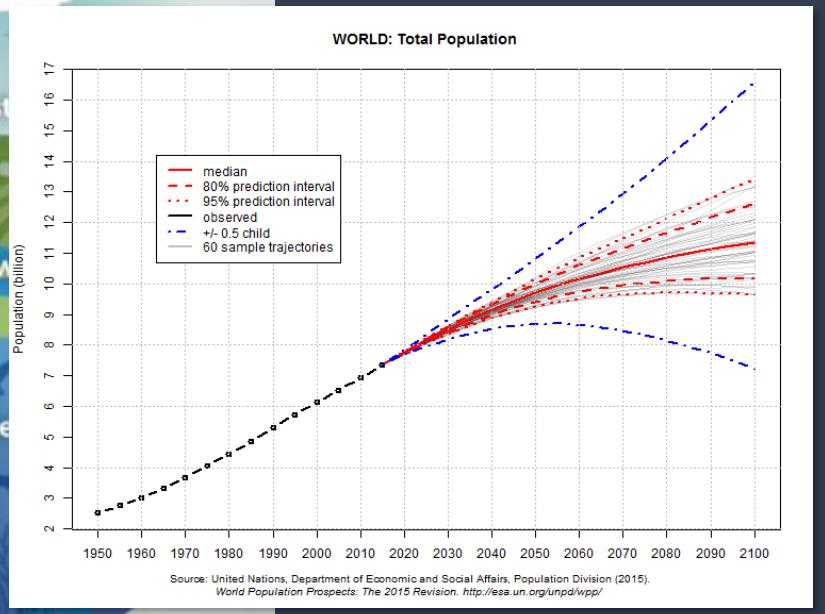
生物多様性の危機| 第６の大量絶滅期

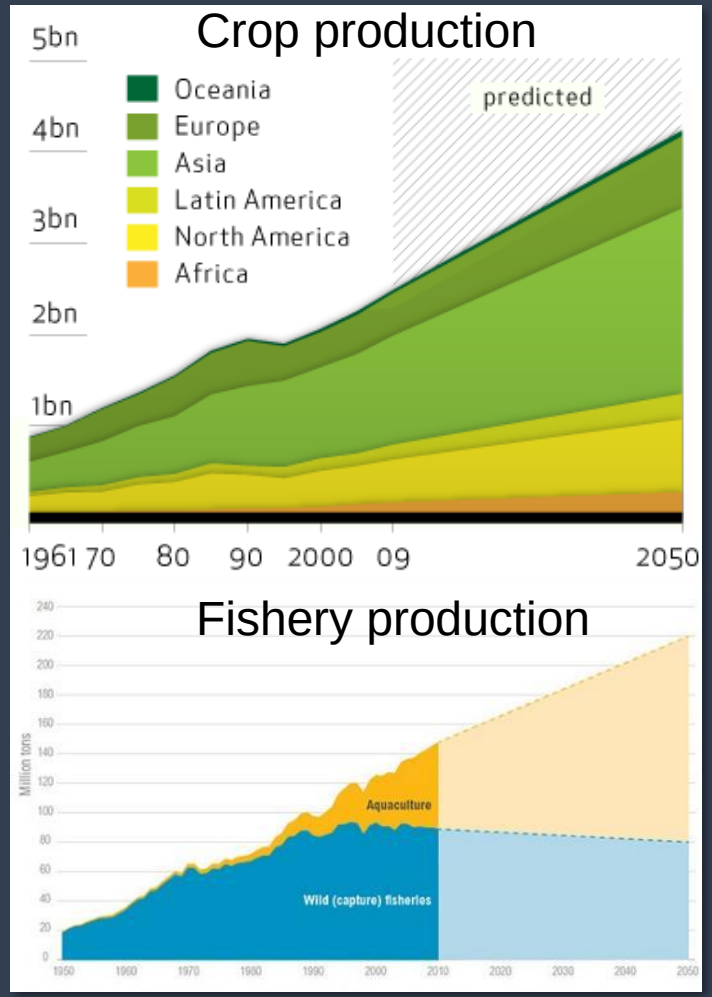


IPBES (2019) Global assessment report on biodiversity and ecosystem services of the IPBES

生物多様性の危機| 人間活動の影響







IPBES (2019) Global assessment report on biodiversity and ecosystem services of the IPBES

生物多様性の危機| 人間社会に及ぼす影響

自然がもたらすもの
(Nature’s contribution to people)
の低下

IPBES (2019) Global assessment report on biodiversity and ecosystem services of the IPBES

生物多様性保全のエビデンス | 科学者にできること

科学的手法を用いて収集された情報
（査読付き論文や学位論文やレポートなどの未出版研究など）

科学的エビデンスの創出

生物多様性に何が起きているか、なぜそうなっているか、どのように保全できるかを理解する

科学的エビデンスの集約

関連したエビデンスを収集し、特定の問題について結論を導く

科学的エビデンスの意思決定者への提供

得られたエビデンスを簡単にアクセス・理解可能な形式で提供する

なぜ言葉の壁が生物多様性の保全で重要か

世界に存在する言語の数

7,164 https://www.ethnologue.com/insights/how-many-languages/

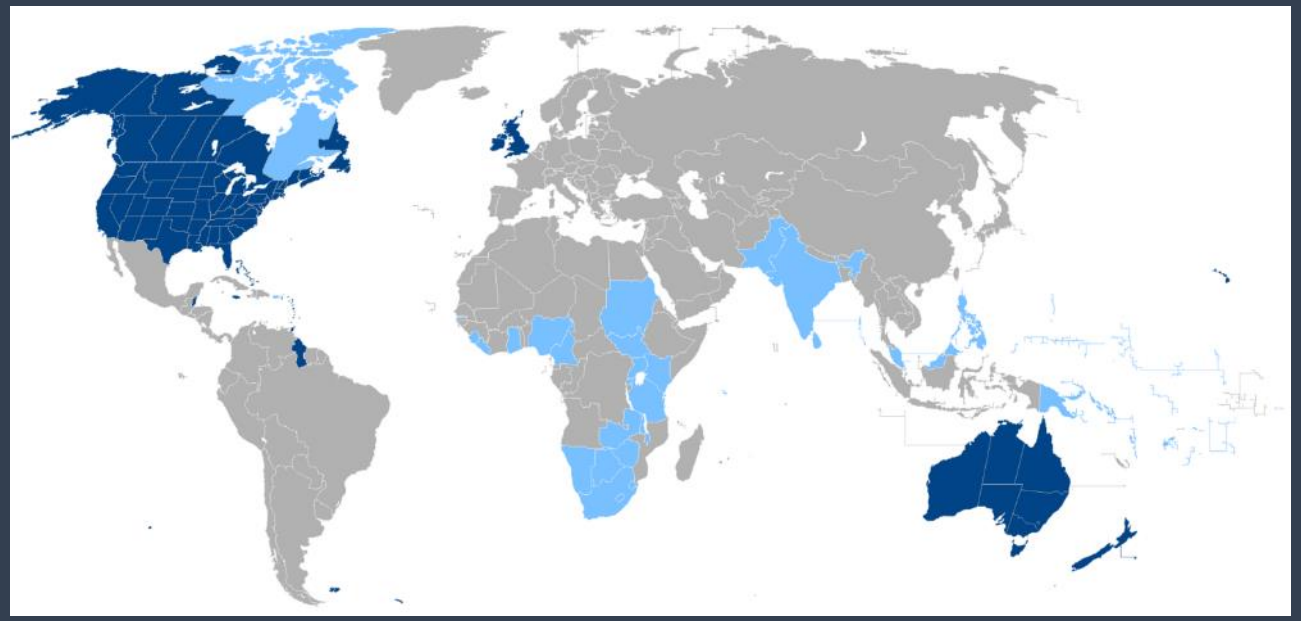
世界におけるネイティブ英語話者の数

3億8千万人 https://www.ethnologue.com/insights/most-spoken-language/

世界の人口80億人の95%が非ネイティブ英語話者

なぜ言葉の壁が生物多様性の保全で重要か

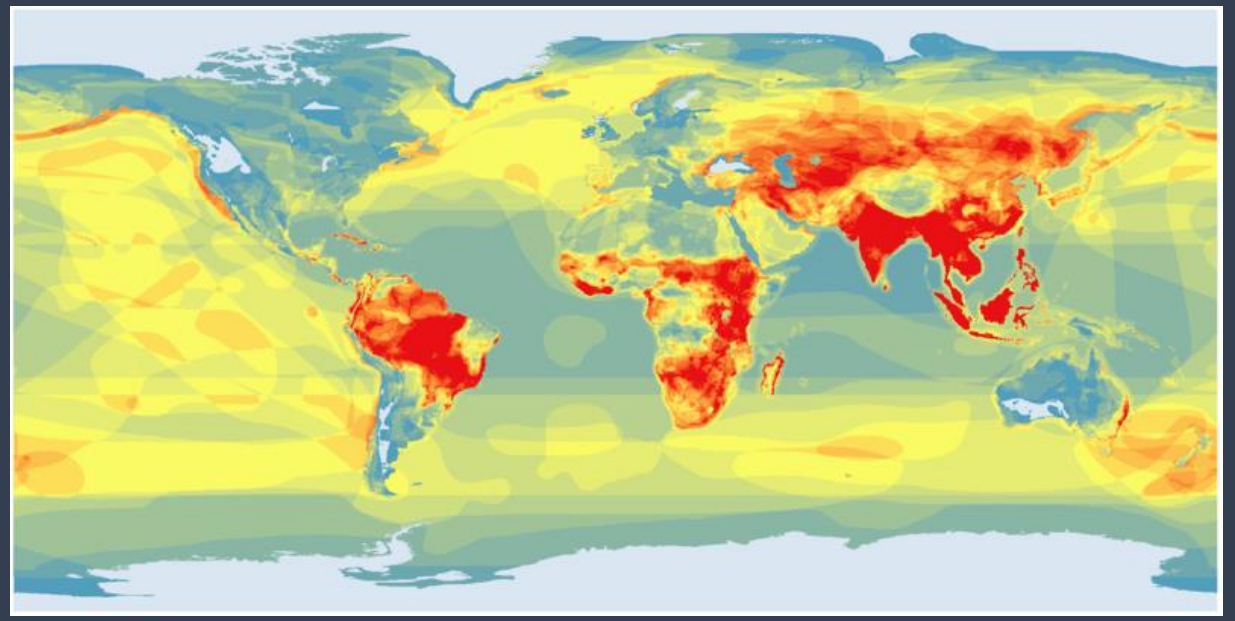
人口の大多数が英語を第一言語とする国・地域



https://commons.wikimedia.org/wiki/File:Anglospeak.png

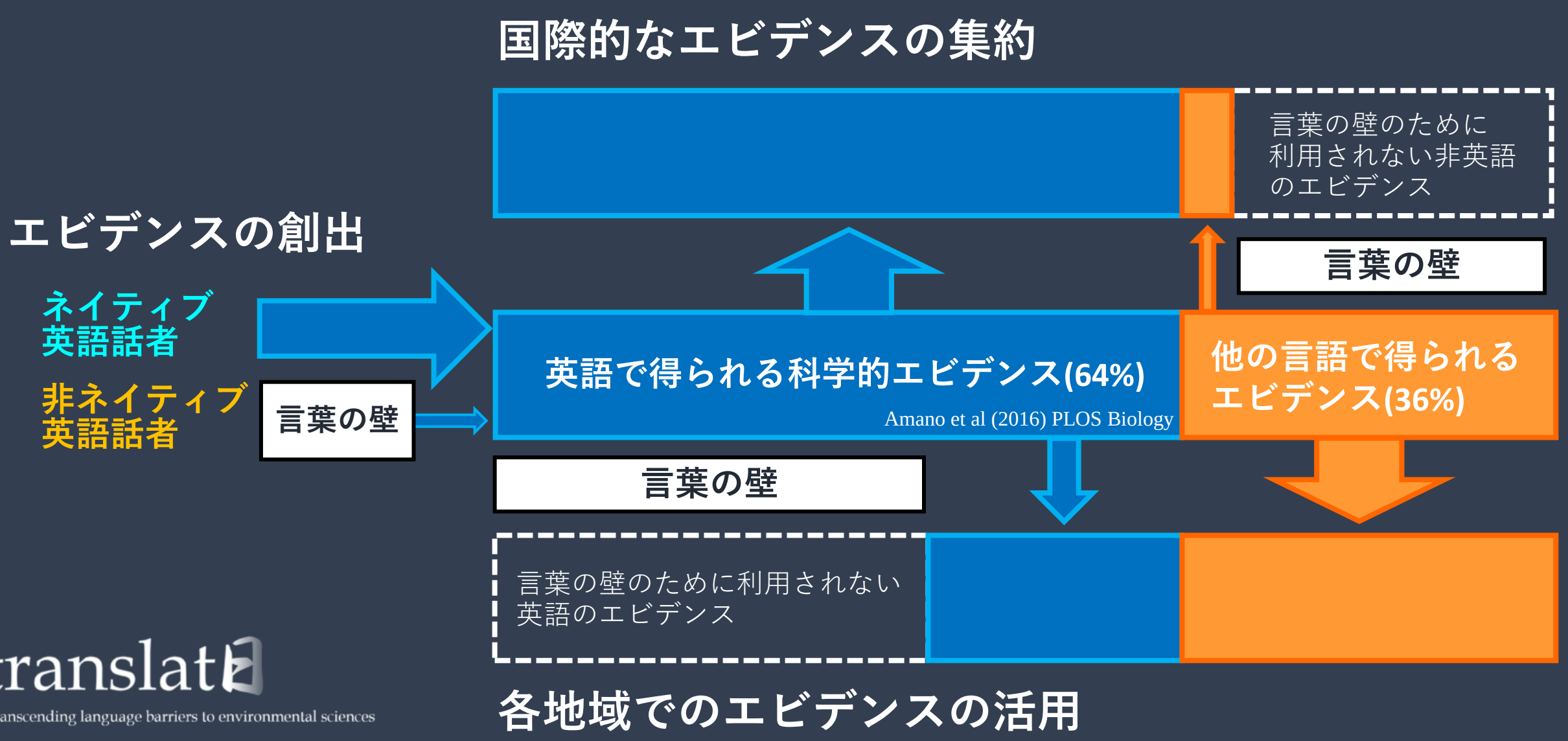
en:User:Iamvered, CC BY 2.0 AT

両生類、鳥類、哺乳類の絶滅危惧種数



https://www.iucnredlist.org/resources/other-spatial-downloads

translatE プロジェクト | 言葉の壁が保全に及ぼす影響を理解する

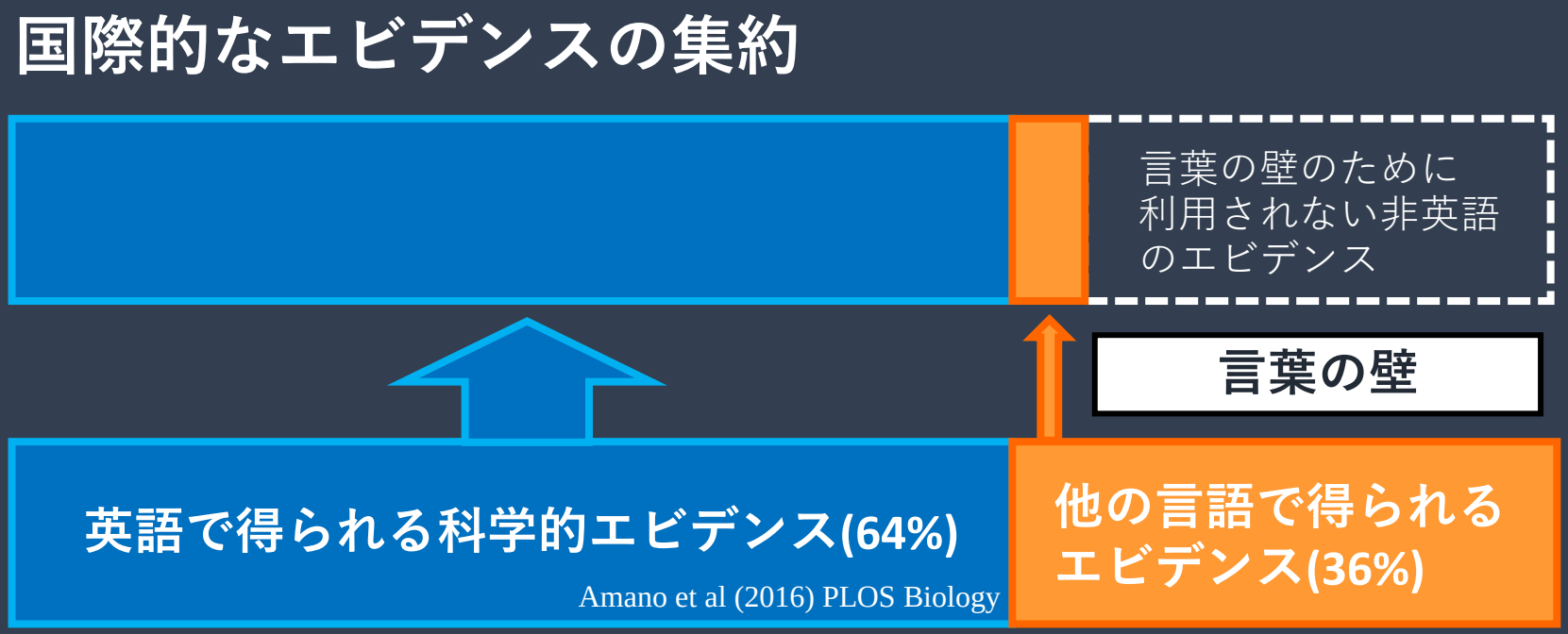


translatE
Transcending language barriers to environmental sciences

translatesciences.com

Amano (2024) figshare. https://doi.org/10.6084/m9.figshare.25669866

国際的なエビデンスの集約に対する言葉の壁



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Amano (2024) figshare. https://doi.org/10.6084/m9.figshare.25669866

国際的なエビデンスの集約に対する言葉の壁

IPBESによる８つのレポートで引用されている文献の平均 96.6% が 英語文献

実在する保全に関する文献

(Amano et al 2016)

English	93.3	93.1	98.0	98.0	94.7	100	94.0	96.3
Spanish	3.3	1.3	0.7		5.3			1.4
French	2.0	3.1	1.3	2.0				1.1
Indonesia	0.7							0.1
Portuguese	0.7	0.6						0.2
German		0.6					0.7	0.2
Italian		0.6						0.1
Russian		0.6					4.7	0.7
Uzbek							0.7	0.1

64%

vs

36%

Lynch et al (2021) One Earth

非英語のエビデンスを利用しないと生じる問題

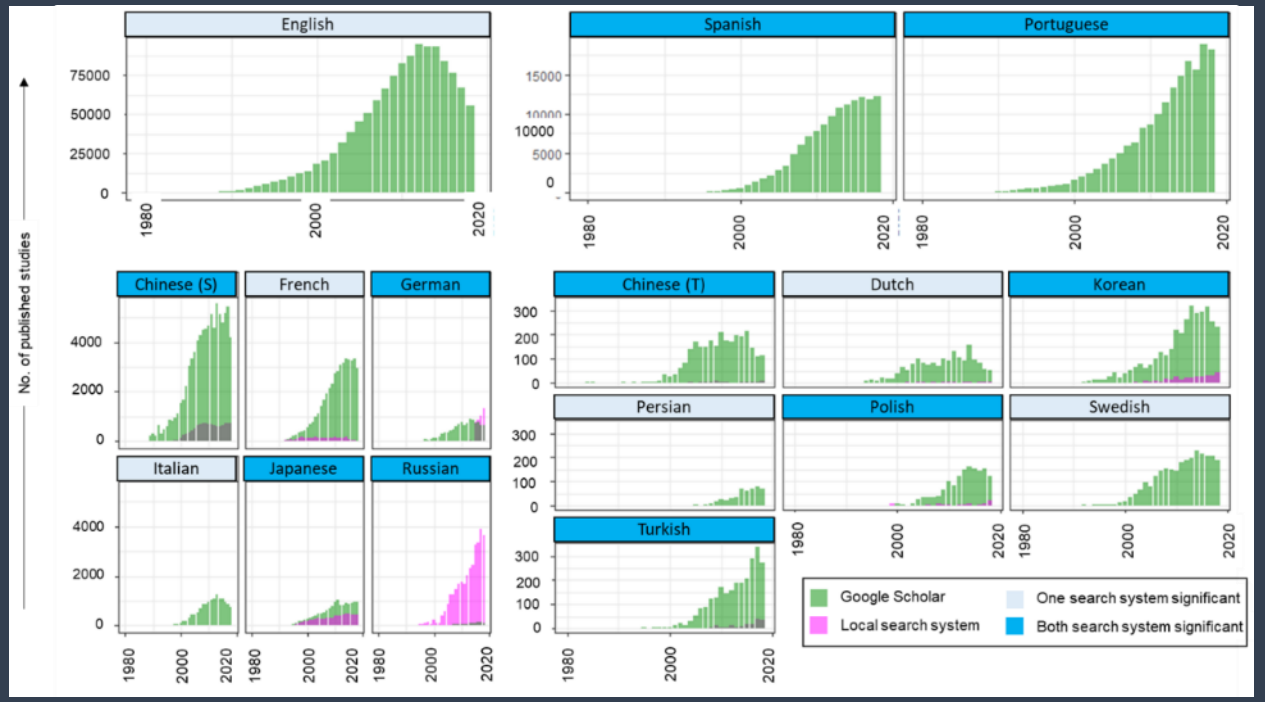
1. 相当量のエビデンスを利用しないことになる

分野横断検索の結果、保全対策の効果を検証した**非英語論文を1,234本**特定

Conservation Evidenceデータベースに収蔵されている**英語文献は4,412本**

Amano et al (2021) PLOS Biology

“biodiversity” と “conservation” で検索した学術文献数の年変化



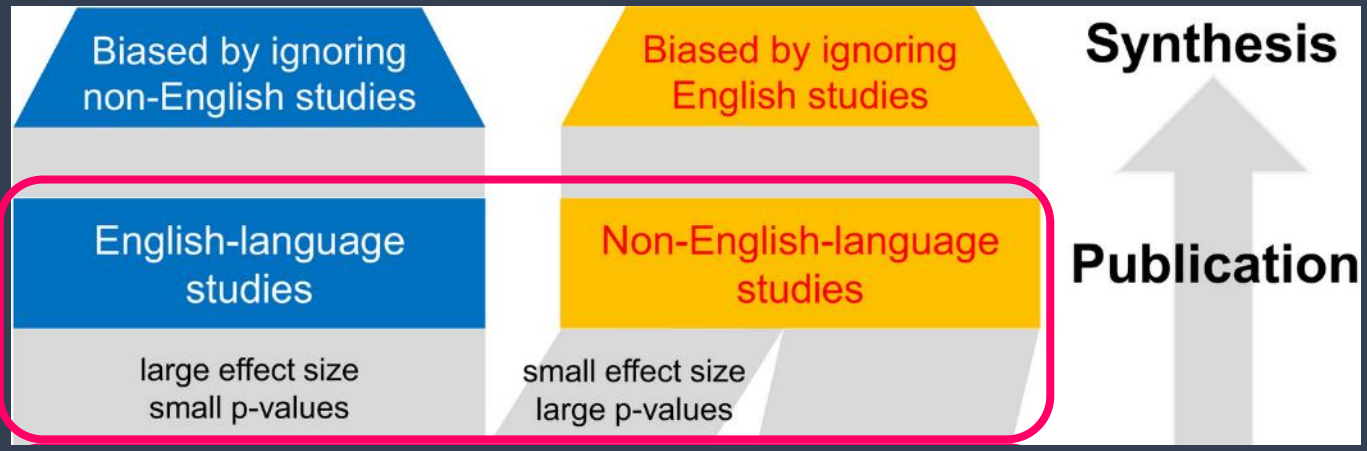
Chowdhury et al (2022) Cons Biol

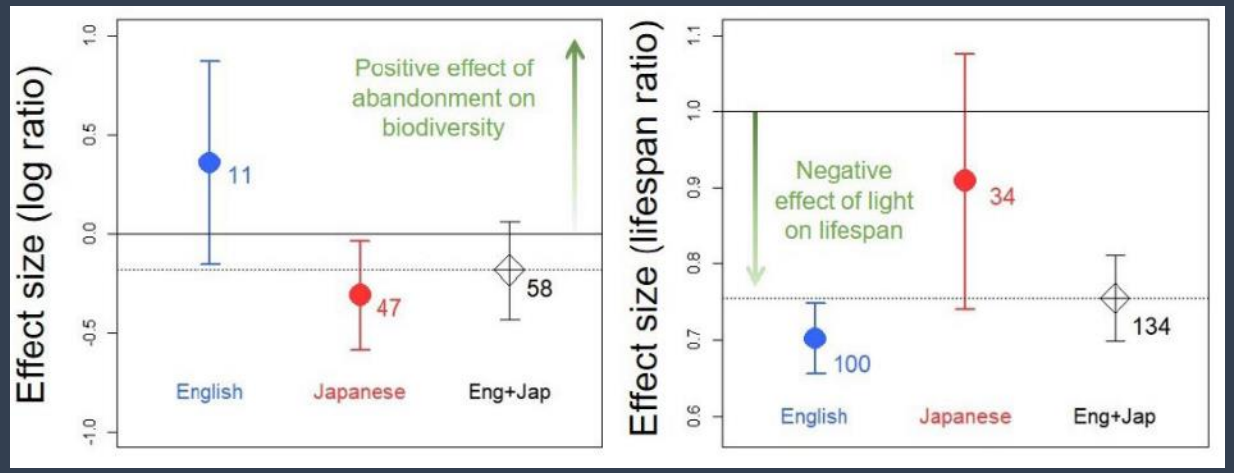
非英語のエビデンスを利用しないと生じる問題

2. 偏った理解をもたらす

エビデンスの集約における言語バイアス

統計結果の言語バイアス





Konno et al (2020) Ecology and Evolution

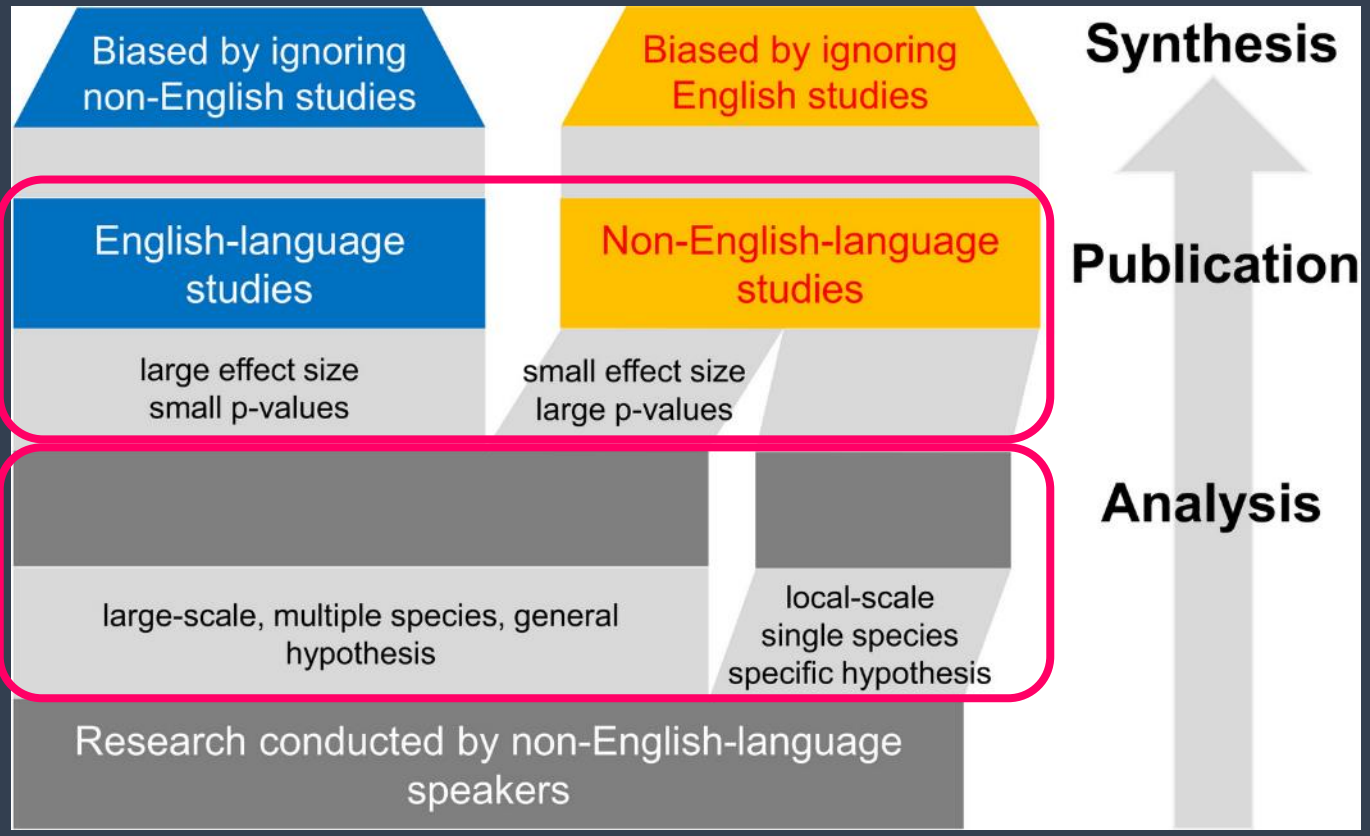
非英語のエビデンスを利用しないと生じる問題

2. 偏った理解をもたらす

エビデンスの集約における言語バイアス

統計結果の言語バイアス

研究対象の言語バイアス

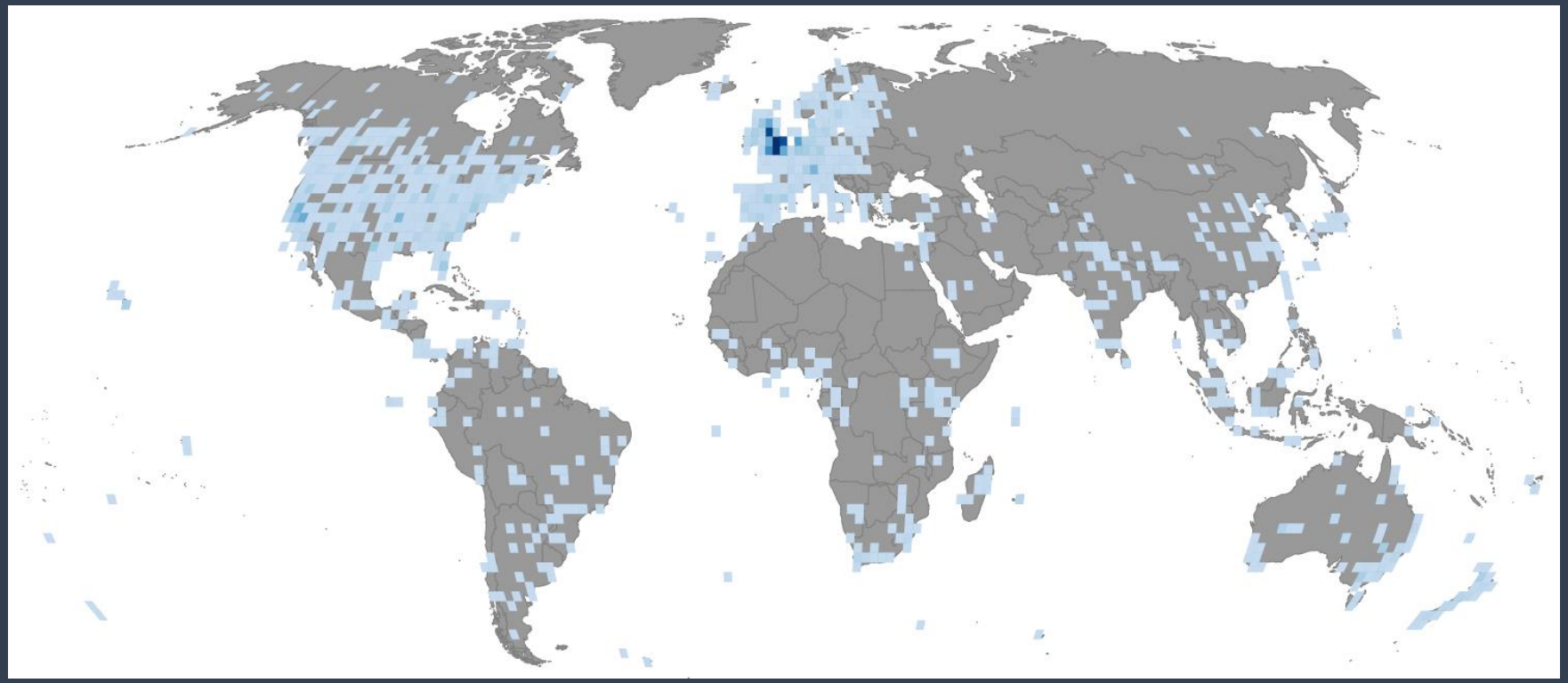


Konno et al (2020) Ecology and Evolution

非英語のエビデンスを利用しないと生じる問題

2. 偏った理解をもたらす

保全対策の効果を検証した英語論文の調査地



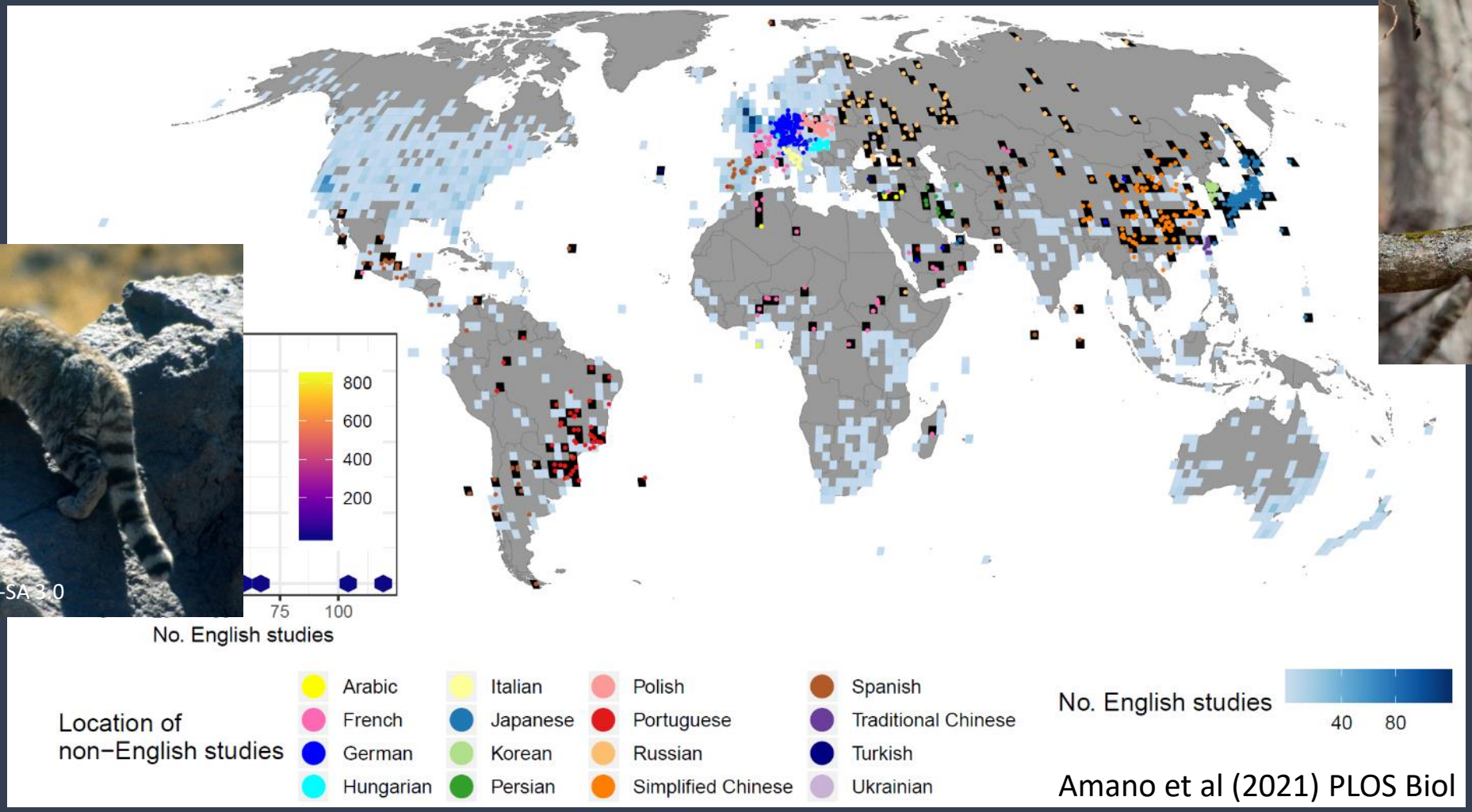
Conservation Evidence
Providing Evidence to Improve Practice

Christie et al (2021) Cons Biol

非英語のエビデンスを利用しないと生じる問題

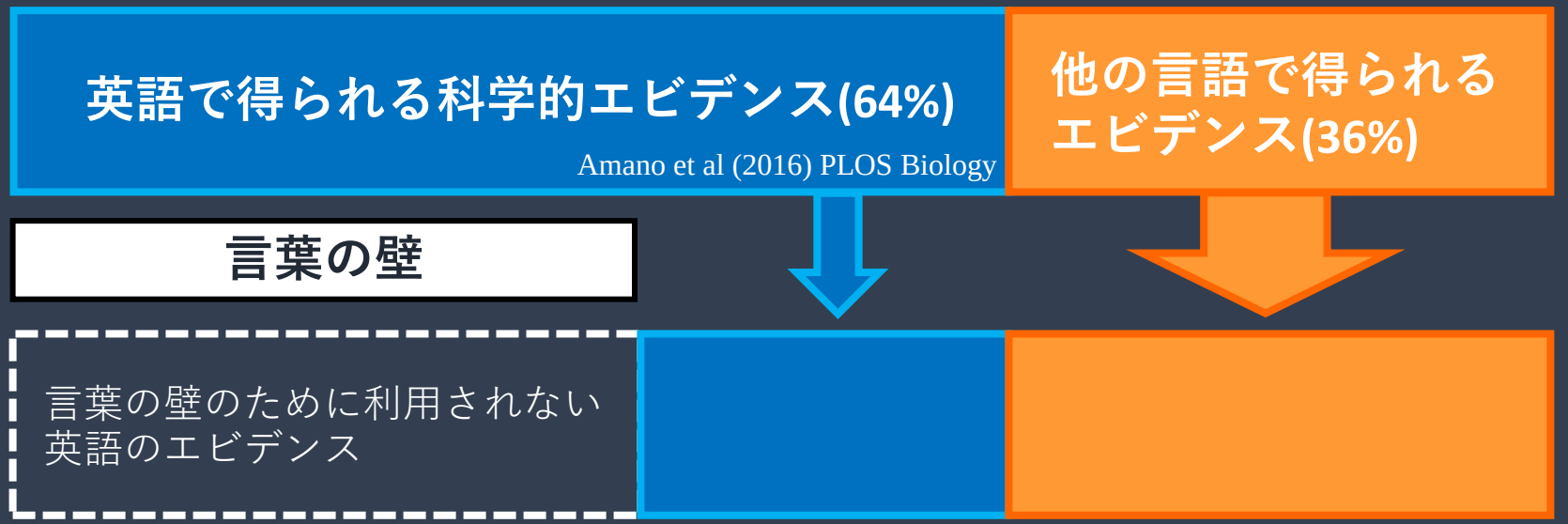
2. 偏った理解をもたらす

保全対策の効果を検証した英語論文と非英語論文の調査地比較



Amano et al (2021) PLOS Biol

各地域でのエビデンス活用に対する言葉の壁



各地域でのエビデンスの活用

translate

Transcending language barriers to environmental sciences

translatesciences.com

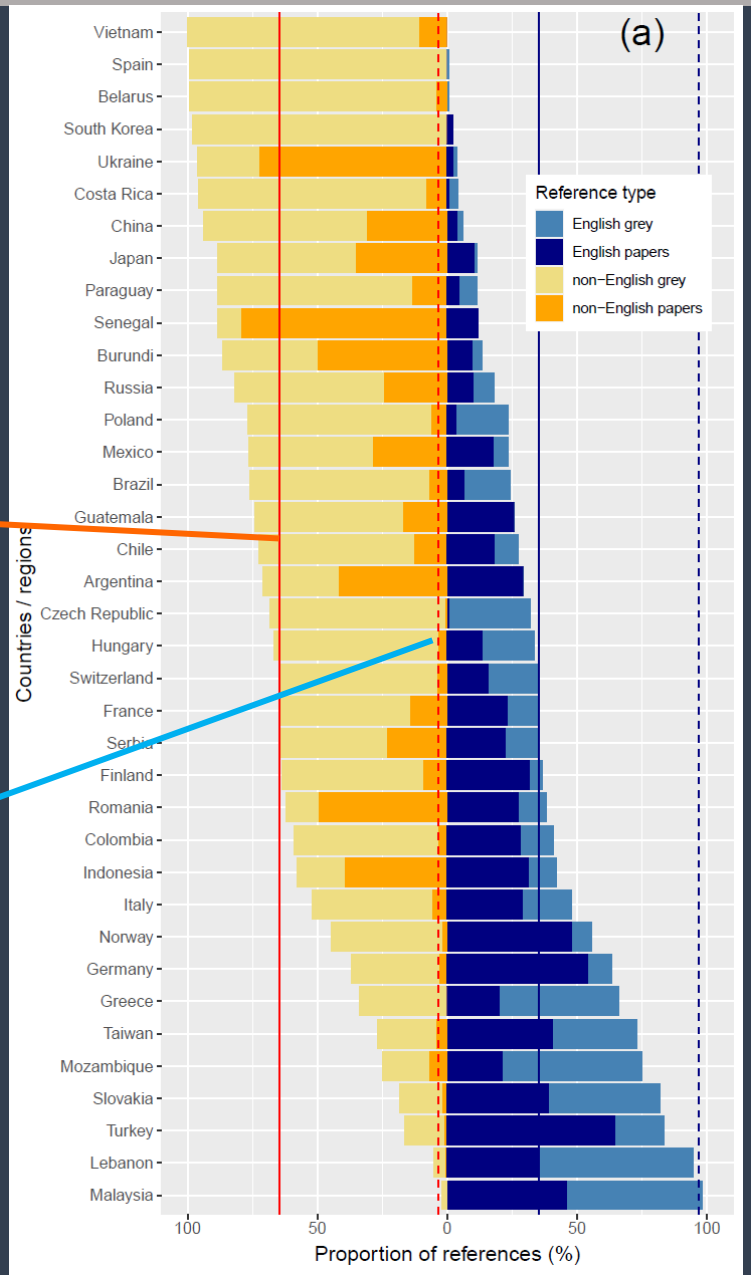
Amano (2024) figshare. https://doi.org/10.6084/m9.figshare.25669866

各地域でのエビデンス活用に対する言葉の壁

英語が公用語でない37の国・地域で発行された
生物多様性に関するレポートで引用されている
英語文献と**非英語文献**の割合

各レポートで引用されている文献の平均
65%が非英語文献

IPBESのレポートでは引用文献の平均
3.4%のみが非英語文献

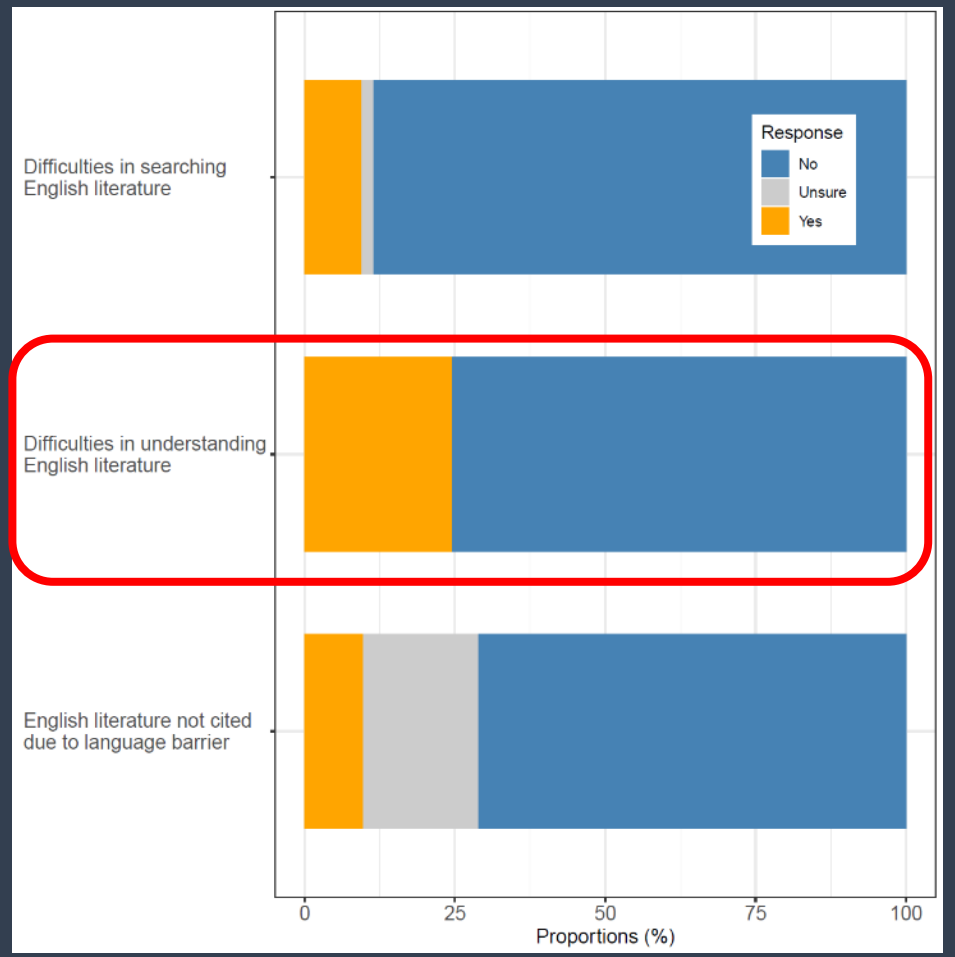


Amano et al (2023) Nature Sustainability

各地域でのエビデンス活用に対する言葉の壁

75%のレポート著者が非英語の文献を重要な情報源と認識

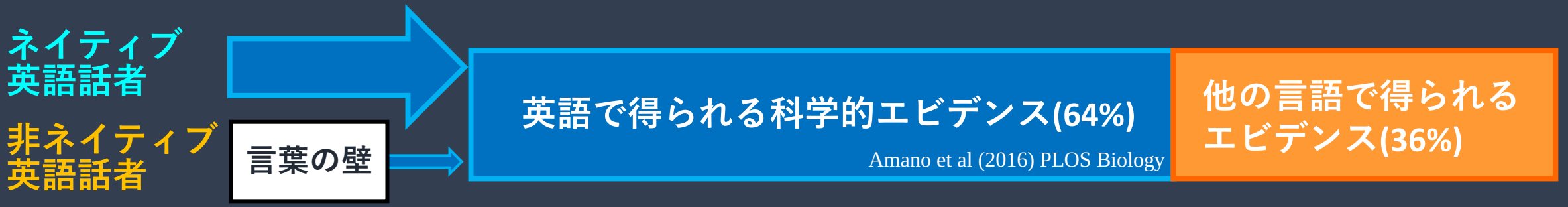
25%のレポート著者が英語文献の理解に苦労したと回答



Amano et al (2023) Nature Sustainability

英語が母語でない研究者によるエビデンス創出に対する言葉の壁

エビデンスの創出



translate

Transcending language barriers to environmental sciences

translatesciences.com

Amano (2024) figshare. https://doi.org/10.6084/m9.figshare.25669866

英語が母語でない研究者によるエビデンス創出に対する言葉の壁

英語論文の理解

Trends in Ecology & Evolution

CellPress

Scientific Life

A solution for breaking the language barrier

Rassim Khelifa[1,2,3,8,*,@], Tatsuya Amano,[4,5] and Martin A. Nuñez[6,7]

Global problems require global scientific solutions, but the dominance of the English language creates a large barrier for many non-English-proficient researchers to make their findings and knowledge accessible globally. Here, we propose integrating peer language

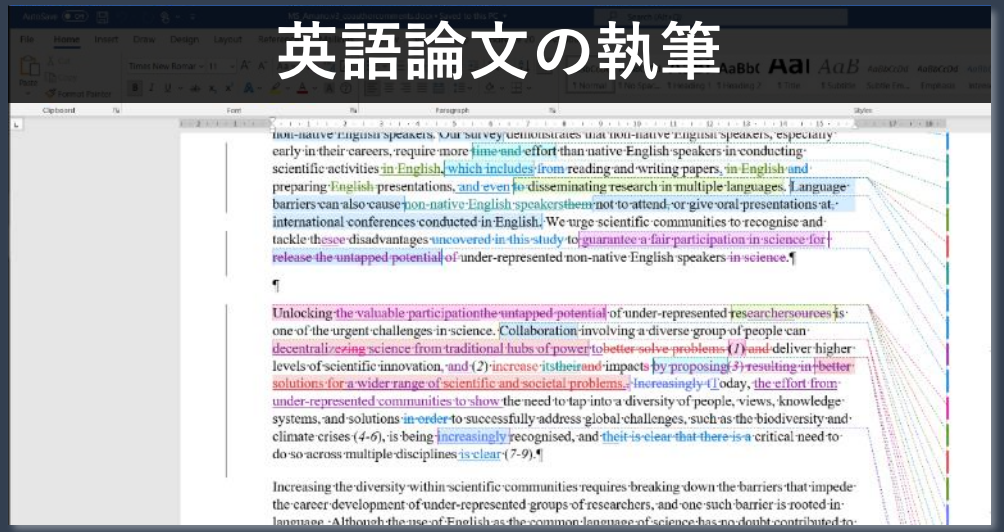
and disseminate their research, impeding the contribution of non-native English speakers to addressing global challenges that require a global perspective. The language barrier also hinders many non-native English-speaking researchers from obtaining essential scientific knowledge [5], posing major obstacles to their career development [6,7]. Nevertheless, scientific communities rarely provide genuine support for non-native English speakers [8]. While recent calls have highlighted the need for urgent measures to increase the representation of non-native English-speaking scientists and to solve inequalities driven by the monolingual system [9–11], we still lack viable long-term solutions to

texts. Although there have been some initiatives from some journals to address the language barrier for authors (e.g., buddy/mentoring systems, abstracts and/or main texts in non-English languages in journals such as *Biotropica*, *Nature*, *PLoS Biology*, and *Biological Conservation*), there have been few centralized systems that allow English-proficient researchers to provide peer language proofing to non-English speaking researchers while receiving recognition for their services.

Peer language proofing in preprint repositories

Preprints repositories, such as bioRxiv, have revolutionized scientific research

英語論文の執筆



non-native English speakers. Our survey demonstrates that non-native English speakers, especially early in their careers, require more time and effort than native English speakers in conducting scientific activities in English, which includes from reading and writing papers, in English and preparing English presentations, and even to disseminating research in multiple languages. Language barriers can also cause non-native English speakersthem not to attend or give oral presentations at international conferences conducted in English. We urge scientific communities to recognise and tackle thesee disadvantages uncovered in this study to guarantee a fair participation in science for release the untapped potential of under-represented non-native English speakers in science.¶

¶

Unlocking the valuable participationthe untapped potential of under-represented researchersources is one of the urgent challenges in science. Collaboration involving a diverse group of people can decentraliz/ezing science from traditional hubs of power to better solve problems (*1*) and deliver higher levels of scientific innovation, and (*2*) increase itstheir and impacts by proposing (*3*) resulting in better solutions for a wider range of scientific and societal problems. Increasingly t Today, the effort from under-represented communities to show the need to tap into a diversity of people, views, knowledge systems, and solutions in order to successfully address global challenges, such as the biodiversity and climate crises (*4-6*), is being increasingly recognised, and theit is clear that there is a critical need to do so across multiple disciplines is clear (*7-9*).¶

Increasing the diversity within scientific communities requires breaking down the barriers that impede the career development of under-represented groups of researchers, and one such barrier is rooted in

英語論文の出版

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Home Page for Dr Tatsuya Amano

Author Tasks

Submit a new manuscript

Live Manuscripts (1)

Post Decision Manuscripts (2)

General Tasks

Modify Unavailability Dates

Log into My Account

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英語での発表・アウトリーチ

英語が母語でない研究者によるエビデンス創出に対する言葉の壁

英語で科学を行うために必要な努力量を定量化する調査

英語レベルと経済レベルを基に選んだ８か国が対象

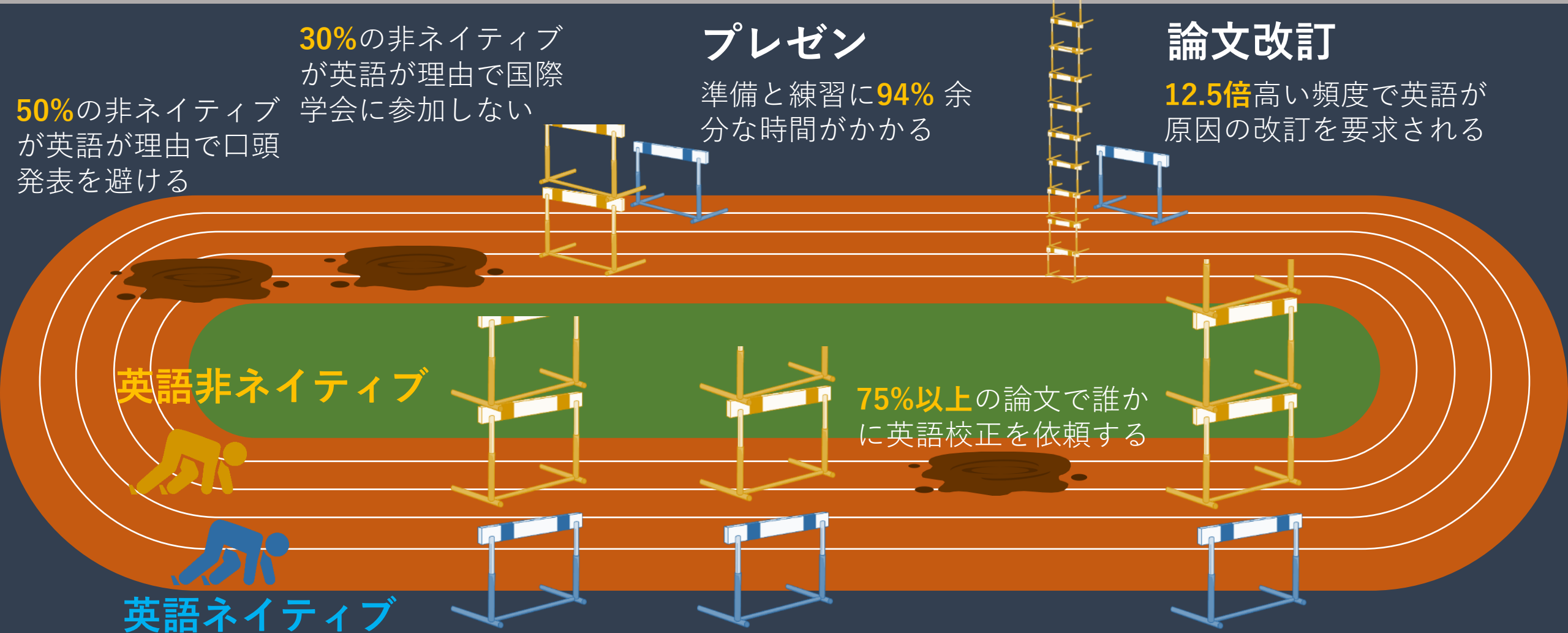
筆頭著者論文を英語で一本以上発表したことのある908人の環境科学者が参加

	英語レベル：低	英語レベル：中	英語が公用語
経済レベル：低ー中	バングラデシュ (108) ネパール (82)	ボリビア (100) ウクライナ (66)	ナイジェリア (40)
経済レベル：高	日本 (294)	スペイン (108)	英国 (112)

カッコ内は調査参加者数

Amano et al (2023) PLOS Biology

英語が母語でない研究者によるエビデンス創出に対する言葉の壁



50%の非ネイティブが英語が理由で口頭発表を避ける

30%の非ネイティブが英語が理由で国際学会に参加しない

プレゼン

準備と練習に**94%** 余分な時間がかかる

論文改訂

12.5倍高い頻度で英語が原因の改訂を要求される

英語非ネイティブ

英語ネイティブ

75%以上の論文で誰かに英語校正を依頼する

論文読解

91% 余分な時間がかかる

論文執筆

51% 余分な時間がかかる

論文の却下

2.6倍高い頻度で英語が原因のリジェクトを経験

Values are for those with one publication
Amano et al (2023) PLOS Biology

どのようにして保全における言葉の壁を克服できるか？

科学における言葉の壁を克服するための10のヒント

エビデンス集約に対する言葉の壁

1. 研究成果を多言語で発信する
2. 多言語の科学的知識を利用する
3. 英語以外の言語で書かれた科学の可視性を高める

エビデンス利用に対する言葉の壁

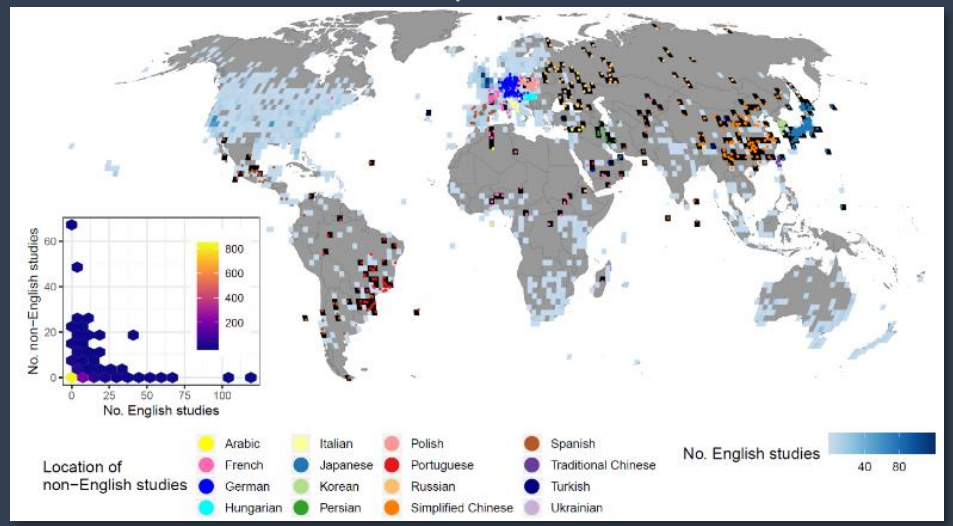
4. 科学用語を翻訳する

エビデンス創出に対する言葉の壁

5. 英語が第一言語でない人へ真のサポートを提供する
6. 言語能力と科学の質を区別する
7. 科学的活動における言語バランスを考慮する
8. 言語の壁を克服するための努力を評価する
9. ネイティブでない人に配慮する
10. 既存のリソースや機会を利用する

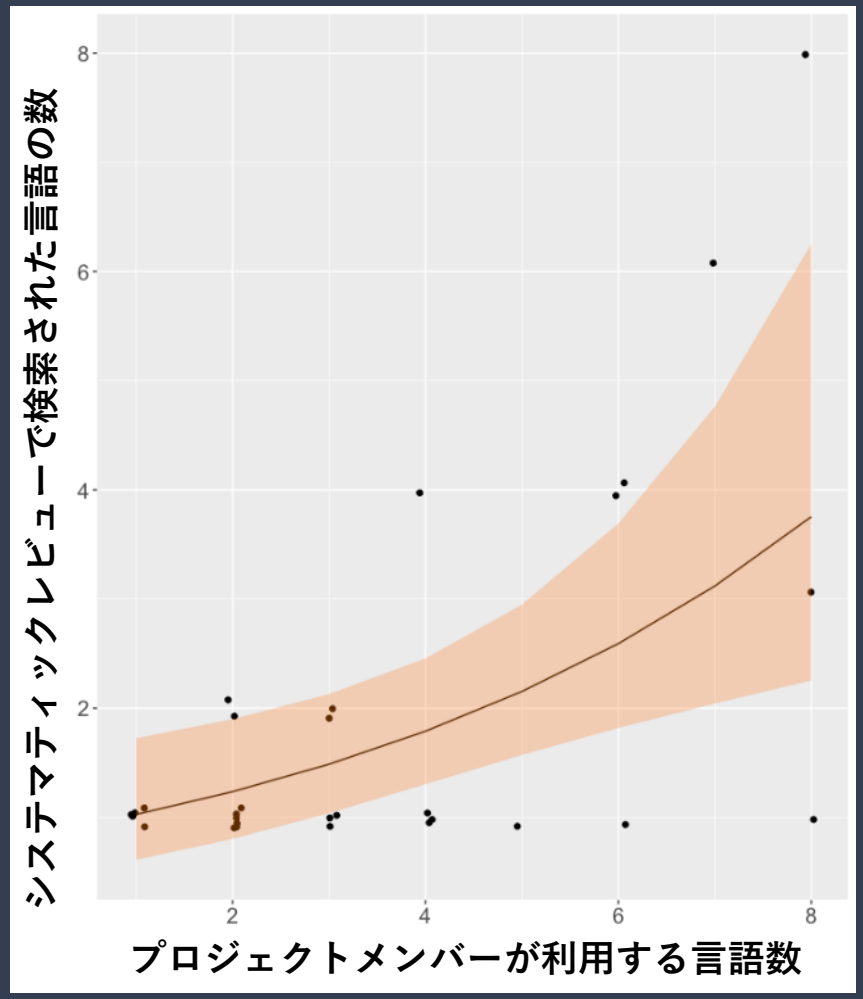
Amano et al (2021) Nature Human Behaviour

多言語の科学的知識を利用する



Amano et al (2021) PLOS Biol

言語的に多様なプロジェクトチームほど、システマティックレビューで多くの言語を対象に検索する



Hannah et al (2024) Research Synthesis Methods

多言語の科学的知識を利用する

生態学・保全分野における英語以外の言語で出版されている466の学術誌リスト

Language	Country/Region	Journal title in English	Journal title in the non-English language	First publication year	Latest publication year	URL
Arabic	Lebanon	Journal of King Abdulaziz University .Environmental Design Science	مجلة جامعة الملك عبد العزيز: علوم تصاميم البيئة	2003	2017	https://
Arabic	Lebanon	The Arab Journal for Arid Environments	المجلة العربية للبيئات الجافة	2009	2018	https://
Arabic	Lebanon	Afak Ilmia journal	مجلة آفاق علمية	2017	2020	https://
Arabic	Lebanon	Marsh Bulletin	مجلة الاهوار	2006	2020	https://
Arabic	Lebanon	Journal of Agricultural, Environmental and Veterinary Sciences	مجلة العلوم الزراعية والبيئية والبيطرية	2017	2020	https://
Arabic	Lebanon	Baghdad Science Journal	مجلة بغداد للعلوم	2004	2020	http://b
Arabic	Lebanon	Journal of King Abdulaziz University: Economics and Administration	مجلة جامعة الملك عبدالعزيز: الاقتصاد والإدارة	1988	2020	https://
Arabic	Lebanon	Journal of King Abdulaziz University: Marine Sciences	مجلة جامعة الملك عبدالعزيز: علوم البحار	1990	2018	https://
Arabic	Lebanon	Tishreen University Journal for Research and Scientific Studies - Biologi	ة تشرين للبحوث والدراسات العلمية _ سلسلة العلوم البيولوجية	2001	2020	http://e
Arabic	Lebanon	Journal of Marine Sciences and Environmental Techniques	مجلة علوم البحار والتقنيات البيئية	2015	2019	https://
Arabic	Lebanon	Journal of thi-qar science	مجلة علوم ذي قار	2008	2018	http://v
Arabic	Lebanon	Journal of Plant Protection	مجلة وقاية النبات العربية	1983	2020	https://
Dutch	Belgium		Mededelingen van de Faculteit Landbouwwetenschappen Universiteit Gent			https://
Dutch	Netherlands		Natuurhistorisch Maandblad			
Finish	Finland		Memoranda Societatis pro Fauna et Flora Fennica			
French	Africa	African Agronomy	Agronomie Africaine	2000	2019	https://
French	Canada	The Canadian Naturalist	Le Naturaliste Canadien	1868	2020	https://
French	France	Alauda	Alauda	1929	2020	https://
French	France	Rural alternatives	Alternatives rurales	2014	2019	http://a
French	France	Annals of the national water and forest school and of the research and	Annales de l'école nationale des eaux et forêts et de	1923	1963	http://d
French	France	Scientific annals of Limousin	Annales Scientifiques du Limousin	1985	2019	https://
French	France	Biotechnology, Agronomy, Society and Environment	Biotechnologie, Agronomie, Société et Environneme	2004	2020	https://
French	France	Tropical Woodlands and Forests	Bois et Forêts des Tropiques	1947	2020	https://
French	France	Bulletin of the French herpetological society	Bulletin de la société herpétologique de France	1976	2020	http://b
French	France	Bulletin of the Vaud Natural Sciences Society	Bulletin de la Société Vaudoise des Sciences Nature	1864	2019	https://
French	France	Bulletin of the French zoology Society	Bulletin de la Société zoologique de France	1876	2020	http://s
French	France		Bulletin FranÃ§ais de la PÃªche et de la Pisciculture			
French	France	Scientific Letters from the regional natural Park of Luberon et and the L	Courrier scientifique du Parc naturel régional du Lub	1997	2016	http://d
French	France	Ecologia mediterranea	Ecologia mediterranea	1975	2020	https://
French	France	Ecological science	Écoscience	2015	2020	https://
French	France	Applied aquatic ecology	Hydroécologie Appliquée	1989	2018	https://
French	France	Earth and life	La terre et la vie (Revue d'écologie)	1931	2018	http://d
French	France	Lambillionea	Lambillionea	1900	2020	http://v
French	France	The avocet	L'avocette	1976	2012	http://v
French	France	Naturae	Naturae	2017	2020	http://s
French	France	Nature Sciences Society	Natures Sciences Sociétés	1993	2019	https://
French	France		Rencontre Recherche Ruminants			
French	France	Journal of soil studies and management	Revue Étude et Gestion des Sols	1994	2020	https://
French	France	French forestry journal	Revue forestière française	1949	2019	http://d
French	France	Water and Land Sciences	Sciences Eaux et Territoires	2010	2020	http://v
French	France	Scientific reports of the Vanoise national park	Travaux scientifiques du Parc national de la Vanoise	1970	2009	http://v
French	France	Scientific reports of the Port-Cros national park	Travaux Scientifiques du Parc National de Port-Cros	1975	2019	http://v

README | Collaborators | List of journals

https://translatesciences.com/resources/#non-english-journals

各言語で主に用いられている文献検索システム

Language	Database	URL
Spanish	SciELO	https://scielo.org/en
Portuguese	SciELO	https://scielo.org/en
Chinese (Simplified)	CNKI	https://cnki.net/
Chinese (Traditional)	Airiti Library	https://www.airitilibrary.com/
French	Persee	https://www.persee.fr/
German	BASE	https://de.base-search.net/
Japanese	J-Stage	https://www.jstage.jst.go.jp/browse/-char/en
Korean	Korean Citation Index	https://www.kci.go.kr/kciportal/main.kci?locale=en
Polish	Polska Bibliografia	https://pbn.nauka.gov.pl/core/#/home

Chowdhury et al (2021) Conserv Biol

Box 1. Strategies for and challenges in synthesising non-English-language literature

Searching effectively and understanding non-English-language literature can be a challenging task, with the lack of relevant language skills often being a key reason for excluding non-English-language literature in evidence synthesis [8]. Here, we summarise how we can practically synthesise non-English-language literature under such restrictions.

How to choose languages

Including more languages would make a synthesis more comprehensive, but given that

Amano et al (2021) PLOS Biology

研究成果を多言語で発信する

Ecological Solutions and Evidence | AER Applied Ecology Resources | BRITISH ECOLOGICAL SOCIETY

REVIEW | Open Access

Training future generations to deliver evidence-based conservation and ecosystem management

Harriet Downey, Tatsuya Amano, Marc Cadotte, Carly N. Cook, Steven J. Cooke, Neal R. Haddaway, Julia P. G. Jones, Nick Littlewood, Jessica C. Walsh, Mark I. Abrahams ... See all authors

First published: 25 January 2021 | https://doi.org/10.1002/2688-8319.12032

Handling Editor: Costanza Rampini

SECTIONS PDF TOOLS SHARE

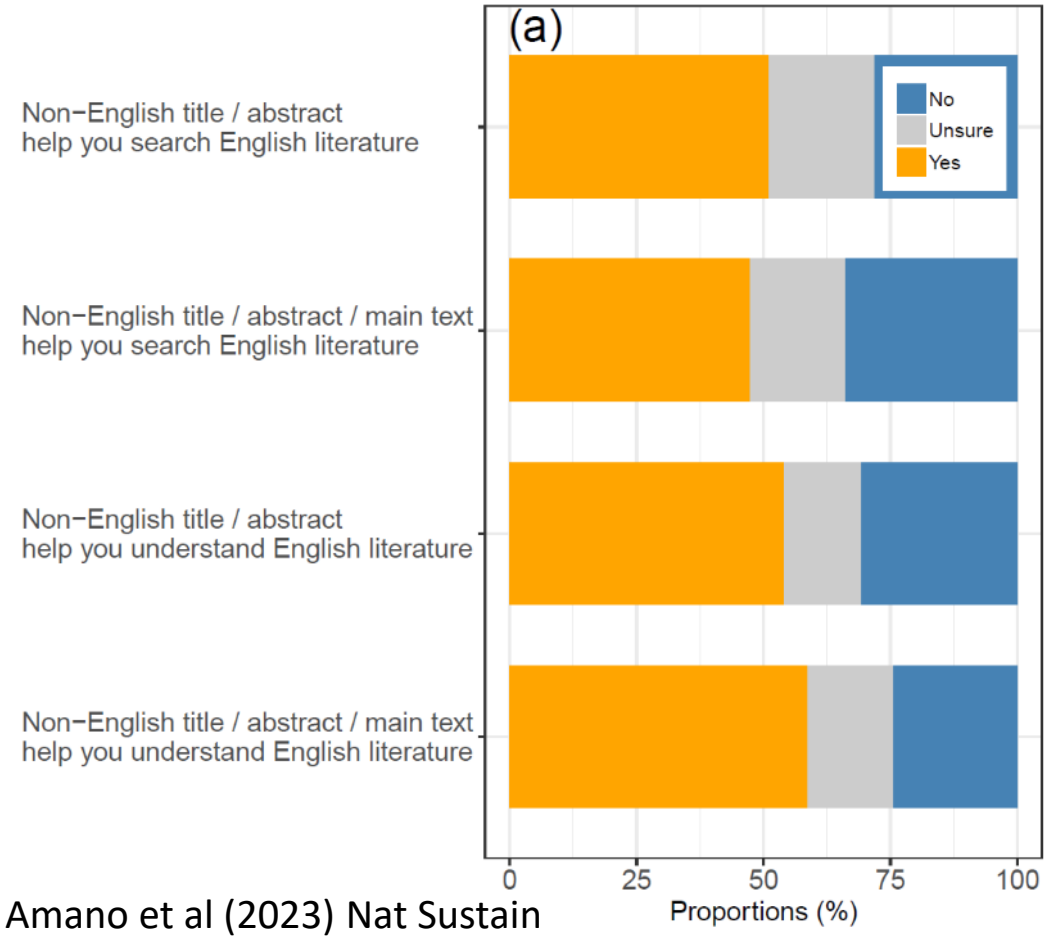
Abstract EN ES DE JA ZH-HANT PT FR

エビデンスに基づいた保全と生態系管理を促進するための次世代教育

1. 生物多様性をより効果的に保全していくために、次世代の実務者はエビデンスに基づいた意思決定の方法とエビデンスを統合することの価値を深く理解し、また批判的な思考を備える必要がある。

2. 生物多様性保全に関する教育課程においてこの課題を取り扱わなければ、現在の学生が今後の保全活動に対して効果的な貢献を行うようにはならないだろう。

生物多様性に関する国レベルの報告書の著者の約半数が、英語以外の言語の論文タイトルと要旨があると内容の理解に助かると回答

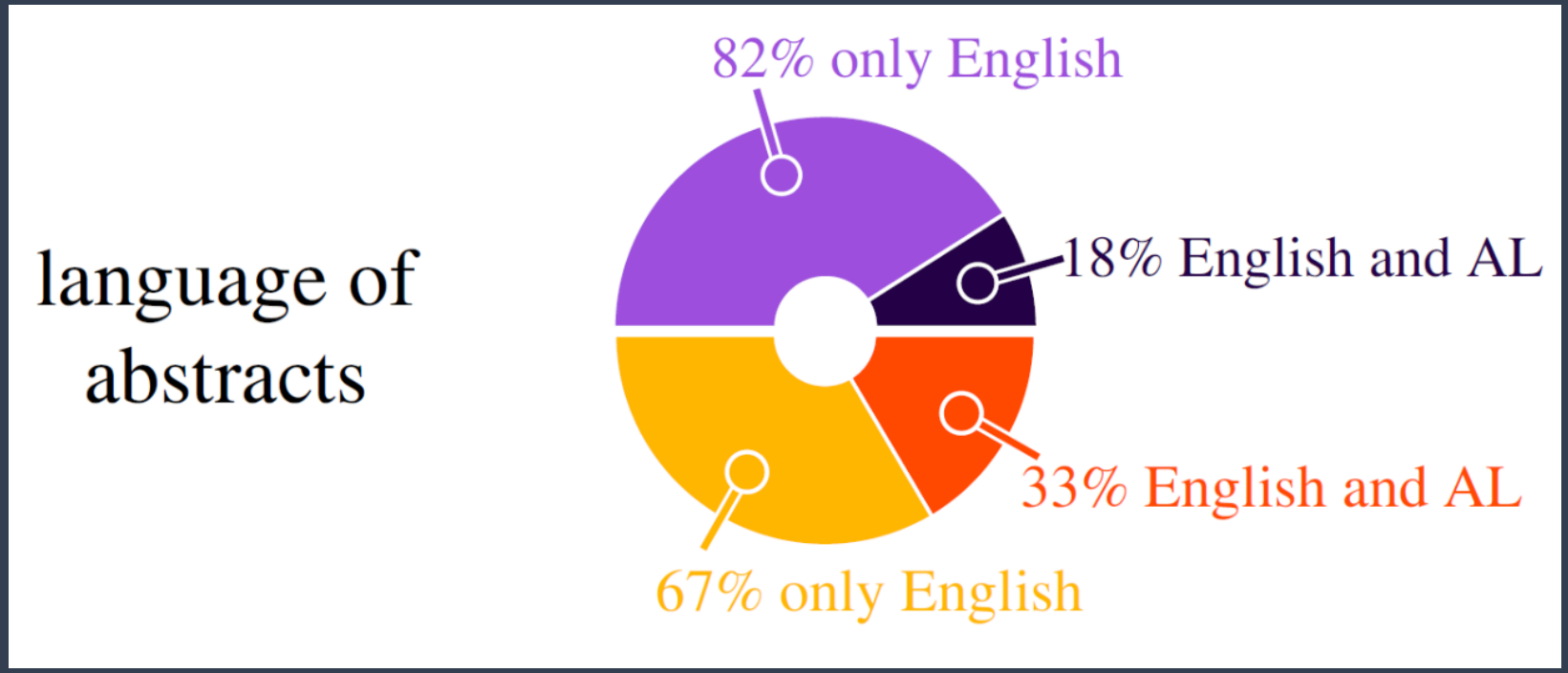


Amano et al (2023) Nat Sustain

研究成果を多言語で発信する

生物科学分野・736の学術誌を対象とした調査

- 18%の雑誌が投稿規定で英語以外の言語の要旨掲載を認めると明記
- 33%の雑誌の編集長が、要求があった場合、英語以外の要旨掲載を認めると回答



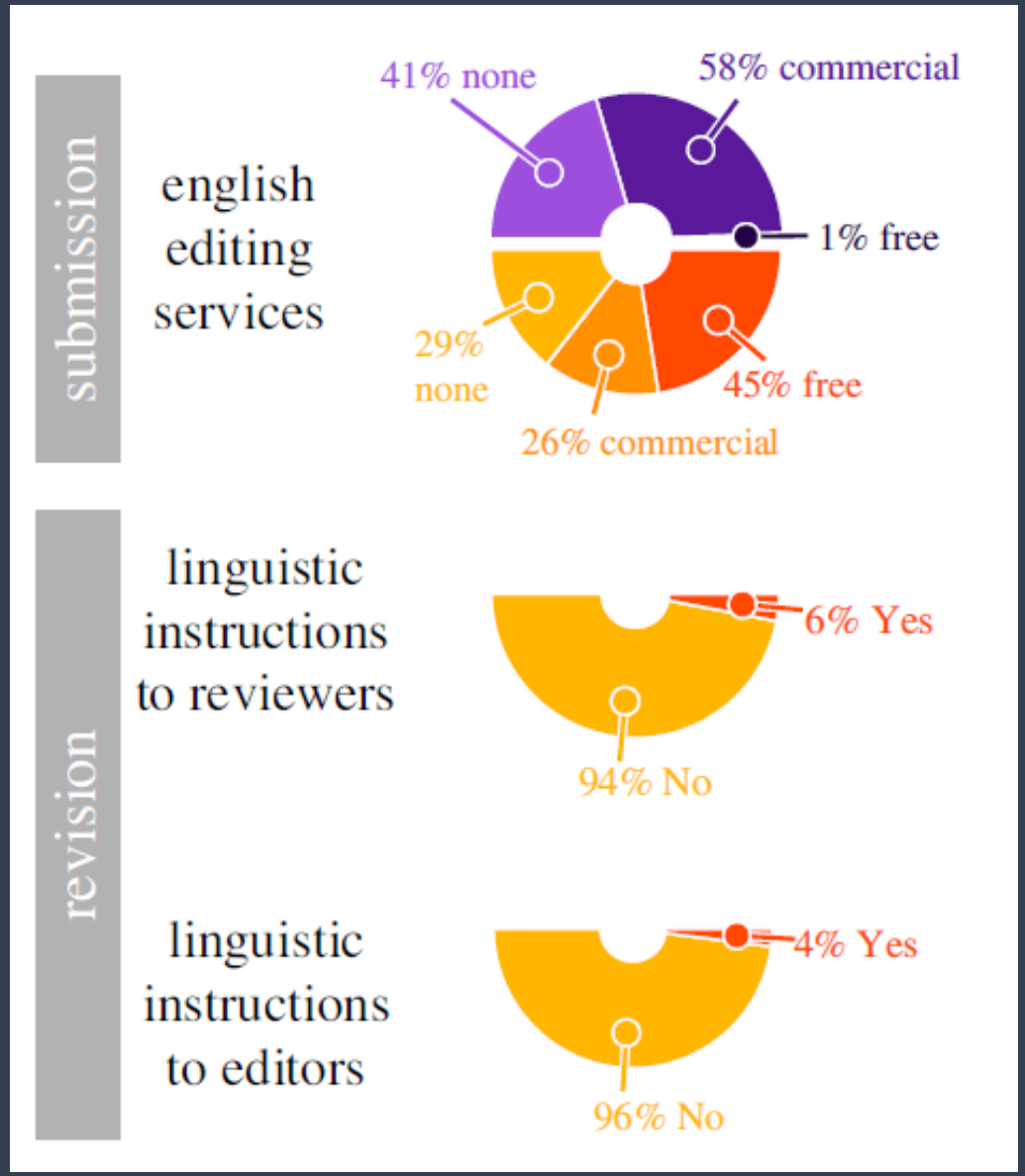
Arenas-Castro et al (2024) Proc R Soc B

研究者に対する英語の壁に学界全体で取り組む

	論文読解	論文執筆・出版	普及活動	国際会議の参加
指導教官 共同研究者	▪ 非ネイティブは英語論文の読解に時間がかかることを認識する ▪ 適切なAIツールの利用を考える	▪ 非ネイティブは英語論文の執筆に時間がかかることを認識する ▪ 英語校正を行う/非ネイティブのサポートをする人を見つける ▪ 適切なAIツールの利用を考える	▪ 複数言語で行う研究の普及活動を評価し、金銭面で支援し、また実際に行う努力をする	▪ 英語発表を準備する際に英語校正を行う
大学 機関	▪ 英語読解のトレーニングを行う機会を提供する ▪ 学生の第一言語での教材を教育に組み込む	▪ 英語執筆のトレーニングを行う機会を提供する ▪ 助成金の設立などにより英語校正や翻訳を金銭的に支援する	▪ 複数言語で行う研究の普及活動を評価し、金銭面で支援し、また実際に行う努力をする	▪ プレゼンテーションの英語校正や翻訳を金銭的に支援する
学術誌	▪ 著作権の放棄などを通して、英語論文の翻訳出版を支援・奨励する	▪ 科学の質にのみ基づいた論文評価を行うための指針（ダブルブラインド・レビューを含む）を策定する ▪ 非ネイティブのサポートをする人を見つける仕組みを確立する ▪ 適切なAIツールの利用を考える	▪ 英語論文の非英語要旨を提供・奨励する ▪ 複数言語での研究の普及活動を支援し、また実際に行う（例：ソーシャルメディアなど）	
資金提供者	▪ 教育を目的とした書籍や原著論文の翻訳に対して資金を提供する。	▪ 特に低所得地域の研究者やキャリア初期の研究者を支援するために、英語校正や翻訳を対象とした助成金を設立する	▪ 複数言語で研究の普及活動を行う計画を評価し、資金を提供する	▪ プレゼンテーションの英語校正や翻訳を対象とした助成金を設立する
学会			▪ 会議録を複数言語で出版する。	▪ 非ネイティブのサポートをする人を見つける仕組みを確立する ▪ 複数言語での発表を奨励する ▪ 言語の壁を考慮した指針を策定する

Amano et al (2023) PLOS Biology

研究者に対する英語の壁に学界全体で取り組む



生物科学分野・736の学術誌を対象とした調査

- 41%の雑誌が英語校正のサポート提供なし
- 58%の雑誌が有償サービスの紹介のみ

- 論文を英語の質だけで評価しないことを指導する査読者向けガイドラインが存在する雑誌は6%
- 編集者向けの同様のガイドラインが存在する雑誌は4%

Arenas-Castro et al (2024) Proc R Soc B

研究者に対する英語の壁に学界全体で取り組む

Evolution Journal
@journal_evo

EVOLUTION ENGLISH LANGUAGUE SUPPORT

We are launching a pilot program to provide cost-free language support to potential authors! We seek to appoint a coordinator and team of editors for this program. Coordinator applications due May 1!

evolutionsociety.org/news/display/2...
ツイートを翻訳

Wader Study
@WaderStudy

Why publish in Wader Study?
Language support – We particularly provide help to those whose first language is not English.
(3/9)
#waders #shorebirds #ornithology
ツイートを翻訳

Animal Behavior Society
@AnimBehSociety

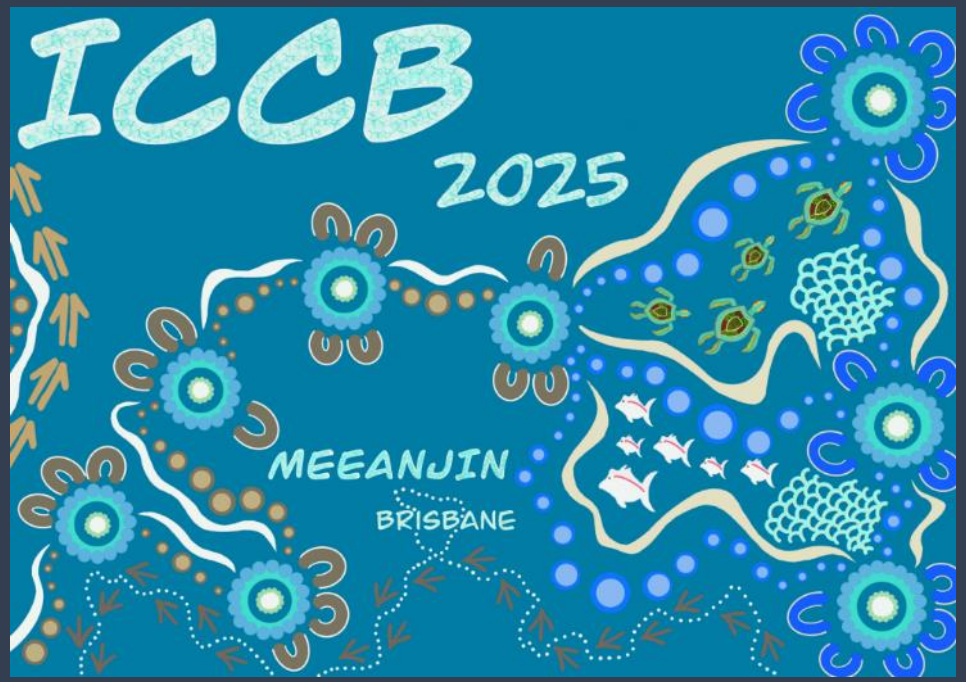
New this year at #ABS2022: Multilingual Buddy Program!

In an effort to promote #inclusivity, we are starting a Multilingual Buddy Program at #ABS2022 as a way to make this meeting #accessible for people not fluent in English.

Sign up here by March 25th: bit.ly/3IWWOPX
ツイートを翻訳

研究者に対する英語の壁に学界全体で取り組む

国際保全生物学会議 2025 理念表明



ICCB2025 では英語が共通言語として用いられることとなります。しかし、英語以外の多くの言語でも生物多様性保全が実践され、情報がやり取りされていることを踏まえ、本大会にはあらゆる言語的背景を持つ方々に是非参加していただきたいと考えています。特に第一言語が英語でない人の場合、国際学会の参加と聞くと気後れしてしまうかもしれません。そこで ICCB2025 では、参加者に対する言葉の壁を最小限にすることに注力しています。現在、多様な言語的背景をもつ参加者をどのようにサポートすることができるか検討中で、多様なコミュニティに対する私たちのコミットメントを共有し、紹介できることを楽しみにしています。

https://conbio.org/conferences/iccb-2025/

AIの役割

1 AUGUST 2022 / PUBLISHERS

British Ecological Society integrates Writefull into submission system

The British Ecological Society, the oldest ecological society in the world, has integrated Writefull into its manuscript submission system. Submitting authors can now use Writefull's language revision free of charge. The British Ecological Society joins other publishers, such as Hindawi, Cambridge University Press, and Karger, in an effort to reduce the language barrier for authors.

Authors who are submitting their manuscript are invited to use Writefull Revise, a web app where they can upload their document, and download a revised version with Writefull's language edits in Track Changes. The language suggestions, provided by Writefull's language models, are tailored to research writing.

Through this integration, the British Ecological Society offers language and writing support to all authors who may need it. As the Society writes: "The expectation for authors to publish in English can be a significant barrier for researchers whose native language is not English. It can also lead to significantly longer times in peer review if Editors also have to return papers to authors where the language isn't of the required

Springer Nature introduces Curie, its AI-powered scientific writing assistant

London | Berlin | New York, 13th October 2023

Springer Nature today announced a new AI-powered in-house writing assistant to support researchers, particularly those whose first language is not English, in their scientific writing.

Global research shows that it takes non-native English speaking scientists 51% more time to write a paper (1). This creates an unequal divide in research, limiting the advancement of knowledge and impacting the submission of high quality research from across the globe.

Curie is our response. It has been specifically trained on academic literature, spanning 447+ areas of study, more than 2,000 field-specific topics and on over 1 million edits on papers published including those in leading Nature journals. It combines the power of large language models (LLMs) with specialised AI digital editing developed in-house and designed specifically for scientific writing. Unlike generalist AI writing apps, *Curie* focuses on the unique pain points of researchers in their professional writing, including translation to English and English language editing to address grammatical errors and improve phrasing and word choice.

When the service was trialed with researchers in China publishing in *Scientific Reports* and the *Discover Series*, of the 67% of authors who used the tool, 90% subsequently saw their manuscript proceed to peer review, with a 14% increase in articles published at the end of the trial (2).

Eugenie Regan, Vice President, Research Solutions at Springer Nature said:

"By evolving our digital experiences to meet the needs of, and support all researchers, we can save them time, enabling them to focus their efforts where they can have the biggest impact - on the groundbreaking research that advances knowledge and propels society forward."

AIの役割

EDITORIAL

ChatGPT is fun, but not an author

In less than 2 months, the artificial intelligence (AI) program ChatGPT has become a cultural sensation. It is freely accessible through a web portal created by the tool's developer, OpenAI. The program—which automatically creates text based on written prompts—is so popular that it's likely to be "at capacity right now" if you attempt to use it. When you do get through, ChatGPT provides endless entertainment. I asked it to rewrite the first scene of the classic American play *Death of a Salesman*, but to feature Princess Elsa from the animated movie *Frozen* as the main character instead of Willy Loman. The output was an amusing conversation in which Elsa—who has come home from a tough day of selling—is told by her son Happy, "Come on, Mom. You're Elsa from *Frozen*. You have ice powers and you're a queen. You're unstoppable." Mash-ups like this are certainly fun, but there are serious implications for generative AI programs like ChatGPT in science and academia.

ChatGPT (Generative Pre-trained Transformer) was developed with a technique called Reinforcement Learning from Human Feedback to train the language model, enabling it to be very conversational. Nevertheless, as the website states, "ChatGPT sometimes writes plausible-sounding but incorrect or nonsensical answers." Several examples show glaring mistakes that it can make, including referencing a scientific study that does not exist.

Many concerns relate to how ChatGPT will change education. It certainly can write essays about a range of topics. I gave it both an exam and a final project that I had assigned students in a class I taught on science denial at George Washington University. It did well finding factual answers, but the scholarly writing still has a long way to go. If anything, the implications for education may push academics to rethink their courses in innovative ways and give assignments that aren't easily solved by AI. That could be for the best.

More worrisome are the effects of ChatGPT on writing scientific papers. In a recent study, abstracts created by ChatGPT were submitted to academic reviewers, who only caught 63% of these fakes. That's a lot of AI-generated text that could find its way into the literature soon.

For years, authors at the *Science* family of journals have signed a license certifying that "the Work is an *original*" (italics added). For the *Science* journals, the word "original" is enough to signal that text written by ChatGPT is not acceptable: It is, after all, plagiarized from ChatGPT. Further, our authors certify that they themselves are accountable for the research in the paper. Still, to make matters explicit, we are now updating our license and Editorial Policies to specify that text generated by ChatGPT (or any other AI tools) cannot be used in the work, nor can figures, images, or graphics be the products of such tools. And an AI program cannot be an author. A violation of these policies will constitute scientific misconduct no different from altered images or plagiarism of existing works. Of course, there are many legitimate data sets (not the text of a paper) that are intentionally generated by AI in research papers, and these are not covered by this change.

> Machines play an important role, but as tools for the people posing the hypotheses... and making sense of the results."

Most instances of scientific misconduct that the *Science* journals deal with occur because of an inadequate amount of human attention. Shortcuts are taken by using image manipulation programs such as Photoshop or by copying text from other sources. Altered images and copied text may go unnoticed because they receive too little scrutiny from each of the authors. On our end, errors happen when editors and reviewers don't listen to their inner skeptic or when we fail to focus sharply on the details. At a time when trust in science is eroding, it's important for scientists to recommit to careful and meticulous attention to details.

The scientific record is ultimately one of the human endeavor of struggling with important questions. Machines play an important role, but as tools for the people posing the hypotheses, designing the experiments, and making sense of the results. Ultimately the product must come from—and be expressed by—the wonderful computer in our heads.

–H. Holden Thorp

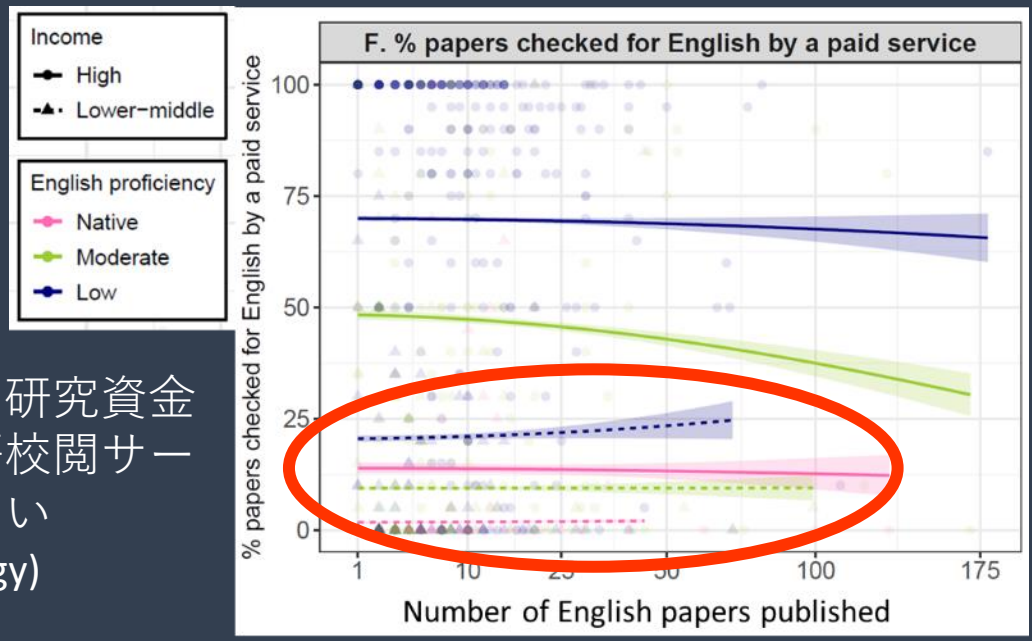
H. Holden Thorp
Editor-in-Chief,
Science journals.
hthorp@aaas.org;
@hholdenthorp

PHOTO: CAMERON DAVIDSON

10.1126/science.adg7879

we are now updating our license and Editorial Policies to specify that text generated by ChatGPT (or any other AI tools) cannot be used in the work, nor can figures, images, or graphics be the products of such tools.

H.H. Thorp, Editor-in-Chief of Science, 26 January 2023



低・中所得国の研究者は研究資金欠如のため、有償の英語校閲サービスをほとんど利用しない
(Amano et al 2023 PLOS Biology)

AIの役割

AI tools can improve equity in science

In his Editorial "ChatGPT is fun, but not an author" (27 January, p. 313), Editor-in-Chief H. H. Thorp describes *Science's* position on using artificial intelligence (AI) in scientific papers. The updated policy essentially bans the use of text generated from AI, machine learning, or similar algorithmic tools in articles. However, Thorp overlooks the potential of AI tools to improve equity in science by alleviating linguistic disparities.

Research has shown that nonnative English speakers need to invest much more effort than native English speakers when writing papers in English (*1*). Journals are more likely to reject or request revisions before acceptance of papers written by nonnative English speakers (*2*, *3*). Human English translation and editing services are costly and time-consuming (*4*), creating a profound disadvantage for the career development and fair participation of nonnative English speakers in science.

Emerging AI tools, such as ChatGPT and DeepL, can proofread English text with high accuracy (*5*, *6*). The availability of quality, free (or affordable) English editing presents an opportunity for nonnative English speakers, especially those in low-income countries, who often cannot afford to use human English editing services (*1*, *4*). Reducing the technical and financial burden of editing and proofreading papers for nonnative English speakers would be a substantial step toward achieving equity in science.

Our relationship with AI should be a partnership, not a competition. Journal policies should allow authors to use AI tools to edit and proofread their manuscripts. Journal editors can ensure that humans wrote the original text by using the detection tools available [e.g., (*7*)]. In addition, they can request that authors declare the use of AI tools, as *Nature* does (*8*), or submit the original version as well as the AI-edited version of the manuscript for full transparency. Regardless of whether they use AI tools, authors will always be responsible for the language used and the content in their final text.

Violeta Berdejo-Espinola* and Tatsuya Amano
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*Corresponding author.
Email: v.berdejoespinola@uq.edu.au

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4. V. Ramírez-Castañeda, *PLOS ONE* **15**, e0238372 (2020).
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7. J. Hendrik Kirchner, L. Ahmad, S. Aaronson, J. Leike, "New AI classifier for indicating AI-written text," *OpenAI* (2023); https://openai.com/blog/new-ai-classifier-for-indicating-ai-written-text/.
8. *Nature* **613**, 612 (2023).

10.1126/science.adg9714

Berdejo-Espinola & Amano (2023) Science

EDITOR'S BLOG | EDITORIAL POLICIES

Change to policy on the use of generative AI and large language models

16 NOV 2023 · 2:00 PM ET · BY H. HOLDEN THORP, AND VALDA VINSON · 2 MIN READ

The adoption of ChatGPT and related large language models to support research and generate scholarly content continues to accelerate. The policy for the *Science* family of journals has been that the use of these tools in research is acceptable as long as proper disclosure appears in the methods section. However, we initially took a very restrictive stance regarding the use of ChatGPT in preparing text and figures while monitoring thoughts and responses across the broad scientific community. As we said earlier this year, "… we believe it is prudent to wait until we have more clarity on what uses the scientific community will see as permissible."

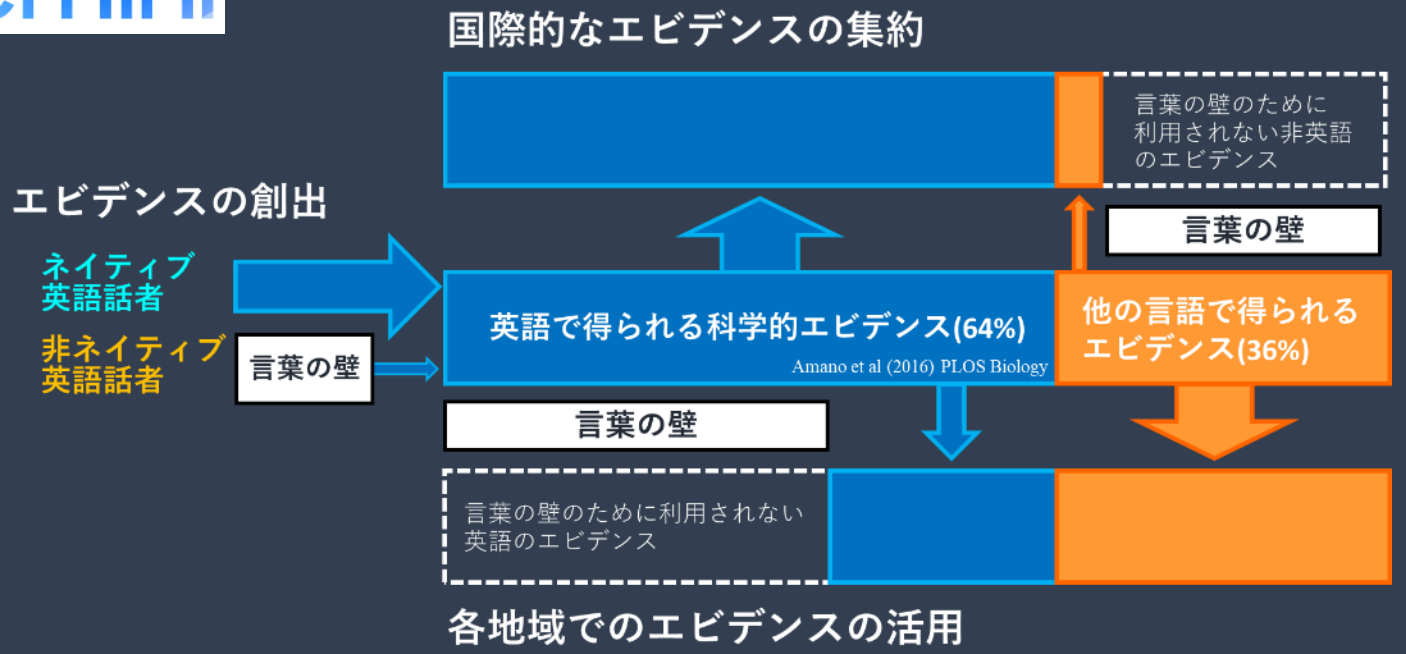
Artificial intelligence (AI). .... Authors who use AI-assisted technologies as components of their research study or as aids in the writing or presentation of the manuscript should note this in the cover letter and in the acknowledgments section of the manuscript. Detailed information should be provided in the methods section: The full prompt used in the production of the work, as well as the AI tool and its version, should be disclosed. Authors are accountable for the accuracy of the work and for ensuring that there is no plagiarism.

AIの役割

Claude

Gemini

Text classifiers based on multilingual models



Elicit

consensus

perplexity

Otter.ai

writefull

Paperpal

DeepL

PopAi

translatE プロジェクト | 言葉の壁が保全に及ぼす影響を理解する

Thanks to over 130 collaborators: https://translatesciences.com/people/

Ten tips for overcoming language barriers in science

1. Disseminate research in multiple languages
2. Use scientific knowledge sourced from multiple languages
3. Increase the visibility of non-English-language science
4. Translate scientific terms
5. Provide genuine support to non-native speakers
6. Distinguish language skills from scientific quality
7. Consider language balance in scientific activities
8. Acknowledge efforts to overcome language barriers
9. Be considerate of non-native speakers
10. Make use of existing resources and opportunities

Amano et al (2021) Nature Human Behaviour

translatE
Transcending language barriers to environmental sciences
translatesciences.com

Kaizen Conservation Group
kaizenconservation.com

Amano et al (2016, 2021, 2023) PLOS Biology
Amano et al (2023) Nature Sustainability
Arenas-Castro et al (2024) Proc R Soc B
Berdejo-Espinola & Amano (2023) Science
Chowdhury et al (2021) Conserv Biol
Hannah et al (2024) Res Synth Methods
Konno et al (2020) Ecology and Evolution
Lynch et al (2021) One Earth