Non-English languages enrich scientific knowledge: the example of economic costs of biological invasions

by

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STOTEN, Science of the Total Environment

Appendix S1

Appendix S1. Entries, documents and contributors (Table S1) **and details for each language search.** (a) Arabic, (b) Chinese, (c) Dutch, (d) English (InvaCost, Diagne et al. 2020), (e) French, (f) German, (g) Greek, (h) Hindi, (i) Japanese, (j) Portuguese, (k) Russian, (l) Spanish, (m) Ukrainian.

Table S1. Number of entries and documents for each language in the InvaCost Non-English database. Contributors for each language (and country or region) are included (initials).

LANGUAGES	Entries	Doc	Contributors
Chinese	117	33	CL- WX
French – (African countries)	1	1	CAKM
French – (African countries	31	17	GD - TA
French – (France)	1112	36	DRe – LBM - GD - TA
French - Wos	4	1	DRe
Spanish - Wos	5	4	EA- MN - DRo
Spanish – Spain	862	37	EA - LBM
Spanish – Spain (Valence)	2086	10	LBM – VGD - EA
Spanish – Latin America	336	46	VGD - LBM - EA - MN
Russian	89	4	NK - EAk
Portuguese	34	21	GH - CC
German	47	5	PJH - MG
Ukrainian	100	98	MG
Dutch	50	15	LV - PJH
Greek	10	6	MK
Japanese	328	22	YW
Hindi languages	0	0	AKB
Arabic	0	0	AT
Total	**5212**	**356**	

(a) Arabic search

a.1. *Search string for WoS Opportunistic search*

LANGUAGE: (Arabic) *AND* TOPIC: (econom* OR cost OR monetary OR dollar OR euro OR "sterling pound") *AND* TOPIC: (invasi* OR alien OR non-indigenous OR nonindigenous OR nonnative OR non-native OR exotic OR introduced OR naturali* OR invader) *NOT* TOPIC: (cancer* OR cardio* OR surg* OR carcin* OR engineer* OR rotation OR ovar* OR polynom* OR purif* OR respirat* OR "invasive technique" OR carbon OR fuel OR therap* OR vehicle OR cell* OR drug OR fitness OR "operational research" OR banking OR liberalization) .

No relevant articles

a.2. *Search string for Google, Google Scholar*

I (AT) searched for studies in the net (including google scholar), using every possible combination of the following words : « invasion, economic cost , invasive species, economics, economic impact, estimated cost» translated in Arabic.

a.3. *Opportunistic search*

I contacted by mailing and phoning many authorities in charge of biological invasion in various Arabic countries (ministerial services, research institutes, health safety service). For example in Morocco we contacted the Institut National de la Recherche Agronomique (INRA), l'Office National de Sécurité Sanitaire des produits Alimentaires (ONSSA), le Ministère de l'Agriculture, de la Pêche Maritime, du Développement Rurale et des Eaux et Forêts, du Haut-Commissariat aux eaux et Forêt et la Lutte contre la Désertification et l'Institut Agronomique et Vétérinaire Hassane II (IAV). I also browsed their official website in order to look for studies or reports about the related topic.

Furthermore, we searched in some Arabic journals of life sciences, animals, plants and environmental (www.dfaj.net), and contacted directly Arabic researchers in biology and environment in different countries that could have potential references.

(b) Chinese search

b.1. *Search string for WoS*

LANGUAGE: (Chinese) *AND* TOPIC: (econom* OR cost OR monetary OR dollar OR euro OR "sterling pound") AND (invasi* OR alien OR non-indigenous OR nonindigenous OR nonnative OR non-native OR exotic OR introduced OR naturali* OR invader) NOT (cancer* OR cardio* OR surg* OR carcin* OR engineer* OR rotation OR ovar* OR polynom* OR purif* OR respirat* OR "invasive technique" OR carbon OR fuel OR therap* OR vehicle OR cell* OR drug OR fitness OR "operational research" OR banking OR liberalization*)*

--- 621 relevant results. Search performed on Feb. 18, 2020.

Below are three steps for searching papers:

1. Screening disciplines. I (CL) filtered out the paper published in irrelevant disciplines, please see the picture for more details:

2. Reading papers. I downloaded the file including titles and abstracts of the 187 papers from disciplines that might be related to InvaCost data. I have a look at the title and abstracts of those references, and I only found one paper relevant to invasive species. Other papers focus on geology, business and economy etc.
3. No paper found. I read the only one paper and found it was a review paper without any InvaCost data.

b.2. *Search string for China National Knowledge Infrastructure*

Consisted of the following steps:

(1) Overarching searching. I (CL) searched and downloaded Chinese's papers using China National Knowledge Infrastructure (CNKI; https://www.cnki.net/). Following the instruction in "INVACOST-Rationale&Methods", I defined the search terms in Chinese: SU = ('入侵'+'外来') and SU=('经济'+'损失'), which corresponded the search terms in WOS: TS = ('Invav*'OR 'Alien') AND ('Econom*' OR 'Cost'). In this step, I retrieved 878 papers in the subject of 'Basic science' and 'Agriculture science' (other subjects are about 'Medical' and 'Engineering' etc.);

(2) Paper filtering. I only focused on 633 papers in Chinese and had a look at the title of those papers, and consequently downloaded 289 papers;

(3) Paper retrieved. I identified 33 Chinese literatures (paper and thesis) containing the InvaCost data, and also 29 potential literatures from the References section. Most of these literatures focus on one species in the specific region, and most literatures focus on the pest of agriculture and forest;

(4) Total number. Chinese dataset includes 111 entries from 32 studies, which were saved in "INVACOSTChinaSubset.xlsx" in "C:\Dropbox\InvaCost Workshop France\Projects\NonEnglishPaper\FilesDataBases".

b.3. *Opportunistic search*

After referring other's strategies of opportunistic search, I (CL) performed the opportunistic searches for Chinese InvaCost data in three ways:

1. Governmental/administration webpages. I visited the webpages of the national administration (e.g. Ministry of Ecology and Environment) and provincial administrations (e.g. Beijing Municipal Ecology and Environment Bureau; also include those of Taiwan, Hongkong and Macao) that are responsible for the management of environmental protection to retrieve the information about InvaCost costs data. After checking their websites, I only found two pages including InvaCost information in Taiwan's website. Most information on their websites were about the pollution and land use, with little InvaCost information (most are news about invasive species). I will collect the information from two Taiwan's pages.
2. Emailing these administrations. I sent an inquiry e-mail to all national and provincial administrations directly to see whether they could provide us the InvaCost data. However, there were only four of 32 administrations providing e-mail address in mainland China. For Taiwan, Hongkong and Macao, all administrations provide the contact e-mail address.
3. Collegues or specialists. I contacts the author of the 32 papers from which I extracted the InvaCost data. Given some authors don't provide the e-mail address, I contacted four authors with valid e-mail address to further ask whether they have more InvaCost data. I also contacted Runzhi Zhang and Fanghao Wan, who are the famous invasion experts in China, to see whether they have some InvaCost data.

Data gathered April 2020 On 27th

(c) Dutch search

c.1. *Search string for WoS*

LANGUAGE: (Dutch) AND TOPIC: (econom* OR cost* OR monetary OR dollar OR euro OR "sterling pound") AND TOPIC: (invasi* OR alien OR non-indigenous OR nonindigenous OR nonnative OR non-native OR exotic OR introduced OR naturali* OR invader) NOT TOPIC: (cancer* OR cardio* OR surg* OR carcin* OR engineer* OR rotation OR ovar* OR polynom* OR purif* OR respirat* OR "invasive technique" OR carbon OR fuel OR therap* OR vehicle OR cell* OR drug OR fitness OR "operational research" OR banking OR liberalization)

c.2. *Search for Google scholar*

A Google Scholar search was conducted using general search terms in Dutch (i.e. “economische schade”, kosten, exoten, euro) and the country and region names (i.e. Nederland, België, Vlaanderen). The search results were screened for relevance using eye checking. Relevant documents were screened in full to check whether it contained any cost estimates. This search resulted mainly in official reports (i.e. risk assessment and feasibility studies).

c.3. *Opportunistic search*

For the Netherlands, we also contacted the responsible national authority (Netherlands Food and Consumer Product Safety Authority; NVWA) to find additional sources of information that we might have missed. Their reply confirmed our finding that little information is available and that this is documented fragmentedly in reports and on websites. We conducted a search on the NVWA website and retrieved some additional cost estimates from reports and factsheets written by experts. Second, we also contacted members of the Dutch Centre of Expertise for Exotic Species who represent species experts that have conducted many of the risk assessments for potentially invasive species in the Netherlands and who have implemented the eradication and management projects commissioned by the government. I (LV) contacted two experts from Belgium (Sonia Vanderhoeven and Tim Adriaens).

(d) English search (Invacost database, Diagne et al. 2020)

e.1. *Search string for Web of Science:*

(econom* OR cost OR monetary OR dollar OR euro OR "sterling pound") AND (invasi* OR alien OR non-indigenous OR nonindigenous OR nonnative OR non-native OR exotic OR introduced OR naturali* OR invader) NOT (cancer* OR cardio* OR surg* OR carcin* OR engineer* OR rotation OR ovar* OR polynom* OR purif* OR respirat* OR "invasive technique" OR carbon OR fuel OR therap* OR vehicle OR cell* OR drug OR fitness OR "operational research" OR banking OR liberalization)

e.2. *Search string for Google Scholar*:

dollars OR euros OR "USD" OR "EUR" OR "NZD" OR "AUD" OR "CAD" OR "GBP" OR "economic cost" OR "economic impact" OR "estimated cost" invasive species

e.3. *Search string for Google:*

economic species invasive OR nonnative OR alien OR exotic OR nonindigenous -disease -surgery -fungus -respiratory

e.4. *Opportunistic search*. Letter template used:

Letter Dear xxx,

I allowed myself to contact you as a post-doctoral researcher recruited by Dr. Franck Courchamp (http://max2.ese.u-psud.fr/epc/conservation/pages/Franck/homepage.html) to lead a global study on the economic cost of invasive species.

We aim at getting the most comprehensible (published and grey) literature review as possible worldwide, and then collecting most info as possible. However, it seems that we are currently missing some crucial info for specific taxa, regions or sectors.

Especially, we are lacking information on monetary information from xxx, and our searches indicated that there are very few scientific papers that provide the required data. We are thus looking for one or some papers/reports that would contain the searched information. Although we are mainly interested by papers/reports written in English, we will be also happy if we can get interesting documents in local languages. In the latter case, could you be interested to help us in locating such articles or reports?

We will be very happy and grateful if you can contribute to this huge work. Please, can you contact us either if a reference comes to your mind, or if you know a colleague that could help us ? Of course, your help will be ackowledged without any doubt in the official repository where our database will be stored and/or within the associated articles.

Please do not hesitate to contact us if you have any question about the work.

Looking forward to your kind response, many thanks in advance for your consideration

Best regards,

(e) French search

d.1. *Search string for WoS*

LANGUAGE: (French) *AND* TOPIC: ((econom* OR cost OR monetary OR dollar OR euro OR "sterling pound")) *AND* TOPIC: ((invasi* OR alien OR non-indigenous OR nonindigenous OR nonnative OR non-native OR exotic OR introduced OR naturali* OR invader)) *NOT* TOPIC: (: (cancer* OR cardio* OR surg* OR carcin* OR engineer* OR rotation OR ovar* OR polynom* OR purif* OR respirat* OR "invasive technique" OR carbon OR fuel OR therap* OR vehicle OR cell* OR drug OR fitness OR "operational research" OR banking OR liberalization))

431 hits, 26 papers potentially containing economic data about invasions, a few containing potentially interesting references (all cheked), only 4 containing economic data, one counting 3 different, but all costs were references to other papers.

d.2. *Search string for Google Scholar*

dollars OR euros OR "USD" OR "EUR" OR "NZD" OR "AUD" OR "CAD" OR "GBP" OR "economic cost" OR "economic impact" OR "estimated cost" invasive species

Pages en français: 4030 hits

dollars OR euros OR "USD" OR "EUR" OR "coût économique" OR "impact économique" OR "coût estimé" espèce invasive;

pages en français: 9220 hits

"EUR" OR "coût économique" OR "impact économique" OR "coût estimé" espèce invasive;

pages en français: 5750 hits

Search done on 11 march 2020

d.3. *Search string for Google*

We scanned the existing cost information on google by using the general French terms 'coût', 'espèce introduite', 'espèce exotique', espèce invasive', 'impact économique', coût des invasions', impact financier'. The search was conducted from November 1st to March 1st. The results were screened for relevance, and relevant documents were screened in full to check whether it contained any cost estimates.

d.4. *Opportunistic search*

For France, emails were sent to the French coordinator of UICN, to the'Centre des Ressources Espèces Exotiques Envahissantes' (CDR EEE), 'Conservatoire Botanique National', 'Conservatoires d'Espaces Naturels' (CEN) and their federation (FCEN). The national contact point for the French Nature Reserves has also been solicited, and we wrote a small article in their monthly bulletin to advert all managers from French reserves about our work on invasion costs and our wish to collect data. Thanks to these contacts, and the subsequent mailing on the lists these persons were having access to, we have been able to find huge amount of additional sources of information that we might have missed with more traditional searches.

(f) German search

f.1. *Search string for WoS*

LANGUAGE: (German / Deutsch) *AND* TOPIC: (econom* OR cost OR monetary OR dollar OR euro OR "sterling pound") *AND* TOPIC: (invasi* OR alien OR non-indigenous OR nonindigenous OR nonnative OR non-native OR exotic OR introduced OR naturali* OR invader) *NOT* TOPIC: (cancer* OR cardio* OR surg* OR carcin* OR engineer* OR rotation OR ovar* OR polynom* OR purif* OR respirat* OR "invasive technique" OR carbon OR fuel OR therap* OR vehicle OR cell* OR drug OR fitness OR "operational research" OR banking OR liberalization)

Results: nothing

f.2. *Search string for Google scholar*

I conducted a Google Scholar search using general search terms in German (search string cmbined from: "finanzieller Schaden", "ökonomische schäden" kosten exoten neobiota euro). The search results were screened for relevance using eye checking. Relevant documents were screened in full to check whether it contained any cost estimates.

f.3. *Opportunistic search*

For Germany, I (PH) contacted the responsible national authority (Bundesamt für Naturschutz (BfN) as well as the Hessian Agency for Nature Conservation, Environment and Geology (HLUG)) to identify data that is used by german authorities and potentially not avalable online. Their replies confirmed, that no information on costs of invasions is currently used or known to German government. A further direct communication with several authorities

confirmed, that the majority of species (especially aquatic) is not considered to be a natural burden.

(g) Greek search (Greece & Cyprus)

g.1. *Search string for WoS*

LANGUAGE: (Greek) *AND* TOPIC: (econom* OR cost OR monetary OR dollar OR euro OR "sterling pound") *AND* TOPIC: (invasi* OR alien OR non-indigenous OR nonindigenous OR nonnative OR non-native OR exotic OR introduced OR naturali* OR invader) *NOT* TOPIC: (cancer* OR cardio* OR surg* OR carcin* OR engineer* OR rotation OR ovar* OR polynom* OR purif* OR respirat* OR "invasive technique" OR carbon OR fuel OR therap* OR vehicle OR cell* OR drug OR fitness OR "operational research" OR banking OR liberalization) 0 relevant results. Search performed on Jan 28, 2020

g.2. *Search string for Google Scholar*

For Greece and Cyprus, a Google Scholar search was conducted using relevant search keywords in Greek (κόστη ξενικών ειδών, εισβάλλοντα ξενικά είδη, αλλόχθονα είδη, μη ιθαγενή είδη, χώρο-κατακτητικά είδη, εισβλητικά είδη, ΥΠΕΝ - Υπουργείο Αγροτικής Ανάπτυξης και Τροφίμων). The search results were screened for relevance and those that were considered relevant were screened for potential cost estimates. 0 relevant results. Search performed on Feb 19 - 28, 2020

g.3. *Search string for Google*

For Greece and Cyprus, a Google search was conducted using relevant search keywords in Greek (κόστη ξενικών ειδών, εισβάλλοντα ξενικά είδη, αλλόχθονα είδη, μη ιθαγενή είδη, χώρο-κατακτητικά είδη, εισβλητικά είδη, ΥΠΕΝ - Υπουργείο Αγροτικής Ανάπτυξης και Τροφίμων). The search results were screened for relevance and those that were considered relevant were screened for potential cost estimates. This search resulted primarily in government reports and budgets for future actions of control and prevention of invasive species. 7 relevant results for Greece and 3 for Cyprus (10 in total). Search performed on Feb 19 - 28, 2020

g.4. *Opportunistic search*

For the purposes of identifying cost estimates that may have not been published, academics from Research Institutes and Universities as well as consultants were contacted to provide any available information. Specifically contacts from the Hellenic Centre for Marine Research and the University of the Aegean were asked to provide more information and/or connect the authors of this paper with the appropriate people who could have relevant knowledge on potentially unpublished reports in Greek containing costs on invasive species. The key contacts that responded include academics from the Hellenic Centre for Marine Research who are well-known for their work on invasive species. They confirmed the lack of published studies or reports on costs of invasive species and highlighted that Greece is currently in the process of conducting such studies which explains the open calls for proposals and related budgets included in the search results from Google. 0 relevant results. Search performed on Feb 19 - 28, 2020

(h) Hindi search (Hindi, Tamil and Telugu and Bengali).

h.1. *Search string for Google Scholar and Google*

Searched Google Scholar using translations of the English key words. No reports found. Search Google with similar terms.

h.2. *Opportunistic search*

Contacted the National Biodiversity Authority (NBA - An Autonomous and Statutory Body of the Ministry of Environment, Forest and Climate Change, Government of India) to check if they have any record or they are aware of studies conducted on economic impacts of alien taxa in the Indian context. Contacted Indian colleagues (speaking different languages) and asked if they were aware of any cost estimate of invasive species reported in Indian languages.

(i) Japanese Search

i.1. *Search string for WoS*

LANGUAGE: (Japanese) *AND* TOPIC: (econom* OR cost OR monetary OR dollar OR euro OR "sterling pound") *AND* TOPIC: (invasi* OR alien OR non-indigenous OR nonindigenous OR nonnative OR non-native OR exotic OR introduced OR naturali* OR invader) *NOT* TOPIC: (cancer* OR cardio* OR surg* OR carcin* OR engineer* OR rotation OR ovar* OR polynom* OR purif* OR respirat* OR "invasive technique" OR carbon OR fuel OR therap* OR vehicle OR cell* OR drug OR fitness OR "operational research" OR banking OR liberalization)

Results: 64 article were hit, but there was no relevant article.

i.2. *Search string for Google Scholar*

円 経済被害 OR 経済的被害 OR 経済評価 OR 経済的評価 OR 被害額 OR 被害金額 OR 損失額 外来 OR 移入 OR 侵入種 OR 侵入生物 -医療 -受診 -患者 -地震 -災害

205 hits in GS

Strings interpreted in English (Yen economic damage OR economical damage OR economic evaluation OR economical evaluation OR price of damage OR amount of money of damage OR price of loss exotic OR introduced OR invasive species OR invasive organism –medical –diagnosis –patient –earthquake –disaster)

Among the 205 articles, 8 articles had description of economic cost.

i.3. *Search string for Google*

I (YW) used same strings as those in GS search, but it was 31,500 hits in Go search. I realized that it is difficult to narrow search results due to the feature of Japanese, in which a character often has many different meanings and there is no physical separation between words.

Using new strings (予算 AND 外来生物: budget AND exotic organisms in English), instead of using “cost”-relating searches. With this search, I found the web-page database (JUDGIT!: https://judgit.net/) of the budget of Japanese governments, in which almost all national projects which were associated with invasive species issues since 2014 must be included. At the web-page, I used strings of 外来生物 (exotic organisms in English) and 10 budget frameworks conducted by Ministry of the Environment were found, six of which included projects in which target species of invasive species was identified from the project title or searchers knowledge. I also used string of 外来種 (exotic species in English) and additional one budget framework conducted by Ministry of the Environment with the title in which target invasive species was identified. I omitted the projects whose target species was

not identified from the project titles or which was conducted after 2018. A total of 200 new entries were added by this opportunistic search.

i.4. *Opportunistic search*

I (YW) visited website of Japanese government and found the statistics of agricultural damage by wildlife, some of which was invasive species. In addition, in Japan, we often do not use "invasive" for invasive insects and fishes so I had realized that previous searches could not find insects and fishes. So, I directly used the species name of major insects and fishes and "economic damage".

(j) Portuguese search

j.1. *Search string for WoS*

LANGUAGE: (Portuguese) *AND* TOPIC: (econom* OR cost OR monetary OR dollar OR euro OR "sterling pound") *AND* TOPIC: (invasi* OR alien OR non-indigenous OR nonindigenous OR nonnative OR non-native OR exotic OR introduced OR naturali* OR invader) *NOT* TOPIC: (cancer* OR cardio* OR surg* OR carcin* OR engineer* OR rotation OR ovar* OR polynom* OR purif* OR respirat* OR "invasive technique" OR carbon OR fuel OR therap* OR vehicle OR cell* OR drug OR fitness OR "operational research" OR banking OR liberalization)

Output: 246 papers; 2 inclusions.

j.2. *Search string for Scielo*

LANGUAGE: (Portuguese) *AND* TOPIC: (econom* OR cost OR monetary OR dollar OR euro OR "sterling pound") *AND* TOPIC: (invasi* OR alien OR non-indigenous OR nonindigenous OR nonnative OR non-native OR exotic OR introduced OR naturali* OR invader) *NOT* TOPIC: (cancer* OR cardio* OR surg* OR carcin* OR engineer* OR rotation OR ovar* OR polynom* OR purif* OR respirat* OR "invasive technique" OR carbon OR fuel OR therap* OR vehicle OR cell* OR drug OR fitness OR "operational research" OR banking OR liberalization)

Output: 348 papers; 0 inclusions.

j.3 *Search string for Google Scholar*

In Google Scholar we used the search expression: custo* AND espécie* AND invasora* OR não-nativa* OR exótica* OR alóctone* -doença -cirurgia -respiratória. Each search result was screened for potential relevance through consultation of title and abstract or introduction sections. Documents deemed as relevant were fully screened for any cost estimates. Output: 998 "papers"; 3 inclusions.

j.4. *Opportunistic search*

For Portugal, we contacted key experts working on biological invasions in the country (Pedro Anastácio, Ronaldo Sousa and Élia Marchante) who sent a few documents they were aware of. All mentioned that there is a great paucity of this type of information for the country. In Google we also performed targeted searches for known 'problematic' invaders, namely Acacia spp., the asian hornet, the palm tree weevil, water hyacinth and the yellow fever mosquito. This search returned a few results with cost data but mainly from sources of low reliability (e.g., newspaper articles).

Output: 20 “papers” inclusions.

In Brazil, we added data from previous knowledge; many information about invasive cost in South America were send by Dr. Rafael Zenni; search by some species at google and google scholar. Later, we contacted researchers, conservation practitioners, project managers, and companies by email. In the beginning, we focused on well-knowing experts and companies with a notable problem with invasive species as the first targets. During the contacted, we asked for data, publications, and additional contacts that could provide data of costs with biological invasion (see the letter template below). While the experts send us the information, we screened that and added the information to the database when it was suitable. Also, we contacted all the additional experts that were suggested to us until none new contact suggest another. In total, was contacted 48 experts and 23 institutions (see the list below).

Letter template used to contact Brazilian experts:

Prezada _____,

Espero que esteja bem e saudável.

Sou pós-doutorando do Programa de Pós-graduação em Ecologia Aplicada e faço parte de uma rede de colaboração que investiga os custos econômicos causados por invasão de espécies exóticas, coordenado pelo Dr. Franck Courchamp (https://www.ese.universite-paris-saclay.fr/en/team-members/franck-courchamp/).

Portanto, gostaria de saber se poderia compartilhar comigo algumas informações sobre o custo de espécies invasoras no Brasil.

Qualquer custo pode ser incluído no estudo, desde que gerado por uma espécie invasora. Por exemplo, tilápia, javali, búfalo, *Aedes aegypti*, uva do Japão, *Acacia mangium* e capim gordura.

Esses custos podem ocorrer devido à prevenção, manejo, pesquisa científica, controle ou erradicação, diminuição de produtividade, danos causados em maquinário, divulgação científica/educação ambiental etc.

Até o momento priorizamos artigos científicos, mas outras fontes também serão muito úteis. Informes técnicos, relatórios públicos, relatórios de projetos (p. ex. prestação de contas par agência de fomento), páginas de internet com dados compilados, e, em casos específicos, banco de dados pessoais ou de empresas (p. ex. dados de projetos executados, mas que não foram que não foram compilados em relatório).

Nesse estudo, já foram triados mais de 1500 trabalhos no Brasil, contudo o montante de informação inserida permanece muito pequeno. Por isso, a contribuição de pesquisadores e gestores de projetos será fundamental.

Se souber de outros pesquisadores ou gestores de projetos que eventualmente possuem informações sobre custos com espécies invasoras, peço gentilmente que me envie o nome.

Em caso de dúvida, entre em contato comigo nesse e-mail.

Grato pela disponibilidade,

List of Brazilian contacts.

nome	contato	instituição
Patrícia Pinha	patricia.pinha@icmbio.gov.br	ICMBio

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k. Russian search

k.1. *Search string for WoS and Scopus*

LANGUAGE: (Russian) AND TOPIC: (econom* OR cost OR monetary OR dollar OR euro OR "sterling pound") AND TOPIC: (invasi* OR alien OR non-indigenous OR nonindigenous OR nonnative OR non-native OR exotic OR introduced OR naturali* OR invader) NOT TOPIC: (cancer* OR cardio* OR surg* OR carcin* OR engineer* OR rotation OR ovar* OR polynom* OR purif* OR respirat* OR "invasive technique" OR carbon OR fuel OR therap* OR vehicle OR cell* OR drug OR fitness OR "operational research" OR banking OR liberalization)

Search was run on 27th of January 2020.

Result: It returned 71 entries. I checked the titles of publications and the abstracts; non of them had the value for our study. They were either about economic sanctions, econometric assessment in business or other things that have nothing to do with the cost of biological invasions.

k.2. *Search string for Google*

I (NK) used Google search, where I applied the combination of words as for search in E-library.ru. The next option was to find the journals on plant quarantine, where potentially cost estimation of invasion could be published; for the latter I used the combination: “карантин, наука, журнал”.

Search was run on 1th of November 2019.

Results: The search using the combination of words as in E-library.ru returned 16 700 links, I went through first 25 pages in google and found no data of interest.

k.3. *Opportunistic search*

(1) I (NK) used Russian electronic library “E-library.ru”, https://www.elibrary.ru/defaultx.asp using my private account in the library to make a search among Russian publications. I used three combination of following key words (in Russian) : 1) (инвазии, вред, экономические затраты NOT медицина); 2) (инвазионные организмы, ущерб, контроль, траты, рубли NOT медицина); 3) (биологические инвазии, вред, оценка ущерба, рубли NOT медицина). I excluded in the keywords the word “medicine” as when I started search, the engine returned to me 723 publications where 99% were about diseases and how to treat them (i.e. how much it may cost).

Search was run on 29th of January 2020.

Result: Overall, the search with all three combinations returned 171 references, among which ~ 40% were abstract of conferences, the rest were papers in Russian proceedings, journals or books. There were different thematic – on quarantine pests, on disease of plants, on black lists of invasive organisms, legislation articles. I checked the most promising sources, but I found no cost estimations.

(2) I also contacted the governmental authority running pest risk assessments of invasive organisms in Russia. I contacted the colleagues working in All Russian Plant Quarantine Center (Rosselkhoznadzor and I asked if they have official reports with invasion costs estimations and if they could share them for scientific analysis), https://www.fsvps.ru/fsvps/news/28972. html?_language=en

Contacts were made and the search of data was done on the period 15–30th of November 2019.

Result: it was successful way to get data. The authority provided me with the access to 35 Pest Risk Analysis reports and with the representative of VNIIKR (All-Russian Russian Plant Quarantine Center), we were able to extract data on various types of costs for 35 organisms.

(3) Search in the journal “Plant Health. Research and Practice” (the journal published by All-Russian Plant Quarantine Center (VNIIKR)). I checked the volumes available online, the years 2012–2018 (x 4 volumes in each year), and I found 2 papers having cost estimations of invasive or potentially invasive organisms in Russia. With a third paper on cost estimations (for an invasive lime leaf miner in Russia) I retrieved costs for 44 invasive or potentially invasive organisms in Russia.

Conclusion: WoS, Scopus, Russian service – E-Library.ru were not effective. The targeted search in Google as well as the direct contact with All-Russian Plant Quarantine Center (VNIIKR) were efficient approaches to obtain data on costs of invasive and potentially invasive organisms in Russia. Overall, 87 cost estimations were retrieved (on different types of costs) for 79 species of organisms (mainly arthropods), some bacteria and plant viruses.

(l) Spanish search

I.1. *Search string for WoS*

LANGUAGE: (Spanish) *AND* TOPIC: (econom* OR cost OR monetary OR dollar OR euro OR "sterling pound") *AND* TOPIC: (invasi* OR alien OR non-indigenous OR nonindigenous OR nonnative OR non-native OR exotic OR introduced OR naturali* OR invader) *NOT* TOPIC: (cancer* OR cardio* OR surg* OR carcin* OR engineer* OR rotation OR ovar* OR polynom* OR purif* OR respirat* OR "invasive technique" OR carbon OR fuel OR therap* OR vehicle OR cell* OR drug OR fitness OR "operational research" OR banking OR liberalization)

We performed another search in Spanish using translated terms and with the next search string: TOPIC: - econom* OR económ* OR cost* OR dinero OR dólar OR euro OR peso* OR boliviano*, bolívar* fuerte OR colón OR colon* OR quetzal* OR lempira* OR "córdoba* nicaragüense" OR "balboa* panameño" OR guaraní* OR paraguayo OR "nuevo sol peruano" AND TOPIC: invas* OR alien OR alócton* OR "no nativa" OR exótic* OR introduc* OR naturaliza* OR estableci* NOT TOPIC: cancer* OR cardio* OR ciru* OR carcin* OR ingenier* OR ovar* OR polinom* OR purif* OR respira* OR "técnica invasiva" OR carbón OR combust OR terap* OR vehícul* OR vehicul* OR célula OR celul* OR drog* OR fitness OR liberalización

Due to the particularities of the information related to the economic cost of invasive mosquito species and the diseases they transmit, data were collected by experts in a specific way using WoS repositories (more information can be found in Diagne et al., in press) with this search string:

LANGUAGE (SPANISH) *AND* TOPIC ("cost effectiveness" OR "cost-effectiveness" OR monetary OR dollars OR euros OR sterling OR DALY OR expenditur* OR economi* OR "cost of illness" OR "cost-of-illness")) *AND* TOPIC (TS=(zika OR chikungunya OR dengue OR "yellow fever" OR albopictus OR aegypti))

I.2. *Google scholar and Scielo search*

* TOPIC: economico AND valor AND costo AND dólar AND invasoras AND exóticas AND sudamerica -NOT TOPIC : tecnica OR cancer OR cardio OR españa

Output: 17 papers; 0 inclusions.

* TOPIC: económico AND valor AND costo AND gasto AND pesos AND invasoras AND exoticas AND sudamerica NOT TOPIC : tecnica OR cancer OR cardio OR españa

Output: 141 papers; 0 inclusions.

* TOPIC: Costo"AND" económico "AND" especie "AND" invasora "AND" Parque "AND" Nacional "AND" USD

Output: 818 papers; 2 inclusions.

We also searched the Scielo literature database with the following terms:

*economico AND gasto AND exotica OR invasora OR no-nativa. Idioma: español. No España

Output: 226 papers; 1 inclusion

I.3. *Google search*

We used the following terms:

*costo+exoticas

*costo+economico+erradicación+exoticas

*costo+economico+enfermedad+mosquito

*costo invasions biologicas + Argentina OR Chile OR Peru OR Paraguay OR Uruguay OR Bolivia OR Ecuador OR Colombia OR Venezuela OR Panama OR Costa Rica OR Nicaragua

Results: we retain 19 documents that finally gave 17 entries

l.4. *Opportunistic search*

For Spain (EA), we contacted all Spanish regional administrations (Comunidades Autónomas) related with invasive species and the environment. First, we sent an email or contacted them by their webpages requesting information of costs. A copy of the typical request text used is below; it was personalized when the information in the webpage allowed it. Second, we also explored their webpages in order to find annual reports that contained such information. Third, we also explored some of the recent workshops related with invasive species, in which these administrations have participated and contacted the speakers that had talks related to costs. Finally, we also requested costs from managers of the National Organism of National Parks (OAPN) and of other protected areas, when the contacts were available online.

For South America we contacted in site page or e-mailed all health and environmental ministries from each country (Argentina, Chile, Peru, Paraguay, Uruguay, Bolivia, Ecuador, Colombia, Venezuela, Panama, Costa Rica, Nicaragua) and look for bibliography inside the sites where was available. We also targeted authorities in the field of invasive species in Chile (F Jaksic Director of the Center of Applied Ecology and Sustainability; J Rau from the Lagos University); in Argentina (N. Bonino, from the Instituto Nacional de Tecnología Agropecuaria), in Ecuador (Heinke Jäger from fcdarwin in Galapagos; Karl Campbell from Island Conservation; Jorge L. Rentería) and Mailyn Adriana Gonzalez Herrera from the Humbolt Institute in Colombia. We targeted authorities of GBIF in different SouthAmerican countries: Anabela Plos from Argentina; Nestor Alberto Acosta Buenaño from Ecuador; Ana Laura Mello from Uruguay; and Pilar Rodríguez, Jordi Pardal and Isabel Gonzalez from Mexico

Letter templates used to contact Spanish experts/authorities

(i) Estimado Sr.,

Me permito contactarle como científica que trabaja en un proyecto a nivel mundial sobre los costes de las invasiones biológicas INVACOST, actualmente desde el grupo Biodiversity Dynamics, de la Universidad París-Saclay en Francia.

Dentro del citado proyecto estoy buscando datos económicos sobre lo que cuestan las especies invasoras, en todos los aspectos (prevención, manejo, control o erradicación, daños, investigación, formación, etc) y respecto a todas las especies (de flora, fauna…). Me interesan especialmente los datos publicados en informes técnicos, u otra información que puedan facilitarme, que se base en datos reales o estimados de los gastos que se realizan en la gestión de las especies invasoras. Cuanto más específicos mejor.

En el caso de España, hay pocos estudios científicos que reporten esos gastos, por lo que los datos que podamos recopilar a través su información serían de gran ayudar para tener una visión de una parte de España. Los datos se analizarán de forma conjunta con datos recabados en el resto de las CCAA, y en otros países de habla no inglesa. Aparecería Ud y/o

las personas o el organismo para el que trabaja como referencia para los datos a los que ha contribuido.

No dude en contactarme si tiene alguna duda. Esperando su respuesta positiva, o que me remita a algún contacto que pueda ofrecernos la información que le he pedido, le saludo atentamente,

(ii) Estimado Sr.,

Me permito contactarle como científica que trabaja en un proyecto a nivel mundial sobre los costes de las invasiones biológicas INVACOST, actualmente desde el grupo de Ecología de invasiones, de la Universidad Nacional del Comahue en Argentina.

Dentro del citado proyecto estoy buscando datos económicos sobre lo que cuestan las especies invasoras, en todos los aspectos (prevención, manejo, control o erradicación, daños, investigación, formación, etc) y respecto a todas las especies (de flora, fauna…). Me interesan especialmente los datos publicados en informes técnicos, u otra información que puedan facilitarme, que se base en datos reales o estimados de los gastos que se realizan en la gestión de las especies invasoras. Cuanto más específicos mejor.

Hay pocos estudios científicos que reporten esos gastos, por lo que los datos que podamos recopilar a través su información serían de gran ayudar para tener una visión global. Los datos se analizarán de forma conjunta con datos recabados en el resto de latinoamerica, y en otros países de habla no inglesa. Aparecería Ud y/o las personas o el organismo para el que trabaja como referencia para los datos a los que ha contribuido.

No dude en contactarme si tiene alguna duda. Esperando su respuesta positiva, o que me remita a algún contacto que pueda ofrecernos la información que le he pedido, le saludo atentamente,

(m) Ukrainian search

m.1. *Search string for WoS*

LANGUAGE: (Ukrainian) AND TOPIC: (econom* OR cost OR monetary OR dollar OR euro OR "sterling pound") AND TOPIC: (invasi* OR alien OR non-indigenous OR nonindigenous OR nonnative OR non-native OR exotic OR introduced OR naturali* OR invader) NOT TOPIC: (cancer* OR cardio* OR surg* OR carcin* OR engineer* OR rotation OR ovar* OR polynom* OR purif* OR respirat* OR "invasive technique" OR carbon OR fuel OR therap* OR vehicle OR cell* OR drug OR fitness OR "operational research" OR banking OR liberalization) 0 results. Search performed on Jan 27, 2020

m.2. *Search for Google scholar*

For Ukraine, we performed multiple advanced Google Scholar searches using different combinations of the relevant keywords in Ukrainian (економічний AND (збиток OR втрата OR витрата OR оцінка OR шкода) AND (гривня, грн., євро, долар) AND (чужорідний OR інвазійний OR карантинний OR неаборигенний OR екзот OR бур'ян OR адвентивний) AND (вид OR рослина OR тварина OR комаха). Although these searches returned a few hundred results, none of those contained economic costs; most often the scientific papers in Ukrainian would only stress the importance of economic evaluation of invasive species yet not present one.

m.3. *Search for Google*

Finally, we performed multiple extensive Google searches for the species that we knew were managed in Ukraine because of their threats to human health, namely *Heracleum* spp. (борщівник AND гривня) and *Ambrosia artemisiifolia* (амброзія AND гривня). This led us to newspaper articles from we which often could trace back original sources and to official reports and public procurements which contained information on the expenditures associated with those two species. The searches were performed on December 10-12, 2019.

m.4. *Opportunistic search*

We also contacted several colleagues and authorities in Ukraine and they confirmed that economic costs of biological invasions have not been quantified for Ukraine. The only exceptions were the two research papers that we had previously known about but whose full text was unavailable; we therefore contacted one of the co-authors and they provided one of the two papers to us.