Manuscript Details

Manuscript number	JMPO_2018_523_R1
Title	Scientific collaboration networks in research on human threats to cetaceans in Brazil
Article type	Full Length Article

Abstract

Scientific networks can maximize research potential through the exchange of knowledge among researchers and institutions. Collaboration networks are especially important for research on cetaceans due to their wide geographic distribution and increasing exposure to human threats. To better understand the status of research on the impacts of human activities on cetaceans, the goal of this study was to describe these studies and determine where, how, and by whom the research on this topic is being conducted in Brazil and to determine what cetaceans are being studied. From a variation of 63 related terms, we gathered the available literature published from 1986 to 2016. We present the collaborations between research institutes and provide an updated distribution map of theme, research areas and institutions. We selected 103 publications involving 82 institutions from 12 countries. Most of these institutions were universities (n = 55), followed by NGOs (n = 15) and research institutes (n = 12). The most studied odontocetes were Sotalia guianensis, and Pontoporia blainvillei with 50 and 38 publications, respectively. For mysticetes, publications on Megaptera novaeangliae (n = 6) and Eubalaena australis (n = 5) predominated. More than a half (54.4%) of the publications focused on pollution, followed by bycatch (19.4%) and boat traffic (10.7%). Most of the study areas took place in the Rio de Janeiro (22.4%) followed by São Paulo (19.7%), and Rio Grande do Sul states (12.9%). The results contribute to identify potential gaps in knowledge and scientific collaborations, providing useful information to guide future cetacean conservation actions.

Keywords	Human impact; Marine Mammals; Cetacean conservation; Research collaboration; Bibliometry; Brazilian coast.

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Submission Files Included in this PDF

File Name [File Type]

Cover Letter.pdf [Cover Letter]

Response to Reviewers.docx [Response to Reviewers (without Author Details)]

Certificate_of_editing-BCARC_1.pdf [Review Reports]

Highlights.docx [Highlights]

Abstract.docx [Abstract]

Title page.docx [Title Page (with Author Details)]

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Fig caption file.docx [Figure]

Fig 1.tif [Figure]

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Appendix C.tiff [Figure]

Table 1.docx [Table]

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Appendix A.docx [Table]

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Appendix D.docx [Table]

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Research Data Related to this Submission

There are no linked research data sets for this submission. The following reason is given:
Data will be made available on request

Fairfax-VA, US, January 23, 2019.

Dr. Hance D. Smith, Editor-in-Chief of Marine Policy

Dear Dr. Smith,

Enclosed is a revised version of the manuscript JMPO_2018_523 entitled "Scientific collaboration networks in research on human threats to cetacean in Brazil". We are delighted to know that our manuscript received the editorial decision to be revised for the Marine Policy journal. We thank the reviewer for his/her thoughtful comments that provided us a chance to improve the quality of our manuscript. We considered carefully every comment of the reviewer and incorporated all comments and suggestions. English has been proofread by a professional corrector.

We hope this revised version is now suitable for publication in Marine Policy.

Below, we provide a detailed outline of how this manuscript has been revised in light of the editor and reviewer comments.

Thank you for your time and consideration.

Yours sincerely,

Marcela Marega Imamura

Revision note about editor and reviewer general comments

Manuscript JMPO_2018_523: "Scientific collaboration networks in research on human threats to cetacean in Brazil".

Authors' response to editor copy-editing requirements:

Copy-editing requirements:

1 Paper should be edited by someone with English as a first language, or equally fluent in English - or enlist help of Elsevier Language Service (journal website).

Authors' response: English has been proofread by a professional corrector. Please consult the attached certificate of English revision certificate.

2 Remove figures, tables and Appendices from text file and upload as individual files;

Authors' response: All figures and tables were uploaded as individual files in the online system.

3 Remove fig captions from fig files and upload a single fig caption file listing these;

Authors' response: Done.

4 Retain table captions on individual table files;

Authors' response: Done.

5 As well as bracketed references to figures and tables in text, insert text line breaks with notes to indicate their approximate positions e.g. Table 1 here;

Authors' response: Done.

6 Note that colour is free for web version, but costs for print version. To ascertain costs e-mail jmpo@elsevier.com To avoid costs redesign in grayscale;

Authors' response: We are not willing to pay the costs of colour for print version, so all the figures are in grayscale

7 Paginate paper.

Authors' response: Done.

Author response to reviewer 1

This is a manuscript that could be of great interest for the readership of Marine Policy and beyond, however, I feel that it needs major revision. The authors are advised to seek a native speaker to correct the many grammatical and syntax errors throughout the text before resubmission. Currently, many of the sentences are unclear and require the reader to read twice to understand what the authors mean. Some words are also used

incorrectly, for example using "panorama" when referring to the current status/situation of cetacean research in Brazil. Many sentences and paragraphs need to be rewritten/rearranged. I did not pointed out every single mistake, as they were too many. A native speaker will be able to help with these.

Authors' response: We thank the reviewer for the positive comment. As requested, English has been proofread by a professional corrector throughout the entire manuscript.

The categories (what authors call 'themes') of threats need to be revised as they are not mutually exclusive (e.g., bycatch belongs in 'fisheries interaction' and seismic surveys belong in 'noise pollution'). I realise this will require to re-analysing everything, but the categories as they are now are not correct.

Authors' response: Thank you for this comment, which prompted us to revise,re-analyze and provide the correct classification of categories in the entire manuscript.

The flowchart (Fig 1) needs to be improved as it is now quite confusing. More comments on this figure are in the PDF attached.

Authors' response: Following the reviewer's comments (including the annotated PDF) we revised the flowchart in order to make it clearer.

Figure 2 could also be improved with a different set of colours.

Authors' response: The colours used in figure 2 were replaced by a gray scale gradient.

Fig 3 could be clearer if the countries with institutions conducting research or collaborating with Brazilian institutions would be coloured (e.g., in grey).

Authors' response: Figure 3 was revised and countries with institutions conducting research/collaborating with Brazilian institutions were gray shaded as suggested. The caption of the figure was also revised in light of the changes.

Fig 4 needs the institutions to be spelled out in the figure caption.

Authors' response: Institutions highlighted in Figure 4 were spelled out in the figure caption.

The results of this study are not properly discussed within the context the authors do provide (e.g., from line 378 - the entire section). Some paragraphs comprise only one or two sentences and seem out of place. Each paragraph should present a different topic. Many other (if not all) paragraphs present ideas incoherently and in no clear order.

Authors' response: We thank the reviewer comments, which greatly improved our text flow and coherence. We revised all results section in order to have a better text flow.

The species names should be the common name in English, not in Portuguese or not the full name in English (e.g., "southern right whale" instead of "right whale"). Also, when discussing a species the name must be in singular (e.g., "the harbour porpoise", not "the harbour porpoises".

Authors' response: All species common names were revised and corrected as requested.

The highlights are too broad (eg. "half", "some"). This is what people are going to read before deciding to read the entire paper. Right now it does not catch my attention. More comments are in the PDF.

Authors' response: The highlights were rewritten as suggested.

The authors have not discussed in a meaningful way the findings of the studies they analyzed, which makes this manuscript of little use. Also, they have not discussed either the importance of collaborations for cetacean research (e.g., did collaboration improved the quality of research? did it lead to conservation measures or policies?). More specific comments are in the PDF attached.

Authors' response: We appreciate these comments and suggestions. The related sentences were rephrased. However, we must highlight that the evaluation of quality of research in relation to institutions collaborations is beyond the scope of this manuscript. We appreciate some of the reviewer's comments, which could be implemented in a future manuscript. Answers to the big concern of the reviewer are detailed in the table along with the 43 comments below.

Page	#Comment	Comment scope	Comment text	Authors' response
Highlights.docx	1	Highlights	The highlights are now too vague (e.g., "half", "Threats suffered by several species...". Also, make point 5 to be point 4	Corrected
1	2	(...) such as overexploitation of natural resources, habitat loss and degradation, chemical and noise pollution.	add "and" before "chemical..."	Done
1	3	Furthermore, around 70% of the oceanic regions are highly impacted by humans or are near to key conservation sites for marine and freshwater mammals.	The second part of the sentence does not seem to be related to the first one... there is a link missing	The sentence was reallocated and rewritten
1	4	The gray whale (*Eschrichtius robustus*) was considered functionally extinct in the Atlantic in the early 18th century, and the most recent ecology extinction was the baiji (*Lipotes vexillifer*) of the Yangtze River in China in 2002, both extinctions were mainly attributed to hunting [9]. Currently, the vaquita (*Phocoena sinus*) is the most critically endangered cetacean species in the world mainly due to bycatch, with a population estimate of 30 individuals.	It would be useful to have information about the situation in Brazil or Latin America instead of discussing species from other areas.	Corrected adding the sentence: *In Brazil, fishery activity is the main threat, especially for franciscana (Pontoporia blainvillei), with accidental mortality events occurring in fishery operations in the south coast of Brazil [11], and for the Amazon River dolphin (Inia geoffrensis) and tucuxi (Sotalia fluviatilis), which are directly exploited as bait in the Amazon [12].*
1	5	"stayed on focus"	It's not clear what the authors mean	The sentence was rewritten: *Issues with the conservation of cetaceans started to increase*
1	6	The moratorium on commercial whaling in the South Atlantic came into force in 1986 and was a decisive factor for recovery of several populations of mysticetes.	This sentence bears no relationship to the previous one. If the authors see a link, please add it in between.	The sentence was reallocated and rewritten

Page	#Comment	Comment scope	Comment text	Authors' response
1	7	(...) since 2000.	Please add a reference for this.	Reference added
1	8	In Brazil, National Action Plans (...)	Put the previous sentence as part of this paragraph.	Corrected: *In addition, National Action Plans were elaborated in 2010 to establish and guide priority actions for the conservation of cetacean species that are included in the Brazilian list of threatened species [7,18-20].*
2	9	There are several benefits of collaboration networks: exchange of knowledge, skills and techniques in the scientific, technical and social contexts, a greater visibility and more practical applications of the research. These factors contribute to enhance effectiveness and success of the research [20]. Collaboration networks can be measured at different levels: interpersonal, interdepartmental, interinstitutional and international. From the exchange of approaches from affiliated researchers to distinct institutions, scientific collaborative networks can improve the quality of research, find most genuine results, and maximize the conservation potential of species.	This sentence is confusing and requires rephrasing to make the spirit of the sentence clear.	To make the spirit of the sentence clear the first phrase was replaced by: *Collaborative scientific networks can improve the quality of research as it enables the exchange of approaches and innovation in methods. Thus, the results can be more reliable and expand the conservation strategies of species [21]. Collaboration networks can be measured at different levels, namely interpersonal, interdepartmental, interinstitutional, and international. With the exchange of approaches from affiliated researchers from distinct institutions, scientific collaborative networks can improve the quality of research, obtain the most accurate results, and maximize the conservation potential of species.*
2	10	2.1. Defining search terms	The main categories (what authors call 'themes') identified here overlap. For example, bycatch is a direct consequence of interaction with fisheries, yet it's a separate category. Another example is	We revise, re-analyze and provide the correct classification of categories for the entire manuscript.

Page	#Comment	Comment scope	Comment text	Authors' response
			Seismic surveys that would qualify in both noise and chemical pollution. My recommendation is to rethink the categories to make them more appropriate (e.g., Pollution - including noise, chemicals, plastic).	
2	11	(...) three Brazilian action plans for cetacean conservation (...)	Action plans should be refered to as action plans and not books.	Corrected
10	12	(...)and a guide for Brazilian cetaceans.	If the authors found a keyword in the guide that was not present in the action plans please	We included at the Results and Discussion (3.3) the threats that are only mentioned in the PANs and Lodi's bookbut are not highlighted and discussed in details.
-	13	'ecotourism'	Use 'tourism' instead. Ecotourism has a very speficic definition, including no or limited impact	The theme *'tourism'* has been deleted since it is not a main threat mentioned in PANs and Lodi's Book.
3	14	'overfishing'	What about bycatch? entanglement? fish predation, leading to bycath or entanglement, too?	We revised, re-analyzed and provide in this revised version the correct classification of categories. The theme *'overfishing'* has been replaced by *'depletion of fish stock' (depletion of fish stocks and temporal variation in the diet, reduction in the availability of prey and overfishing).*
-	15	'seismic activities (exploration of oil and natural gas)'	Noise, chemical pollution, habitat degradation...?	We revised, re-analyzed and provide the correct classification of categories. The theme 'seismic activities' has been deleted since it is not a main threat mentioned in PANs and Lodi's Book..
3	16	'boat traffic (disordered tourism, crossing	noise pollution, collision, chemical	We detail the term 'boat traffic' in

Page	#Comment	Comment scope	Comment text	Authors' response
		boats, ships)'	pollution...?	parentheses. We attributed this theme to those studies that indicate *change in behavior against boat traffic*.
3	17	(...) we conducted an initial search for articles published between 1986 and 2016 (...)	Was the search only conducted in English or also in Portuguese? this is not clear.	Corrected
11	18	Between 1986 and 2016	Both included? that's 31 years (not 30 as said before).	Corrected
3	19	Table 1. Terms used in search fields	It is not clear why there is a * in most words and why some of them are spelt incorrectly (e.g., "human effec", "toxic wast")	Words corrected and the follow sentence added: *Symbol - *, named symbol of truncation, is used in the bibliographic search, at the end of the words to find them in the singular, plural and variations of writing of them (recovers any amount of characters, including none).*
3	20	'Selecting'	finding...?	Corrected
3	21	We excluded publications prior to 1986 (...)	The moratorium started in 1986 but was decided in 1982, have the authors considered that it as 1982 the year when the interest in conservation could have peaked since?	The authors considered and checked that 1982 could be the year when the interest in conservation could have peaked since. We repeated the search for articles to previous years before 1986 and as verified in our research, Brazil only began to insert its research in the international systems recently (1996). As there is no brazilian publications focusing on human threats to cetaceans before 1986 we preserve the premise and the sentence.
3	22	selected	found	Corrected

Page	#Comment	Comment scope	Comment text	Authors' response
3	23	Fig. 1. Flowchart, Identification	Were these articles 'identified' or 'found'? What are these other sources?	Articles were 'identified' and databases sources are now informed in the flowchart .
4	24	Fig. 1. Flowchart	There are 5 steps and 4 words. It is unclear which word belong to which step	We have designed a clearer and more concise flowchart.
4	25	Fig. 1. Flowchart	This flowchart is not useful as it is. Overall, it is not clear at which step what types of articles were discarded and how many. The arrows on the right are confusing. And the look requires work too (e.g., neighbouring boxes are not of the same size, arrows are not aligned)	We have designed a clearer and more concise flowchart.
4	26	The authors of each publication were categorized according to the institutions to which they are linked. The locations of the institutions were obtained from the institutional web site or through Google Earth.	Does this related to point 2? if not, it should be in a separate paragraph.	Maintained, as related to point 2
5	27	A few decades ago, the information to describe the distribution of mysticetes in Brazil was obtained from data of animals stranded on the coast, occasional observation efforts or reports of the time when hunting was permitted [29]. For example, studies on humpback whales, only began in the late 1980s in Brazil [30]. From 2007, financial resources for research in Brazil, both from federal and	These paragraphs are quite interesting, however, the order seems ackward. It would greatly benefit from rearranging and rewriting some of the sentences and discussing a bit further (do the authors expect to see a decrease of studies in the near future after the crisis?)	We rearranged the sentences: *A few decades ago, information to describe the distribution of mysticetes in Brazil was obtained from data of animals stranded on the coast, occasional observation efforts, or reports of the time when hunting was permitted [30]. Scientific studies, such as on humpback whales, only began in the late 1980s in Brazil [31].*

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		state sources, in the various areas of knowledge, were abundant [31]. This fact may have reflected directly in the great number of studies considered by this survey between 2007 and 2010, compared to the average of previous years. In 2014, a Brazilian economic crisis culminated in the cut of funding for research and scholarships in almost all federal and state research financial agencies [32] and it is current collapsing.		*Financial resources for research in Brazil from federal and state sources were abundant between 2007 and 2014 [32], which may justify the large number of studies found between 2007 and 2010 compared to previous years. However, from 2014, a Brazilian economic crisis culminated in the progressive decrease in funding for research in almost all funding agencies [33]. Therefore, it was expected that there would be a reduction in studies that required large resources to be executed during this period. The lack of financial resources for scientific research in Brazil also increases the difficulties in the development of studies by research networks (see [34]).*
6	28	Among all institutions, UFRJ (degree: 41; betweenness: 6.601.274.813), UERJ (degree: 41; betweenness: 6.572.674.415), UENF (degree: 28, betweenness: 4.646.638.888), FURG (degree: 31; betweenness: 4.066.830.162) and USP (degree: 21; betweenness: 2.214.702.781) universities followed by the NGO Biopesca (degree: 25; betweenness: 1.315.616.058) had large number of partnerships and publications (Figure 4, Appendices C and D). These six institutions contributed most to the	What do the UFRJ and the rest of them stand for?	We rearranged the sentences: *Six institutions contributed most to the network of collaborations in research on human threats to cetaceans in Brazil (i.e., they had a large number of partnerships and publications) (number of publications = 66; 64.1%); among them, there were five universities, namely the Federal University of Rio de Janeiro (UFRJ) (degree: 41; betweenness: 657.9570871), State University of Rio de Janeiro (UERJ) (degree: 39; betweenness: 540.4076494), Federal University of Rio Grande*

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		network of collaborations in research on human threats to cetaceans in Brazil.		*(FURG) (degree: 31; betweenness: 427.4717971), State University of Norte Fluminense Darcy Ribeiro (UENF) (degree: 28; betweenness: 448.6591569), University of São Paulo (USP) (degree: 21; betweenness: 219.8557787), and one NGO, namely the BioPesca Project (BioPesca) (degree: 25; betweenness: 130.1570978) (Figure 4 and Appendices C and D).*
7	29	A global meta-analysis on cetacean diversity by Tittensor et al. [37] points out a greater diversity of species in the subtropical waters of southeastern and southern Brazil.	What is the importance of this? and what is the relationship with the previous sentence?	To make the relation of the sentences more clearly we replaced by: *It was expected that institutions placed in southeastern and southern regions would have more research. As highlighted by Tittensor et al. [38] in their global meta-analysis on cetacean diversity, the locations of the most collaborative research institutions presented in our work corresponded to diversity hotspots of cetaceans (subtropical waters of southeastern and southern Brazil) as there are two in the state of São Paulo (BioPesca and USP), three in Rio de Janeiro (UFRJ, UERJ, and UENF), and one in Rio Grande do Sul (FURG).*
7	30	The smaller number of publications on mysticetes in relation to odontocetes must be directly related to the higher cost of studying mysticetes that involves more logistics, equipment and a specialized	This sentence is likely true, but please explain why (e.g., further from the coast).	Sentence completed: *The smaller number of publications on mysticetes in relation to that on odontocetes might be directly related to the higher cost of studying mysticetes, as it involves more logistics,*

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		team.		*equipment, and a specialized team because of their greater distance from the coast.*
7	31	Table 2. column [min-max] median	This is rather confusing. The actual number of institutes working on each species would be much more useful. This number is just how many institutions collaborate in each article focused on that species, which really does not say anything.	We incorporated the actual number of institutes working on each species.
7	32	Table 2. List of 27 target species studied in 114 researches on human threats to cetaceans in Brazil, published between 1986 and 2016. Minimum (min), maximum (max) and median (median) number of institutions involved in studies with the related species, total number of articles (Articles), threat category in the ICMBio Brazilian list (Brazilian List) and in the World Conservation Union list (IUCN Red List). Threat categories - CR: (Critically endangered); EN (Endangered); VU (Vulnerable); DD (Data deficient). *Species is included in State lists of endangered species (Bahia and Paraná). "**": Species occurring in Brazilian waters but not included in the Brazilian national list. The species Delphinus sp. and Stenella sp. are not part of the species count.	Either use ** and * or "**" and "*".	Corrected
7	33	Forty five (46 considering Delphinus sp.	Then it is 46, as those are two	Corrected to *48* as Delphinus sp. and

Page	#Comment	Comment scope	Comment text	Authors' response
		as Delphinus capensis and Delphinus delphis) (...)	different species.	Stenella sp. are different species.
7	34	Forty five (46 considering Delphinus sp. as Delphinus capensis and Delphinus delphis) species occur in Brazilian jurisdictional waters (see [21]), therefore, the threats suffered by 19 species occurring in Brazilian jurisdictional waters [38] were not studied yet, these species are (...)	Would be much useful to have all species in the table, and signal which ones haven't been studied in the column 'Articles' as 0 or NA. And then use the text to discuss the relevance of this.	We added the 48 species that occur in Brazilian jurisdictional waters to the list, indicating the ones that have not been studied in the column 'Articles' with *0*.
8	35	'toninha'	Use the name in English for all species	Corrected as "'franciscana'
8	36	'right whales'	It is the "southern right whale"	Corrected
7	37	The smallest number of studies for these species may be related to preferences for greater depths and distance from the coast [39] places of distant and difficult access.	Discuss this idea more clearly	The sentence has been rewritten for clarity purpose: *The smaller number of publications on mysticetes in relation to odontocetes must be directly related to the higher cost of studying mysticetes that involves more logistics, equipment and a specialized team because of their greater distance from the coast.*
8	38	Researchers studying the behavior of cetaceans at sea also face methodological challenges. Many species swim fast, travel long distances daily, and have seasonal migrations of thousands of miles. This difficult the obtaintion of basic information needed to assess population health, impacts of environmental changes, human threats, identify key areas and cetacean activities	These 5 paragraphs require a lot of work. Some sentences are not in proper English and the ideas are not connected in a meaningful way.	The sentence has been rewritten for clarity purpose: *One of the reasons attributed to the nonexistence or few articles with several species of cetaceans in the Brazilian coast is the methodological challenges. Many species swim at high speeds, travel long distances daily, or migrate seasonally over thousands of miles. These behaviors make it difficult to obtain basic information and determine*

Page	#Comment	Comment scope	Comment text	Authors' response
		in different seasons [40].		*the impacts that they are subject to.*
8	39	Bycatch in fishing nets is the main threat to marine mammals affecting 78% of species [43] and the main cause of mortality of cetaceans [47, 48, 49, 50]. The death of individuals of many species of cetaceans is attributed to accidents in gill nets. Despite the high impact rate of cetacean populations, related to fishing activity, this was not the predominant thematic among the published studies evaluated. Odontocetes with coastal and estuarine habitats, such as Guiana dolphin and porpoise, are prone to a greater variety of human activities that threaten their survival (habitat loss, pollution, and vessel traffic) and are some of the cetaceans most vulnerable to fishing gear in Brazil.	Two different ideas in one paragraph. Either find the connection or separate them	The sentence has been rewritten for clarity purpose: *Bycatch in fishing nets is the main threat to marine mammals, affecting 78% of species [40] and being the main cause of mortality of cetaceans [42-45]. Odontocetes with coastal and estuarine habitats, such as the Guiana dolphin and franciscana, are prone to a greater variety of human activities that threaten their survival (habitat loss, pollution, and vessel traffic), and are some of the cetaceans most vulnerable to fishing gear in Brazil [44]. Despite the high impact rate of fishing activity on cetacean populations, this was not the predominant thematic among the evaluated published studies.*
9, 10	40	Interactions between cetaceans and vessels increased since the 1990s due to the accelerated growth of human activities in coastal regions. In Brazil, publications on this thematic were published only after 2006. The development of whale watching highlights the need for studies on possible impacts of vessel traffic. This activity doubled in the world between 1991 and 1998 and by the year 2006 it increased at an average annual rate of 11.3% currently	A discussion about the threats cetaceans face in Brazil is lacking - the authors do not discuss the papers they have analysed.	We included a detailed discussion about the studied threats: *Four of the hunting themed publications identified here were focused on the theme of piracatinga bait.* *(...)* *Some themes require further studies; although seismic activities are also associated with a significant impact on cetaceans [53], we found only one published article dealing with this thematic [54]. No studies were found on*

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		involves 87 countries. As an example, Tisher *et al*. observed that 81% of the tourists in Fernando de Noronha archipelago choose on-board trips aimed spinner dolphin observation (*Stenella longirostris*), nevertheless, this activity has already been described in the literature as harmful to spinner dolphin population.		*the theme of depletion of fish stock, and within the pollution theme, there were only two publications aimed at noise pollution consequences and one on the consequences of rubbish ingestion.* *(...)* *Deforestation of riparian forests and their implications to fluvial species, introduction of exotic species, and swimming with cetaceans are threats that were mentioned but not highlighted or discussed in detail in our reference book guides.*
11	41	"entire Brazilian coast"	That's not what the map shows	*The spatial distribution of the studies did not cover only one of the Brazilian coastal states (Piauí state) and covered some river areas*
11	42	This study presented a review of the works published in the last 30 years on the threats of human impacts to cetaceans in Brazil and intends to contribute as a guide for future studies aimed at the conservation of cetaceans in Brazil.	This study does not present a review of the work done in Brazil. It provides information of the studies, but not of the findings of those studies. Moreover, there is no discussion whatsoever of the importance of collaboration - which seemed to be the main objective of the study in the first place.	The sentence has been rewritten for clarity our purpose: *This study presented the works published in the last 31 years on the threats of human impacts to cetaceans in Brazil, and intended to act as a guide for future studies aimed at the conservation of cetaceans..*
-	43	Research on marine mammals has become a complex undertaking, where each project requires the combination of different expertises (e.g. behavioral observation, statistical skills, laboratory	This paragraph here is not something that the authors discussed properly before, so it is hardly a conclusion. There needs to be that discussion somewhere.	Paragraph removed

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		techniques, among others). Thus, the partnership between different laboratories contributes for many research projects and research can be carried out with excellence.		

CERTIFICATE OF ENGLISH EDITING

This document certifies that the paper listed below has been edited to ensure that the language is clear and free of errors. The edit was performed by professional editors at Editage, a division of Cactus Communications.The intent of the author's message was not altered in any way during the editing process. The quality of the edit has been guaranteed, with the assumption that our suggested changes have been accepted and have not been further altered without the knowledge of our editors.

Title Of The Paper

SCIENTIFIC COLLABORATION NETWORKS IN RESEARCH ON HUMAN THREATS TO CETACEANS IN BRAZIL

Authors

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Operations-Author Services, Editage

Date of Issue
January 21, 2019

Highlights:

- 103 Brazilian studies on threats to cetacean were published during the last decades
- 35% of the publications compiled have some international collaboration
- 55% of the study areas are concentrated in three of the 16 Brazilian states studied
- Pollution, bycatch and boat traffic are the main themes studied

Abstract
Scientific networks can maximize research potential through the exchange of knowledge among researchers and institutions. Collaboration networks are especially important for research on cetaceans due to their wide geographic distribution and increasing exposure to human threats. To better understand the status of research on the impacts of human activities on cetaceans, the goal of this study was to describe these studies and determine where, how, and by whom the research on this topic is being conducted in Brazil and to determine what cetaceans are being studied. From a variation of 63 related terms, we gathered the available literature published from 1986 to 2016. We present the collaborations between research institutes and provide an updated distribution map of theme, research areas and institutions. We selected 103 publications involving 82 institutions from 12 countries. Most of these institutions were universities (n = 55), followed by NGOs (n = 15) and research institutes (n = 12). The most studied odontocetes were *Sotalia guianensis*, and *Pontoporia blainvillei* with 50 and 38 publications, respectively. For mysticetes, publications on *Megaptera novaeangliae* (n = 6) and *Eubalaena australis* (n = 5) predominated. More than a half (54.4%) of the publications focused on pollution, followed by bycatch (19.4%) and boat traffic (10.7%). Most of the study areas took place in the Rio de Janeiro (22.4%) followed by São Paulo (19.7%), and Rio Grande do Sul states (12.9%). The results contribute to identify potential gaps in knowledge and scientific collaborations, providing useful information to guide future cetacean conservation actions.

Keywords: Human impact; Marine Mammals; Cetacean conservation; Research collaboration; Bibliometry; Brazilian coast.

SCIENTIFIC COLLABORATION NETWORKS IN RESEARCH ON HUMAN THREATS TO CETACEANS IN BRAZIL

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Declaration of Interest statement

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1. Introduction

Around 70% of oceanic regions are highly impacted by humans or are near key conservation sites for marine and freshwater mammals [1]. The fact that more than half of the human population lives in coastal and surrounding areas directly fosters negative changes in marine ecosystems [1-3]. Despite the importance of maintaining biodiversity to conserve aquatic ecosystems [4], coastal and marine ecosystems are greatly damaged by a combination of several anthropogenic impacts, such as overexploitation of natural resources, habitat loss and degradation, and chemical and noise pollution [5,6].

Cetaceans are especially vulnerable compared with other groups of marine mammals because of their slow development, low reproductive rates, and potential bioacumulation of heavy metals [7]. The extinction of cetacean populations and species is mainly due to overexploitation and accidental capture [8,9]. The gray whale (*Eschrichtius robustus*) was considered functionally extinct in the Atlantic in the early 18th century [8], and the most recent ecological extinction was the baiji (*Lipotes vexillifer*) of the Yangtze River in China in 2002; both extinctions were mainly attributed to hunting [9]. Currently, the vaquita (*Phocoena sinus*) is the most critically endangered cetacean species in the world mainly owing to bycatch, with a population estimate of 30 individuals [10]. In Brazil, fishery activity is the main threat, especially for franciscana (*Pontoporia blainvillei*), with accidental mortality events occurring in fishery operations in the south coast of Brazil [11], and for the Amazon River dolphin (*Inia geoffrensis*) and tucuxi (*Sotalia fluviatilis*), which are directly exploited as bait in the Amazon [12].

Issues with the conservation of cetaceans started to increase in the 1970s [13], and the first biennial conference on the biology of marine mammals took place in 1975. In 1981, the Society for Marine Mammalogy was founded, which fostered the following conferences and led the collaboration between researchers from several institutions and countries [14]. In 1986, the scientific society headed the moratorium on commercial whaling in the South Atlantic as a decisive factor for recovery of several populations of mysticetes [15].

The Brazilian coast was decreed a sanctuary of whales and dolphins in 2008 [16], and a proposal for the creation of a South Atlantic Whale Sanctuary has been advocated in the International Whaling Commission (IWC) plenary sessions by several countries since 2001 [17]. In addition, National Action Plans were elaborated in 2010 to establish and guide priority actions for the conservation of cetacean species that are

included in the Brazilian list of threatened species [7,18-20]. These plans are of strategic importance to guide conservation efforts because they have been conducted with the collaboration of research institutions, non-governmental organizations (NGOs), and universities. They are an example of scientific collaboration, which can be defined as the mutual participation of researchers working toward a common goal in the production of new knowledge [21].

Collaborative scientific networks can improve the quality of research as it enables the exchange of approaches and innovation in methods. Thus, the results can be more reliable and expand the conservation strategies of species [21]. Collaboration networks can be measured at different levels, namely interpersonal, interdepartmental, interinstitutional, and international. With the exchange of approaches from affiliated researchers from distinct institutions, scientific collaborative networks can improve the quality of research, obtain the most accurate results, and maximize the conservation potential of species.

Based on the need to better understand the status of research on the impacts of human activities on cetaceans, the goal of this study was to describe these studies and determine where, how, and by whom the research on this topic is being conducted in Brazil and to determine what species of cetaceans are being studied. Thus, we addressed the following questions: (1) What institutions conduct research on the impacts of human activities on cetaceans and how are they spatially distributed? (2) What is the status of the networks of collaboration? (3) What types of human threats and what cetacean species are investigated? (4) Where are the surveys directed in Brazil?

To achieve this goal, we conducted a systematic bibliographic compilation of published scientific studies over the last three decades in order to identify the species, themes, and locations that need further research efforts. These findings might guide future conservation actions and help research institutions, universities, and NGOs to identify potential research partners that are focused on the conservation of cetaceans.

2. Materials and Methods

2.1. Defining search terms

A survey of the main human threats to cetaceans in Brazil was created using three Brazilian action plans for cetacean conservation [7,19,20] and a guide book for Brazilian cetaceans [22] as a reference. The main themes of threats were identified in these reference books, and we classified them into seven categories, namely boat traffic

(change in behavior against boat traffic), boat collision, bycatch (incidental mortality in fishing nets), hunting (intentional capture, disorderly killing, and slaughter because of resource competition), pollution (ingestion of marine debris, chemicals, and noise pollution), dam construction (construction of hydroelectric power plants), and depletion of fish stock (depletion of fish stocks and temporal variation in the diet, reduction in the availability of prey, and overfishing). We categorized the threat as "several" when the article addressed more than one threat.

Subsequently, variations of 63 terms in English related to human threats to cetaceans in Brazil were elaborated. From a combination of these terms (Table 1), we conducted an initial search for articles published between 1986 and 2016 available in two databases, namely the Web of Science bibliographic platform and the bibliographic database of the Natural History Museum of Los Angeles County [23].

Table 1 here

The Web of Science platform was chosen as it is one of the most comprehensive databases for finding articles from peer-reviewed journals based on specific terms. The bibliographic database of the Natural History Museum of Los Angeles County covers scientific literature exclusively on subjects related to aquatic mammals. We excluded publications prior to 1986, which was the year the hunting moratorium was established, because this historical landmark for the conservation of cetaceans may have increased the attention of the scientific community (and subsequently of scientific publications) on these animals.

2.2. Compilation of studies

We found a total of 1047 articles from the initial search in the two databases. Among these, we only selected articles that were published in peer-reviewed journals concerning studies conducted in Brazil and only dealt with anthropogenic impacts on one or more species, thereby resulting in a total of 103 publications (Appendix A). We excluded gray literature (i.e., dissertations, theses, and unpublished reports) to ensure greater credibility of the data, even though these documents may achieve a similar quality to that of peer-reviewed articles. The criteria and details of inclusion and exclusion of the articles were recorded according to the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) [24] (Figure 1).

Figure 1 here

The following data were extracted from each publication: 1) authors (as recommended by Salinero and Michalski [25]); 2) respective affiliations, namely the name of the institution, type (i.e., NGO, university, or research institute), geographic location, and coordinates of the institution; 3) target species, including name, family, and suborder; 4) theme of the threat (boat traffic, boat collision, bycatch, hunting, pollution, dam construction, depletion of fish stock, or several); and 5) study areas of research including geographical locations and coordinates. The authors of each publication were categorized according to the institutions to which they were linked. The locations of the institutions were obtained from the institutional web site or through Google Earth.

When data collection of a study (i.e., publication) included more than one location or extensive area(s) of a unique Brazilian state, we considered the central geographic coordinates of the locations or area(s). When data collection of a study included more than one Brazilian state, we considered one central geographical point per state. When no geographic coordinates were reported, we searched for the closest coordinates supported by the maps of the publication and according to landmarks, such as municipalities, rivers, or estuaries, mentioned in the publication with the aid of images available on Google Earth. Geographic coordinates for mapping the distribution of studies were obtained from Google Earth Version Pro 7.1 and georeferenced on the QGIS 2.18.7 platform [26].

2.3. Data analysis

The graphical images of the collaboration networks between the institutions were elaborated using the methodology of Salinero and Michalski [25] with the igraph package [27] for R software [28]. In the network of collaborations, each of the nodes represented a research institution. The interaction was based on a combination of the number of intermediate nodes and binding weights. In the present study, two measures of centrality of the node were used to calculate the degree of influence of the institutions, namely the degree of centrality (degree) and the centrality of intermediation (betweenness).

The degree refers to the number of adjacencies of each node in a network, i.e., the number of nodes to which the focal node is connected. The higher the degree, the

larger the area of a circle in the graphs. The betweenness is the measure of the influence that a node has on the propagation of the information flow through the network. The greater the value of betweenness, the more centralized the circle is on the graph [29]. Therefore, in our study, the degree represented the number of direct contacts that an institution had with others, and the betweenness represented the potential of communication of an institution, which acted as a bridge of information.

3. Results and Discussion

The 103 scientific papers that met the inclusion criteria of this research (i.e., dealing with human impacts on cetaceans in Brazil) were published between 1996 and 2016. No publications that met the inclusion criteria of this research were found between 1986 and 1995.

Almost half (47.6%) of the publications on human threats to cetaceans in Brazil (n = 49) were published between the last six years analyzed (2001 to 2016). The largest number of publications (n = 13) were published in a single year (2012), while no publications were found in 1999 and 2001 (Figure 2).

Figure 2 here

A few decades ago, information to describe the distribution of mysticetes in Brazil was obtained from data of animals stranded on the coast, occasional observation efforts, or reports of the time when hunting was permitted [30]. Scientific studies, such as on humpback whales, only began in the late 1980s in Brazil [31].

Financial resources for research in Brazil from federal and state sources were abundant between 2007 and 2014 [32], which may justify the large number of studies found between 2007 and 2010 compared to previous years. However, from 2014, a Brazilian economic crisis culminated in the progressive decrease in funding for research in almost all funding agencies [33]. Therefore, it was expected that there would be a reduction in studies that required large resources to be executed during this period. The lack of financial resources for scientific research in Brazil also increases the difficulties in the development of studies by research networks (see [34]).

3.1. Institutions involved

In total, 257 authors were involved in these publications (mean ± SD = 5.9 ± 3.6, range = 1-16 authors). We identified 82 institutions related to these authorships.

The number of institutions per publication ranged from 1 to 11, with a median of 3 institutions per publication (mean = 3.2 ± 2). These institutions were distributed in 12 different countries, and among them 55 were national (Brazilian) and 27 were international (other countries except Brazil) (Figure 3 and Appendix B).

Figure 3 here

Overall, 35% (n = 36) of the 103 publications were (co-)authored by at least one international institution. Most of the institutions were universities (n = 55), followed by NGOs (n = 15) and research institutes (n = 12).

Leimu and Koricheva [35] showed that the involvement of two or more institutions in the development of ecological studies favors productivity, quality, and impact in scientific publications. In addition, several authors have shown that research involving international institutions has more citations in comparison to research involving only collaborators from the same country, thereby providing greater visibility in the scientific community (e.g., [21,36]).

NGOs focused on environmental conservation have played an important participatory role in the management of biodiversity preservation, recovery, and research. In addition, the involvement of this type of institution in research favors the dissemination of research, increases social pressure against harmful activities, and stimulates environmental awareness of the society [37].

3.2. Collaboration networks

Six institutions contributed most to the network of collaborations in research on human threats to cetaceans in Brazil (i.e., they had a large number of partnerships and publications) (number of publications = 66; 64.1%); among them, there were five universities, namely the Federal University of Rio de Janeiro (UFRJ) (degree: 41; betweenness: 657.9570871), State University of Rio de Janeiro (UERJ) (degree: 39; betweenness: 540.4076494), Federal University of Rio Grande (FURG) (degree: 31; betweenness: 427.4717971), State University of Norte Fluminense Darcy Ribeiro (UENF) (degree: 28; betweenness: 448.6591569), University of São Paulo (USP) (degree: 21; betweenness: 219.8557787), and one NGO, namely the BioPesca Project

(BioPesca) (degree: 25; betweenness: 130.1570978) (Figure 4 and Appendices C and D).

Figure 4 here

It was expected that institutions placed in southeastern and southern regions would have more research. As highlighted by Tittensor et al. [38] in their global meta-analysis on cetacean diversity, the locations of the most collaborative research institutions presented in our work corresponded to diversity hotspots of cetaceans (subtropical waters of southeastern and southern Brazil) as there are two in the state of São Paulo (BioPesca and USP), three in Rio de Janeiro (UFRJ, UERJ, and UENF), and one in Rio Grande do Sul (FURG).

3.3. Target species and thematic

Most of the publications (89.3%; n = 92) directed their efforts to one or more odontocete species, while only 8.7% (n = 9) of the publications directed their efforts to one or more mysticete species and 1.9% (n = 2) directed their efforts to both mysticetes and odontocetes. The first publication on human threats related to mysticetes in Brazil dates back to 2006, but most publications were published on odontocetes in subsequent years (Figure 5).

Figure 5 here

The smaller number of publications on mysticetes in relation to that on odontocetes might be directly related to the higher cost of studying mysticetes, as it involves more logistics, equipment, and a specialized team because of their greater distance from the coast.

The compiled studies covered 28 species, namely 1 Balaenidae, 3 Balaenopteridae, and 24 odontocetes including the families Delphinidae, Iniidae, Kogiidae, and Pontoporiidae (Table 2).

Table 2 here

Forty-eight species are found in Brazilian jurisdictional waters (see [22]); therefore, the threats to 20 species occurring in Brazilian jurisdictional waters [39] have

not yet been studied (Table 2). Nonetheless, it is necessary to intensify research efforts to increase our knowledge and the conservation efficiency of these species in Brazil.

The number of species studied per publication ranged up to 15. Thirty-five publications investigated more than one target species.

The most studied odontocete was the Guiana dolphin (*Sotalia guianensis*) with 50 publications, followed by franciscana (*P. blainvillei*) with 38 publications, bottlenose dolphin (*Tursiops truncatus*) with 17 publications, and Atlantic spotted dolphin (*Stenella frontalis*) with 16 publications. The most studied mysticetes were the humpback whale (*Megaptera novaeangliae*) (n = 6) and southern right whale (*Eubalaena australis*) (n = 5).

One of the reasons attributed to the nonexistence or few articles with several species of cetaceans in the Brazilian coast is the methodological challenges. Many species swim at high speeds, travel long distances daily, or migrate seasonally over thousands of miles. These behaviors make it difficult to obtain basic information and determine the impacts that they are subject to.

The publications were distributed over seven types of threats (themes), and more than half (54.4%) of these articles were focused on pollution (n = 56), followed by bycatch (n = 20; 19.4%) and boat traffic (n = 11; 10.7%).

According to Schipper et al. [40], pollution is the second major threat to marine mammals. Although pollution research involves high costs for laboratory analysis, cetacean carcasses as well as tissue collection are easily accessible. In addition, this thematic has a global scope and commonly involves more than one species, consequently involving large collaboration networks.

Because it is necessary to obtain the carcass of the animal to obtain data, there is a large lack of knowledge about the extent of the impacts of marine debris on cetacean populations. However, the available evidence suggests a high prevalence of debris interactions and high mortality rates in some cetacean populations, thereby pointing to an urgent need for stranding research networks to collect and publish data on the rate of interactions in different species and the resulting mortality rates or other pathology [41].

Bycatch in fishing nets is the main threat to marine mammals, affecting 78% of species [40] and being the main cause of mortality of cetaceans [42-45]. Odontocetes with coastal and estuarine habitats, such as the Guiana dolphin and franciscana, are prone to a greater variety of human activities that threaten their survival (habitat loss, pollution, and vessel traffic), and are some of the cetaceans most vulnerable to fishing

gear in Brazil [44]. Despite the high impact rate of fishing activity on cetacean populations, this was not the predominant thematic among the evaluated published studies.

Dolphins that inhabit fluvial environments are considered the most threatened cetaceans because they occur in areas of high human occupation. Conflicts and anthropic pressure on natural resources are more intense [45]. Four of the hunting themed publications identified here were focused on the theme of piracatinga bait. The use of *I. geoffrensis* (Amazon River dolphin) as bait for the piracatinga fishery in the Amazon region has been observed in recent years and has led to several surveys (e.g., [12]) of public conservation policies, such as a moratorium on piracatinga fishing for five years.

Despite the high threat to the conservation of river species, our analysis indicated that studies on the Amazon River dolphin are the fifth most common. A greater effort to conduct studies mainly on river dolphins is needed to better assess the impact of threats and to design effective measures for conservation [46]. In addition, according to Pompa et al. [1], the Amazon is among the 20 key conservation sites for marine mammal diversity.

As discussed at the last South American Meetings of Experts Work on Marine Mammals (XII SOLAMAC, Peru, November 2018), Brazil is one of the worst-performing Latin American countries in relation to both artisanal and industrial fishery monitoring data. There are little data and random collections on the number of bycatch events in addition to little articulation and lack of government support (personal communication).

The incidence and degree of impact vary considerably among populations and species of cetaceans [47], and pose a greater threat to populations that are already vulnerable. Endemic and restricted species have a high priority for conservation, as they are generally more vulnerable to anthropogenic impacts [48,49]. The list of threatened species in Brazil [39] showed that there are more studies on the threat category of some of the species that we observed, such as the southern right whale and franciscana species, which are categorized as endangered (EN) and the Guiana dolphin and humpback as vulnerable (VU).

Interactions between cetaceans and vessels have increased since the 1990s due to the accelerated growth in human activities in coastal regions [45]. In Brazil, publications on this thematic were published only after 2006. The development of whale

watching highlights the need for studies on the possible impacts of vessel traffic. This activity doubled worldwide between 1991 and 1998, and by the year 2006 it was increasing at an average anual rate of 11.3% [50]. It currently involves 87 countries [20]. As an example, Tisher et al. [51] observed that 81% of the tourists in the Fernando de Noronha Archipelago choose on-board trips aimed at spinner dolphin observation (*Stenella longirostris*); nevertheless, this activity has already been described in the literature as harmful to the spinner dolphin population [52].

Once several of these threats are complex processes that are interrelated, undergo synergy, occur simultaneously, or a consequence of another threat [22], they are not mutually exclusive. For example, in this work, we classified the theme of the works as boat traffic when dealing with behavioral changes at the individual or group level in this scenario. However, this issue can still lead to noise pollution, chemical pollution, collisions, or release of marine debris, which were classified according to the direct analysis of the study on the effects of these causes.

Some themes require further studies; although seismic activities are also associated with a significant impact on cetaceans [53], we found only one published article dealing with this thematic [54]. No studies were found on the theme of depletion of fish stock, and within the pollution theme, there were only two publications aimed at noise pollution consequences and one on the consequences of rubbish ingestion.

Deforestation of riparian forests and their implications to fluvial species, introduction of exotic species, and swimming with cetaceans are threats that were mentioned but not highlighted or discussed in detail in our reference book guides. It is noteworthy that other impacts related to human activities, such as climate change, were not addressed in the present study, and are of the most importance (e.g., [55,56,57].

3.4. Spatial distribution of studies

From the 103 publications, we identified 63 study areas (Figure 6 and Table 3). For 56 of the publications, we determined the central position between points that were 144 km apart on average (min = 12 km; max = 443 km). In 10 publications, more than one geographical reference point was plotted, and for 37 studies, only one point was referenced (Appendix A).

Figure 6 here

Table 3 here

The spatial distribution of the studies did not cover only one of the Brazilian coastal states (Piauí state) and covered some river areas. These publications were more concentrated in the state of Rio de Janeiro (RJ), which comprised 22.4% (n = 33), followed by the states of São Paulo (SP) (n = 29; 19.7%), Rio Grande do Sul (n = 19; 12.9%), Amazonas (n = 11; 7.5%), Bahia (BA) (n = 9; 6.1%), Ceará (n = 9; 6.1%), and Paraná (n = 9; 6.1%). Other Brazilian states presented lower representativeness, namely Alagoas, Amapá, Maranhão (MA), and Sergipe, as they only had one publication each.

A few study areas were found along the coast of BA, even though the state has the longest coastline. Similarly, MA presented only one study site despite having the second longest stretch of coastline. The largest number of study areas was identified in RJ, even though it is the Brazilian state with the third longest stretch of coastline.

The concentration of both institutes and areas of study in certain regions of Brazil may be related to a greater amount of financial resources, and thus to the establishment of more research groups. This distribution of institutes and areas of study may be negatively affecting the knowledge of human impacts on cetaceans in other Brazilian regions. The southeast region contains the largest number of institutions of higher education and research, as well as the greatest density of researchers. Therefore, greater participation of institutions in the state of RJ and SP in the network of collaborations was expected.

4. Conclusions

This study presented the works published in the last 31 years on the threats of human impacts to cetaceans in Brazil, and intended to act as a guide for future studies aimed at the conservation of cetaceans.

Brazil is a country with large coastal territories, but, as pointed out here, it was verified that the northern and northeastern regions have a knowledge gap regarding studies on cetaceans in all possible thematics. The coast of BA is an important breeding ground for humpback whales [58], and other cetaceans also occur in this region, thereby indicating that it is an area of great ecological importance for research and conservation of cetacean species [59]. Thus, the region should be a priority for studies and conservation. We suggest the need to increase the number of studies on cetaceans on the coast of BA.

Research on marine mammals has become a complex undertaking, where each project requires a combination of different expertise (e.g., behavioral observation, statistical skills, and laboratory techniques, among others). Thus, partnership between different laboratories contributes to many research projects and allows high-quality research to be conducted [14].

Our results can help researchers to define priority themes and partnerships for future research, as well as to identify species and regions of Brazil with knowledge gaps. Collaboration networks and partnerships between the institutions involved and those not yet identified in this study should be broadened and strengthened. With joint efforts and exchange of information, the studies on cetaceans in Brazil can be effective in the conservation of these species.

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Fig. 1. Flowchart containing information about the phases of the systematic review according to PRISMA guidelines (left) and the respective exclusion criteria (right).

Fig. 2. Annual number of publications on human threats to cetaceans in Brazil, published between 1996 and 2016 (n = 103) separated by theme of threat. The various scales of gray represent each research themes.

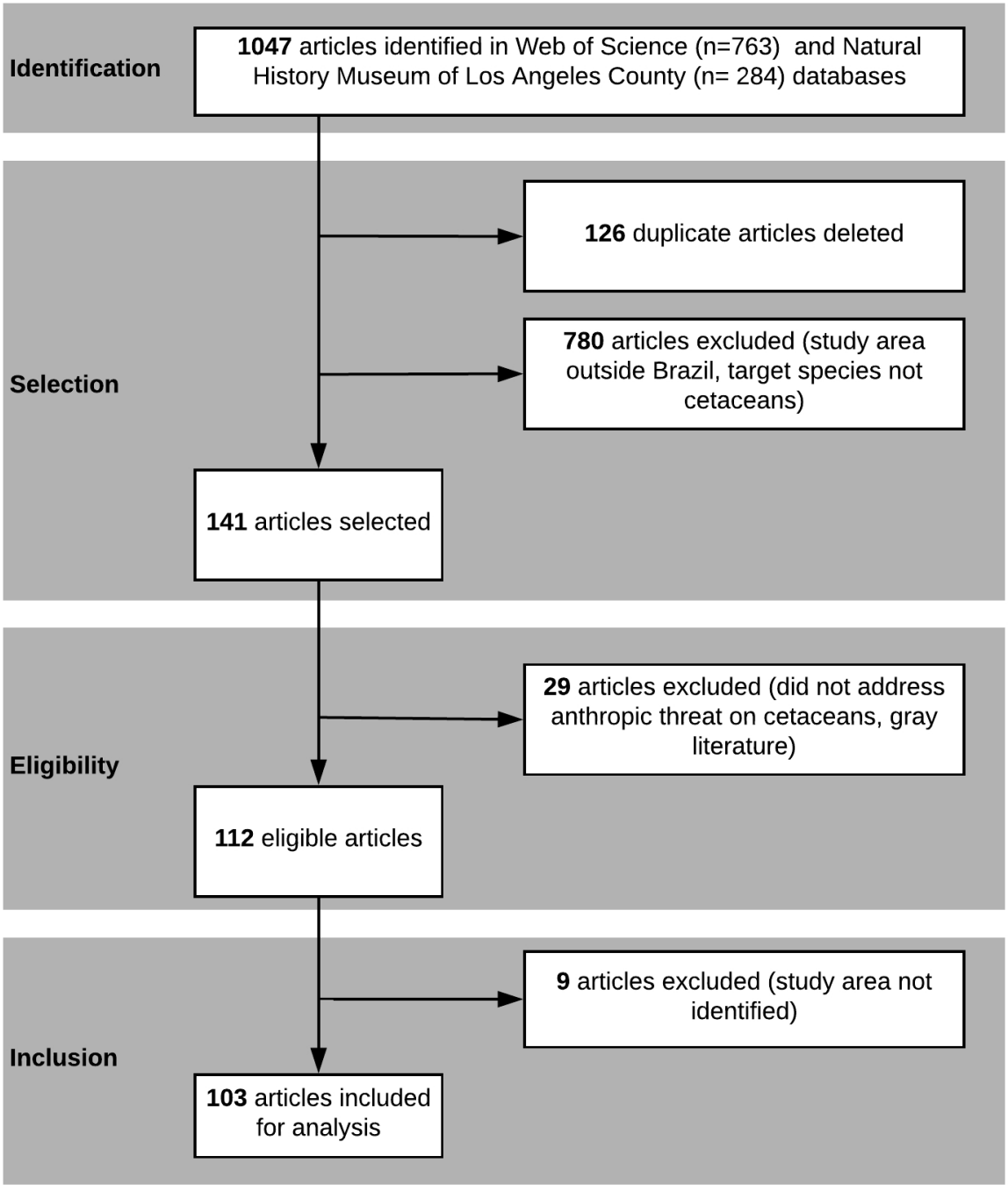
Fig. 3. Geographic distribution of national (n = 55) and international (n = 27) institutions involved in 114 researches on human threats to cetaceans in Brazil. Each symbol represents the type of institution.

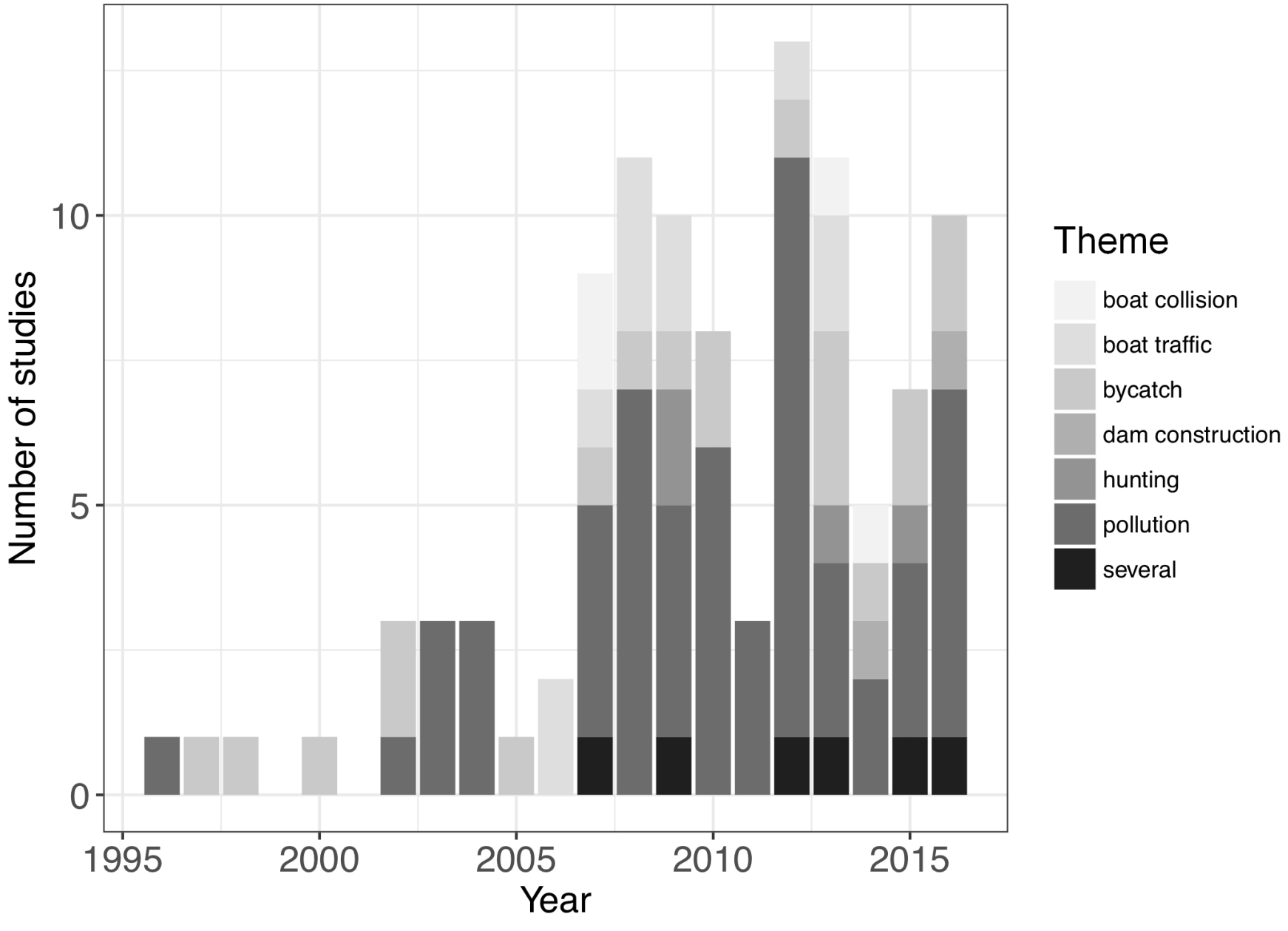
Fig. 4. Networks of scientific collaboration in researches on human threats to cetaceans in Brazil based on 103 publications. Each circle represents an institution (n = 82), and the connection link the institutions that collaborate. The area of the circles is proportional to the degree of centrality of the institution. The acronyms of the six institutions that contribute most to the network are informed. Universities: UENF - Universidade Estadual do Norte Fluminense Darcy Ribeiro; UERJ - Universidade do Estado do Rio de Janeiro; UFRJ - Universidade Federal do Rio de Janeiro; FURG - Universidade Federal do Rio Grande; USP - Universidade de São Paulo and non-governmental organization: BioPesca - Projeto BioPesca.

Fig. 5. Annual number of studies on human threats to cetaceans in Brazil published between 1996 and 2016, separated by cetaceans groups of the target species, as one same publication could target more than one species the total number here is 228. Gray bars representing publications on Odontocetes species and black bars representing publications on mysticetes species.

Fig. 6. Geographic distribution maps of the study areas of 103 publications on human threats to cetaceans in Brazil. Coverage of Brazilian publications, the quadrant presents the region with the highest concentration of publications; each symbol represents the theme addressed.

Appendix C. Networks of scientific collaboration in researches on human threats to cetaceans in Brazil based on 103 publications. Each circle represents an institution (n = 82), and the connection link the institutions that collaborate. The area of the circles is proportional to the degree of centrality of the institution. The acronyms of all the institutions are informed.


Identification
1047 articles identified in Web of Science (n=763) and Natural History Museum of Los Angeles County (n= 284) databases
Selection
126 duplicate articles deleted
780 articles excluded (study area outside Brazil, target species not cetaceans)
141 articles selected
Eligibility
29 articles excluded (did not address anthropic threat on cetaceans, gray literature)
112 eligible articles
Inclusion
9 articles excluded (study area not identified)
103 articles included for analysis


Number of studies
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Theme
boat collision
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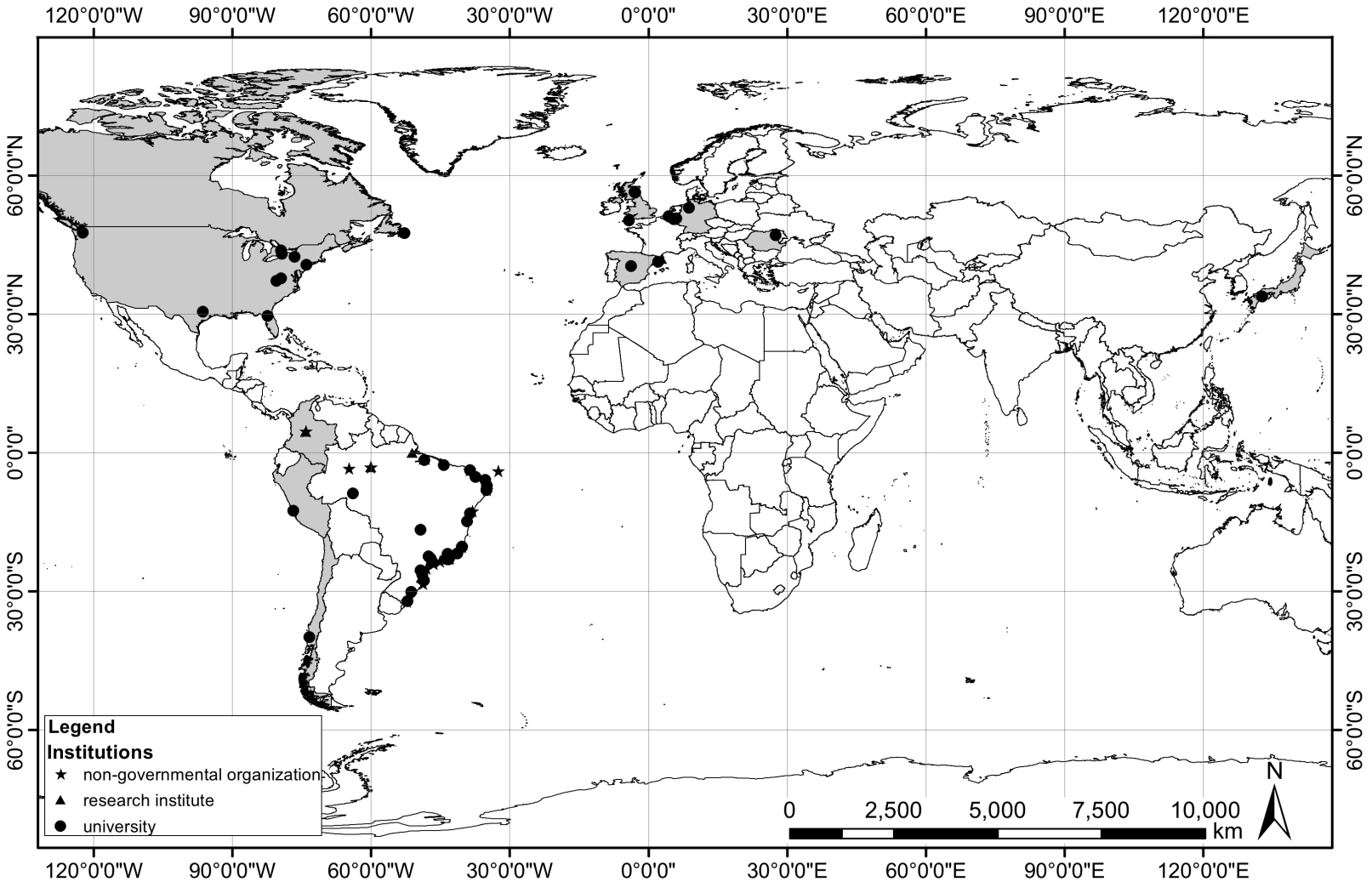
bycatch
dam construction
hunting
pollution
several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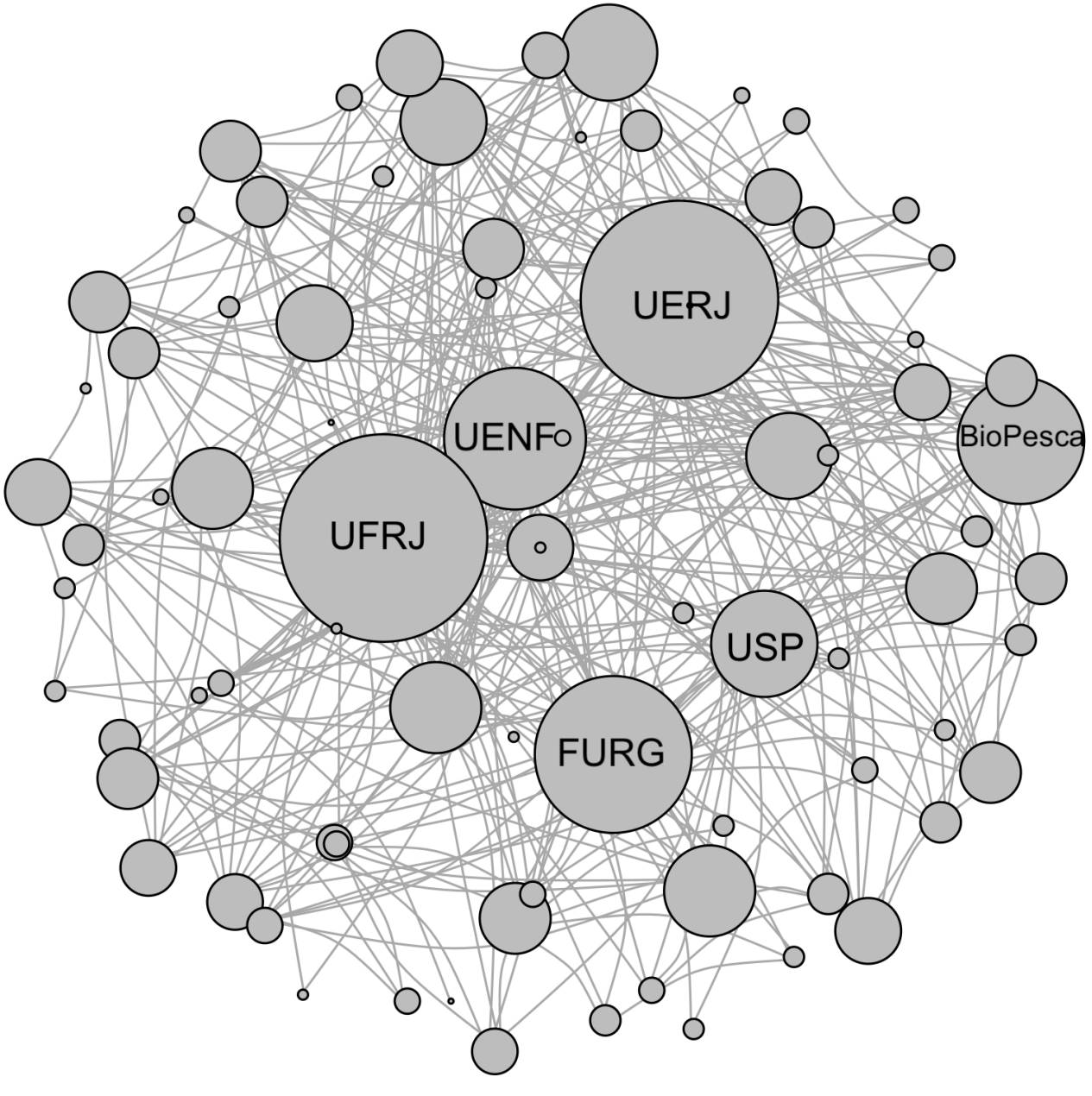
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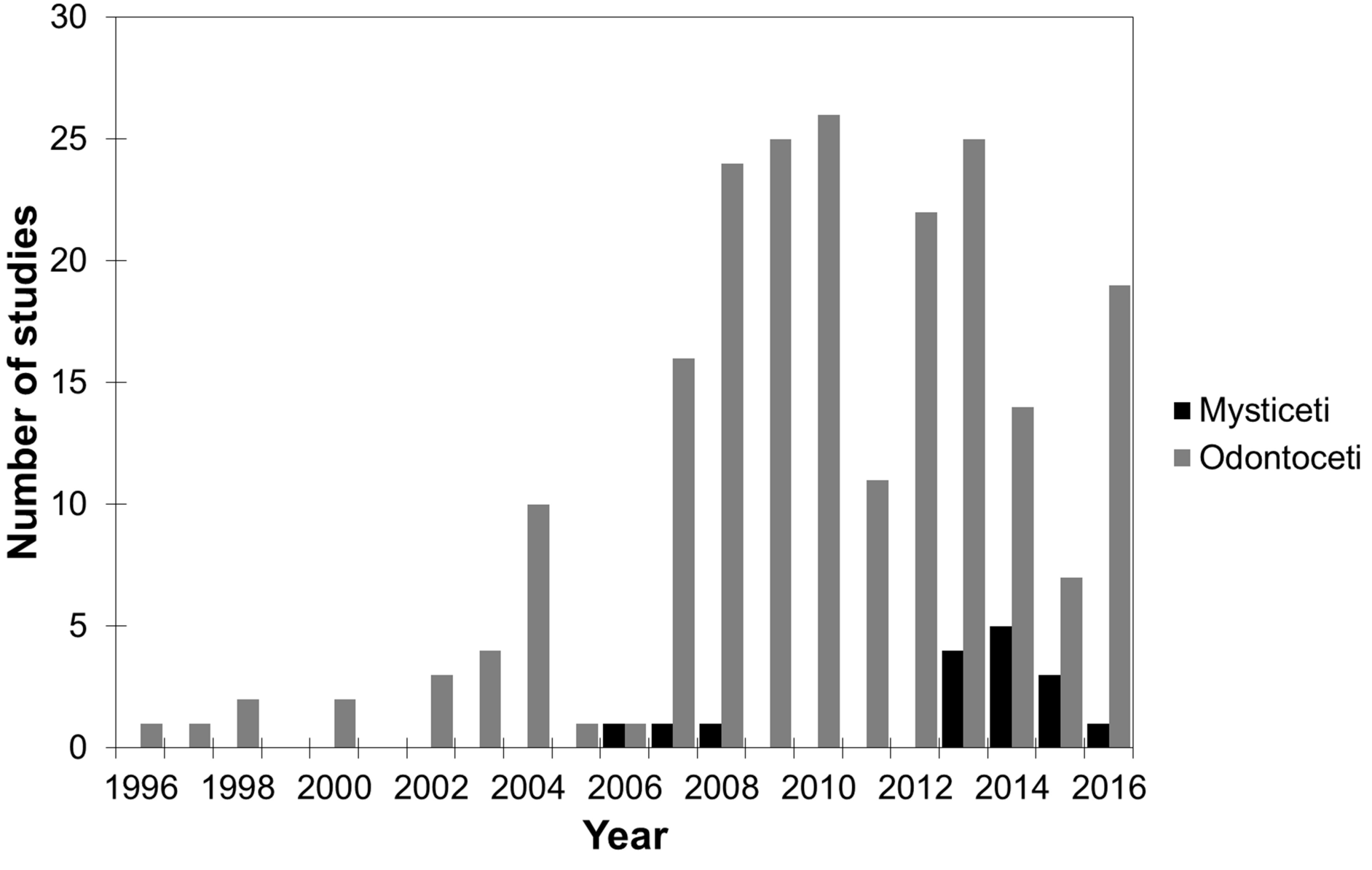
USP
FURG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Number of studies
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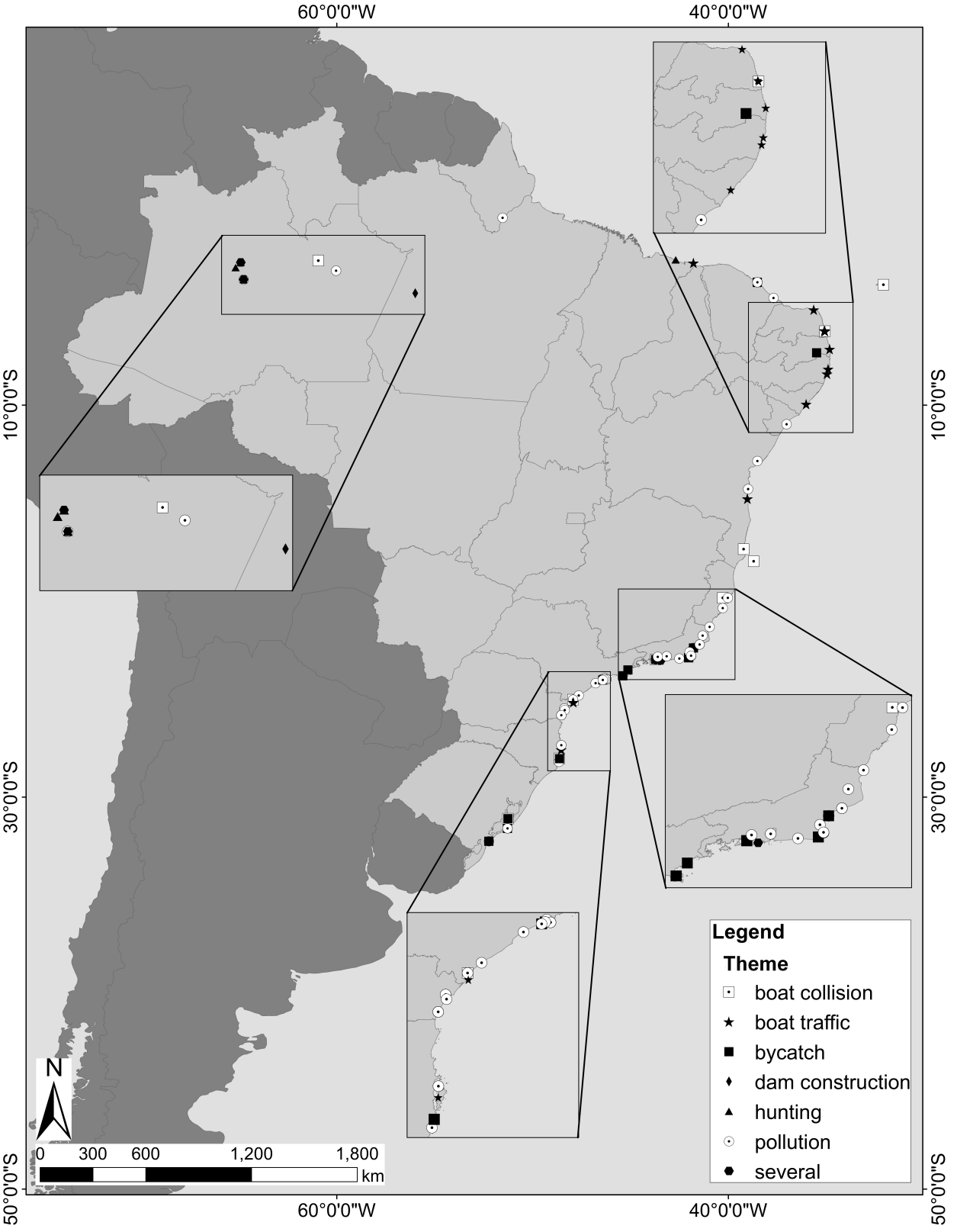
Mysticeti
Odontoceti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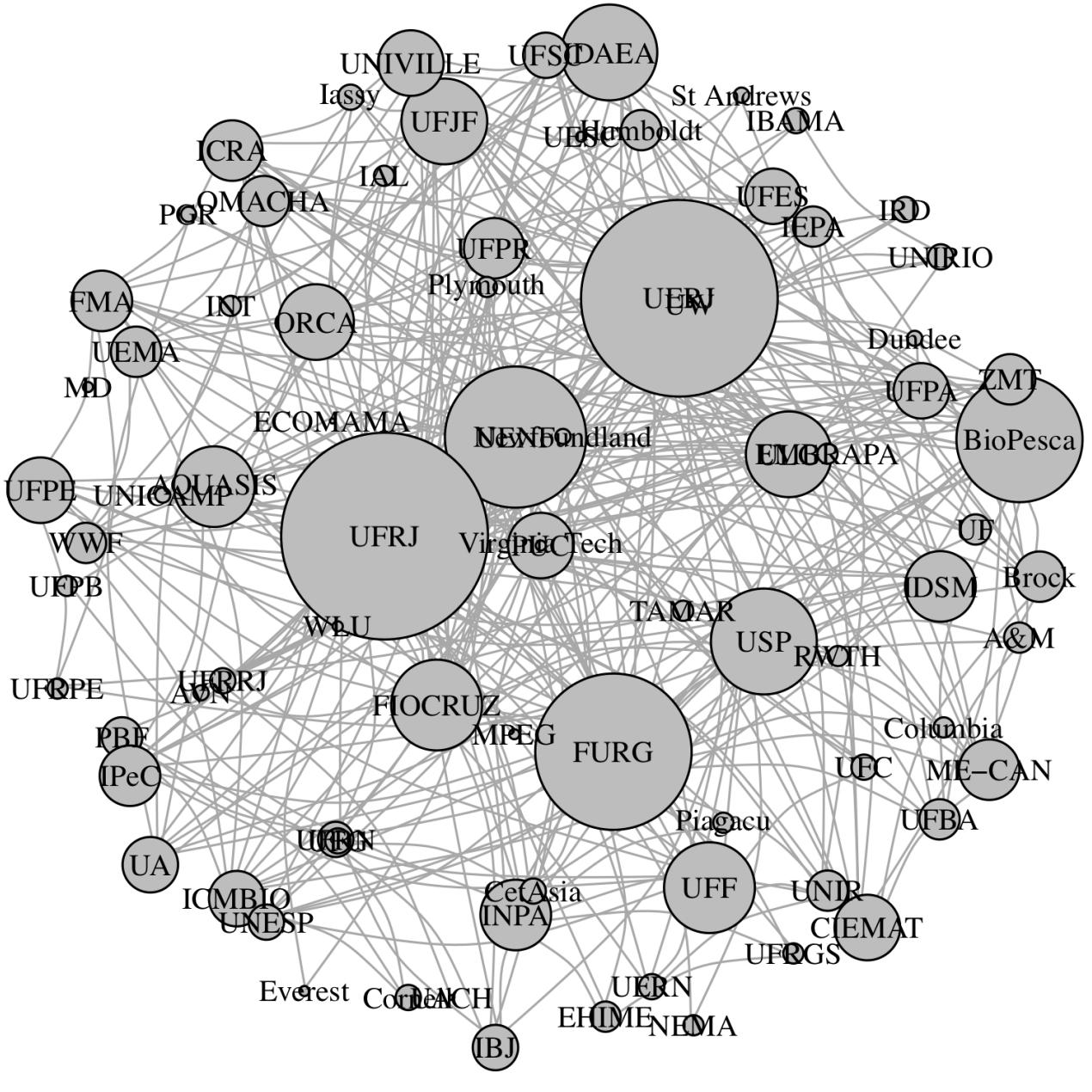
UNIVILLE
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UERJ
UW
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ORCA
UEMA
Dundee
MD
UFPA
ZMT
ECOMAMA
NENFO
Newfoundland
BioPesca
UFPE
UNICAMP
AQUASIS
UFRJ
WWF
Virginia Tech
UF
UFPB
IDSM
Brock
TAMAR
WLU
USP
A&M
UFRPE
AON
FIOCRUZ
PBF
MPEG
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Columbia
IPeC
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ME-CAN
Piagacu
UFBA
UA
ICMBIO
CetAsia
UFF
UNIR
UNESP
INPA
CIEMAT
UFRGS
Everest
Cornell
EHIME
NEMA
IBJ

Sources of bibliographic data	Web of Science bibliographic platform (http://isiknowledge.com/) and the bibliographic database of the Natural History Museum of Los Angeles County
Period of publication	Between 1986 and 2016
Search field	Topic (article titles, abstracts, author keywords, keywords created)
Terms used in search fields	Brazil OR South Atlantic AND cetacea* OR dolphin* OR whale* OR odontocet* OR mysticet* OR toothed whale* AND anthropogenic impact* OR human impact* OR human effect* OR disturbance* OR threat* OR pressure on marine ecosystem* OR habitat loss* OR habitat degradation* OR marine scrap* OR marine rubbish* OR marine trash* OR marine garbage* OR marine rubble* OR pollution by plastic* OR ingestion OR floating solid waste debris* OR bridge construction* OR oil exploration* OR natural gas exploration* OR mining exploration* OR overfishing* OR depletion of fish stock* OR resource competition* OR incidental capture* OR incidental catch* OR accidental capture* OR accidental catch* OR capture in fishing net* OR capture in gillnet* OR capture in trawl net* OR intentional capture* OR hunt* OR slaughter* OR killing by competition* OR intensification of maritime traffic* OR traffic of vessel* OR transit of vessel* OR boat* OR ship* OR collision* with vessel* OR ships collision* OR noise pollution* OR noise of anthropogenic origin* OR seismic prospect* OR dredging* OR perforation* OR chemical pollution* OR contaminant* OR toxic waste* OR oil* OR oil spill* OR micro pollutant* OR uncontrolled OR observation tourism* OR whale watching*

Table 1. Search information and terms used for initial identification of articles focusing on human threats to cetaceans in the bibliographic databases Web of Science and David Janiger. Symbol - *, named symbol of truncation, is used in the bibliographic search, at the end of the words to find them in the singular, plural and variations of writing of them (recovers any amount of characters, including none).

Taxon	Common name	Number of institutes	Brazilian List	IUCN Red List
Suborder Mysticeti				
Family Balaenidae				
Eubalaena australis	Southern right whale	12	EN	LC
Family Balaenopteridae				
Balaenoptera acutorostrata	Minke whale	6	DD	LC
Balaenoptera bonaerensis	Antarctic minke whale	0	DD	NT
Balaenoptera borealis	Sei whale	0	VU	EN
Balaenoptera edeni	Bryde's whale	3	DD	DD
Balaenoptera musculus	Blue whale	0	CR	EN
Balaenoptera physalus	Fin whale	0	EN	VU
Megaptera novaeangliae	Humpback whale	14	VU	LC
Suborder Odontoceti				
Family Delphinidae				
Cephalorhynchus commersonii	Commerson's dolphin	0	**	LC
Delphinus capensis	Long-beaked common dolphin	9	DD	DD
Delphinus delphis	Short-beaked common dolphin	14	DD	LC
Delphinus sp.	Delphinus sp	6	DD	DD
Feresa attenuata	Pygmy killer whale	9	DD	DD
Globicephala macrorhynchus	Short-finned pilot whale	0	DD	DD
Globicephala melas	Long-finned pilot whale	7	DD	DD
Grampus griseus	Risso's dolphin	9	DD	LC
Lagenorhynchus australis	Peale's dolphin	0	**	DD
Lagenodelphis hosei	Fraser's dolphin	13	DD	LC
Lissodelphis peronii	southern right whale Dolphins	0	**	LC
Orcinus orca	Killer whale	11	DD	DD
Peponocephala electra	Melon-headed whale	7	DD	LC
Pseudorca crassidens	False killer whale	17	DD	DD
Sotalia fluviatilis	Tucuxi	10	**	LC
Sotalia guianensis	Guiana dolphin	61	VU*	DD
Stenella attenuata	Pantropical spotted dolphin	13	DD	LC

Stenella clymene	Clymene dolphin	4	DD	DD
Stenella coeruleoalba	Striped dolphin	21	DD	LC
Stenella frontalis	Atlantic spotted dolphin	33	DD	DD
Stenella longirostris	Spinner dolphin	22	DD	DD
Stenella sp.	Stenella sp	1	DD	DD
Steno bredanensis	Rough-toothed dolphin	30	DD	LC
Tursiops truncatus	Common bottlenose dolphin	29	DD	LC
Family Iniidae				
Inia geoffrensis	Amazon river dolphin	24	**	VU
Family Hyperoodontidae				
Hyperoodon planifrons	Southern bottlenose whale	0	DD	LC
Family Kogiidae				
Kogia sima	Dwarf sperm whale	8	DD	DD
Kogia breviceps	Pygmy sperm whale	0	DD	DD
Family Physeteridae				
Physeter macrocephalus	Sperm whale	0	VU	VU
Family Phocoenidae				
Phocoena dioptrica	Spectacled porpoise	0	**	LC
Phocoena spinipinnis	Burmeister's porpoise	0	**	NT
Family Pontoporiidae				
Pontoporia blainvillei	Franciscana	40	EN	VU
Family Ziphiidae				
Berardius arnuxii	Arnoux's beaked whale	0	DD	DD
Mesoplodon europaeus	Gervais' beaked whale	0	DD	DD
Mesoplodon densirostris	Blainville's beaked whale	0	DD	DD
Mesoplodon grayi	Gray's beaked whales	0	DD	DD
Mesoplodon hectori	Hector's beaked whale	0	DD	DD
Mesoplodon layardii	Strap-toothed beaked whale	0	DD	DD

Mesoplodon mirus	True's beaked whale	0	**	DD
Ziphius cavirostris	Cuvier's beaked whales	0	DD	LC

Table 2. List of 48 species that occur in Brazilian jurisdictional waters. Twenty eight species were target of studies on human threats to cetaceans in Brazil, published between 1986 and 2016. The number of institutions involved on these studies, the threat categories in the ICMBio Brazilian list (Brazilian List) and in the World Conservation Union list (IUCN Red List) are informed for each species. Threat categories: CR - Critically endangered; DD - Data deficient; EN - Endangered; LC - Least concern; NT - Near threatened and VU - Vulnerable. Symbols: * - Species is included in State lists of endangered species (Bahia and Paraná); ** - Species occurring in Brazilian waters, but not included in the Brazilian national list.

N	Name of study area	State	Latitude (degrees)	Longitude (degrees)
1	Amapá	AP	0°25'46.57"S	51°31'38.43"W
2	Aracaju	SE	10°58'15.67"S	37° 2'7.04" W
3	Arquipélago dos Abrolhos	BA	17°57'45.40"S	38°42'15.83" W
4	Baia de Guanabara	RJ	22°48'41.66"S	43° 9'16.07" W
5	Baia de Paranaguá	PR	25°27'50.57"S	48°22'57.84" W
6	Baia de Santos	SP	23°58'32.91"S	46°20'8.62" W
7	Baia de Sepetiba	RJ	22°58'15.43"S	43°43'9.26" W
8	Baia de todos os Santos	BA	12°50'36.42"S	38°31'28.95" W
9	Baia Norte	SC	27°34'23.50"S	48°32'3.06" W
10	Barra de São João	RJ	22°35'48.92"S	41°59'23.16" W
11	Barra do Furado	RJ	22°12'25.73"S	41°28'22.67"W
12	Barra do Riacho	ES	19°49'22.69"S	40°16'47.54"W
13	Cabo Frio	RJ	22°53'12.32"S	42° 1'34.54"W
14	Caburé	MA	2°34'53.56"S	42°41'31.53"W
15	Cananéia	SP	25° 1'14.59"S	47°55'55.09"W
16	Costa ES	ES	19°49'31.67"S	40° 2'9.48"W
17	Costa PB	PB	7° 8'3.38"S	34°49'21.13"W
18	Costa PE	PE	8°23'49.84"S	34°57'48.33"W
19	Costa PR	PR	25°48'59.88"S	48°32'1.18"W
20	Costa RJ	RJ	31°35'6.08"S	51°17'2.31"W
21	Costa RN	RN	5° 7.267'S	35° 38.154'W
22	Costa RS	RS	31°35'6.08"S	51°17'2.31"W
23	Costa SC	SC	27° 20.493'S	48° 31.816'W
24	Costa SP	SP	23°58'50.96"S	46°13'39.52"W
25	ETA Guandu	RJ	22°50'22.13"S	43°36'36.70"W
26	Fernando de Noronha	PE	3°51'0.02"S	32°25'0.00"W
27	Fortaleza	CE	3°43'4.15"S	38°31'12.87"W
28	Garopaba	SC	28° 1'24.27"S	48°37'2.99"W
29	Ilha Comprida	SP	24°48'36.55"S	47°38'43.11"W
30	Ilha do Cardoso	SP	25° 9'34.75"S	47°55'2.60"W
31	Itacaré	BA	14°16'40.52"S	38°59'38.81"W

32	Itanhaém	SP	24°10'54.49"S	46°47'6.14"W
33	Lagoa dos Patos	RS	31° 5'59.92"S	51°15'2.05"W
34	Macaé	RJ	22°23'8.51"S	41°47'4.19"W
35	Manacapuru	AM	3°17'23.02"S	60°37'54.87"W
36	Novo Airão	AM	2°37'0.01"S	60°56'0.00"W
37	Pontal do Sul	PR	25°33'28.77"S	48°21'51.12"W
38	Porto do Malhado	BA	14°46'8.02"S	39° 1'33.03"W
39	Porto São Sebastião	SP	23°48'12.57"S	45°23'10.52"W
40	Prado	BA	17°20'24.58"S	39°13'1.33"W
41	Praia Canoa Quebrada	CE	4°31'28.35"S	37°42'5.61"W
42	Praia da Piedade	PE	8° 8'55.50"S	34°54'24.24"W
43	Praia da Pipa	RN	6°13'21.18"S	35° 4'15.93"W
44	Praia da Ribanceira	BA	28° 11.438'S	48° 39.743'W
45	Praia do J F. do Quissamã	RJ	22°12'25.73"S	41°28'22.67"W
46	Praia Grande	SP	24° 0'51.79"S	46°24'44.37"W
47	Recreio dos Bandeirantes	RJ	23° 1'30.99"S	43°27'17.08"W
48	Reserva Mamirauá	AM	3°35'0.01"S	64°45'0.03"W
49	Rio Amazonas	AM	3° 8'8.96"S	60° 1'51.34"W
50	Rio Araguaia	AM	11°41'58.35"S	50°41'32.34"W
51	Rio Grande	RS	32°14'57.48"S	52°13'55.01"W
52	Rio Japurá	AM	2°43'13.22"S	64°53'46.64"W
53	Rio Paraíba	PB	7°19'16.36"S	35°29'50.17"W
54	Rio Paraíba do SuL	SP	21°45'19.83"S	41°19'6.14"W
55	Rio São Francisco	AL	9° 56.716'S	36° 1.356'W
56	Rio Tapajós, Itaituba	PA	4°16'59.31"S	55°59'32.07"W
57	S. F.de Itabapoana	RJ	21°18'19.39"S	40°57'35.77"W
58	Saco da Ribeira, Ubatuba	SP	23°30'11.18"S	45° 7'35.42" W
59	São Paulo (estuário)	SP	23°55'26.42"S	46°18'27.46" W
60	Saquarema	SP	22°55'12.02"S	42°30'37.00" W
61	Tibau do Sul	RN	6°11'15.48"S	35° 5'43.11" W
62	Urani	AM	2°58'56.08"S	65° 9'33.72" W
63	Vila Velha	ES	20°20'48.48"S	40°17'41.23" W

Table 3. List of 63 study areas relating to 103 researches on human threats to cetaceans in Brazil with their names, Brazilian states, and geographical coordinates.

Appendix A. List of 103 researches on human threats to cetaceans in Brazil published between 1996 and 2016 with the respective theme, information on the geographic coordinates of the study areas and target species.

Source	Central point	Reported coordinates	Name of study area	State	topic	Target species
1	NO	NO	Costa RJ	RJ	pollution	*T. truncatus*
						S. bredanensis
						S. guianensis
						P. blainvillei
3	YES	YES	Praia Grande	SP	bycatch	*P. blainvillei*
5	NO	NO	Costa PR	PR	pollution	*S. guianensis*
5	NO	NO	Costa RJ	RJ		
5	NO	NO	Vila Velha	ES		
5	NO	NO	Fortaleza	CE		
6	NO	NO	Costa RJ	RJ	pollution	*P. blainvillei*
7	YES	YES	Ilha Comprida	SP	pollution	*S. frontalis*
8	NO	NO	Cananéia	SP	pollution	*S. guianensis*
9	YES	YES	Praia da Pipa	RN	boat collision	*S. guianensis*
10	NO	NO	Rio Amazonas	AM	pollution	*I. geoffrensis*
11	YES	YES	Fortaleza	CE	pollution	*S. guianensis*
12	YES	YES	Rio Tapajós, Itaituba	AM	dam construction	*I. geoffrensis*
						S. fluviatilis
13	YES	YES	Praia da Ribanceira	BA	pollution	*E. australis*
14	NO	NO	Fortaleza	CE	bycatch	*S. guianensis*
						S. bredanensis
16	NO	NO	Rio Grande	RS	bycatch	*P. blainvillei*
17	YES	YES	Praia Grande	SP	bycatch	*P. blainvillei*
18	NO	NO	Costa PR	PR	pollution	*S. guianensis*
18	NO	NO	Costa SP	SP		*P. blainvillei*
						S. frontalis
						D. capensis
						S. coeruleoalba
21	YES	YES	Costa RS	RS	pollution	*P. blainvillei*
23	NO	NO	Costa SP	SP	pollution	*P. blainvillei*
						S. guianensis
						S. frontalis

						D. capensis
24	NO	NO	Baia de Santos	SP	bycatch	*O. orca*
25	NO	NO	Costa RS	RS	pollution	*P. blainvillei*
25	NO	NO	São Paulo (estuário)	SP		
28	NO	NO	Fortaleza	CE	pollution	*S. guianensis*
						L. hosei
						S. longirostris
						S. frontalis
						S. coeruleoalba
29	YES	YES	Recreio dos Bandeirantes	RJ	several	*E. australis*
30	YES	YES	Cabo Frio	RJ	bycatch	*O. orca*
						M. novaeangliae
						E. australis
						B. acutorostrata
						B. brydei
						P. blainvillei
						T. truncatus
						S. bredanensis
						S. frontalis
						Delphinus sp.
31	YES	YES	Rio Grande	RS	pollution	*P. blainvillei*
33	YES	YES	Fortaleza	CE	pollution	*S. bredanensis*
34	YES	YES	Baia Norte	SC	boat traffic	*S. guianensis*
35	YES	YES	Costa RJ	RJ	pollution	*S. guianensis*
35	YES	YES	Costa SP	SP		*S. frontalis*
35	YES	YES	Costa PR	PR		*T. truncatus*
35	YES	YES	Costa SC	SC		*S. bredanensis*
						S. attenuata
						S. longirostris
						S. coeruleoalba
						D. capensis
						K. sima
40	NO	NO	Costa RJ	RJ	pollution	*S. guianensis*
41	NO	NO	Costa RJ	RJ	pollution	*P. blainvillei*
41	NO	NO	Costa SP	SP		
41	NO	NO	Costa PR	PR		
41	NO	NO	Costa RS	RS		
41	NO	NO	Costa SC	SC		
41	NO	NO	Costa ES	ES		
42	YES	YES	Fortaleza	CE	boat traffic	*S. guianensis*
42	YES	YES	Costa RN	RN		

42	YES	YES	Rio São Francisco	AL		
42	YES	YES	Costa PE	PE		
42	YES	YES	Costa PB	PB		
43	NO	NO	Baia de Guanabara	RJ	pollution	*S. guianensis*
44	YES	YES	Costa RJ	RJ	pollution	*P. blainvillei*
						S. guianensis
45	YES	YES	Praia da Piedade	PE	boat traffic	*S. guianensis*
46	YES	YES	Costa RS	RS	pollution	*P. blainvillei*
46	YES	YES	Costa RJ	RJ		
47	YES	YES	Caburé	MA	hunting	*L. hosei*
48	YES	YES	Arquipélago dos Abrolhos	BA	boat traffic	*M. novaeangliae*
50	YES	YES	Costa RS	RS	bycatch	*T. truncatus*
52	NO	NO	Costa ES	ES	pollution	*P. blainvillei*
52	NO	NO	Costa SP	SP		
52	NO	NO	Costa RS	RS		
52	NO	NO	Costa SC	SC		
53	YES	YES	Arquipélago dos Abrolhos	BA	boat traffic	*M. novaeangliae*
54	YES	YES	Fortaleza	CE	several	*S. guianensis*
						S. frontalis
						P. crassidens
						T. truncatus
						S. bredanensis
						D. delphis
						S. attenuata
						S. longirostris
						S. coeruleoalba
						L. hosei
						G. griseus
						K. sima
						P. blainvillei
						P. electra
						G. macrorhynchus
56	YES	YES	Macaé	RJ	bycatch	*S. guianensis*
57	NO	NO	Costa RJ	RJ	pollution	*O. orca*
						P. crassidens
						T. truncatus
						S. bredanensis
						D. capensis

						L. hosei
61	NO	NO	Macaé	RJ	pollution	*P. blainvillei*
						S. guianensis
62	YES	YES	Lagoa dos Patos	RS	bycatch	*T. truncatus*
63	NO	NO	Barra de São João	RJ	pollution	*S. guianensis*
67	NO	YES	Baia de Guanabara	RJ	pollution	*S. guianensis*
67	NO	NO	Costa ES	ES		*S. frontalis*
						P. crassidens
						T. truncatus
						S. bredanensis
						D. delphis
						S. attenuata
						S. longirostris
						S. coeruleoalba
						L. hosei
						G. griseus
						K. sima
						P. blainvillei
68	NO	NO	Costa RS	RS	pollution	*P. blainvillei*
70	NO	NO	Reserva Mamirauá	AM	pollution	*I. geoffrensis*
						S. fluviatilis
73	YES	YES	Praia da Pipa	RN	boat traffic	*S. guianensis*
74	YES	YES	Costa RS	RS	pollution	*P. blainvillei*
74	YES	YES	Costa RJ	RJ		*P. blainvillei*
76	NO	NO	Saquarema	SP	pollution	*S. guianensis*
						S. frontalis
						P. crassidens
						T. truncatus
						S. bredanensis
						D. delphis
						S. attenuata
						S. longirostris
						S. coeruleoalba
						L. hosei
77	NO	NO	Saco da Ribeira, Ubatuba	SP	bycatch	*S. frontalis*
						S. longirostris
						P. electra

						F. attenuata
						T. truncatus
78	YES	YES	Cananéia	SP	pollution	*S. guianensis*
78	YES	YES	Baia de Paranaguá	PR		
80	NO	NO	Baia de Sepetiba	RJ	pollution	*S. guianensis*
81	NO	NO	Rio Japurá	AM	hunting	*I. geoffrensis*
						S. fluviatilis
82	YES	YES	Ilha do Cardoso	SP	boat traffic	*S. guianensis*
83	NO	NO	Baia de todos os Santos	BA	pollution	*S. guianensis*
						S. clymene
84	YES	YES	Praia do J F. do Quissamã	RJ	pollution	*S. guianensis*
85	NO	NO	Itanhaém	SP	pollution	*P. blainvillei*
						S. frontalis
						S. guianensis
						T. truncatus
						S. bredanensis
86	NO	NO	Costa SP	SP	pollution	*S. frontalis*
						S. bredanensis
						S. guianensis
						T. truncatus
						P. blainvillei
						S. clymene
						Delphinus sp.
						D. delphis
						S. coeruleoalba
87	NO	NO	Amapá	AP	pollution	*S. guianensis*
88	YES	YES	Baia de Santos	SP	pollution	*S. frontalis*
88	YES	YES	Baia de Paranaguá	PR		
88	YES	YES	Costa SC	SC		
89	YES	YES	Baia de Sepetiba	RJ	bycatch	*S. guianensis*
90	NO	NO	Rio Paraíba do SuL	SP	pollution	*I. geoffrensis*
90	NO	NO	ETA Guandu	RJ		
91	NO	NO	Macaé	RJ	pollution	*P. blainvillei*
						S. guianensis

92	NO	NO	Costa RJ	RJ	pollution	*S. guianensis*
93	YES	YES	Tibau do Sul	RN	boat traffic	*S. guianensis*
94	YES	YES	Rio Grande	RS	pollution	*P. blainvillei*
96	YES	YES	Rio Grande	RS	bycatch	*P. blainvillei*
98	YES	YES	Pontal do Sul	PR	pollution	*P. blainvillei*
98	YES	YES	Praia Grande	SP		
100	NO	NO	Reserva Mamirauá	AM	hunting	*I. geoffrensis*
101	YES	YES	S. F.de Itabapoana	RJ	pollution	*S. guianensis*
102	NO	NO	Costa SP	SP	pollution	*P. blainvillei*
102	NO	NO	Costa RS	RS		
103	NO	NO	Costa RJ	RJ	pollution	*P. blainvillei*
103	NO	NO	Costa SP	SP		
103	NO	NO	Costa PR	PR		
103	NO	NO	Costa RS	RS		
103	NO	NO	Costa SC	SC		
103	NO	NO	Costa ES	ES		
104	YES	YES	Fernando de Noronha	PE	boat collision	*S. longirostris*
105	NO	NO	Praia da Pipa	RN	boat traffic	*S. guianensis*
106	YES	NO	Baia de Santos	SP	pollution	*S. guianensis*
106	YES	NO	Praia Grande	SP		
108	YES	YES	Porto do Malhado	BA	boat traffic	*S. guianensis*
						S. frontalis
						Stenella sp.
						S. bredanensis
109	YES	YES	Fortaleza	CE	pollution	*S. guianensis*
110	YES	YES	Garopaba	SC	bycatch	*E. australis*
111	YES	YES	Rio Grande	RS	bycatch	*P. blainvillei*
112	NO	NO	Manacapuru	AM	several	*I. geoffrensis*
						S. fluviatilis
113	NO	NO	Baia de Guanabara	RJ	pollution	*P. blainvillei*
						S. guianensis
115	YES	YES	Porto do Malhado	BA	boat traffic	*S. guianensis*
116	YES	YES	Barra do Furado	RJ	bycatch	*P. blainvillei*

						S. guianensis
117	YES	YES	Praia do J F. do Quissamã	RJ	pollution	*F. attenuata*
						O. orca
						P. blainvillei
						S. guianensis
						S. frontalis
						S. bredanensis
						T. truncatus
120	NO	NO	Rio Japurá	AM	several	*I. geoffrensis*
						S. fluviatilis
121	YES	YES	Novo Airão	AM	boat collision	*I. geoffrensis*
121	YES	YES	Prado	BA		*S. guianensis*
121	YES	YES	Barra do Riacho	ES		*T. truncatus*
121	YES	YES	Baia de Sepetiba	RJ		*E. australis*
121	YES	YES	Cananéia	SP		*M. novaeangliae*
121	YES	YES	Garopaba	SC		
121	YES	YES	Lagoa dos Patos	RS		
123	NO	NO	Costa SP	SP	pollution	*P. blainvillei*
						S. guianensis
						S. bredanensis
						P. crassidens
124	YES	YES	Porto São Sebastião	SP	bycatch	*B. acutorostrata*
125	YES	YES	Itacaré	BA	pollution	*M. novaeangliae*
125	YES	YES	Aracaju	SE		
126	YES	YES	Arquipélago dos Abrolhos	BA	boat collision	*M. novaeangliae*
127	NO	NO	Rio Araguaia	AM	dam construction	*I. geoffrensis*
						S. fluviatilis
128	YES	YES	Praia do J F. do Quissamã	RJ	pollution	*P. blainvillei*
						S. guianensis
129	NO	NO	Reserva Mamirauá	AM	several	*I. geoffrensis*
130	YES	YES	Rio Paraíba	PB	bycatch	*G. griseus*
131	NO	NO	Urani	AM	hunting	*I. geoffrensis*

133	NO	NO	Praia do J F. do Quissamã	RJ	pollution	*S. guianensis* *S. bredanensis*
134	YES	YES	Pontal do Sul	PR	several	*S. guianensis* *P. blainvillei* *S. frontalis* *S. longirostris* *T. truncatus* *G. melas*
136	YES	YES	Porto São Sebastião	SP	bycatch	*B. acutorostrata*
138	YES	YES	Lagoa dos Patos	RS	bycatch	*T. truncatus*
139	NO	NO	Praia do J F. do Quissamã	RJ	pollution	*P. blainvillei*
140	NO	NO	Baia de Santos	SP	pollution	*P. blainvillei*
140	NO	NO	Baia de Sepetiba	RJ		*S. guianensis*
140	NO	NO	Praia Canoa Quebrada	CE		
141	YES	YES	Lagoa dos Patos	RS	bycatch	*T. truncatus*

Appendix B. List with full names, acronyms and geographic coordinates of the 82 institutions involved in conducting 103 publications on human threats to cetaceans in Brazil, published between 1986 and 2016.

n	Type, country, Abbreviation	Institution	Latitude (degrees)	Longitude (degrees)
	Non-governmental organizations			
	Brazil:			
1	AVN	Associação Ambiental Voz da Natureza	20°18'52.03"S	40°18'10.79"O
2	AQUASIS	Associação de Pesquisa e Preservação de Ecossistemas Aquáticos	3°41'31.81"S	38°37'38.25"O
3	PGR	Centro Golfinho Rotador	3°50'54.40"S	32°25'37.70"O
4	FMA	Fundação Mamíferos Aquáticos	8° 1'45.68"S	34°54'26.37"O
5	IBJ	Instituto Baleia Jubarte	12°34'32.68"S	38° 0'28.02"O
6	IDSM	Instituto de Desenvolvimento Sustentável Mamirauá	3°21'19.05"S	64°43'52.15"O
7	IPeC	Instituto de Pesquisas Cananéia	25° 0'56.70"S	47°55'41.81"O
8	ORCA	Instituto ORCA	20°20'6.42"S	40°17'2.78"O
9	Piagaçu	Instituto Piagaçu	3° 5'42.08"S	59°59'27.51"O
10	NEMA	Núcleo de Educação e Monitoramento Ambiental	32°11'15.66"S	52° 9'28.48"O
11	PBF	Projeto Baleia Franca	28°19'53.24"S	48°42'37.00"O
12	BioPesca	Projeto BioPesca	24° 0'31.86"S	46°24'44.86"O
13	TAMAR	Projeto TAMAR	23°27'10.26"S	45° 4'13.79"O
14	WWF	World Wide Fund for Nature	3° 4'25.70"S	59°58'29.10"O
	Colombia:			
15	OMACHA	Fundación Omacha	4°40'20.11"N	74° 3'40.36"O
	Research institutes			
	Brazil:			
16	EMBRAPA	Empresa Brasileira de Pesquisa Agropecuária	22°58'16.32"S	43°13'24.91"O
17	FIOCRUZ	Fundação Oswaldo Cruz	22°52'32.55"S	43°14'34.76"O
18	IAL	Instituto Adolfo Lutz	23°33'15.10"S	46°40'13.91"O
19	IBAMA	Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis	26°55'7.04"S	48°40'12.54"O
20	ICMBio	Instituto Chico Mendes de Conservação da Biodiversidade	26°57'41.93"S	49° 4'11.28"O
21	INPA	Instituto Nacional de Pesquisas da Amazonia	3° 6'35.74"S	60° 1'16.55"O
22	INT	Instituto Nacional de Tecnologia	22°53'46.31"S	43°11'3.43"O
	Canada:			
23	ME-CAN	Ministry of Environment Canadá	43°41'10.59"N	79°24'3.66"O
	Colombia:			

24	Humboldt	Instituto de Investigación de Recursos Biológicos	4°36'59.80"N	74° 4'23.47"O
25	IEPA	Instituto de Pesquisa Científicas e Tecnológicas do Estado do Amapá	0° 1'44.37"N	51° 4'2.25"O
26	MPEG	Museu Paraense Emílio Goeld	1°27'3.22"S	48°26'44.42"O
	Spain:			
27	ICRA	Catalan Institute for Water Research	41°58'2.29"N	2°50'26.34"L
	Universities			
	Belgium:			
28	ULG	Université de Liège	50°34'59.25"N	5°33'32.56"L
29	UA	University of Antwerp	51°13'22.11"N	4°24'36.83"L
	Brazil:			
30	CetAsia	CetAsia Research Group Ltd	43°48'17.03"N	79°25'22.06"O
31	Everest	Everest Tecnologia em Serviços Ltda	20°18'56.12"S	40°17'43.23"O
32	ECOMAMA	Instituto de Estudos da Ecologia de Mamíferos Marinhos	22°54'27.93"S	43°11'1.88"O
33	IRD	Instituto de Radioproteção e Dosimetria	22°59'33.61"S	43°25'12.39"O
34	PUC	Pontifícia Universidade Católica	22°58'45.09"S	43°13'59.17"O
35	USP	Universidade de São Paulo	23°33'36.23"S	46°43'48.25"O
36	UERJ	Universidade do Estado do Rio de Janeiro	22°54'39.26"S	43°14'8.27"O
37	UERN	Universidade do Estado do Rio Grande do Norte	5°12'19.59"S	37°19'5.49"O
38	UNICAMP	Universidade Estadual de Campinas	22°49'5.33"S	47° 3'53.12"O
39	UESC	Universidade Estadual de Santa Cruz	14°47'50.03"S	39°10'16.63"O
40	UEMA	Universidade Estadual do Maranhão	2°34'34.11"S	44°12'31.46"O
41	UENF	Universidade Estadual do Norte Fluminense Darcy Ribeiro	21°45'48.13"S	41°17'30.22"O
42	UNESP	Universidade Estadual Paulista	22°23'43.10"S	47°32'42.72"O
43	UFBA	Universidade Federal da Bahia	12°59'57.56"S	38°30'26.66"O
44	UFPB	Universidade Federal da Paraíba	7° 8'18.10"S	34°50'41.15"O
45	UFG	Universidade Federal de Goiás	16°36'18.47"S	49°15'39.91"O
46	UFJF	Universidade Federal de Juiz de Fora	21°46'37.02"S	43°22'8.34"O
47	UFPE	Universidade Federal de Pernambuco	8° 3'6.55"S	34°57'1.17"O
48	UNIR	Universidade Federal de Rondônia	8°45'48.40"S	63°54'23.56"O
49	UFSC	Universidade Federal de Santa Catarina	27°36'1.37"S	48°31'10.45"O
50	UFC	Universidade Federal do Ceará	3°44'19.89"S	38°34'9.45"O
51	UFES	Universidade Federal do Espírito Santo	20°16'38.38"S	40°18'15.08"O
52	UNIRIO	Universidade Federal do Estado do Rio de Janeiro	22°57'6.67"S	43°10'27.91"O
53	UFPA	Universidade Federal do Pará	1°28'28.04"S	48°27'11.62"O
54	UFPR	Universidade Federal do Paraná	25°25'36.87"S	49°15'42.36"O
55	UFRJ	Universidade Federal do Rio de Janeiro	22°50'33.04"S	43°14'4.34"O

56	FURG	Universidade Federal do Rio Grande	32° 1'52.27"S	52° 6'6.63"O
57	UFRN	Universidade Federal do Rio Grande do Norte	5°50'5.52"S	35°12'41.05"O
58	UFRGS	Universidade Federal do Rio Grande do Sul	30° 2'1.85"S	51°13'6.84"O
59	UFF	Universidade Federal Fluminense	22°53'49.56"S	43° 7'34.49"O
60	UFRPE	Universidade Federal Rural de Pernambuco	8° 0'49.17"S	34°56'53.49"O
61	UFRRJ	Universidade Federal Rural do Rio de Janeiro	22°46'6.23"S	43°41'6.16"O
62	UNIVILLE	Universidade Regional de Joinville	26°15'14.47"S	48°51'28.58"O
	Canada:			
63	Newfoundland	Memorial University of Newfoundland	47°34'25.67"N	52°43'58.46"O
64	Brock	Universidade Brock	43° 7'3.25"N	79°14'51.72"O
	Chile:			
65	UACH	Universidad Austral de Chile	39°48'22.51"S	73°15'0.69"O
	Germany:			
66	ZMT	Leibniz-Zentrum für Marine Tropenforschung	53° 6'28.82"N	8°50'45.53"L
67	RWTH	RWTH Aachen University	50°46'48.20"N	6° 3'56.47"
	Japan:			
68	EHIME	Ehime University	33°51'0.54"N	132°46'21.04"L
	Peru:			
69	MD	Museo de Delfines	12°27'53.73"S	76°46'5.30"O
	Romania:			
70	Iassy	University of Iassy	47°10'29.76"N	27°34'26.69"L
	Spain:			
71	CIEMAT	Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas	40°27'18.45"N	3°43'36.02"O
72	IDAEA	Institute of Environmental Assessment and Water Research	41°23'15.23"N	2° 6'53.82"L
	United Kingdom:			
73	Plymouth	Plymouth University	50°22'33.07"N	4° 8'22.56"O
74	Dundee	University of Dundee	56°27'29.27"N	2°58'55.83"O
75	St Andrews	University of St Andrews	56°20'24.89"N	2°47'48.15"O
	USA:			
76	Columbia	Columbia Univesity	40°42'40.01"N	73°56'29.22"O
77	Cornell	Cornell University	42°27'12.42"N	76°28'24.61"O
78	A&M	Texas A&M University	30°37'6.36"N	96°20'11.41"O
79	UF	University of Florida	29°38'33.99"N	82°21'17.96"O
80	UW	University of Washington	47°39'19.21"N	122°18'12.67"O
81	Virginia Tech	Virginia Polytechnic Institute and State University	37°13'42.18"N	80°25'24.30"O
82	WLU	Washington and Lee University	37°47'25.75"N	79°26'41.84"O

Appendix D. List of 82 institutions involved in 103 scientific scientific articles on human threats to cetaceans in Brazil published between 1986 and 2016 and their respective contributions in the scientific collaboration network detailed in degrees and betweenness values.

Institution	betweenness	degree
A&M	0	6
AQUASIS	113.1221654	16
AVN	0	3
BioPesca	130.1570978	25
Brock	0	10
CetAsia	0	5
CIEMAT	0.2222222	13
Columbia	0	4
Cornell	0	5
Dundee	1.3443182	3
ECOMAMA	0	1
EHIME	0	6
EMBRAPA	0	4
Everest	0	2
FIOCRUZ	225.4661369	18
FMA	87.3938823	12
FURG	427.4717971	31
Humboldt	0	8
IAL	0	4
Iassy	0	5
IBAMA	0	5
IBJ	30.4994621	9
ICMBIO	34.9080110	11
ICRA	1.4838097	12
IDAEA	28.7774078	19
IDSM	35.9381364	14
IEPA	0	8
INPA	308.2936035	14
INT	0	4
IPeC	32.5157007	12
IRD	0	5
MD	0	2
ME-CAN	0	12
MPEG	0	2
NEMA	0	4
Newfoundland	0	3
OMACHA	0	10
ORCA	8.9109065	15
PBF	75.6400488	8

PGR	0	3
Piagacu	0	4
Plymouth	0	4
PUC	58.4731093	13
RWTH	0	4
St Andrews	0	3
TAMAR	4.9008866	4
UA	45.3234775	11
UACH	0	1
UEMA	0	10
UENF	448.6591569	28
UERJ	540.4076494	39
UERN	0.6186869	5
UESC	0	2
UF	33.7990496	6
UFBA	5.2435481	8
UFC	0	5
UFES	20.1331789	11
UFF	2341544039	18
UFG	0	5
UFJF	387.5498518	17
UFPA	28.8500412	11
UFPB	0	4
UFPE	100.9312467	13
UFPR	8.9024598	12
UFRGS	0	4
UFRJ	657.9570871	41
UFRN	14.6688766	7
UFRPE	0	4
UFRRJ	78.0000000	5
UFSC	51.9961601	9
ULG	35.6037138	17
UNESP	18.8298463	7
UNICAMP	0	3
UNIR	12.7462662	8
UNIRIO	2.8133700	5
UNIVILLE	2.9492691	13
USP	219.8557787	21
UW	0	1
Virginia Tech	0	2
WLU	0	2
WWF	0	8
ZMT	27.4881791	10