Colmea
Colóquio Interinstitucional
(13 Abr 2022)

Pteronotus parnellii (*Photo © Oriol Massana & Adrià López-Baucells*)

COMO (E POR QUANTO) PREVENIR A PRÓXIMA PANDEMIA?

Dra. Mariana M. Vale
Depto. Ecologia
UFRJ

PANDEMIAS DE ORIGEM ZOONÓTICA

fontes e referências

http://www.globalviromeproject.org/

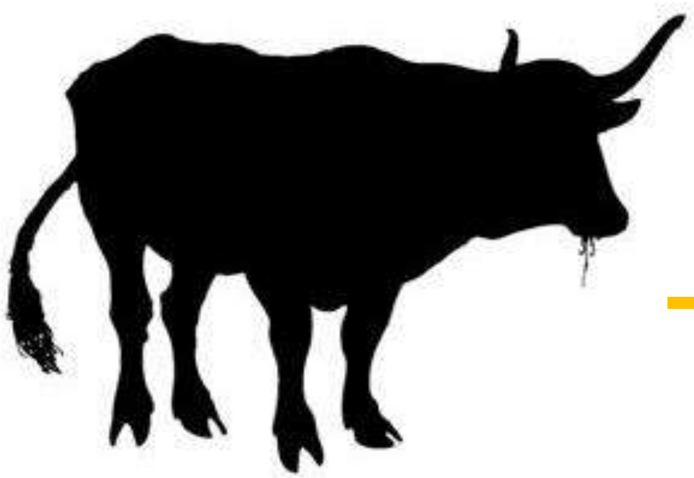
PANDEMIAS DE ORIGEM ZOONÓTICA

75%

doenças infecciosas
emergentes
vieram de animais

http://www.globalviromeproject.org/

PANDEMIAS DE ORIGEM ZOONÓTICA

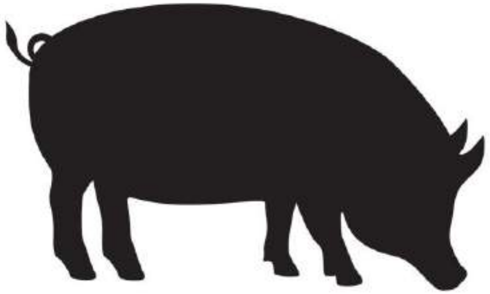


gado

sarampo

Wolfe et al. 2007. *Nature* 447: 279-283. doi:10.1038/nature05775

PANDEMIAS DE ORIGEM ZOONÓTICA

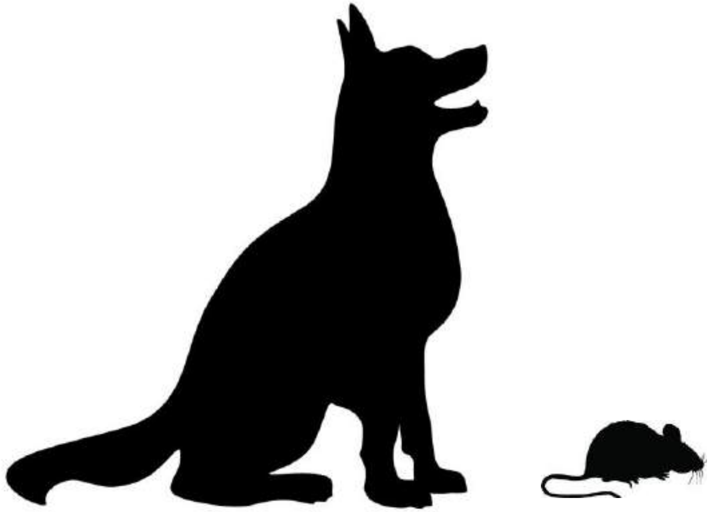


porcos
(provavelmente)

→ caxumba

Wolfe et al. 2007. *Nature* 447: 279-283. doi:10.1038/nature05775

PANDEMIAS DE ORIGEM ZOONÓTICA

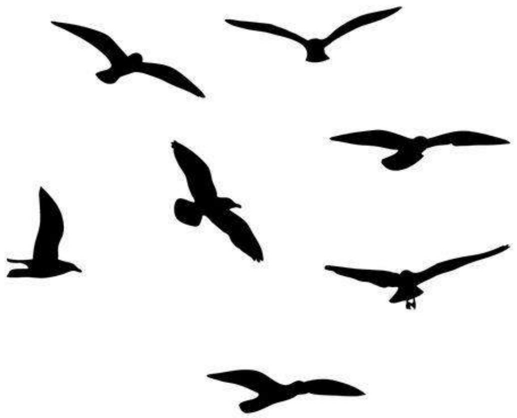


cães e ratos

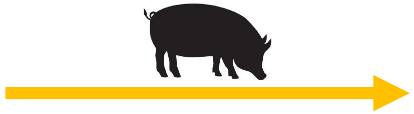
leishmaniose visceral

Wolfe et al. 2007. *Nature* 447: 279-283. doi:10.1038/nature05775

PANDEMIAS DE ORIGEM ZOONÓTICA



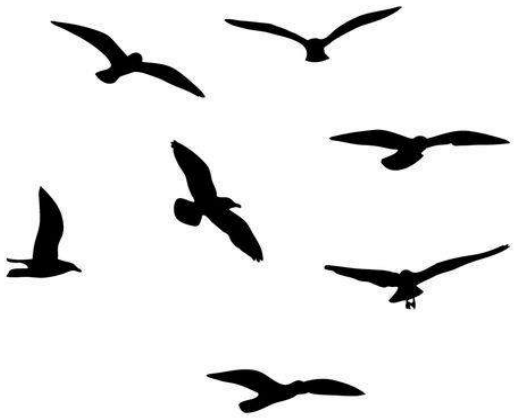
aves



influenza A

Wolfe et al. 2007. *Nature* 447: 279-283. doi:10.1038/nature05775

PANDEMIAS DE ORIGEM ZOONÓTICA

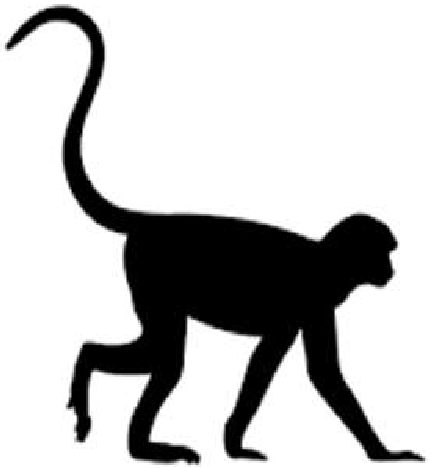


aves

malaria falciparum

Wolfe et al. 2007. *Nature* 447: 279-283. doi:10.1038/nature05775

PANDEMIAS DE ORIGEM ZOONÓTICA

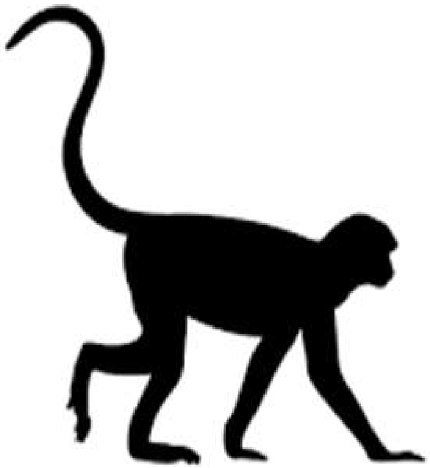


primatas africanos

febre amarela

Wolfe et al. 2007. *Nature* 447: 279-283. doi:10.1038/nature05775

PANDEMIAS DE ORIGEM ZOONÓTICA



primatas
do Velho Mundo

→

dengue
hemorrágica

Wolfe et al. 2007. *Nature* 447: 279-283. doi:10.1038/nature05775

PANDEMIAS DE ORIGEM ZOONÓTICA

chimpanzé

HIV

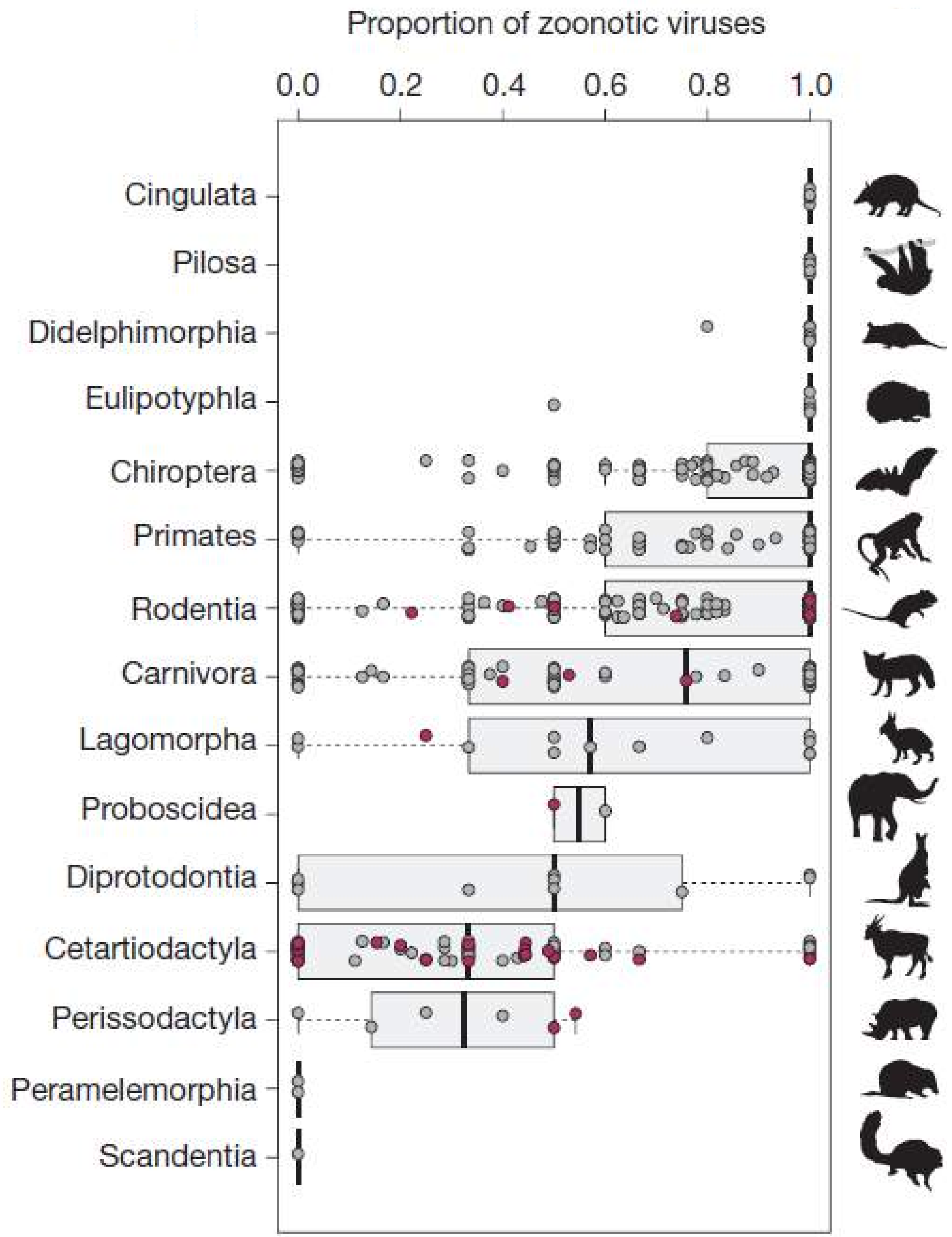
Wolfe et al. 2007. *Nature* 447: 279-283. doi:10.1038/nature05775

PANDEMIAS DE ORIGEM ZOONÓTICA

morcegos

COVID-19

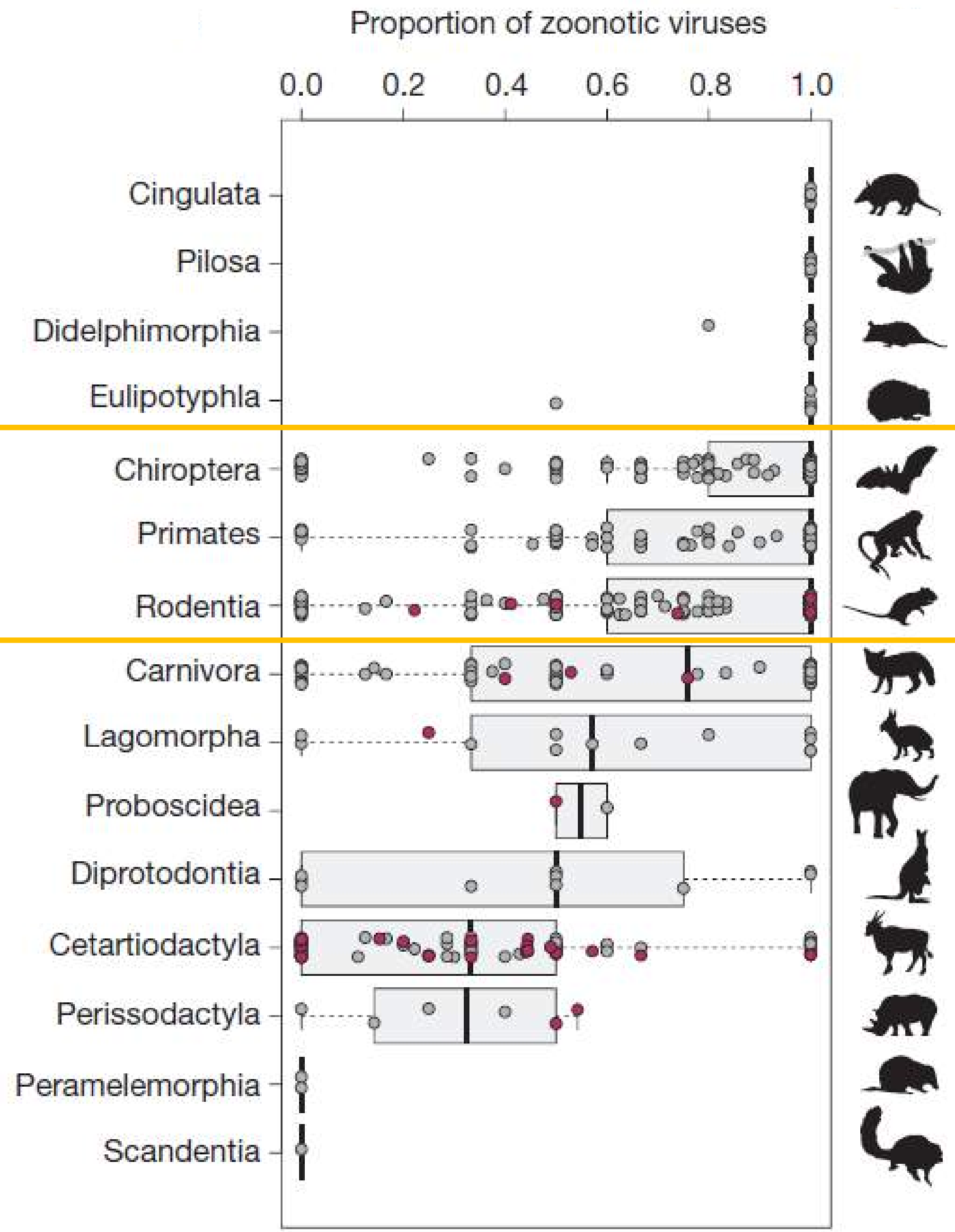
CARACTERÍSTICAS DOS HOSPEDEIROS



Animal silvestre

Animal doméstico

Olival et al. 2017. *Nature* 546: 646-654. doi:10.1038/nature22975



Animal silvestre

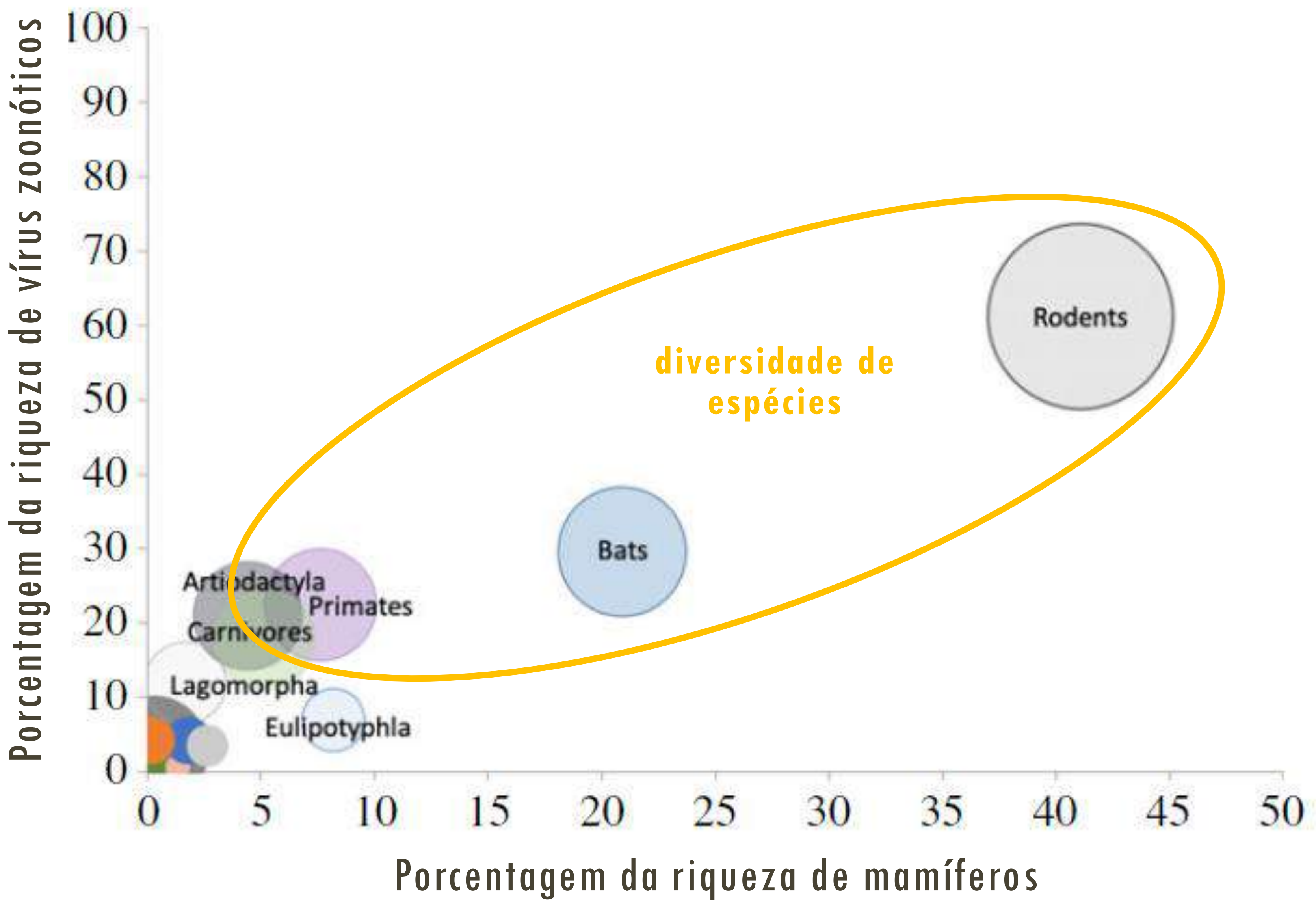
Animal doméstico

Olival et al. 2017. *Nature* 546: 646-654. doi:10.1038/nature22975

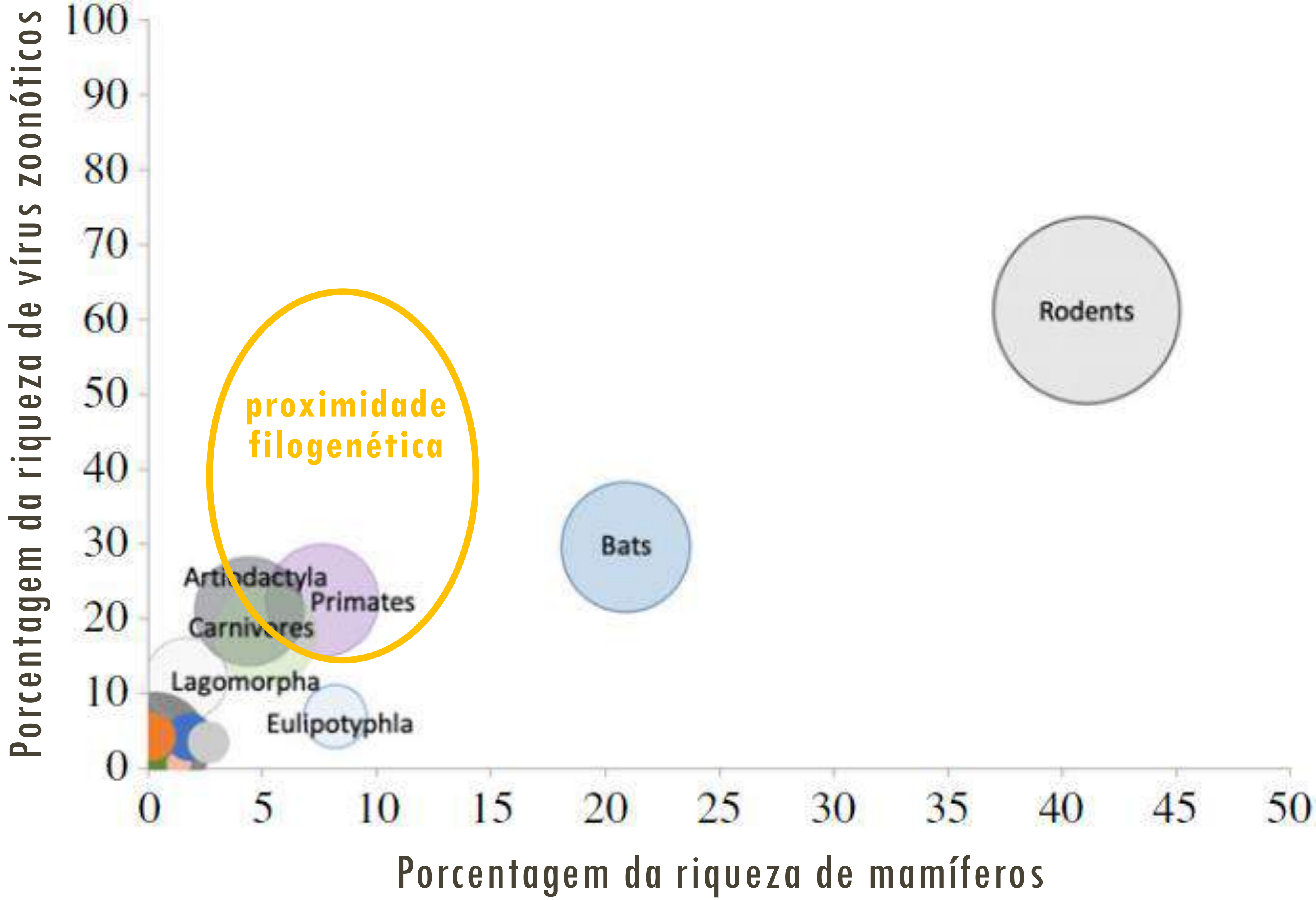
morcegos

primatas

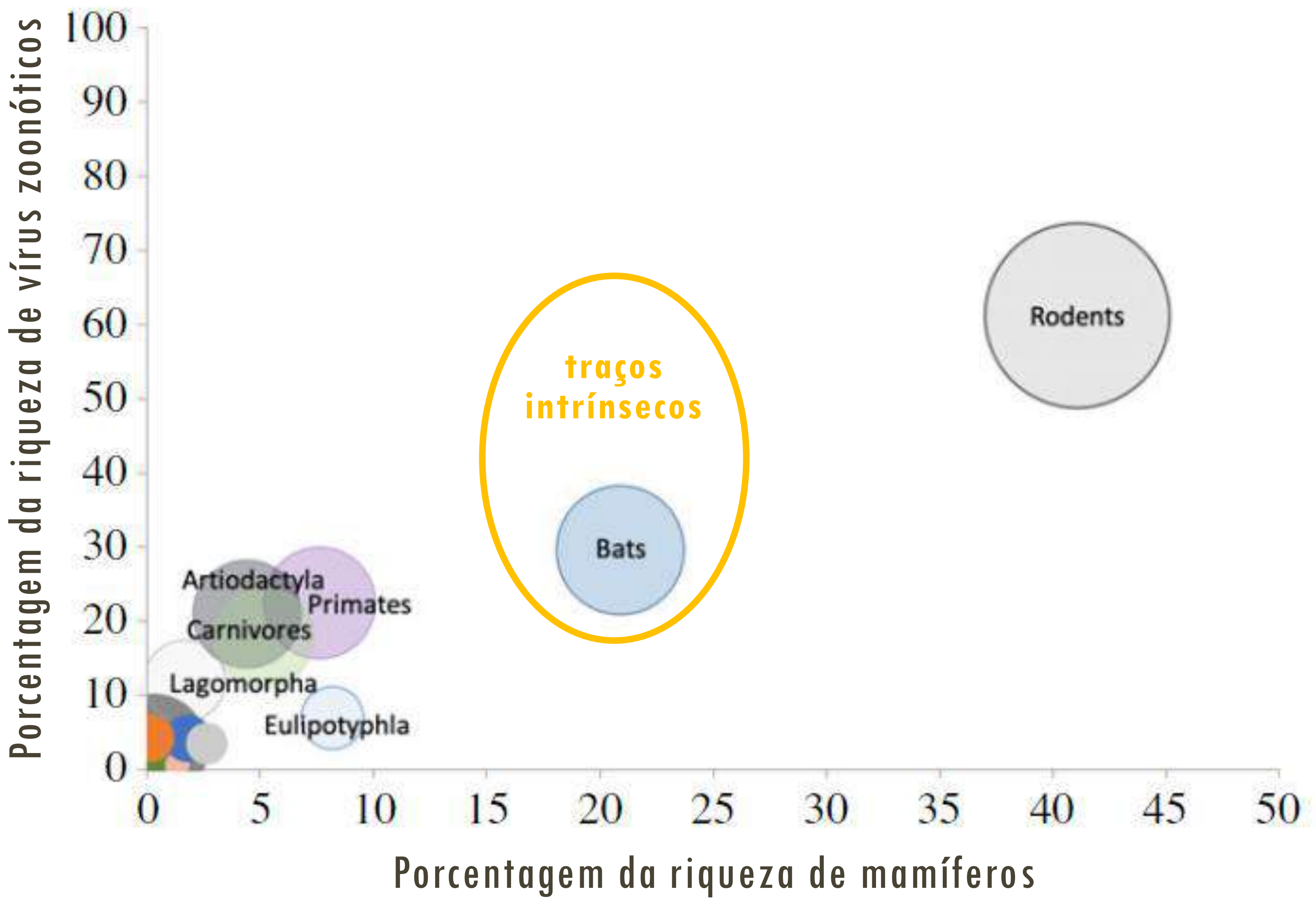
roedores



Johnson et al. 2020. *PNAS* 287: 20192736. doi:10.1098/rspb.2019.2736



Johnson et al. 2020. *PNAS* 287: 20192736. doi:10.1098/rspb.2019.2736



Johnson et al. 2020. *PNAS* 287: 20192736. doi:10.1098/rspb.2019.2736

CARACTERÍSTICAS DOS HOSPEDEIROS

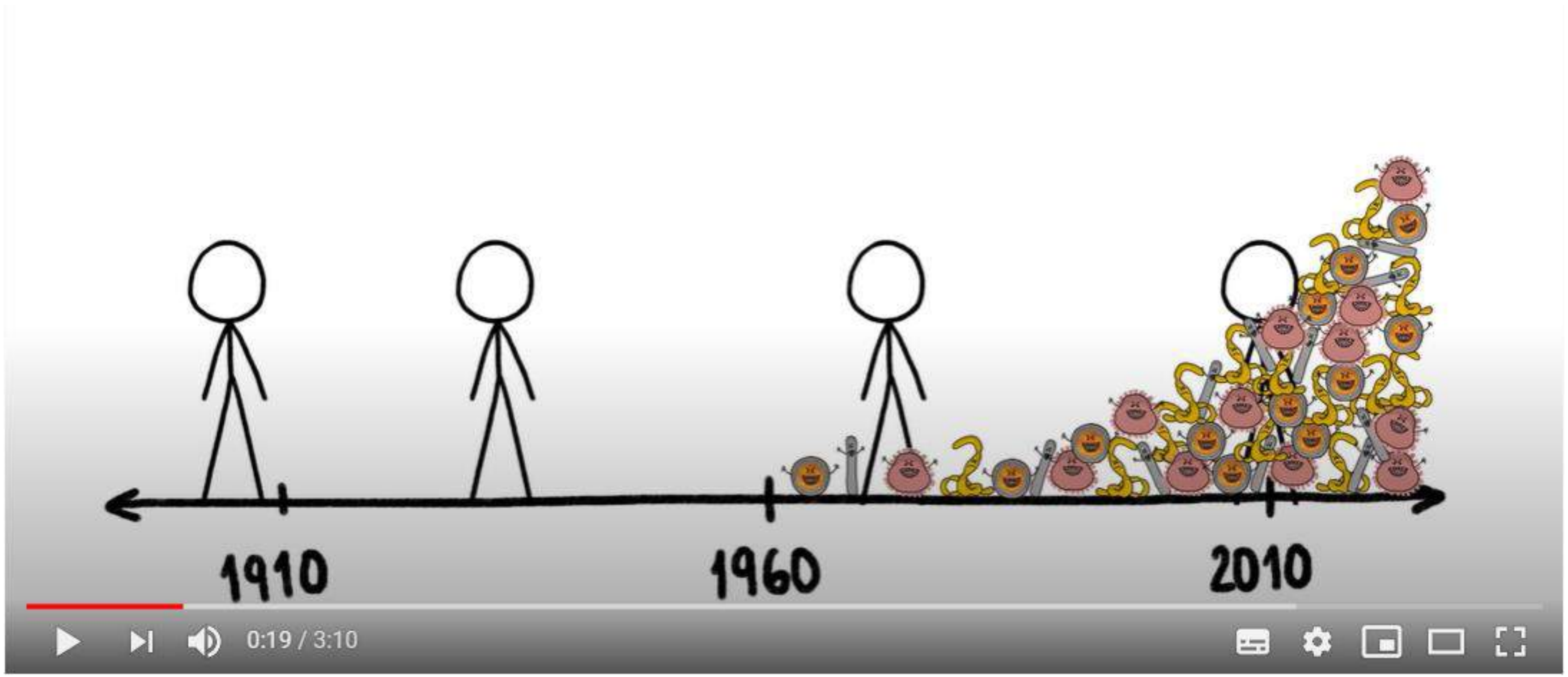
Por que os morcegos transmitem tantas doenças? | Minuto da Terra

Minuto da Terra • 473 mil visualizações • há 4 anos

Morcegos carregam alguns dos piores vírus para os seres humanos, mas será que a culpa é mesmo deles? Contato: ...

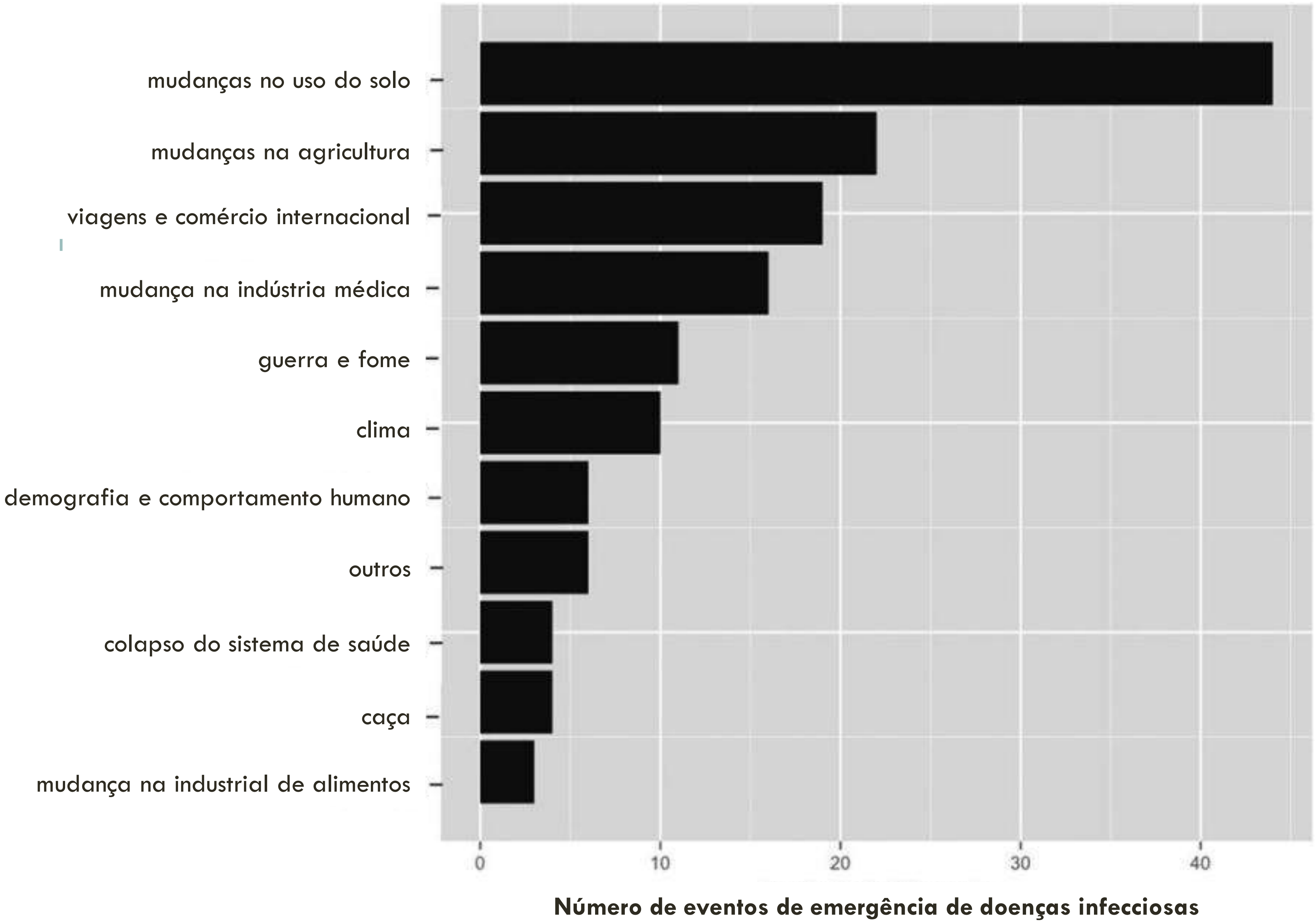
Legendas

https://www.youtube.com/watch?v=kIAJ8HgEPdQ



https://www.youtube.com/watch?v=kIAJ8HgEPdQ

COMPORTAMENTO DE RISCO EM HUMANOS



Loh et al. 2015. *Vector Borne Zoonotic Dis.* 15: 432-437. doi: 10.1089/vbz.2013.1563

COMPORTAMENTO HUMANO

O desmatamento e o tráfico de animais silvestres coloca as pessoas (e animais domésticos) em contato com animais que carregam patágenos

COMPORTAMENTO HUMANO

https://phys.org/news/2019-08-stability-earth-climate-amazonia.html

> 25%

desmatamento

↓

aumento na probabilidade de transmissão viral

Faust *et al. 2018. Ecol. Lett.* 21: 471-483. doi: 10.1111/ele.12904

COMPORTAMENTO HUMANO

SCIENTIFIC REPORTS

OPEN

Recent loss of closed forests is associated with Ebola virus disease outbreaks

Jesús Olivero[1], John E. Fa[2,3], Raimundo Real[1], Ana L. Márquez[1], Miguel A. Farfán[1], J. Mario Vargas[1], David Gaveau[3], Mohammad A. Salim[3], Douglas Park[4], Jamison Suter[5], Shona King[4], Siv Aina Leendertz[6,7], Douglas Sheil[8] & Robert Nasi[3]

Received: 19 May 2017
Accepted: 16 October 2017
Published online: 30 October 2017

Olivero et al. 2017. *nature* 7: 14291. doi: 10.1038/s41598-017-14727-9

COMPORTAMENTO HUMANO

JOURNAL OF THE ROYAL SOCIETY Interface

J. R. Soc. Interface (2012) **9**, 89–101
doi:10.1098/rsif.2011.0223
Published online 1 June 2011

Agricultural intensification, priming for persistence and the emergence of Nipah virus: a lethal bat-borne zoonosis

Juliet R. C. Pulliam[1,2,†], Jonathan H. Epstein[3], Jonathan Dushoff[1,‡], Sohayati A. Rahman[4,5,§], Michel Bunning[6], Aziz A. Jamaluddin[7], Alex D. Hyatt[8], Hume E. Field[9], Andrew P. Dobson[1], Peter Daszak[3,*] and the Henipavirus Ecology Research Group (HERG)[3,¶]

Olivero et al. 2017. *Nature* 7: 14291. doi: 10.1038/s41598-017-14727-9

COMPORTAMENTO HUMANO

OPEN ACCESS Freely available online

PLOS ONE

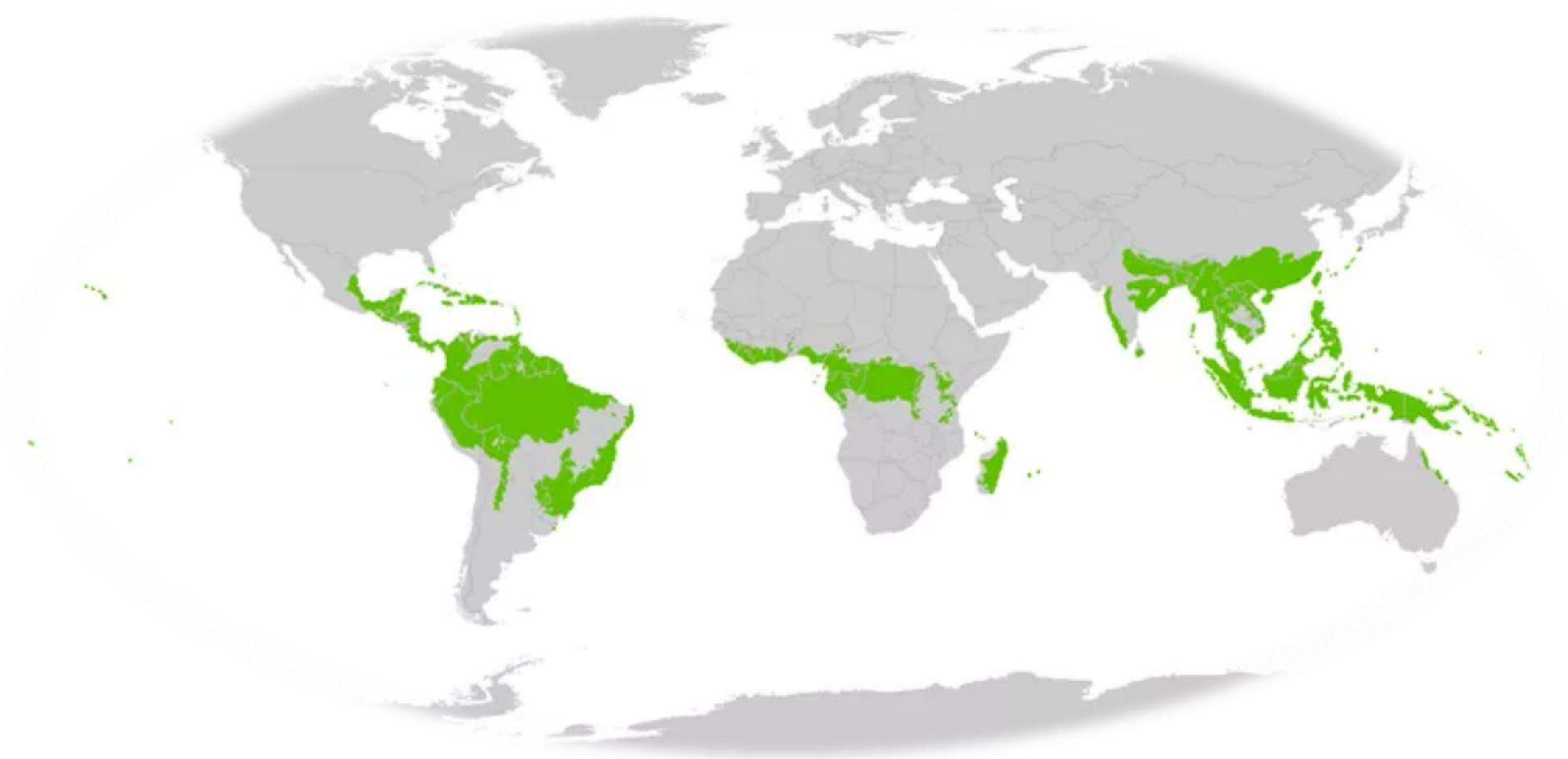
Influence of Deforestation, Logging, and Fire on Malaria in the Brazilian Amazon

Micah B. Hahn[1,2]*, Ronald E. Gangnon[2], Christovam Barcellos[3], Gregory P. Asner[4], Jonathan A. Patz[1,2]

1 Nelson Institute, SAGE (Center for Sustainability and the Global Environment), University of Wisconsin-Madison, Madison, Wisconsin, United States of America, **2** Department of Population Health Sciences, School of Medicine and Public Health, University of Wisconsin-Madison, Madison, Wisconsin, United States of America, **3** Health Information Research Department, Oswaldo Cruz Foundation, Rio de Janeiro, Brazil, **4** Department of Global Ecology, Carnegie Institution for Science, Stanford University, Stanford, California, United States of America

Hanh et al. 2015. PLoS ONE 9(1): e85725. doi:10.1371/journal.pone.0085725

ÁREAS DE RISCO



ÁREAS DE RISCO

riqueza de hospedeiros silvestres

+

desmatamento

e tráfico de animais silvestres

PREVENÇÃO

O que podemos fazer a respeito?

PREVENÇÃO

POLICY FORUM

ECOLOGY AND ECONOMICS: COVID-19

Ecology and economics for pandemic prevention

Investments to prevent tropical deforestation and to limit wildlife trade will protect against future zoonosis outbreaks

By **Andrew P. Dobson[1], Stuart L. Pimm[2], Lee Hannah[3], Les Kaufman[4], Jorge A. Ahumada[3], Amy W. Ando[5], Aaron Bernstein[6], Jonah Busch[7], Peter Daszak[8], Jens Engelmann[9], Margaret F. Kinnaird[10], Binbin V. Li[11], Ted Loch-Temzelides[12], Thomas Lovejoy[13], Katarzyna Nowak[14], Patrick R. Roehrdanz[3], Mariana M. Vale[15]**

to contact wildlife when more than 25% of the original forest cover is lost (*4*), and such contacts determine the risk of disease transmission. Pathogen transmission depends on the contact rate, the abundance of susceptible humans and livestock, and the abundance of infected wild hosts. Con-

about $1 billion supported land-use zoning, market and credit restrictions, and state-of-the-science satellite monitoring. Brazil's program reduced forest fragmentation and edge at a lower cost than could have been achieved by carbon-pricing approaches (*9*).

Several estimates of the effectiveness and cost of strategies to reduce tropical deforestation are available (*8*, *9*). At an annual cost of $9.6 billion, direct forest-protection payments to outcompete deforestation economically could achieve a 40% reduction in areas at highest risk for virus spillover [see supplementary materials (SM)]. Multiple payment-for-ecosystem-services programs demonstrate the effectiveness of this approach. At the low end, widespread adoption of the earlier Brazil policy model could achieve the same reduction for only $1.5 billion annually by removing subsidies that favor deforestation, restricting private land clearing, and supporting territorial rights

Dobson et al. 2020. *Science* 369: 379-381. DOI: 10.1126/science.abc3189

PREVENÇÃO

1. Controle do desmatamento
2. Controle do tráfico de animais silvestres
3. Biossegurança na criação animal
4. Vigilância sanitária nas áreas de risco

PREVENÇÃO

1. Controle do desmatamento
2. Controle do tráfico de animais silvestres
3. Biossegurança na criação animal
4. Vigilância sanitária nas áreas de risco

PREVENÇÃO

US$ 22 a 31 bilhões/ano

programa de prevenção

em escala global

PREVENÇÃO

É muito dinheiro?

PREVENÇÃO

SCIENCE ADVANCES | REVIEW

EPIDEMIOLOGY

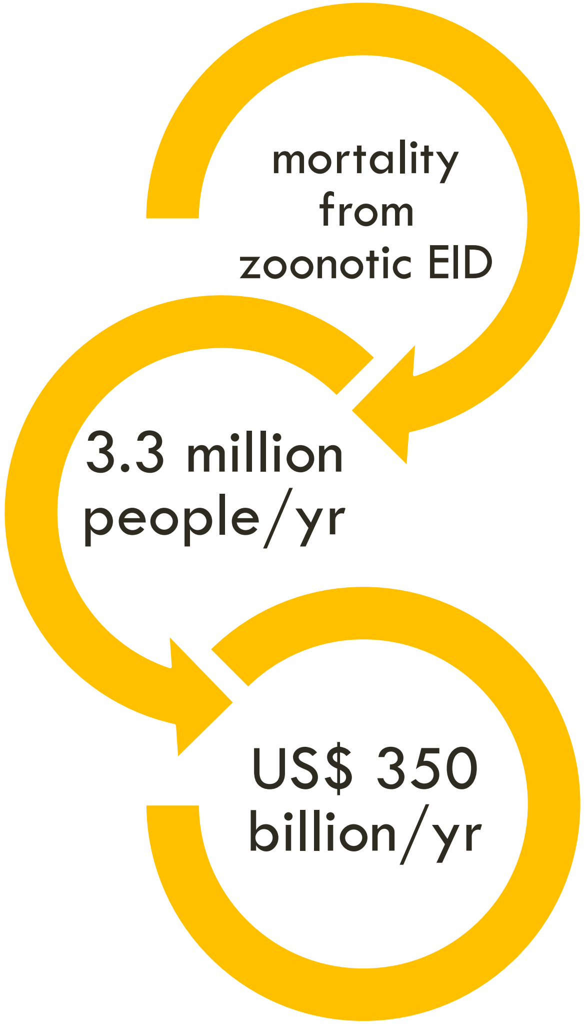
The costs and benefits of primary prevention of zoonotic pandemics

Aaron S. Bernstein[1]*, Amy W. Ando[2,3], Ted Loch-Temzelides[4], Mariana M. Vale[5,6], Binbin V. Li[7,8], Hongying Li[9], Jonah Busch[10], Colin A. Chapman[11,12,13,14], Margaret Kinnaird[15], Katarzyna Nowak[16]†, Marcia C. Castro[17], Carlos Zambrana-Torrelio[9], Jorge A. Ahumada[10], Lingyun Xiao[18], Patrick Roehrdanz[10], Les Kaufman[19], Lee Hannah[10], Peter Daszak[9], Stuart L. Pimm[8]*, Andrew P. Dobson[20,21]*

The lives lost and economic costs of viral zoonotic pandemics have steadily increased over the past century. Prominent policymakers have promoted plans that argue the best ways to address future pandemic catastrophes should entail, "detecting and containing emerging zoonotic threats." In other words, we should take actions only after humans get sick. We sharply disagree. Humans have extensive contact with wildlife known to harbor vast numbers of viruses, many of which have not yet spilled into humans. We compute the annualized damages from emerging viral zoonoses. We explore three practical actions to minimize the impact of future pandemics: better surveillance of pathogen spillover and development of global databases of virus genomics and serology, better management of wildlife trade, and substantial reduction of deforestation. We find that these primary pandemic prevention actions cost less than 1/20th the value of lives lost each year to emerging viral zoonoses and have substantial cobenefits.

Bernstein et al. 2022. Science Adv. 8, eabl4183

Virus	Year	Deaths
Spanish influenza	1918	50,000,000
Hantaan virus	1951	46,430
South American hantaviruses	1956	1990
Kyasanur forest disease	1957	1,000
H2N2 influenza	1957	1,100,000
Junin virus	1958	5,900
Lacrosse virus	1960	300
Machupo virus	1963	290
Marburg virus	1967	370
H3N2 influenza	1968	1,000,000
Lassa fever	1969	250,000
Venezuelan equine encephalitis	1969	300
Monkeypox	1970	5,000
Ebola	1976	12,930
Rift Valley fever	1977	3,000
HIV	1980	10,700,000
Puumala virus	1980	10
Guanrito virus	1989	140
Sin Nombre virus	1993	260
Andes	1995	130
Nipah	1998	200
West Nile	1999	2,330
SARS	2002	770
Chikungunya	2004	35,000
H1N1 influenza	2008	284,000
Severe fever thrombocytopenia syndrome	2009	370
MERS	2012	860
Zika	2015	50
COVID-19†	2020	4,000,000†



PREVENÇÃO

US$ 22 a 31 bilhões/ano

programa de prevenção

em escala global

PREVENÇÃO

1/20

dos custos com doenças emergentes

PREVENÇÃO

O que podemos fazer a respeito?

1. CONTROLE DO DESMATAMENTO

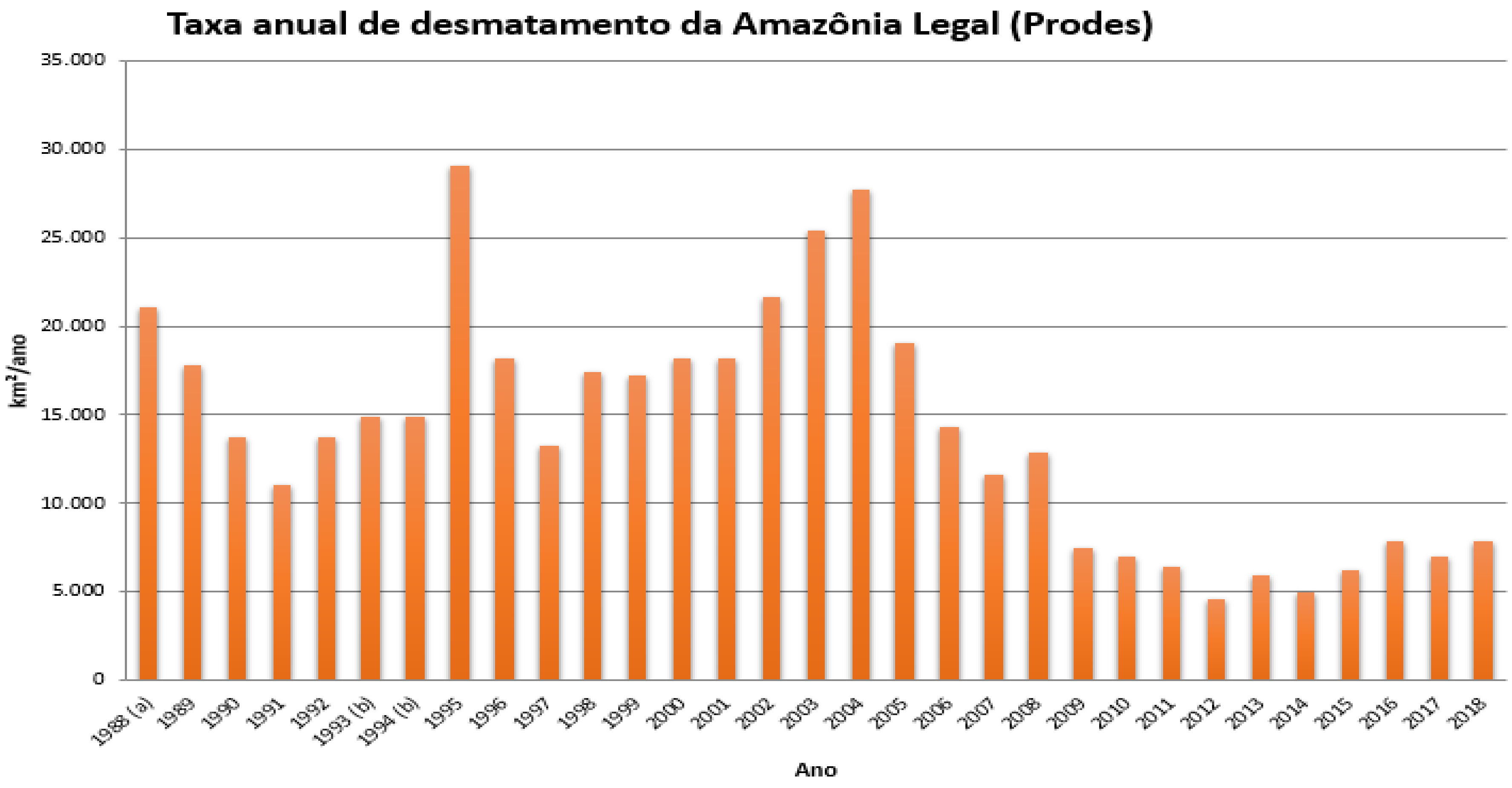
1. CONTROLE DO DESMATAMENTO

Summary of prevention costs, benefits, and break-even probability change

ITEM	VALUES (2020 $)
Expenditures on preventive measures	
Annual funding for monitoring wildlife trade (CITES+)	$250–$750 M
Annual cost of programs to reduce spillovers	$120–$340 M
Annual cost of programs for early detection and control	$217–$279 M
Annual cost of programs to reduce spillover via livestock	$476–$852 M
Annual cost of reducing deforestation by half	$1.53–$9.59 B
Annual cost of ending wild meat trade in China	$19.4 B
TOTAL GROSS PREVENTION COSTS (*C*)	**$22.0–$31.2 B**

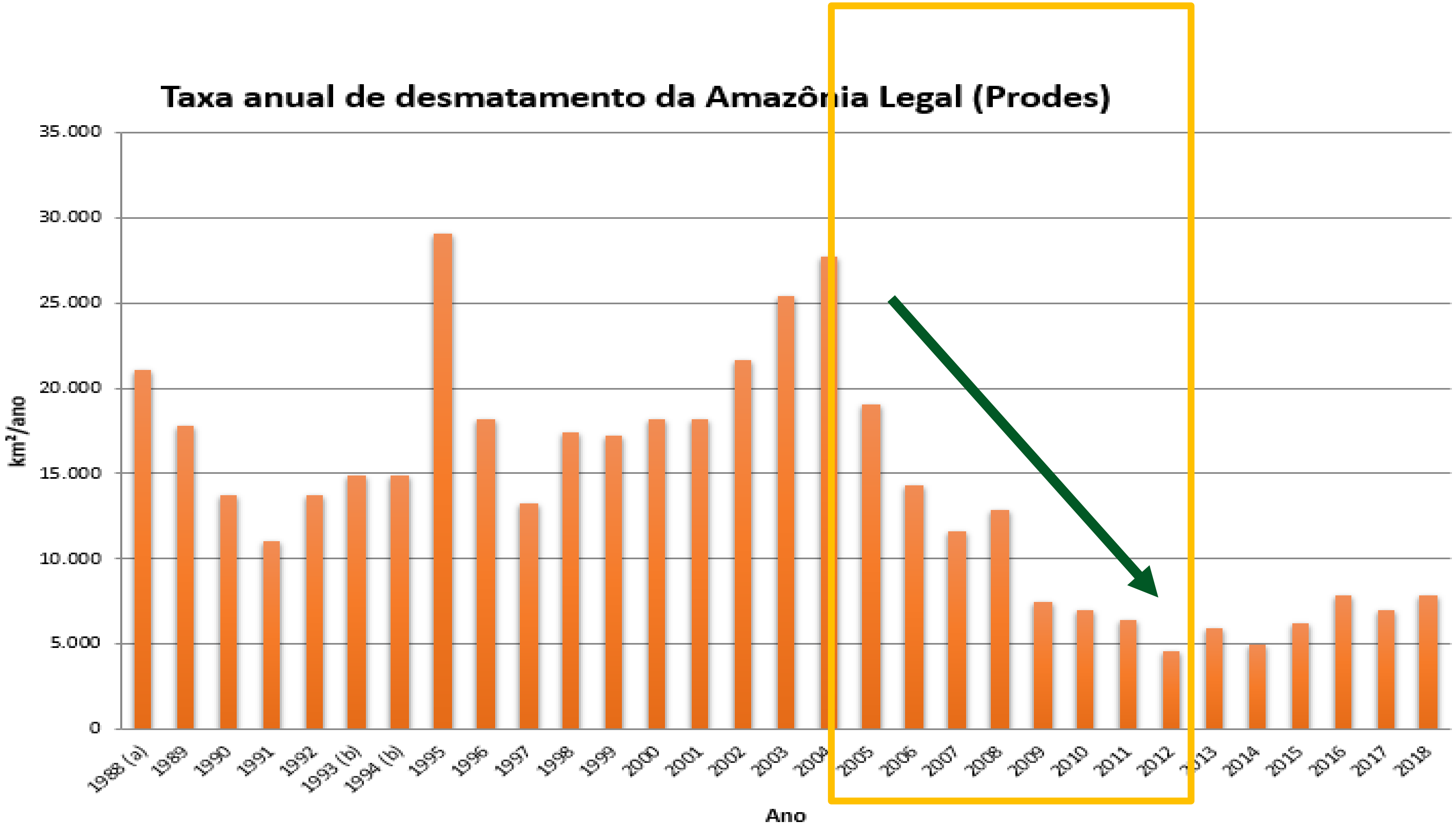
US$ 1.5 a 10 bilhões/ano

1. CONTROLE DO DESMATAMENTO



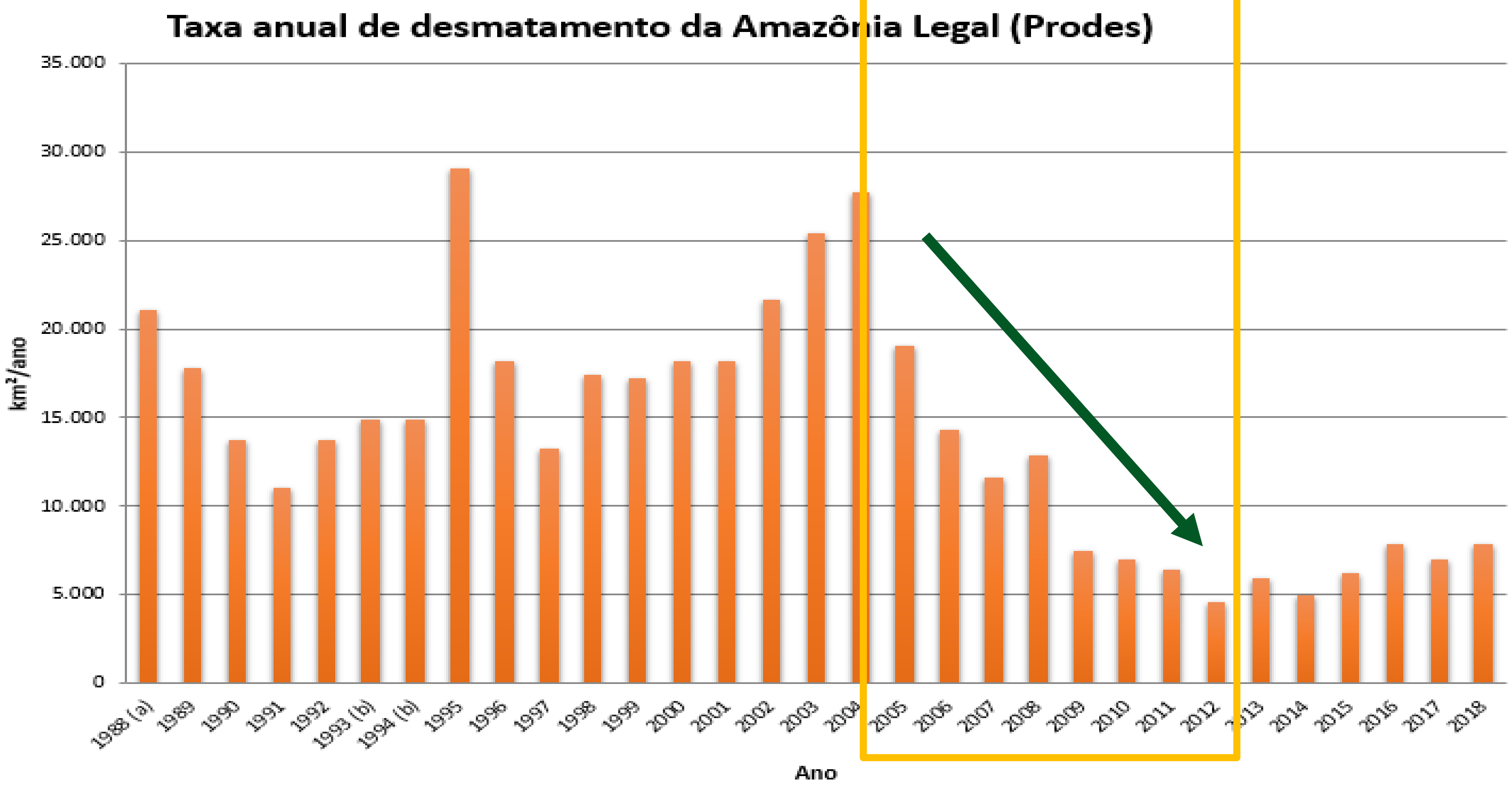
http://snif.florestal.gov.br/es/dados-complementares/233-perda-da-cobertura-florestal-amazonia-tabelas-e-graficos

1. CONTROLE DO DESMATAMENTO



http://snif.florestal.gov.br/es/dados-complementares/233-perda-da-cobertura-florestal-amazonia-tabelas-e-graficos

1. CONTROLE DO DESMATAMENTO



Produção de soja cresceu

70%

PIB amazônico cresceu

140%

http://snif.florestal.gov.br/es/dados-complementares/233-perda-da-cobertura-florestal-amazonia-tabelas-e-graficos

1. CONTROLE DO DESMATAMENTO

PPCDAM

Plano de Ação para Prevenção
e Controle do Desmatamento
na Amazônia Legal

1. CONTROLE DO DESMATAMENTO

PPCDAM

Plano de Ação para Prevenção e Controle do Desmatamento na Amazônia Legal

1. Ordenamento fundiário e territorial
2. Monitoramento e controle ambiental
3. Fomento à produção sustentável

ICMBio INSTITUTO CHICO MENDES MMA

FUNAI

INCRA

1. CONTROLE DO DESMATAMENTO

PPCDAM

Plano de Ação para Prevenção e Controle do Desmatamento na Amazônia Legal

1. Ordenamento fundiário e territorial
2. Monitoramento e controle ambiental
3. Fomento à produção sustentável

1. CONTROLE DO DESMATAMENTO

PPCDAM

Plano de Ação para Prevenção e Controle do Desmatamento na Amazônia Legal

1. Ordenamento fundiário e territorial
2. Monitoramento e controle ambiental
3. Fomento à produção sustentável

1. CONTROLE DO DESMATAMENTO

PPCDAM

Plano de Ação para Prevenção e Controle do Desmatamento na Amazônia Legal

1. Ordenamento fundiário e territorial
2. Monitoramento e controle ambiental
3. Fomento à produção sustentável

"modelo brasileiro"

1. CONTROLE DO DESMATAMENTO

“modelo brasileiro”

1 bilhão de dólares/ano ao Brasil

Cunha et al. 2016. Ecological Economics 130. DOI: 10.1016/j.ecolecon.2016.07.007

1. CONTROLE DO DESMATAMENTO

“modelo brasileiro”

1 bilhão de dólares/ano ao Brasil

(0,1% orçamento federal)

Cunha et al. 2016. Ecological Economics 130. DOI: 10.1016/j.ecolecon.2016.07.007

1. CONTROLE DO DESMATAMENTO

“modelo brasileiro”

AMAZON FUND

Cunha et al. 2016. Ecological Economics 130. DOI: 10.1016/j.ecolecon.2016.07.007

1. CONTROLE DO DESMATAMENTO

"modelo brasileiro"

1 bilhão de dólares/ano ao Brasil

96.4 bilhão de dólares

com covid-19

(01/02/2021)

https://www.tesourotransparente.gov.br/visualizacao/painel-de-monitoramentos-dos-gastos-com-covid-19

2. CONTROLE DO TRÁFICO DE ANIMAIS SILVESTRES

2. CONTROLE DO TRÁFICO DE ANIMAIS SILVESTRES

Bastante difícil de calcular...

2. CONTROLE DO TRÁFICO DE ANIMAIS SILVESTRES

Summary of prevention costs, benefits, and break-even probability change

ITEM	VALUES (2020 $)
Expenditures on preventive measures	
Annual funding for monitoring wildlife trade (CITES+)	$250–$750 M
Annual cost of programs to reduce spillovers	$120–$340 M
Annual cost of programs for early detection and control	$217–$279 M
Annual cost of programs to reduce spillover via livestock	$476–$852 M
Annual cost of reducing deforestation by half	$1.53–$9.59 B
Annual cost of ending wild meat trade in China	$19.4 B
TOTAL GROSS PREVENTION COSTS (*C*)	**$22.0–$31.2 B**

US$ 20 bilhões/ano

2. CONTROLE DO TRÁFICO DE ANIMAIS SILVESTRES

Acabar com o tráfico de animais silvestres na China (US$19.4 bilhões)

Dra. Binbin Li

2. CONTROLE DO TRÁFICO DE ANIMAIS

Conservation Biology

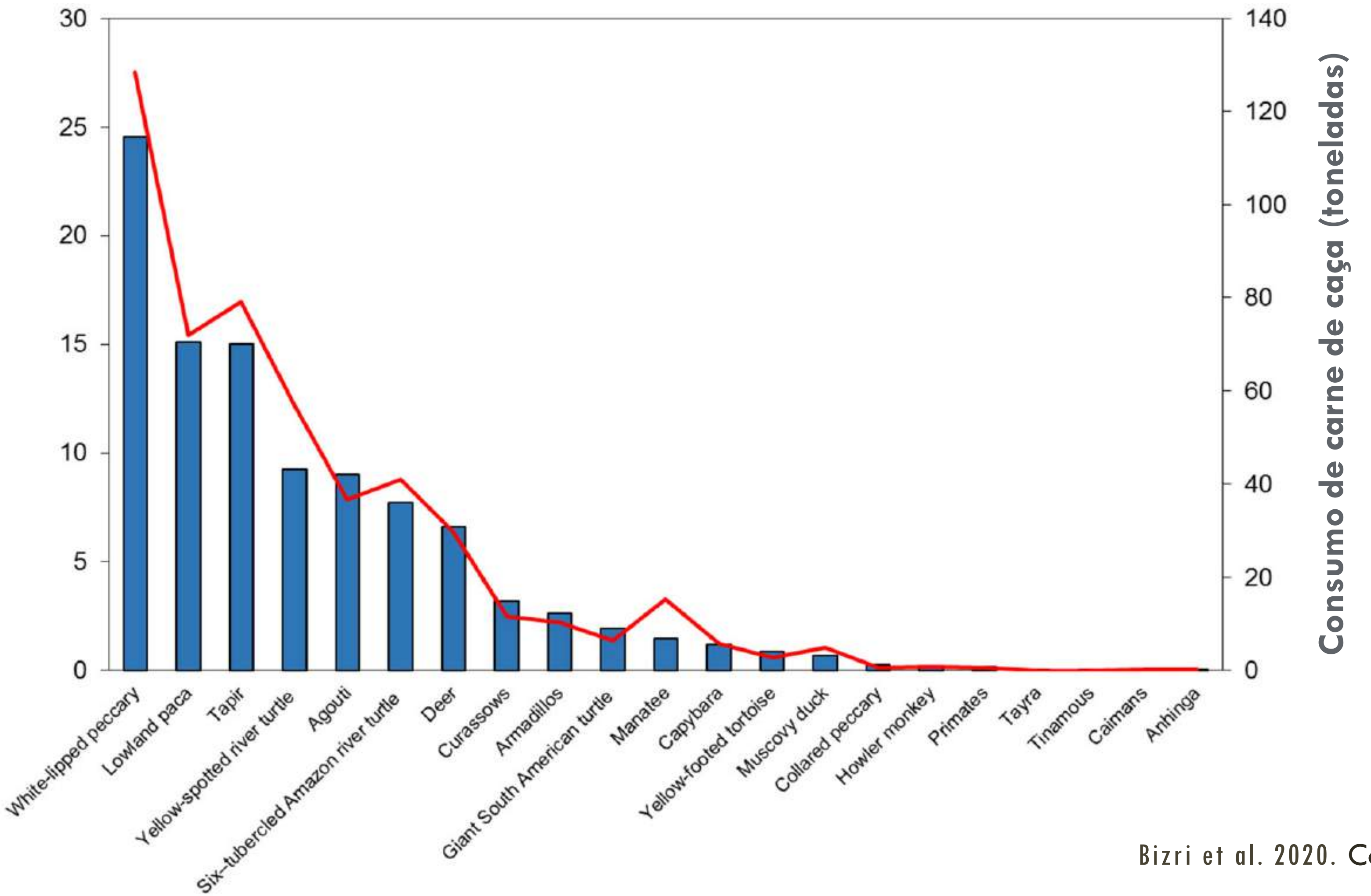
Contributed Paper

Urban wild meat consumption and trade in central Amazonia

Hani R. El Bizri,[1,2,3,4*,†] Thaís Q. Morcatty,[2,5 †] João Valsecchi,[2,3,4] Pedro Mayor,[3,6,7] Jéssica E. S. Ribeiro,[2] Carlos F. A. Vasconcelos Neto,[2] Jéssica S. Oliveira,[2] Keilla M. Furtado,[2] Urânia C. Ferreira,[2] Carlos F. S. Miranda,[2] Ciclene H. Silva,[2] Valdinei L. Lopes,[2] Gerson P. Lopes,[2,8] Caio C. F. Florindo,[2,9] Romerson C. Chagas,[2] Vincent Nijman,[5] and John E. Fa[1,10]

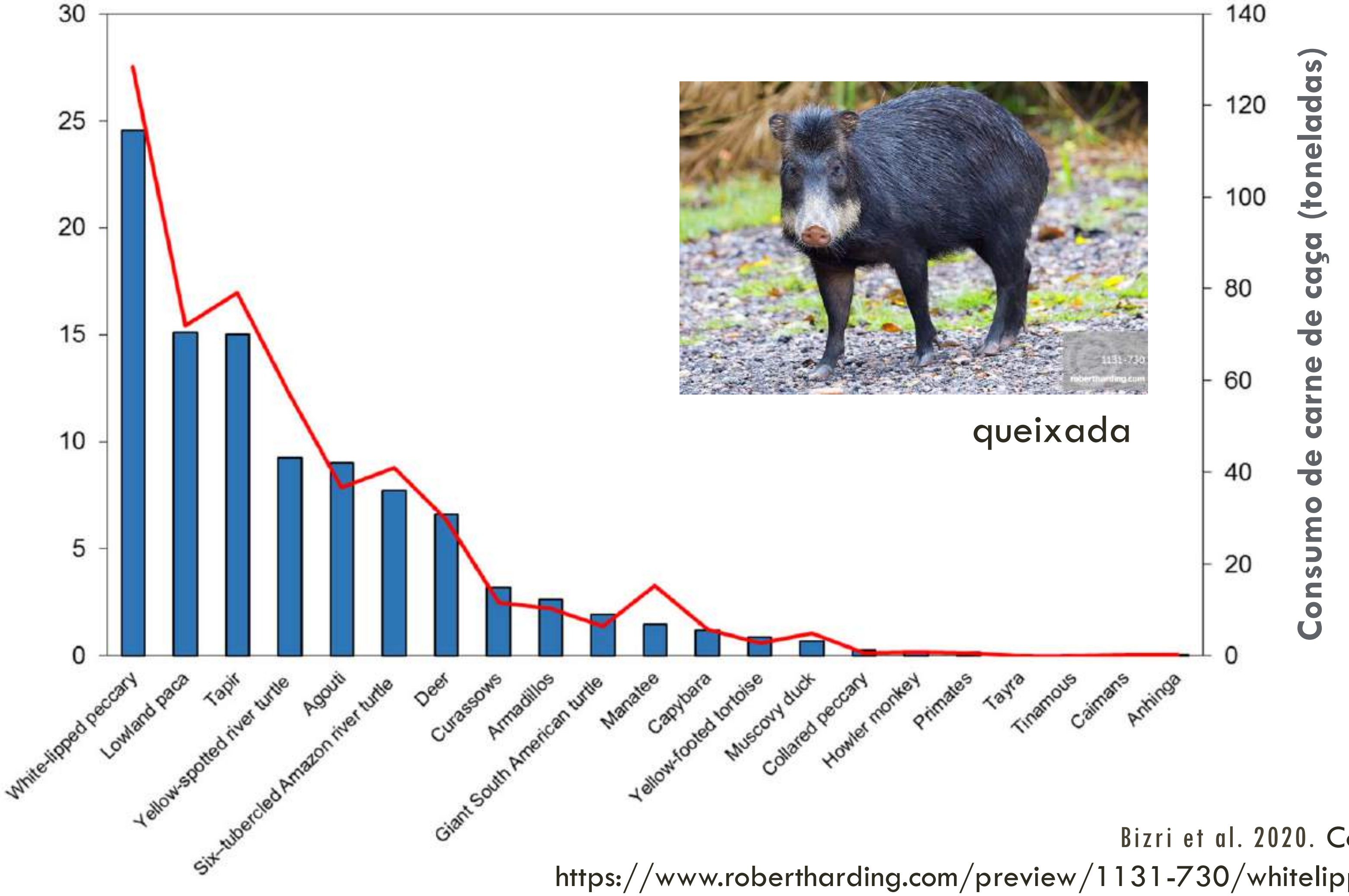
Bizri et al. 2020. Conservation Biology 34. DOI: 10.1111/cobi.13420

2. CONTROLE DO TRÁFICO DE ANIMAIS



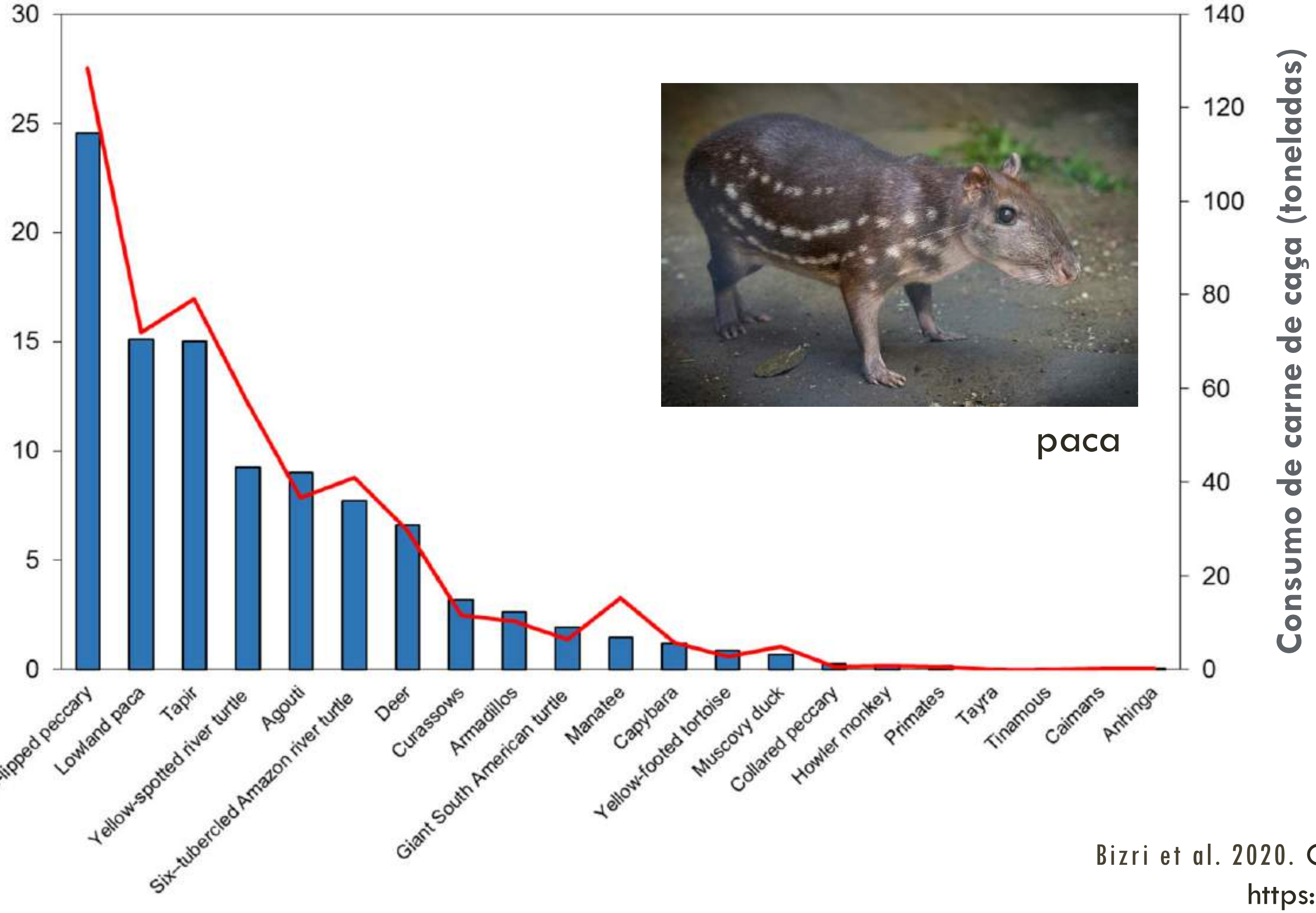
Bizri et al. 2020. Conservation Biology 34. DOI: 10.1111/cobi.13420

2. CONTROLE DO TRÁFICO DE ANIMAIS



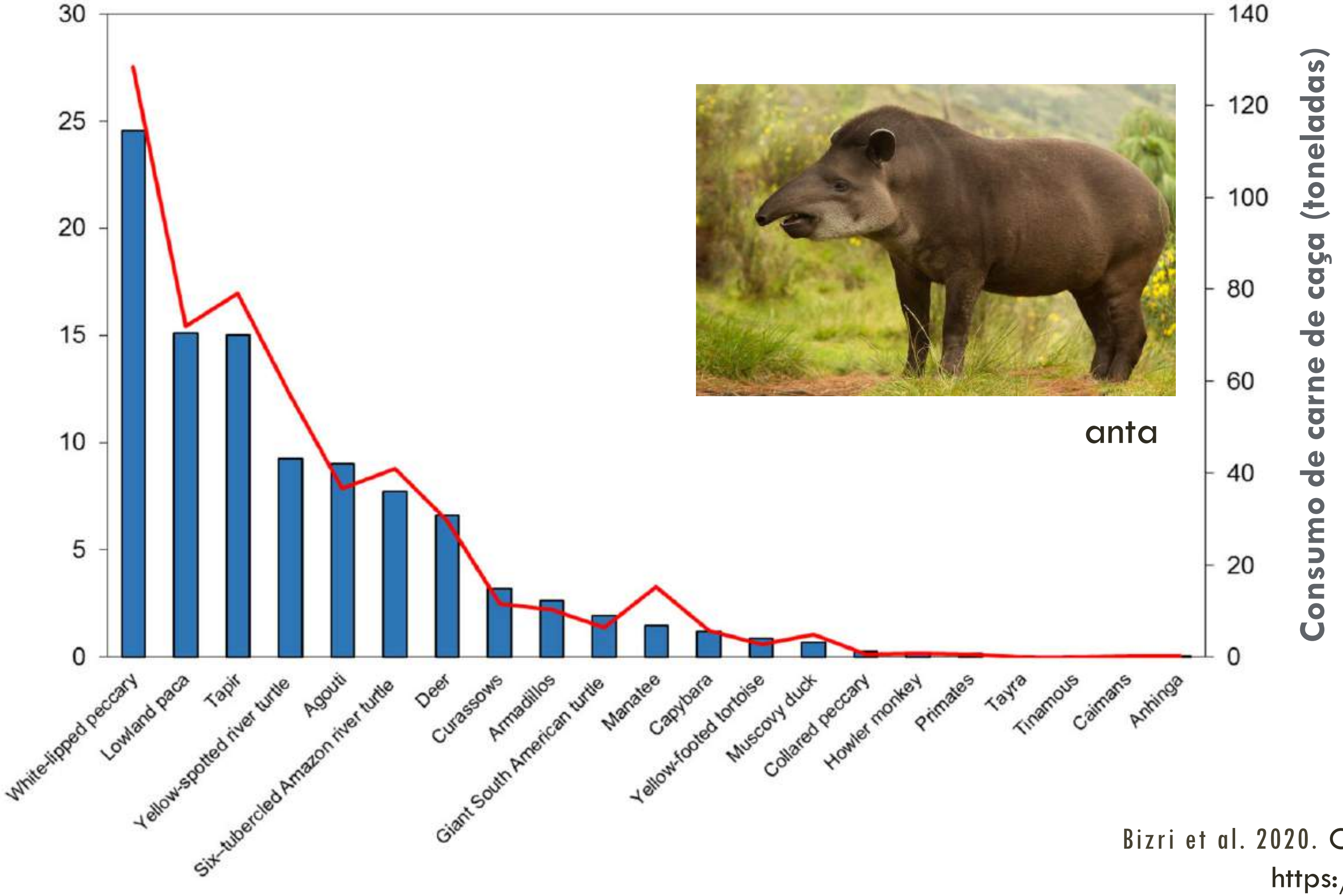
Bizri et al. 2020. Conservation Biology 34. DOI: 10.1111/cobi.13420
https://www.robertharding.com/preview/1131-730/whitelipped-peccary-tayassu-pecari-mato-grosso-sul-brazil

2. CONTROLE DO TRÁFICO DE ANIMAIS



Bizri et al. 2020. Conservation Biology 34. DOI: 10.1111/cobi.13420
https://www.lazoo.org/animals/mammals/paca-lowland

2. CONTROLE DO TRÁFICO DE ANIMAIS



10.700 t/ano
(US$35 milhões)

Bizri et al. 2020. Conservation Biology 34. DOI: 10.1111/cobi.13420
https://www.lazoo.org/animals/mammals/paca-lowland

2. CONTROLE DO TRÁFICO DE ANIMAIS

maioria comprada

Table 3. Declared means by which urban consumers obtained wild meat in 5 cities in central Amazonia.

City	*No. buying (%)*	*No. hunting (%)*	*No. buying or hunting (%)*	*No. receiving gifts (%)*	*Total*
Alvarães	100 (75.8)	18 (13.6)	14 (10.6)	0 (0.0)	132
Coari	42 (82.4)	4 (7.8)	3 (5.9)	2 (3.9)	51
Fonte Boa	16 (80.0)	4 (20.0)	0 (0.0)	0 (0.0)	20
Maraã	19 (86.4)	2 (9.1)	1 (4.5)	0 (0.0)	22
Tefé	463 (75.9)	146 (23.9)	0 (0.0)	1 (0.2)	610
Total (average %)	640 (80.1)	174 (14.9)	18 (4.2)	3 (0.8)	835

Bizri et al. 2020. Conservation Biology 34. DOI: 10.1111/cobi.13420

2. CONTROLE DO TRÁFICO DE ANIMAIS

O consumo de caça é cultural e não uma necessidade nutricional.

Morsello et al. 2015. Ecology and Society 20. DOI: 10.5751/ES-07771-200421

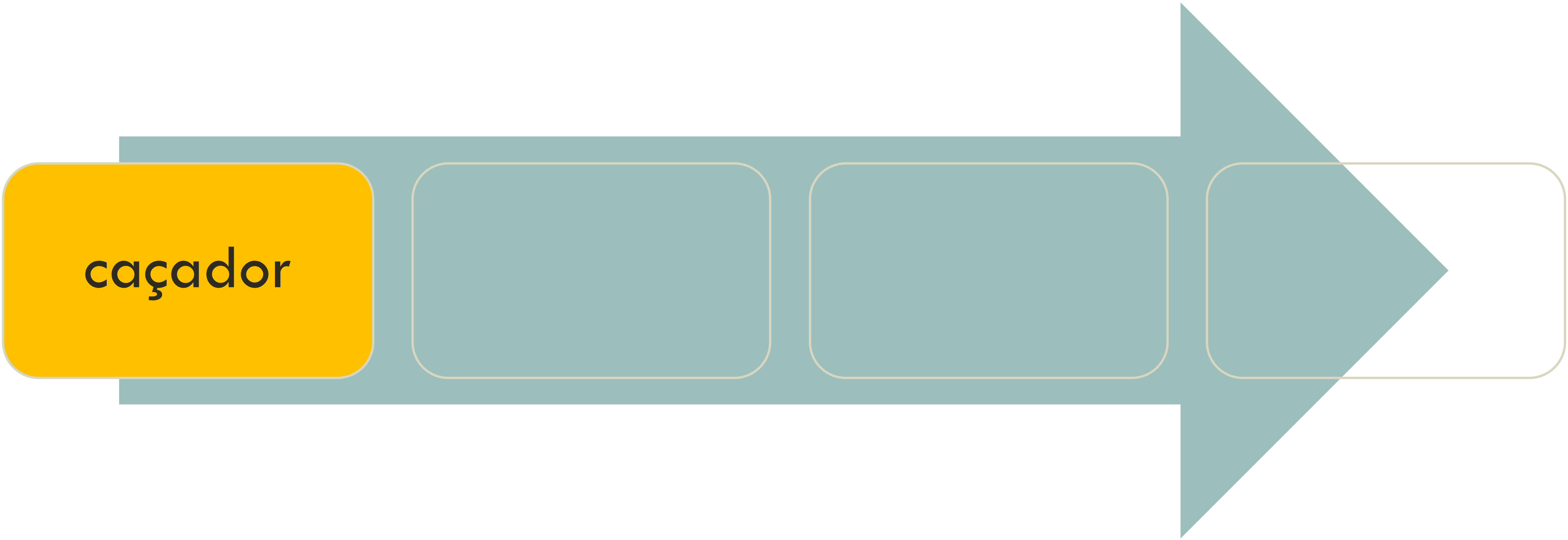
2. CONTROLE DO TRÁFICO DE ANIMAIS

pet

carne de caça

Morsello et al. 2015. Ecology and Society 20. DOI: 10.5751/ES-07771-200421

TRÁFICO DE ANIMAIS SILVESTRES



TRÁFICO DE ANIMAIS SILVESTRES

caçador

https://br.pinterest.com/pin/187110559494575846/

TRÁFICO DE ANIMAIS SILVESTRES

caçador

https://brasil.mongabay.com/2016/06/provas-revelam-volume-caca

TRÁFICO DE ANIMAIS SILVESTRES

caçador → atravessador → comerciante → consumidor final

https://brasil.mongabay.com/2016/06/provas-revelam-volume-caca

TRÁFICO DE ANIMAIS SILVESTRES

caçador → atravessador → comerciante → consumidor final

https://www.cifor.org/publications/pdf_files/Books/BVanVliet1401P.pdf

TRÁFICO DE ANIMAIS SILVESTRES

caçador → atravessador → comerciante → consumidor final

https://www.cifor.org/publications/pdf_files/Books/BVanVliet1401P.pdf

PREVENÇÃO

PREVENÇÃO

US$ 22 a 31 bilhões/ano

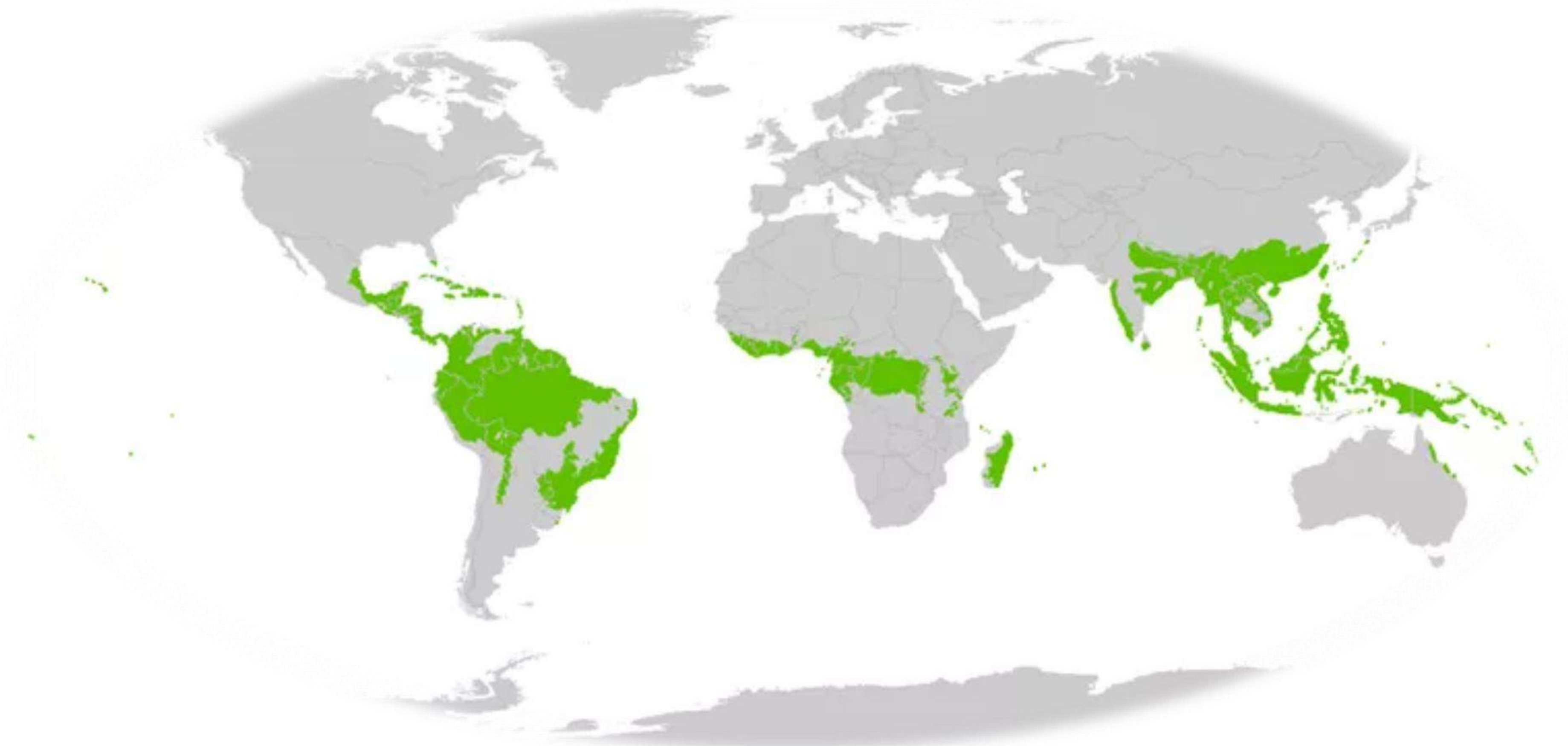
programa de prevenção

em escala global

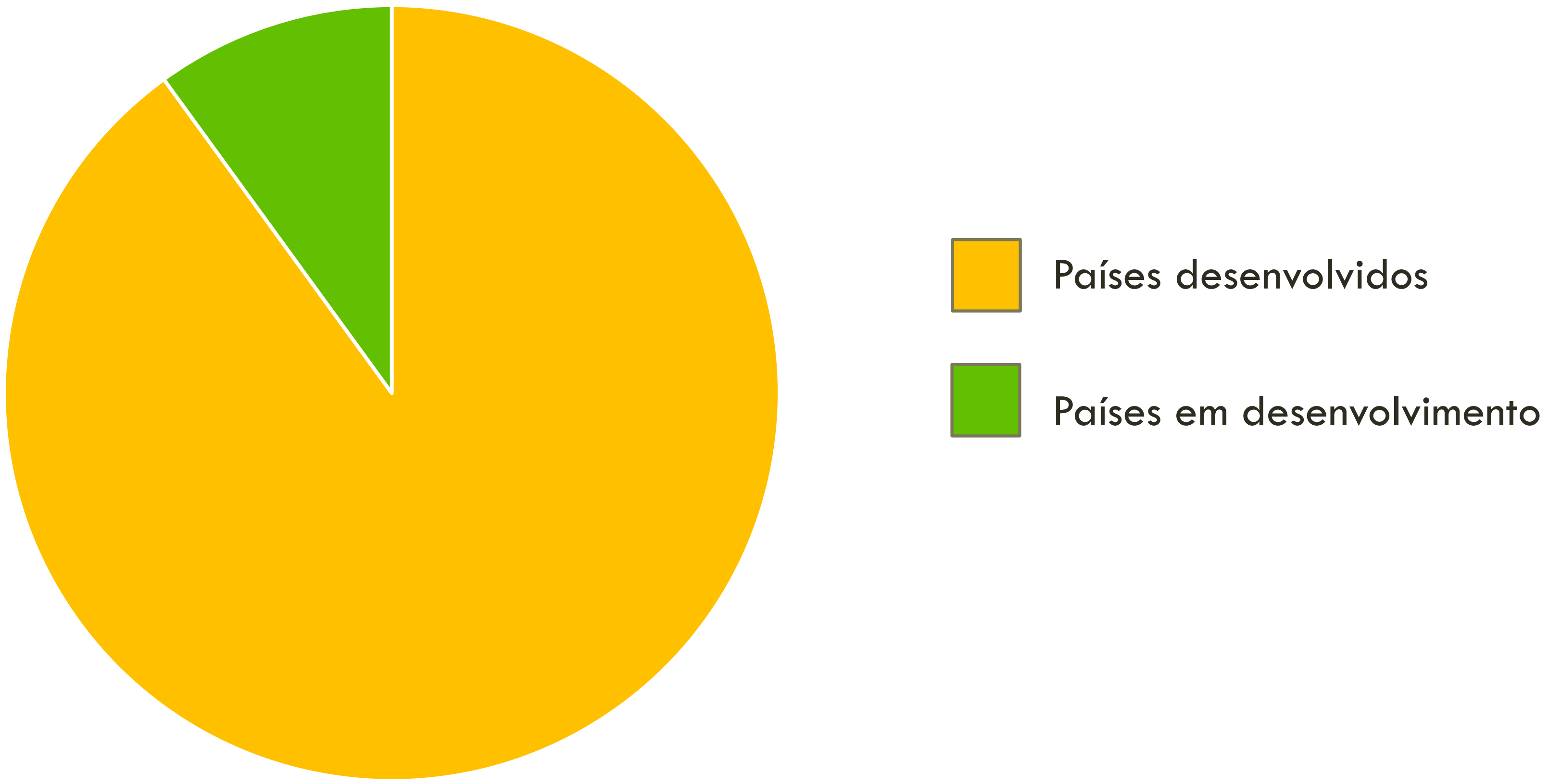
PREVENÇÃO

Quem vai pagar?

ÁREAS DE RISCO



FUNDO INTERNACIONAL



MUITO OBRIGADA

colmea

CAPES

CNPq
Conselho Nacional de Desenvolvimento Científico e Tecnológico

UNIVERSIDADE DO BRASIL

UFRJ faz 100 ANOS
1920 | 2020

FAPERJ