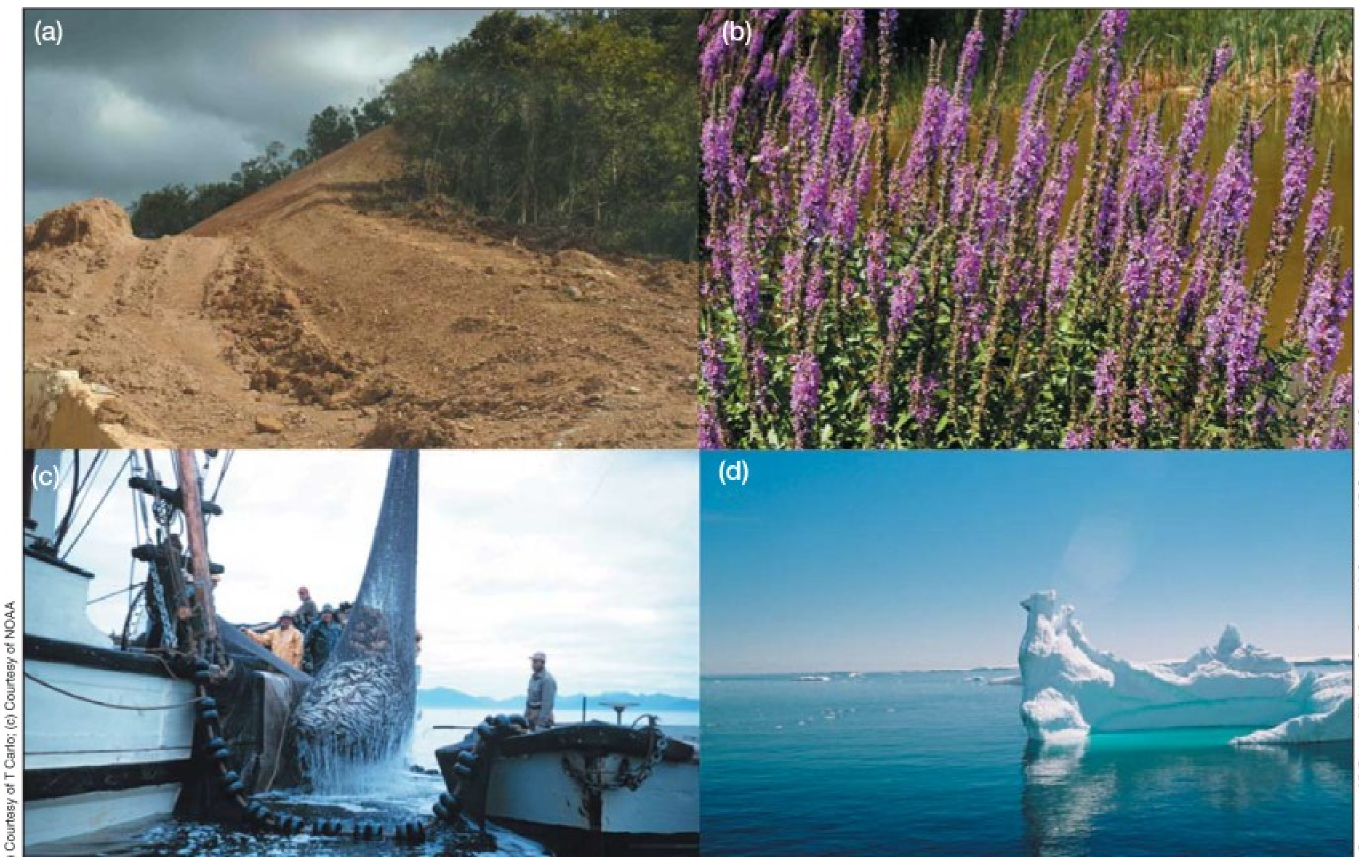
Amenazas a la biodiversidad: Introducción



Esquema de la charla

- La historia del dodo.
- La amenaza de extinción en números.
- Principales factores de amenaza a la extinción de las especies.
- Interacciones entre factores de amenaza.

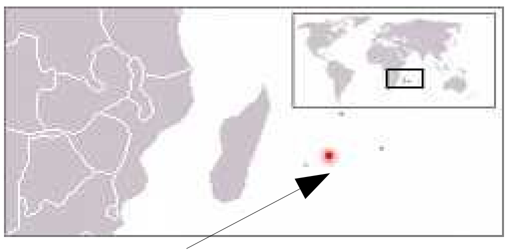
Dodo (*Raphus cucullatus*)

[...] un tipo de ave grande, más grande que nuestros cisnes, con una gran cabeza, la mitad de la cual está cubierta por piel como una capucha. A estas aves les faltan las alas, y en su lugar tienen tres o cuatro plumas negruzcas. La cola consiste en unas pocas plumas delgadas y curvas, de color gris. Lo llamamos *Walckvögel*, porque cuanto más se los hierve, más duros e incomibles se vuelven.

-- Jacob Cornelius van Neck, navegante holandés, 1601

La tripulación entera realizó una comida completa con tres o cuatro dodos, y aun sobró una parte.

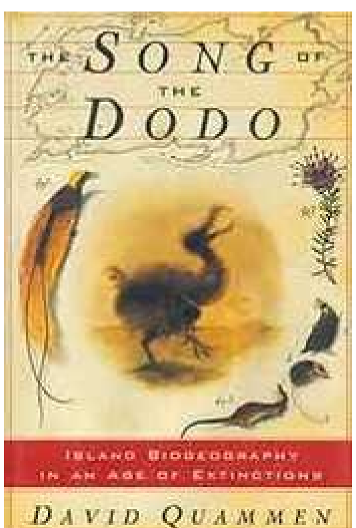
-- Náufragos holandeses en Mauricio, ca. 1610



Isla de Mauricio,
Islas Mascareñas

Eran muy serenos y majestuosos, se mostraban con un rosto extremadamente oscuro y un pico abierto, muy elegantes y audaces en su caminar, y apenas se apartaban de nuestro camino.

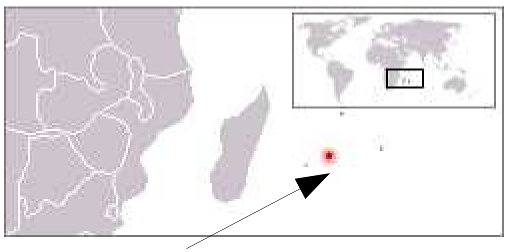
-- Otro navegante holandés, 1631



Cuando eran sostenidos de una pata emitía un gemido, y otros venían corriendo para ayudar al prisionero y eran también atrapados.

-- Volquad Iversen, navegante holandés, último registro de los dodos en Mauricio, 1662

Posibles causas de la extinción del dodo

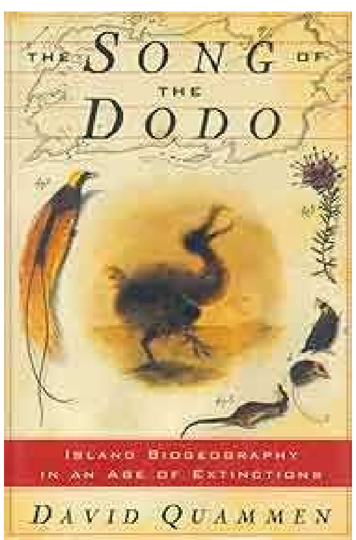


Isla de Mauricio,
Islas Mascareñas

Sobreexplotación

Los dodos fueron cazados sin misericordia durante el corto período en el que los europeos estuvieron en contacto con ellos y por un período de poco más de medio siglo ellos fueron una fuente muy útil de carne para los viajeros en el Océano Índico.

-- Erroll Fuller (1988) Extinct birds. Facts on File.



Predación por especies introducidas

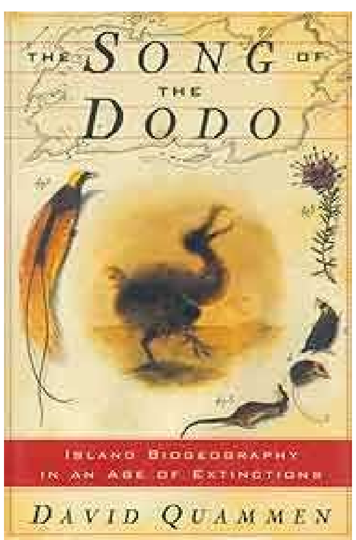
En mi opinión, quien sea que introdujo en macaco cagrejero [*Macaca fascicularis*], por la razón inescrutablemente estúpida que sea, cometió un acto de enormes consecuencias. Sospecho que esos monos han sido muy subestimados como un factor contribuyente a la extinción del dodo.

-- David Quammen (1996) The song of the dodo. Scribner

Esqueleto de dodo
Museo de Historia Natural, Londres

Lo central del problema de la extinción (de *Raphus cucullatus* y de cualquier otra especie) no es quién o qué mata el último individuo. Esa muerte final refleja sólo una causa próxima. La causa, o causas, últimas pueden ser muy diferentes. Para el momento en que la muerte del último individuo es inminente, una especie ya ha perdido demasiadas batallas en la lucha por la supervivencia. Ha sido barrida por un vórtice de complejos males. Su adaptabilidad evolutiva casi ha desaparecido. Ecológicamente, se ha vuelto moribunda. El puro azar, entre otros factores, está en su contra. La cadena del inodoro de su destino ha sido tirada. [...] Las causas de la extinción son usualmente múltiples y están unidas por una complicada sinergia. **La precondición para la extinción puede ser resumida en una sola palabra: rareza.**

-- David Quammen (1996) The song of the dodo. Scribner



Prehistoric Extinctions of Pacific Island Birds: Biodiversity Meets Zooarchaeology

David W. Steadman

On tropical Pacific islands, a human-caused "biodiversity crisis" began thousands of years ago and has nearly run its course. Bones identified from archaeological sites show that most species of land birds and populations of seabirds on those islands were exterminated by prehistoric human activities. The loss of birdlife in the tropical Pacific may exceed 2000 species (a majority of which were species of flightless rails) and thus represents a 20 percent worldwide reduction in the number of species of birds. The current global extinction crisis therefore has historic precedent.

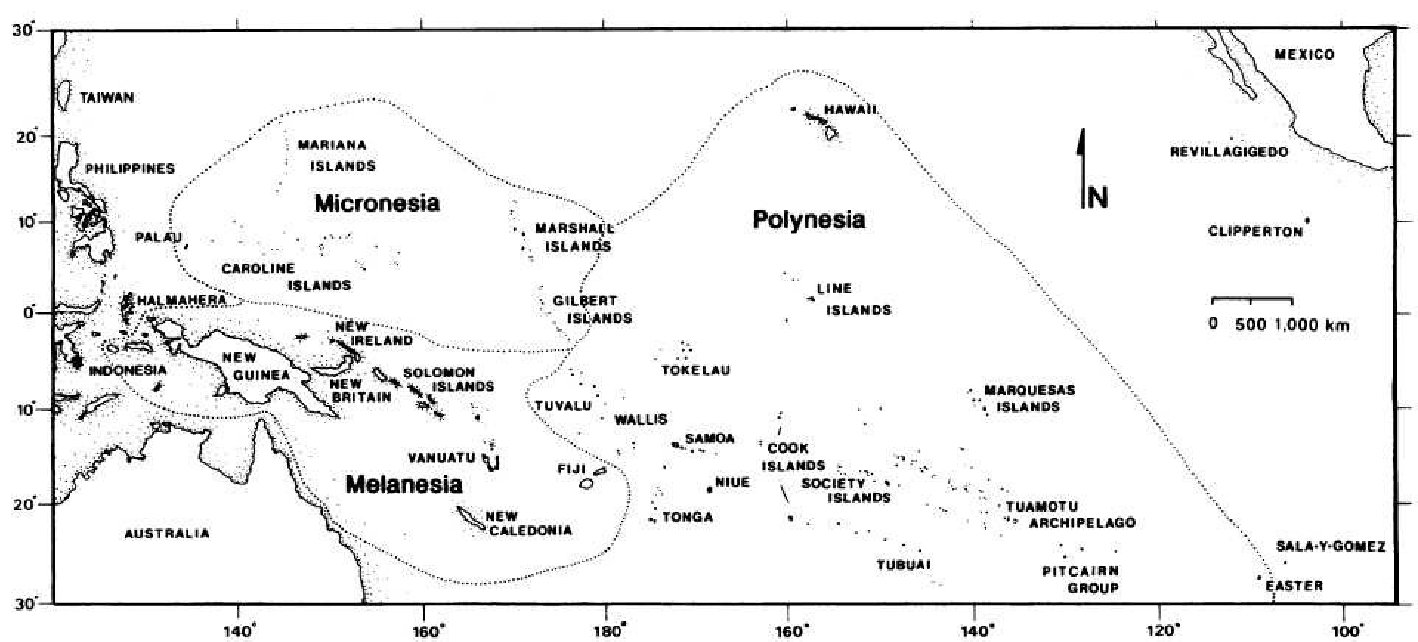


Fig. 1. The tropical Pacific Ocean, showing major island groups.

Assessing the Causes of Late Pleistocene Extinctions on the Continents

Anthony D. Barnosky,[1*] Paul L. Koch,[2] Robert S. Feranec,[1] Scott L. Wing,[3] Alan B. Shabel[1]

1 OCTOBER 2004 VOL 306 SCIENCE

One of the great debates about extinction is whether humans or climatic change caused the demise of the Pleistocene megafauna. Evidence from paleontology, climatology, archaeology, and ecology now supports the idea that humans contributed to extinction on some continents, but human hunting was not solely responsible for the pattern of extinction everywhere. Instead, evidence suggests that the intersection of human impacts with pronounced climatic change drove the precise timing and geography of extinction in the Northern Hemisphere. The story from the Southern Hemisphere is still unfolding. New evidence from Australia supports the view that humans helped cause extinctions there, but the correlation with climate is weak or contested. Firmer chronologies, more realistic ecological models, and regional paleoecological insights still are needed to understand details of the worldwide extinction pattern and the population dynamics of the species involved.

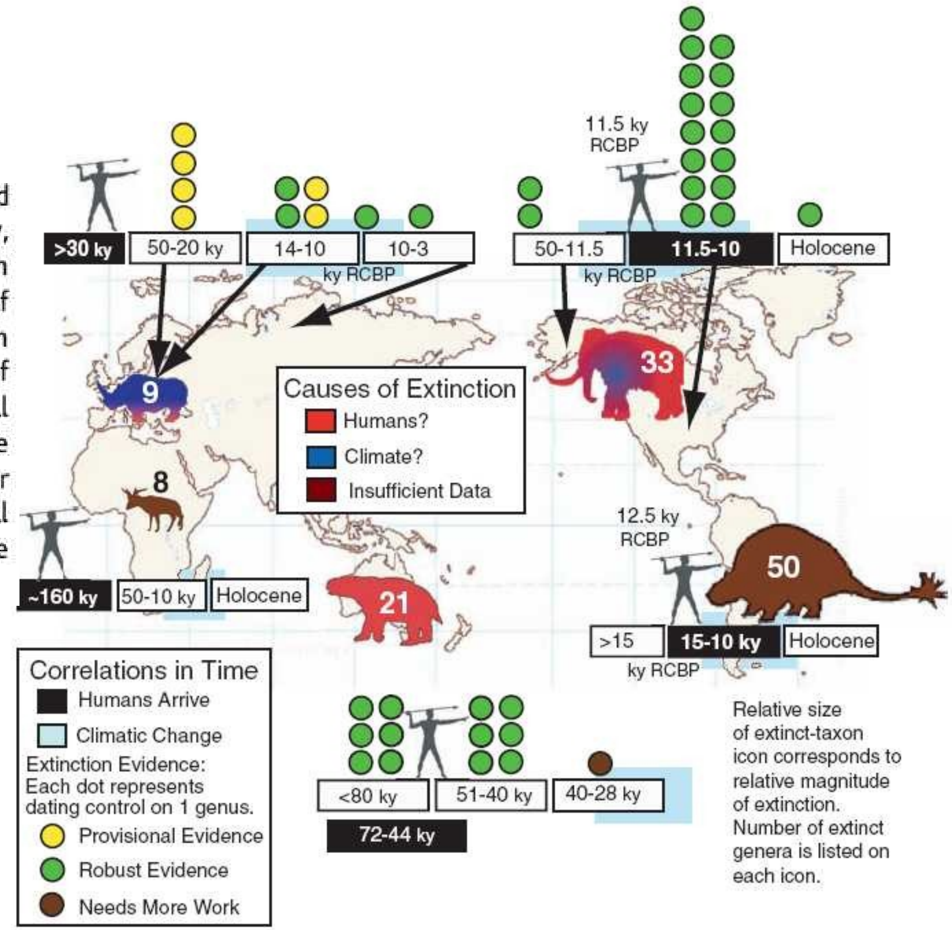


Fig. 1. Summary of the numbers of megafaunal genera that went extinct on each continent (Table 1), the strength of the extinction chronology, and a comparison of the timing of extinction with the timing of human arrival and late Pleistocene climatic change. Extinction timing for individual genera was judged as robust or provisional based on previous publications that evaluated quality of dates. Sources are as follows: Europe (*3*, *14*, *47*), Siberia (*48*), North America (*11*, *29*, *46*, *57*), and Australia (*4*, *7*). For humans, the date is the earliest generally accepted arrival of *Homo sapiens sapiens*; pre-*sapiens* hominins were present in Eurasia and Africa much earlier.

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Amenaza de extinción en números

The Future of Biodiversity

Stuart L. Pimm,* Gareth J. Russell, John L. Gittleman,
Thomas M. Brooks

Recent extinction rates are 100 to 1000 times their pre-human levels in well-known, but taxonomically diverse groups from widely different environments. If all species currently deemed "threatened" become extinct in the next century, then future extinction rates will be 10 times recent rates. Some threatened species will survive the century, but many species not now threatened will succumb. Regions rich in species found only within them (endemics) dominate the global patterns of extinction. Although new technology provides details of habitat losses, estimates of future extinctions are hampered by our limited knowledge of which areas are rich in endemics.

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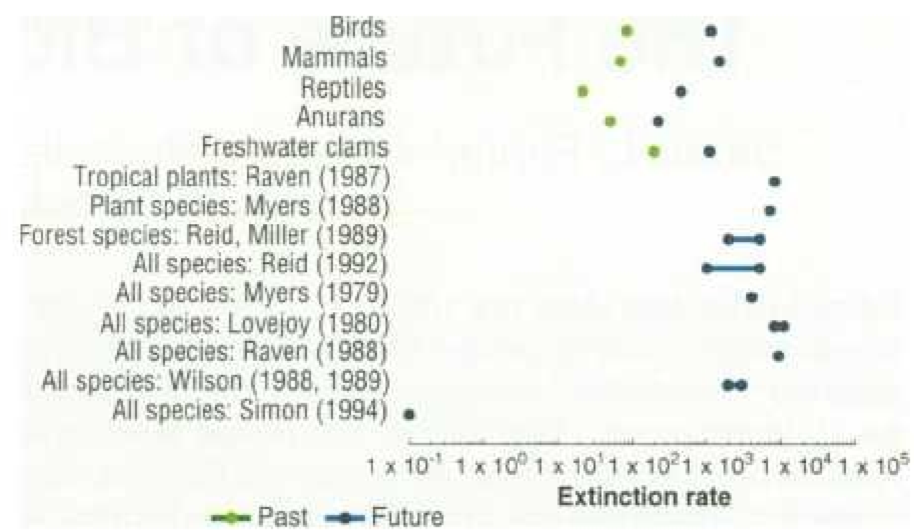


Fig. 2. Estimates of extinction rates expressed as extinctions per million species-years. For birds through clams, we derive past rates from known extinctions in the last 100 years; we derive future rates by assuming that all currently threatened species will be extinct in 100 years. The latter rates are much higher than the former but are still far too low. The remaining estimates are previously published (*1*, *16*, *27*). Myers (1979) (*27*) assumes an exponential increase in the number of extinctions. Myers (1988) (*16*) assumes the loss of a small number of areas rich in endemics. With the exception of Simon, the rest are estimates based on the relation between habitat loss and species loss. Simon's claims (*1*) of one (or a few) species per year (out of a conservative total of 10^7 species) are not scientifically credible.

Amenaza de extinción en números

RECUADRO 4 Como se estima el riesgo de extinción

Las categorías de la Lista Roja de la UICN reflejan la probabilidad de extinción de una especie si persisten las condiciones actuales. La situación de riesgo en que se encuentran las especies se basa en la información recabada con la labor de miles de científicos de todo el mundo.

Las estimaciones se realizan siguiendo un sistema riguroso por el cual se clasifica a las especies en una categoría de las ocho de la lista: extinta, extinta en estado silvestre, en peligro crítico de extinción, en peligro, vulnerable, casi amenazada, preocupación menor y datos insuficientes. Se consideran amenazadas las especies clasificadas en las categorías "en peligro crítico de extinción", "en peligro" o "vulnerable".

La clasificación en las categorías de riesgo de extinción se rige por criterios que contemplan umbrales cuantitativos del tamaño y la estructura de la población el ritmo de disminución de la población, el tamaño y la estructura de la zona de distribución y el riesgo de extinción determinados mediante modelos de viabilidad de la población.

Hasta 2009, se habían evaluado 47 677 especies, de las cuales el 36% se considera en peligro de extinción; mientras que, de las 25 485 especies de los grupos evaluados en su totalidad (mamíferos, aves, anfibios, corales, cangrejos de agua dulce, cícadas y coníferas), el 21% se considera amenazado. De las 12 055 especies vegetales evaluadas, el 70% está en peligro. Sin embargo, en esta muestra están representadas de más las especies de plantas con mayor riesgo medio de extinción.

Fuente: Secretaría del Convenio sobre la Diversidad Biológica (2010) Perspectiva Mundial sobre la Diversidad Biológica 3. Montreal

Amenaza de extinción en números

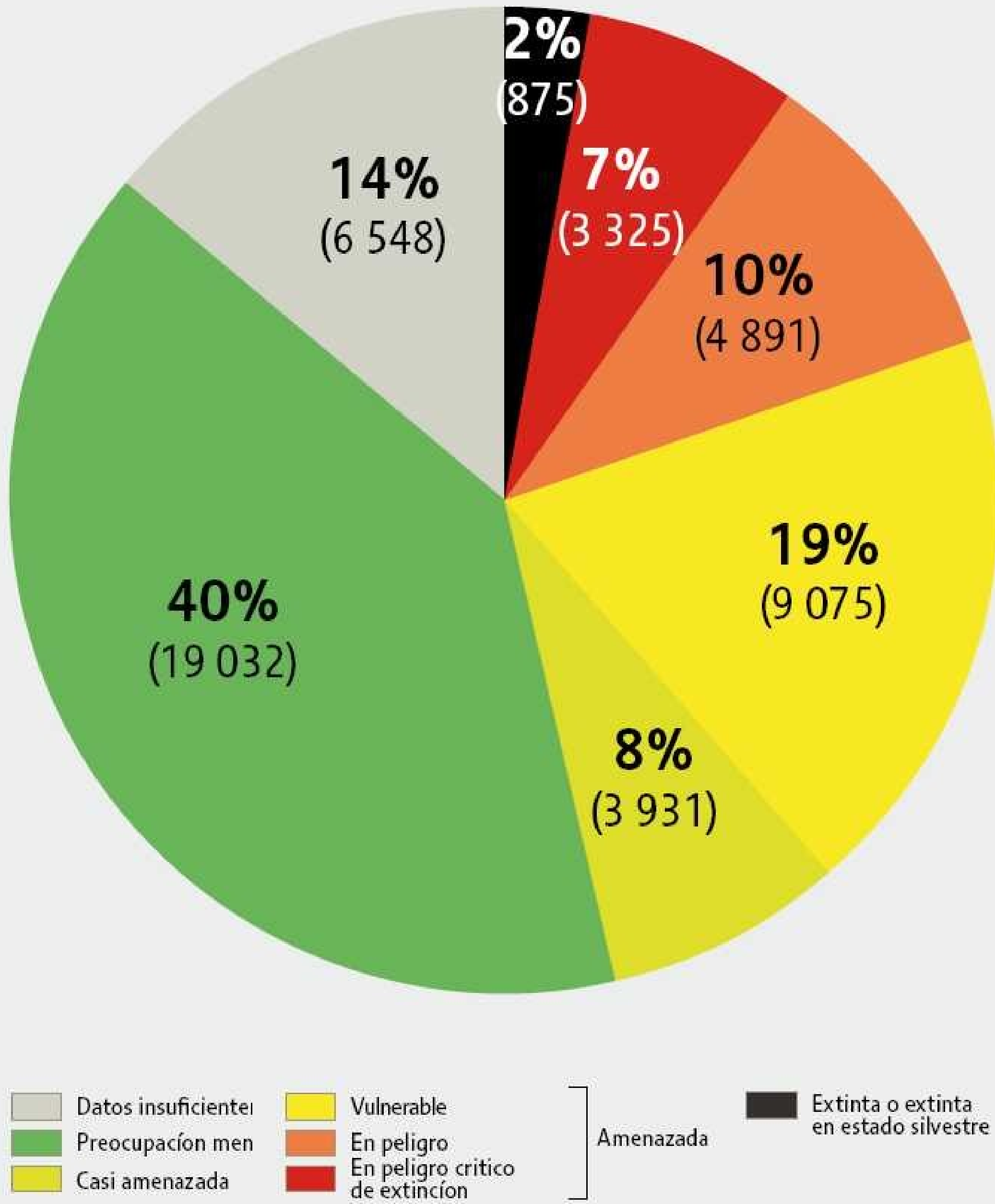


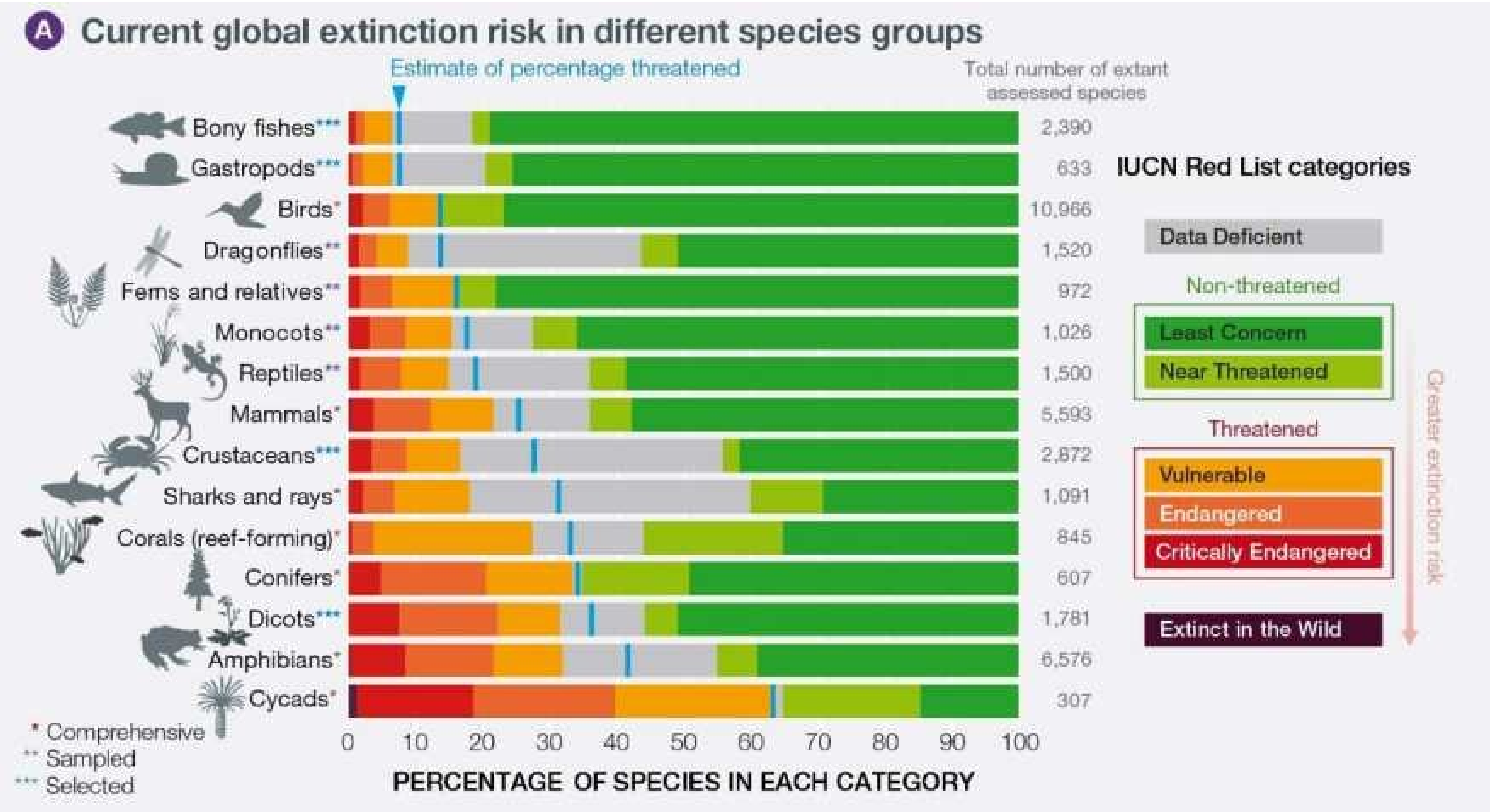
FIGURA 3 Porcentaje de especies en distintas categoría de amenaza

Porcentajes de todas las especies evaluadas en distintas categorías de peligro de extinción incluidas en la Lista Roja de la UICN, basados en datos de 47 677 especies. Se considera que más de un tercio (36%) de las especies evaluadas está amenazado, es decir, que son especies vulnerables, están en peligro de extinción o en peligro crítico de extinción.

Fuente: IUCN

Fuente: Secretaría del Convenio sobre la Diversidad Biológica (2010) Perspectiva Mundial sobre la Diversidad Biológica 3. Montreal

Amenaza de extinción en números



Fuente: Díaz et al. (2019) IPBES Global Assessment Summary for Policymakers. IPBES

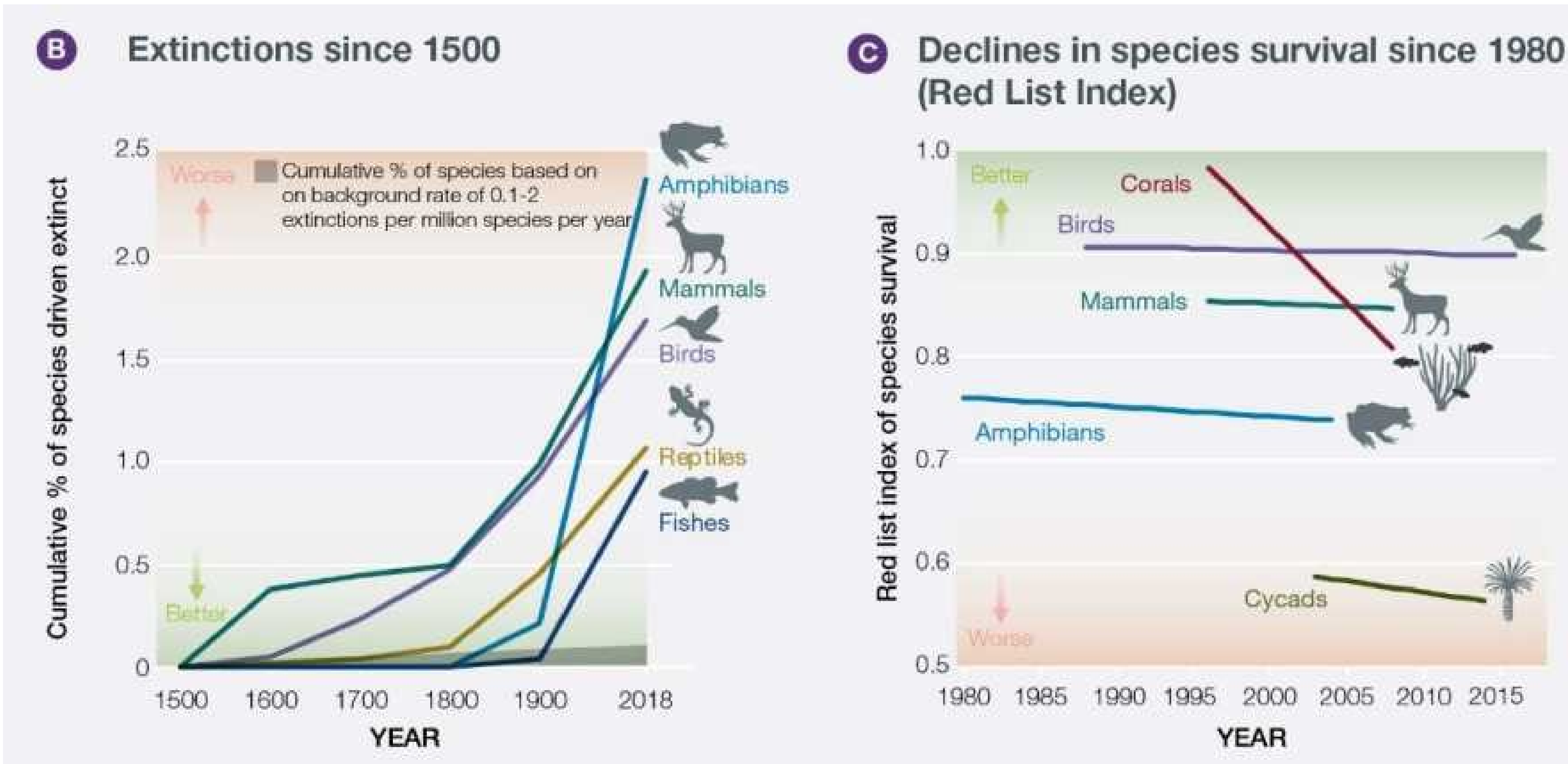
Amenaza de extinción en números

Table 1
Proportion of declining and threatened species per taxa according to IUCN criteria (> 30% decline), the annual rate of decline in species (i.e. additional declines per year) and the local or regional extinction rate (i.e. percent of species not observed in > 50 years).

Taxon	Declining (%)	Threatened (%)	Annual species declines (%)	Extinction rate (%)	No. Reports
A) Insects	41	31	1.0	10	73[a]
Coleoptera	49	34	2.1	6.6	12
Diptera (Syrphidae)	25	0.7[g]	n.a.	n.a.	4
Ephemeroptera	37	27	0.6	2.7	3
Hemiptera (Auchenorrhyncha)	8[g]	n.a.	0.2[g]	n.a.	1
Hymenoptera	46	44	1.0	15	21
Lepidoptera	53	34	1.8	11	17
Odonata	37	13	1.0	6	6
Orthoptera	49	n.a.	1.0	n.a.	1
Plecoptera	35	29	0.6	19	7
Trichoptera	68	63	0.6	6.8	1
Terrestrial	38	28	1.2	11	56
Aquatic	44	33	0.7	9	17
B) Vertebrates	22	18	2.5	1.3	11
Amphibians	23	23	n.a	n.a.	1[b]
Birds	26	13	2.3	0.8	3[c]
Mammals (land)	15	15	0.1	1.8	3[d]
Mammals (Chiroptera)	27	n.a.	5.2	1.2	3[e]
Reptiles	19	19	n.a.	n.a.	1[f]

Fuente: Sánchez-Bayo & Wyckhuys (2019) Biological Conservation 232: 8-27

Amenaza de extinción en números



Fuente: Díaz et al. (2019) IPBES Global Assessment Summary for Policymakers. IPBES

Amenaza de extinción en números

Fig. 7. Photos of selected primates from each major world region. Conservation status and photo credits include the following: (A) Golden snub-nosed monkey (Rhinopithecus roxellana), Endangered, P. A. Garber. (B) Ring-tailed lemur (Lemur catta), Endangered, R. A. Mittermeier. (C) Udzungwa red colobus (P. gordonorum), Endangered (Photo Credit: Thomas Struhsaker, Duke University). (D) Javan slow loris (Nycticebus javanicus), Critically Endangered (Photo Credit: Andrew Walmsley, Andrew Walmsley Photography). (E) Sumatran orangutan (P. abelii), Critically Endangered (Photo Credit: Perry van Duijnhoven). (F) Azara's night monkey (Aotus azarae), Least Concern (Photo Credit: Claudia Valeggia (Yale University)/Owl Monkey Project, Formosa-Argentina).

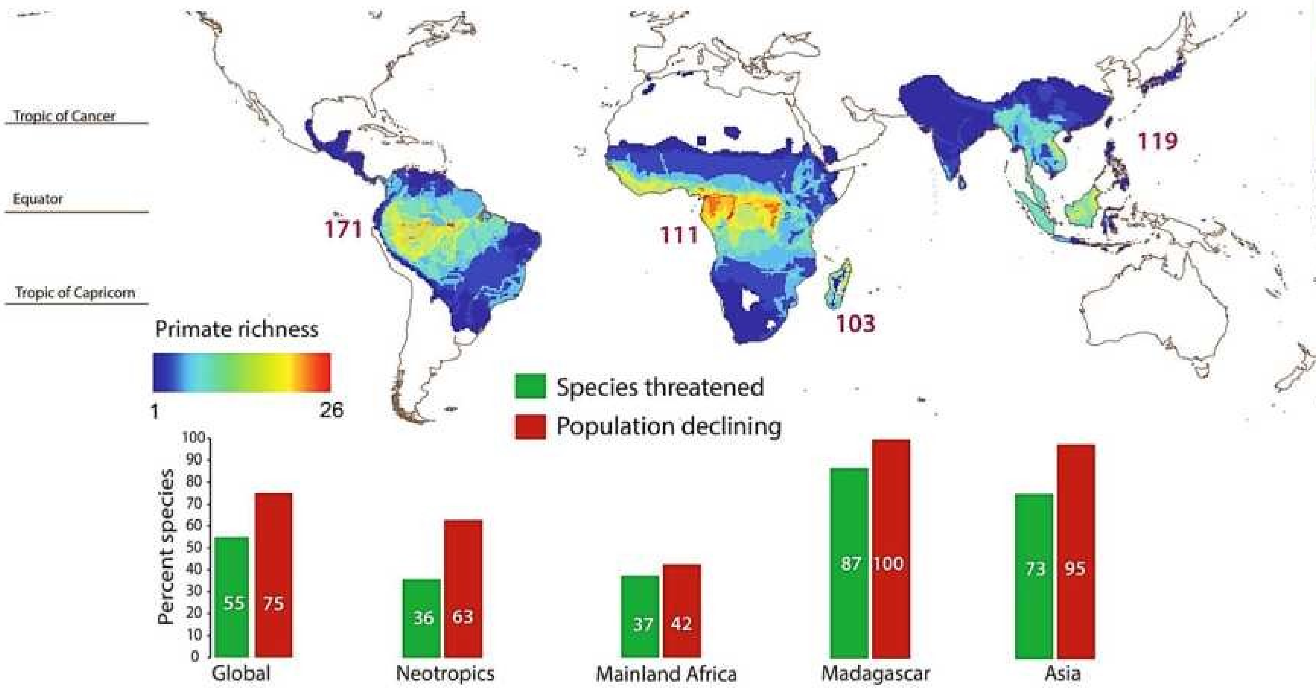


Fig. 1. Global primate species richness, distributions, and the percentage of species threatened and with declining populations. Geographic distribution of primate species. Numbers in red by each region refer to the number of extant species present. The bars at the bottom show the percent of species threatened with extinction and the percent of species with declining populations in each region. Percentage of threatened species and percentage of species with declining populations in each region from tables S1 to S4. Geographical range data of living, native species from the IUCN Red List (www.iucnredlist.org) are overlaid onto a 0.5° resolution equal-area grid. In cases in which a species' range was split into multiple subspecies, these were merged to create a range map for the species. Mainland Africa includes small associated islands.

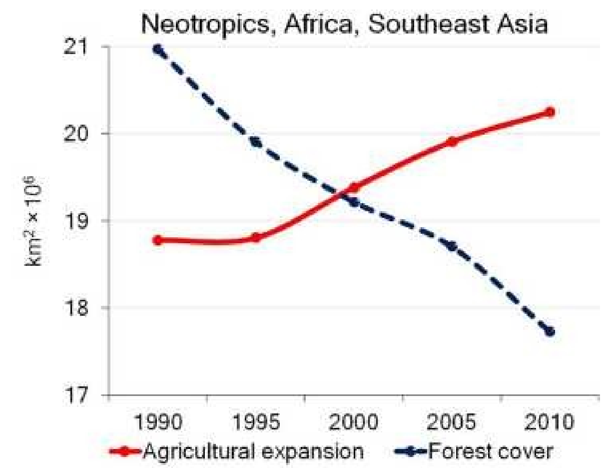


Fig. 3. Agricultural expansion and declines in forest cover for the period 1990–2010 in primate range regions. A rapid expansion of agriculture in primate range regions has been paralleled by a sharp decline in forest cover in the 20-year period considered. Trends for each individual region are shown in fig. S6 (A to C). Data for Africa include Madagascar (source of raw data, FAOSTAT: faostat.fao.org/site/377/DesktopDefault.aspx?PageID=377#ancor. Consulted June 2016).

Fuente: Estrada et al. (2017) Science Advances 3: e1600946

Amenaza de extinción en números

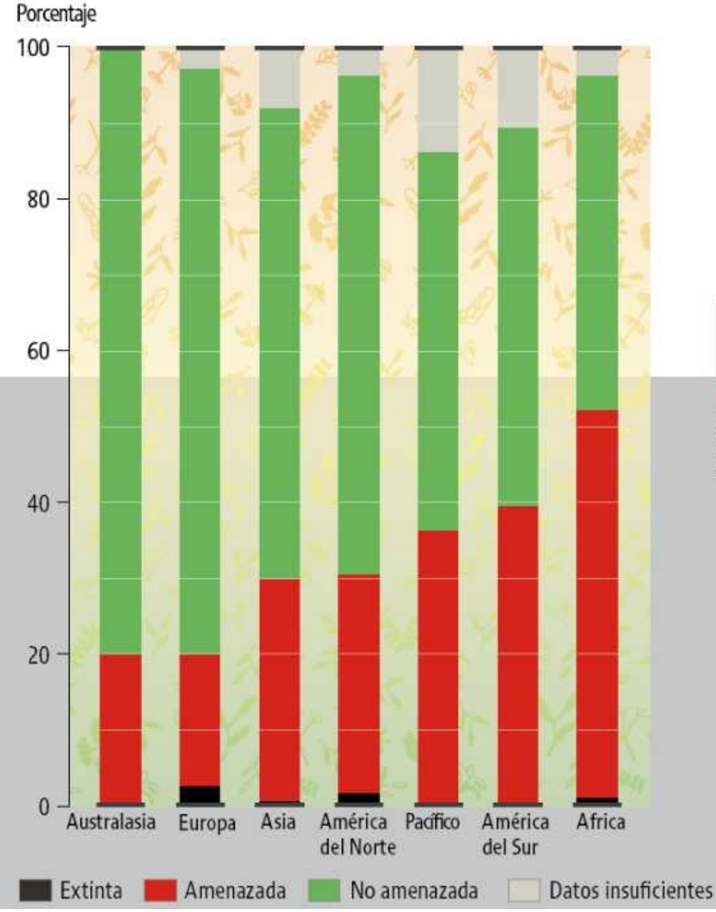


FIGURA 6 Estado de conservación de especies de plantas medicinales en distintas regiones geográficas

El mayor peligro de extinción se da en las regiones donde más común es el uso de las plantas medicinales, África, Sudamérica y el Pacífico.
Fuente: IUCN

Fuente: Secretaría del Convenio sobre la Diversidad Biológica (2010) Perspectiva Mundial sobre la Diversidad Biológica 3. Montreal

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(a) Courtesy of T Clark; (c) Courtesy of NOAA

(b) Courtesy of D Brenner/Michigan Sea Grant; (d) Courtesy of R Salm and S Salm

Figure 4. *Four major threats to biodiversity. (a) Habitat loss is the leading threat to biodiversity* (Wilcove et al. 1998; Lawler et al. 2002). *(b) Exotic species, such as purple loosestrife, often out-compete native species for critical resources. (c) Over-exploitation is the leading threat to marine species* (Kappel 2005). *(d) Climate change poses substantial threats to many ecological systems* (Parmesan and Yohe 2003).

Fuente: Lawler et al. (2006) Front. Ecol. Environ. 4: 473-480

Principales factores de amenaza

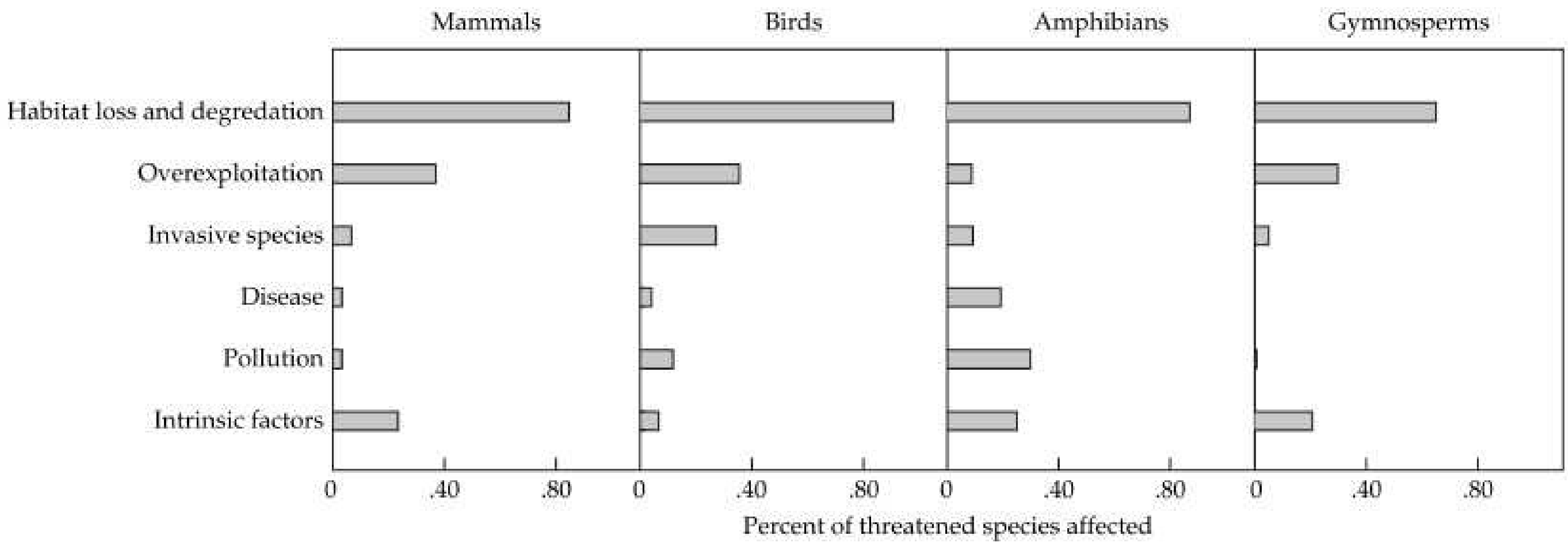


Figure 3.6 Habitat loss and degradation is the greatest threat to global biodiversity among mammals, birds, amphibians, and gymnosperms. Because not all threats are documented, this figure underestimates threat levels among Red Listed species. Overexploitation includes both direct mortality and by-catch. (Modified from IUCN 2004.)

Fuente: Groom et al. (2006) Principles of Conservation Biology, Sinauer

Principales factores de amenaza

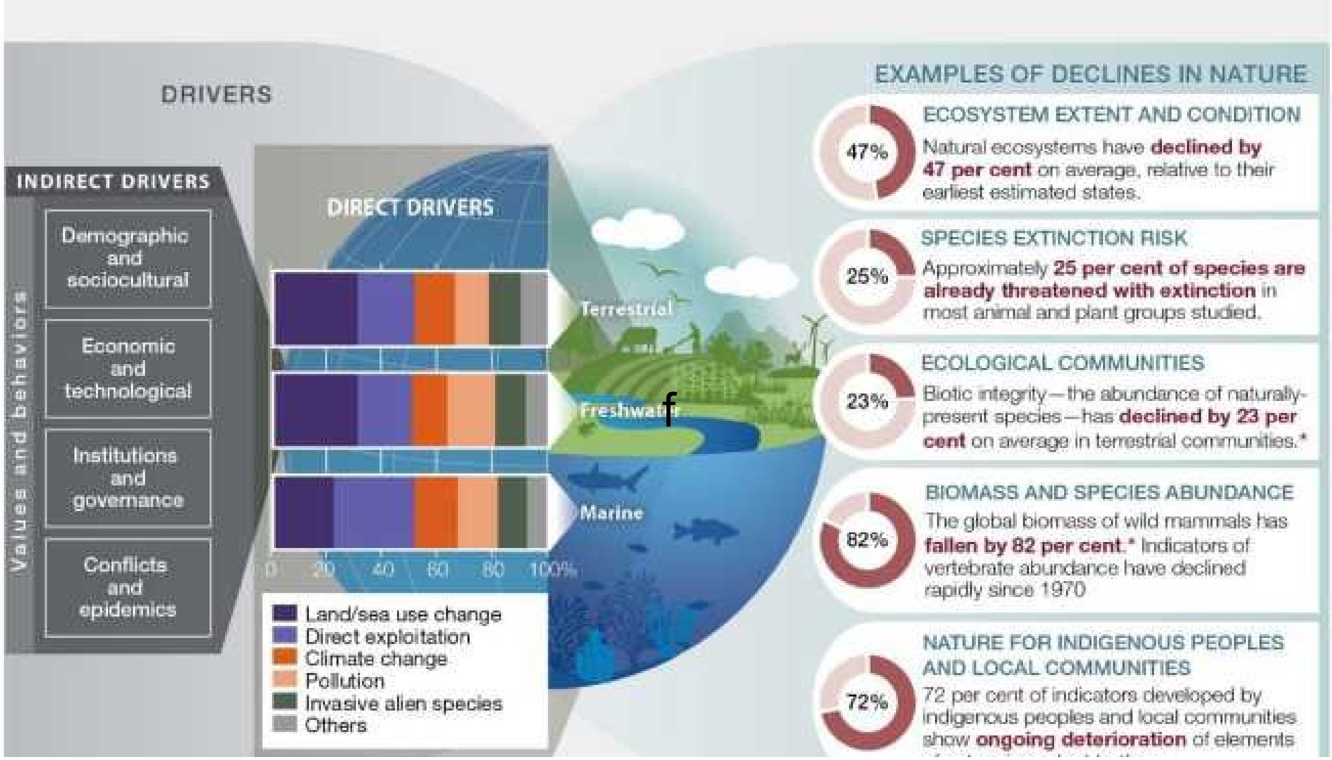


Figure 2. Examples of global declines in nature, emphasizing declines in biodiversity, that have been and are being caused by direct and indirect drivers of change. The direct drivers (land/sea use change; direct exploitation of organisms; climate change; pollution; and invasive alien species)[5] result from an array of underlying societal causes[6]. These causes can be demographic (e.g. human population dynamics), sociocultural (e.g. consumption patterns), economic (e.g. trade), technological or relating to institutions, governance, conflicts and epidemics; these are called indirect drivers[7], and are underpinned by societal values and behaviors. The colour bands represent the relative global impact of direct drivers on (from top to bottom) terrestrial, freshwater and marine nature as estimated from a global systematic review of studies published since 2005. Land and sea use change and direct exploitation account for more than 50 per cent of the global impact on land, in fresh water and in the sea, but each driver is dominant in certain contexts {2.2.6}. The circles illustrate the magnitude of the negative human impacts on a diverse selection of aspects of nature over a range of different time scales, based on a global synthesis of indicators {2.2.5, 2.2.7}.

Fuente: Díaz et al. (2019) IPBES Global Assessment Summary for Policymakers. IPBES

Principales factores de amenaza

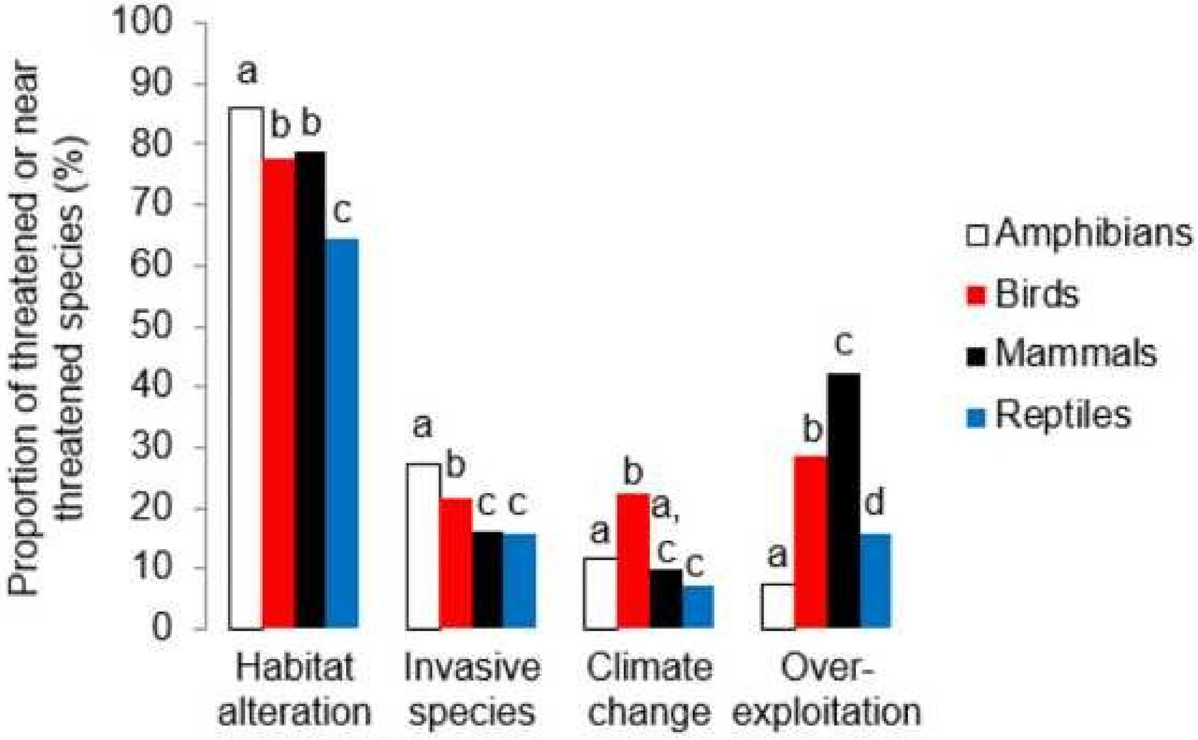


Figure 2 Proportion of near-threatened and threatened species affected by each of the four threat categories used in the current analysis (habitat alteration, invasive species, climate change, overexploitation). Data are shown separately for mammals, birds, reptiles and amphibians. Letters indicate the significance of differences between classes within each threat category.

Fuente: Ducatez et al. (2017) Conservation Letters 10: 186-194

Principales factores de amenaza

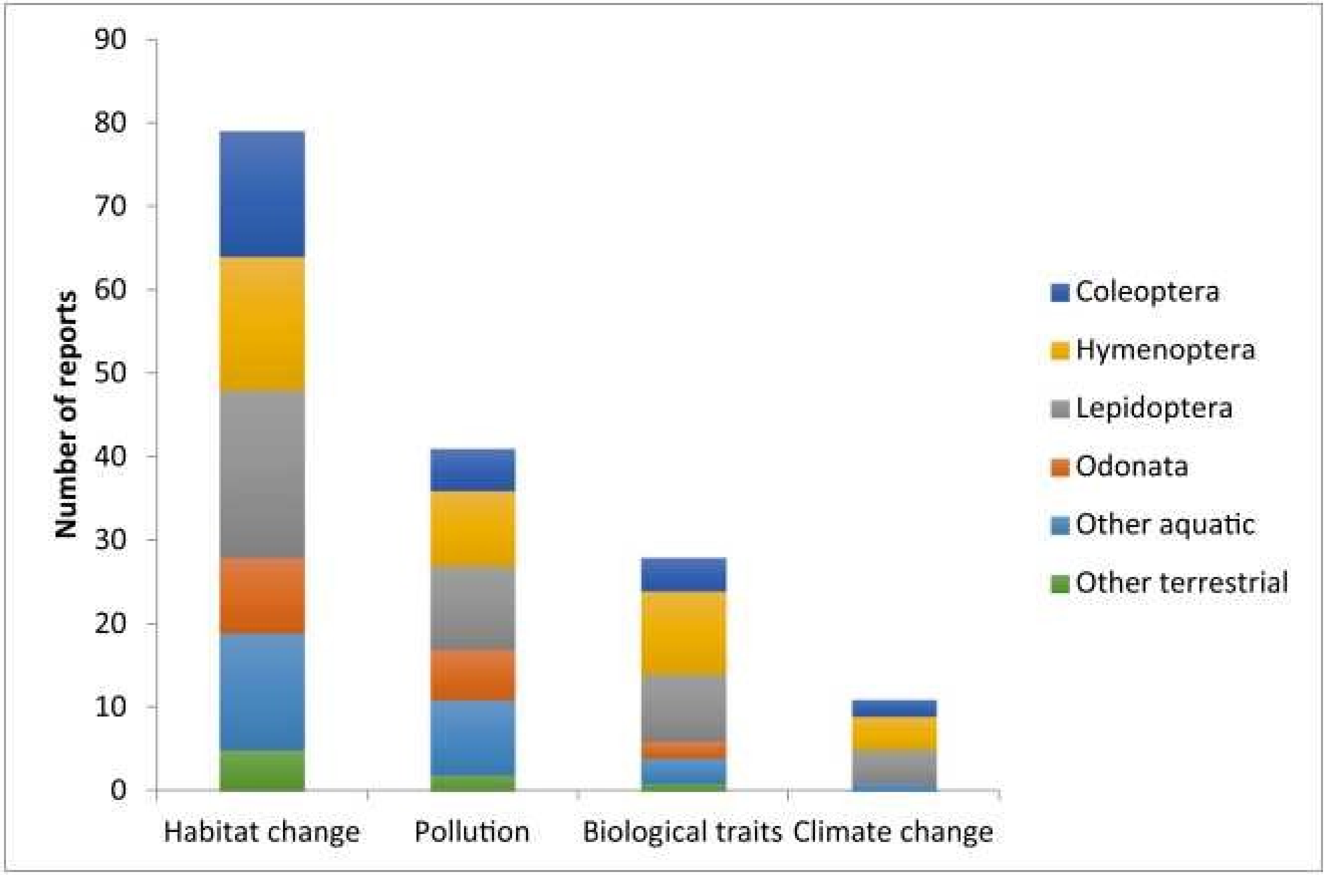


Fig. 5. The four major drivers of decline for each of the studied taxa according to reports in the literature.

Fuente: Sánchez-Bayo & Wyckhuys (2019) Biological Conservation 232: 8-27

Principales factores de amenaza

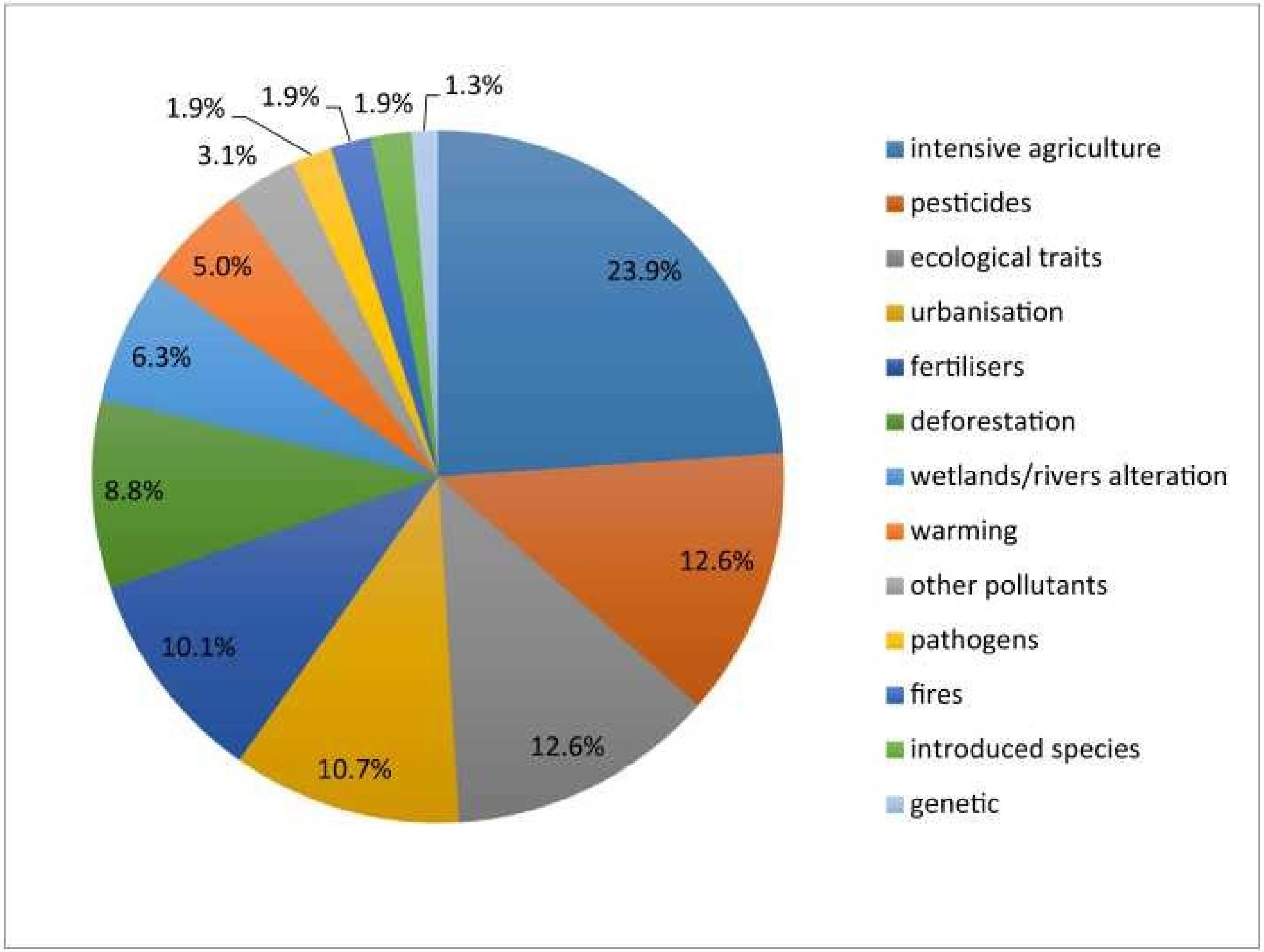
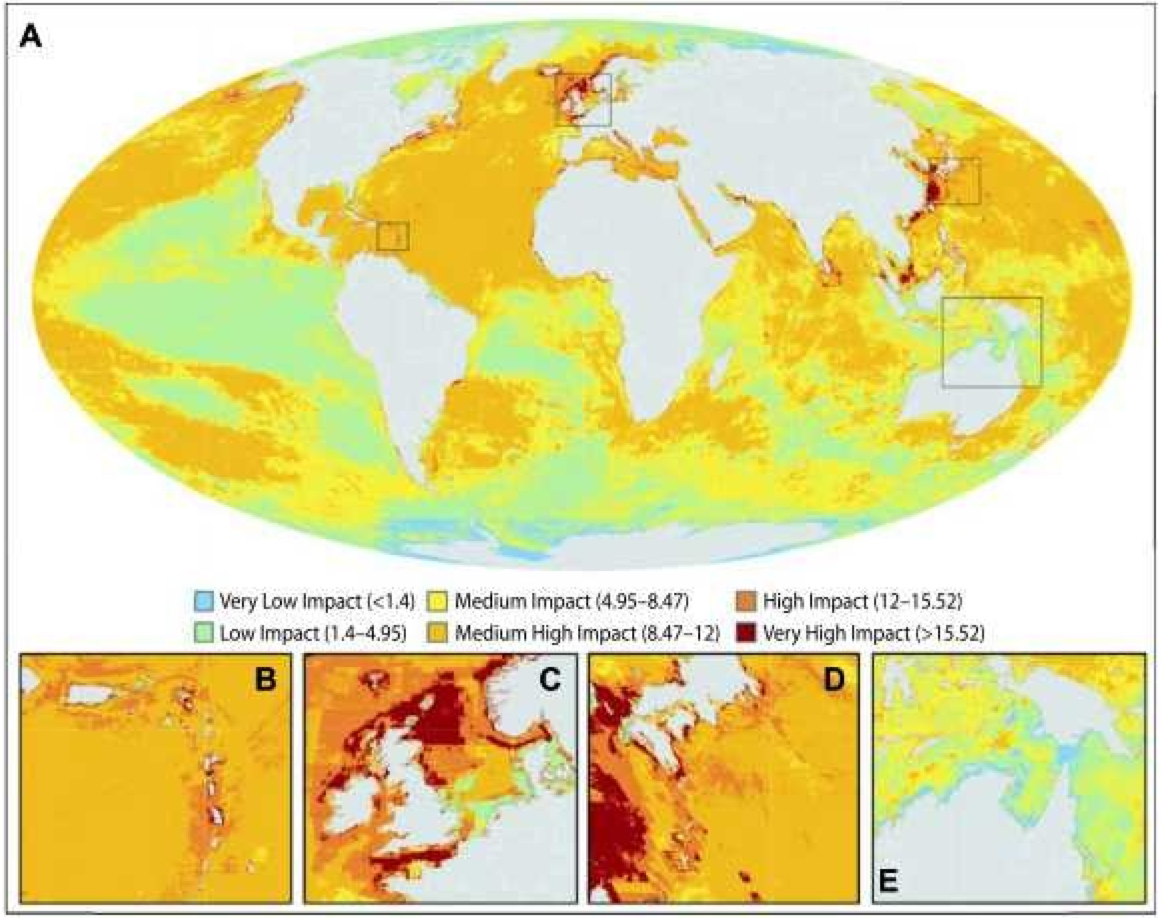


Fig. 6. Main factors associated with insect declines – see also Fig. 5.

Fuente: Sánchez-Bayo & Wyckhuys (2019) Biological Conservation 232: 8-27

Principales factores de amenaza

Fig. 1. Global map (**A**) of cumulative human impact across 20 ocean ecosystem types. (Insets) Highly impacted regions in the Eastern Caribbean (**B**), the North Sea (**C**), and the Japanese waters (**D**) and one of the least impacted regions, in northern Australia and the Torres Strait (**E**).



Fuente: Halpern et al. (2008) Science 319: 948-952

Principales factores de amenaza

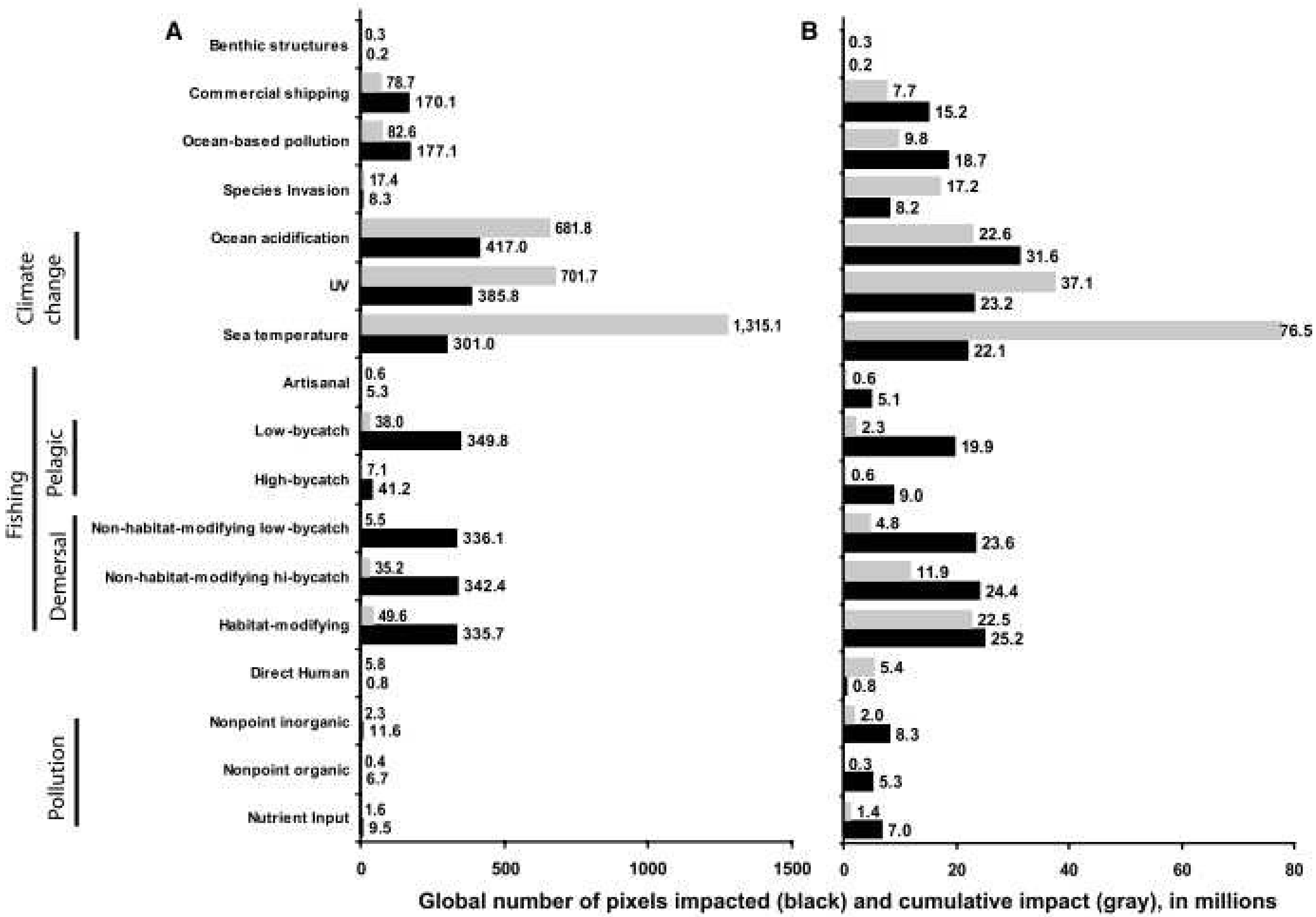
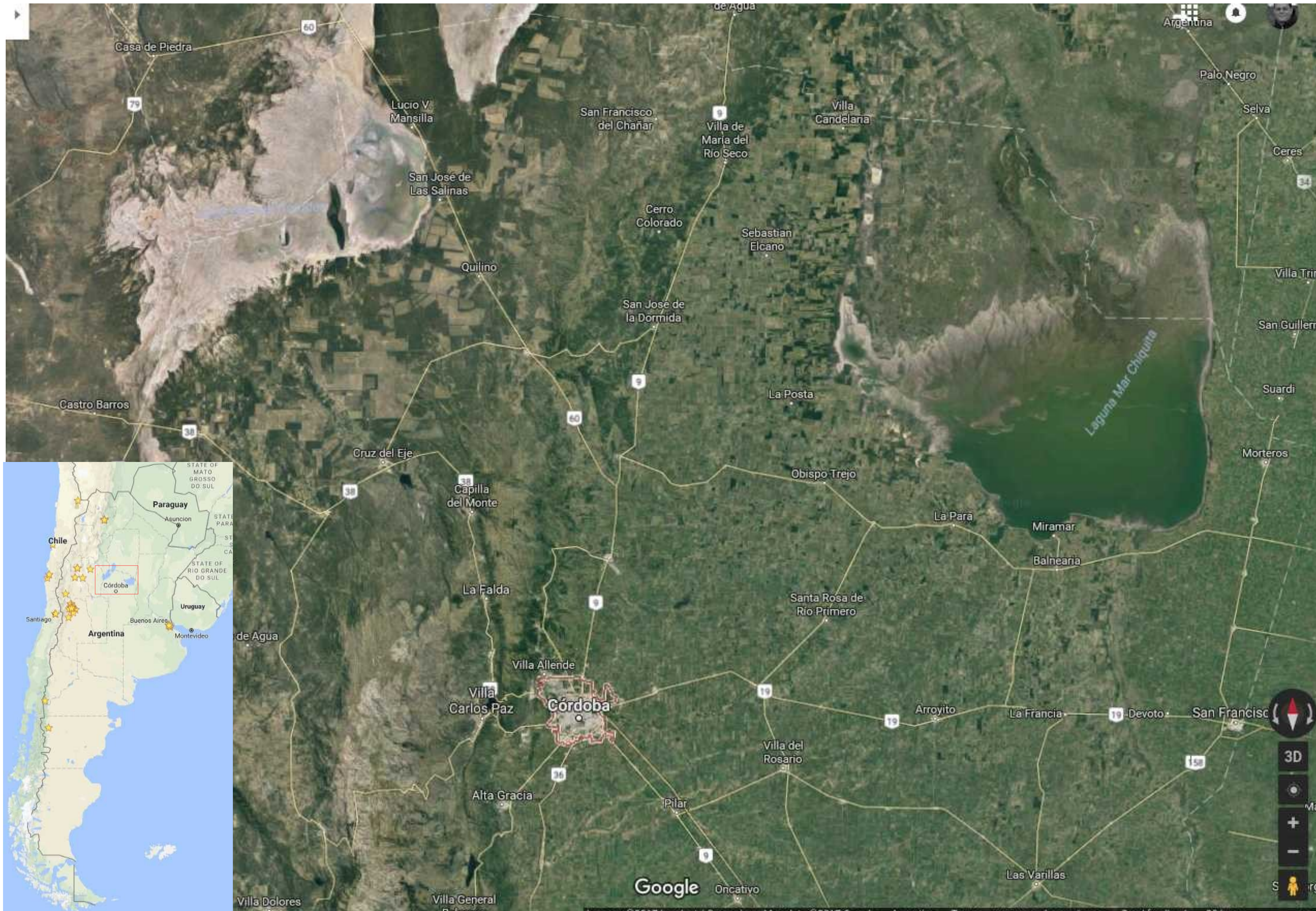


Fig. 4. Total area affected (square kilometers, gray bars) and summed threat scores (rescaled units, black bars) for each anthropogenic driver (**A**) globally and (**B**) for all coastal regions <200 m in depth. Values for each bar are reported in millions.

Fuente: Halpern et al. (2008) Science 319: 948-952

Pérdida y fragmentación de hábitat



Pérdida y fragmentación de hábitat

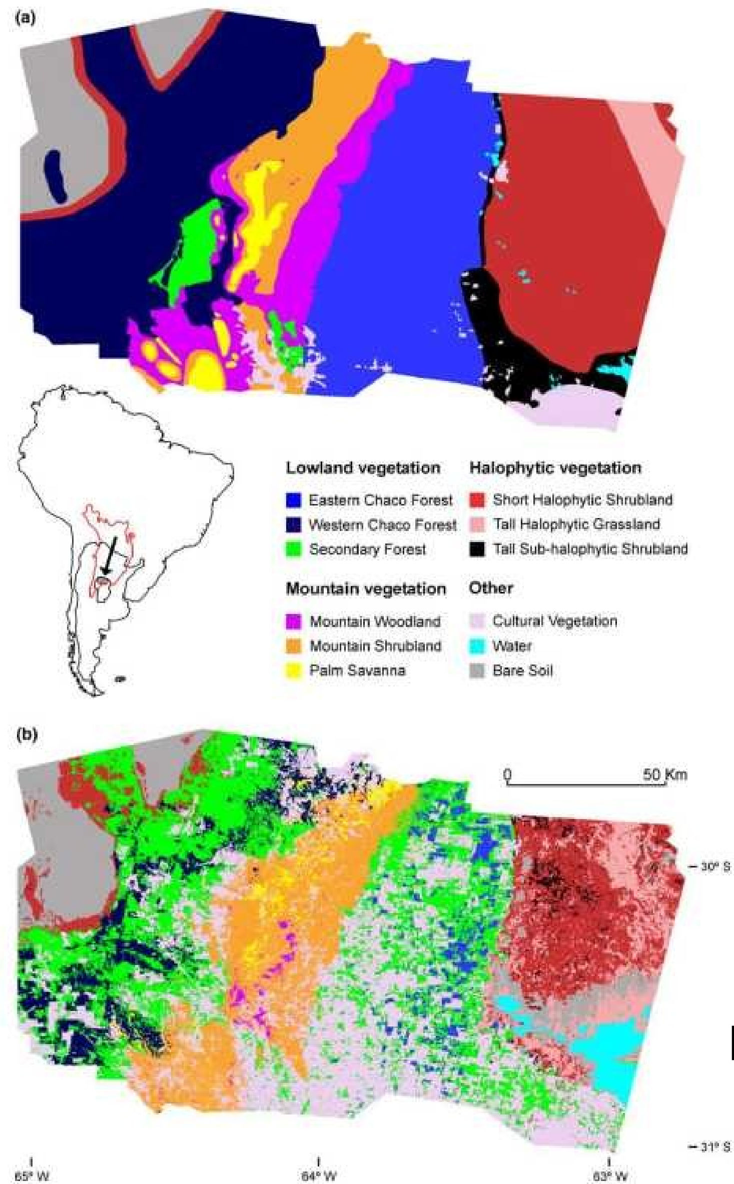


Fig. 1. Thematic maps for the study area: (a) 1969 map; (b) 1999 map. Coincident colors in both maps identify the same land cover types. The South American map shows the location of the study area (pointed with an arrow) at the southern edge of the Gran Chaco (red outline) in the northern part of the Córdoba Province, Argentina.

Fuente: Zak et al. (2004) Biological Conservation 120: 589-598

Pérdida y fragmentación de hábitat

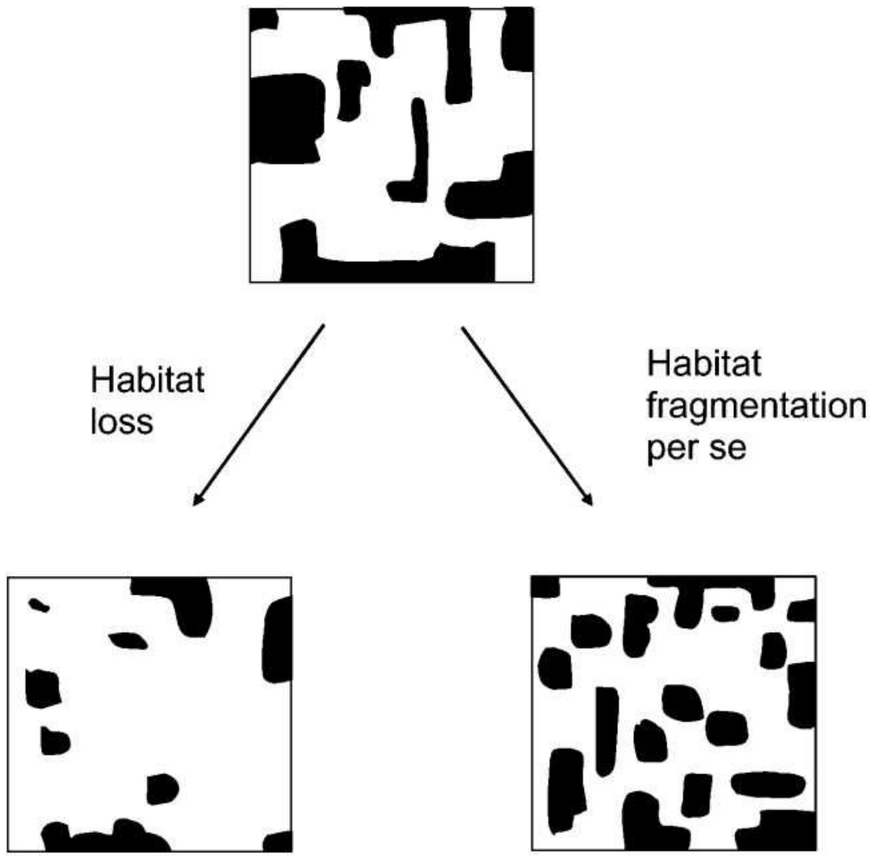


Figure 5 Both habitat loss and habitat fragmentation per se (independent of habitat loss) result in smaller patches. Therefore, patch size itself is ambiguous as a measure of either habitat amount or habitat fragmentation per se. Note also that habitat fragmentation per se leads to reduced patch isolation.

Fuente: Fahrig (2003) Ann. Rev. Ecol., Evol. & Syst. 34: 487-515

Pérdida y fragmentación de hábitat

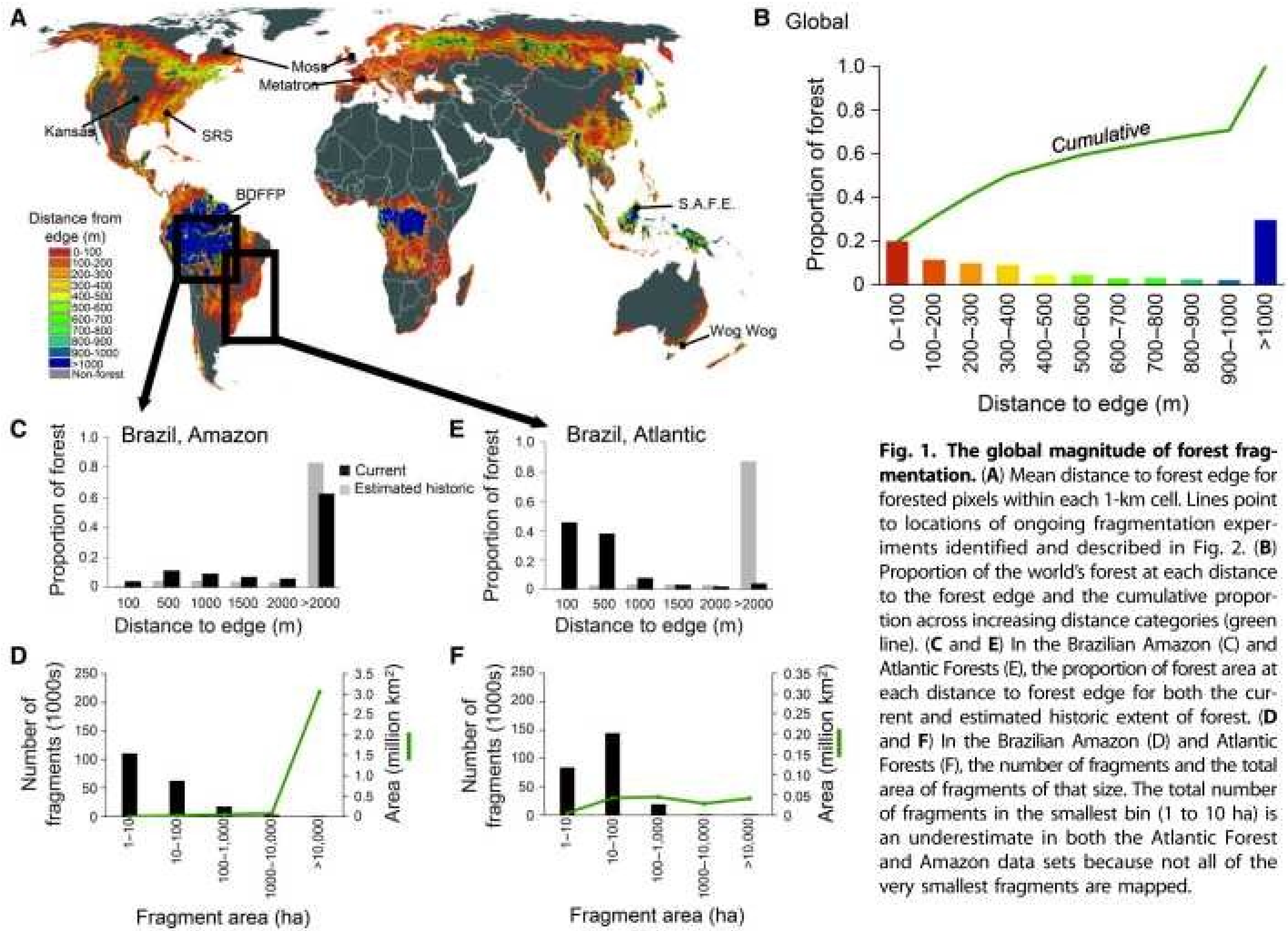


Fig. 1. The global magnitude of forest fragmentation. (**A**) Mean distance to forest edge for forested pixels within each 1-km cell. Lines point to locations of ongoing fragmentation experiments identified and described in Fig. 2. (**B**) Proportion of the world's forest at each distance to the forest edge and the cumulative proportion across increasing distance categories (green line). (**C** and **E**) In the Brazilian Amazon (C) and Atlantic Forests (E), the proportion of forest area at each distance to forest edge for both the current and estimated historic extent of forest. (**D** and **F**) In the Brazilian Amazon (D) and Atlantic Forests (F), the number of fragments and the total area of fragments of that size. The total number of fragments in the smallest bin (1 to 10 ha) is an underestimate in both the Atlantic Forest and Amazon data sets because not all of the very smallest fragments are mapped.

Fuente: Haddad et al. (2015) Science Advances 1: e1500052

Pérdida y fragmentación de hábitat

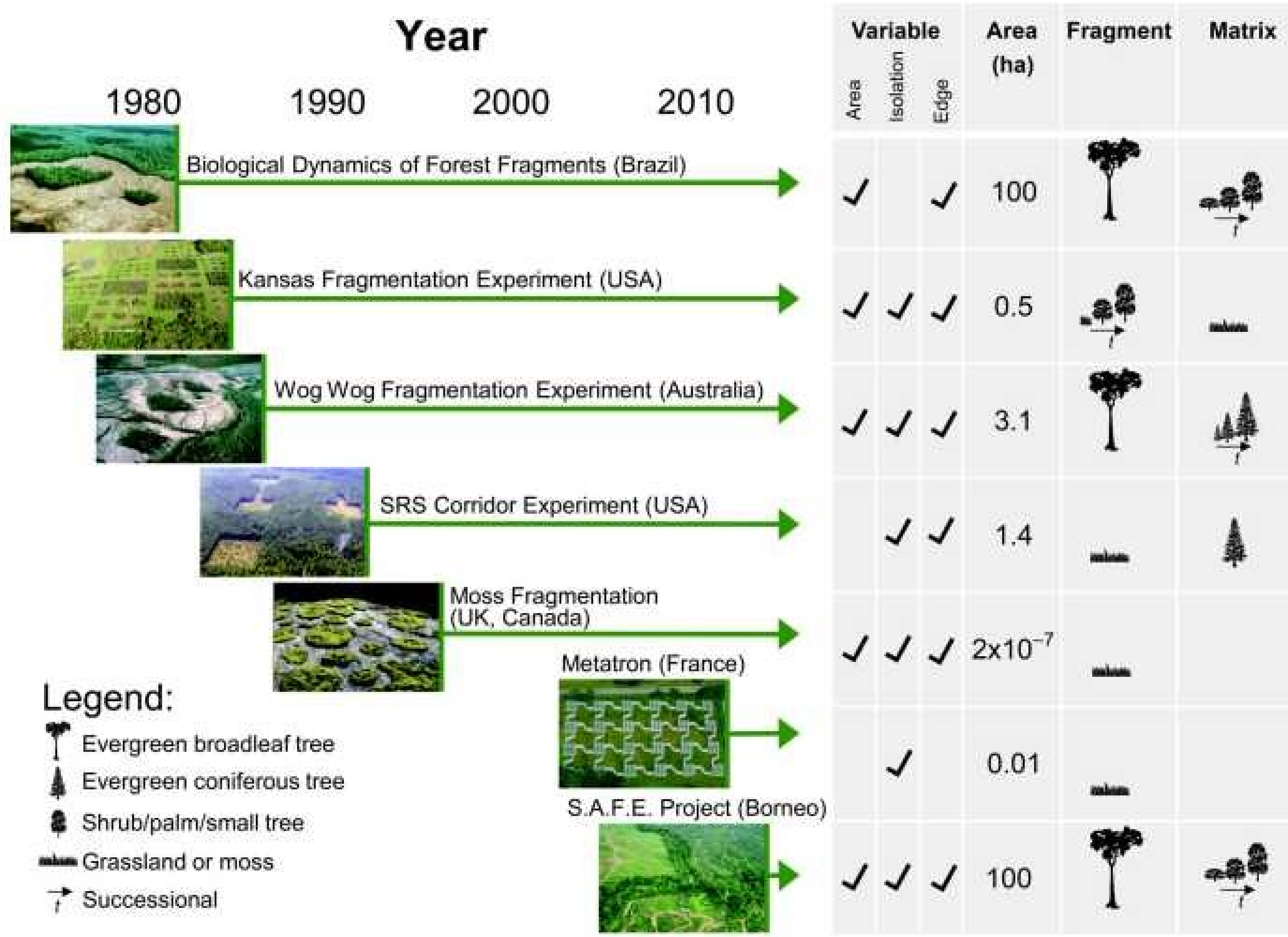
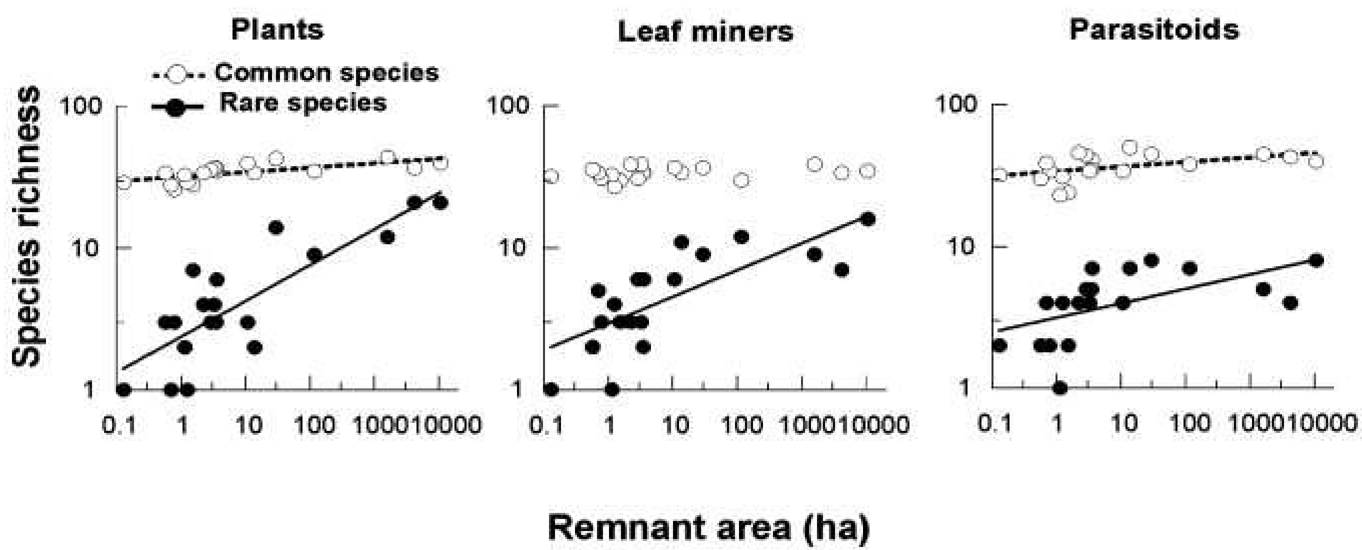


Fig. 2. The world's ongoing fragmentation experiments. All experiments have been running continuously since the time indicated by the start of the associated arrow (with the exception of the moss fragmentation experiment, which represents a series of studies over nearly two decades). The variables under study in each experiment are checked. The area is that of the experiment's largest fragments. Icons under "Fragment" and "Matrix" indicate the dominant community and its relative height, with multiple trees representing succession.

Fuente: Haddad et al. (2015) Science Advances 1: e1500052

Pérdida y fragmentación de hábitat

Plantas, minadores y parasitoides en fragmentos de Chaco Serrano, Córdoba



Luciano Cagnolo

Fuente: Cagnolo et al. (2009) Cons. Biol. 23: 1167-1175

Especies exóticas

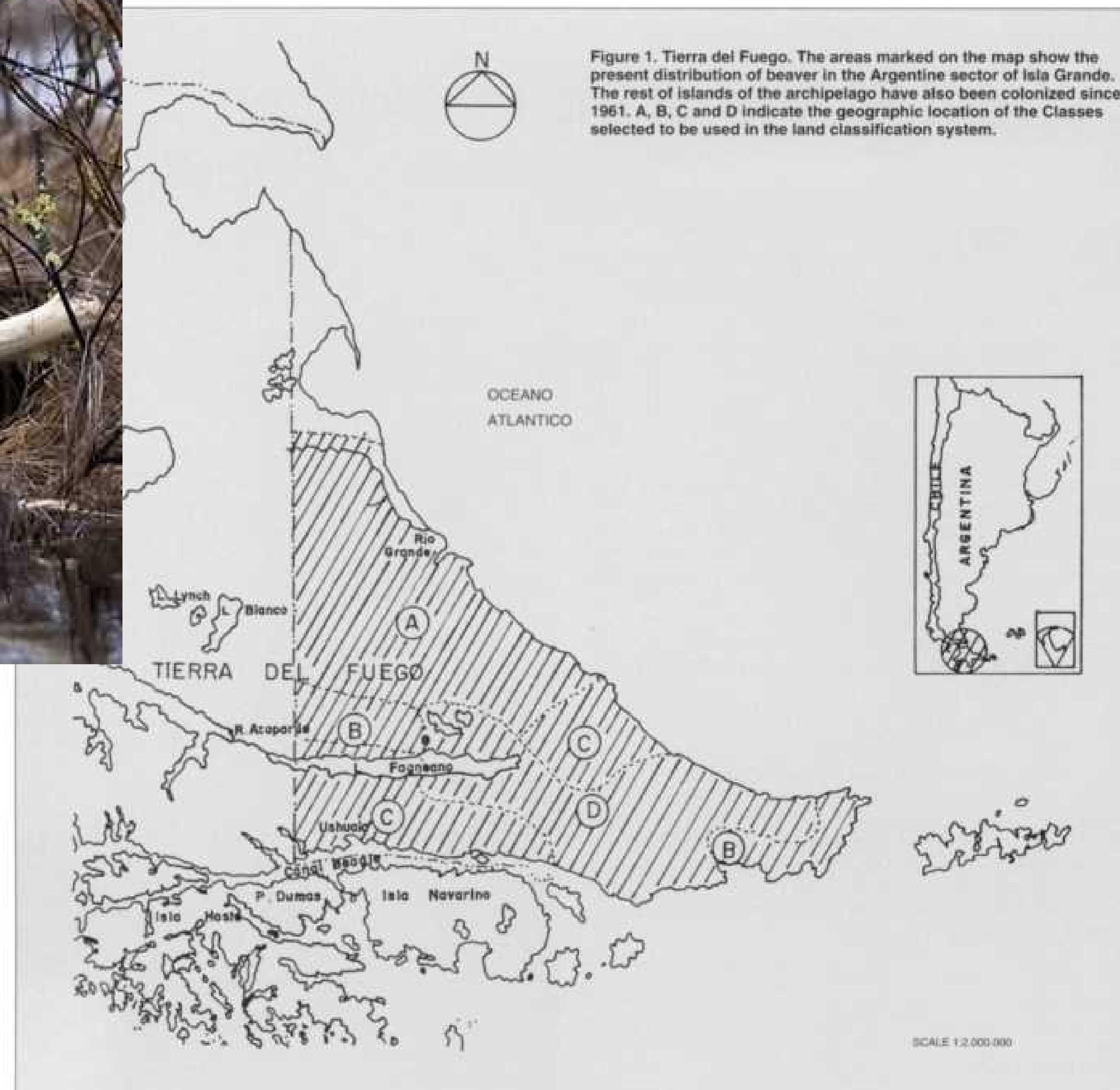


Figure 1. Tierra del Fuego. The areas marked on the map show the present distribution of beaver in the Argentine sector of Isla Grande. The rest of islands of the archipelago have also been colonized since 1961. A, B, C and D indicate the geographic location of the Classes selected to be used in the land classification system.

Fuente: Lizarralde (2003) Ambio 22: 351-358

Especies exóticas

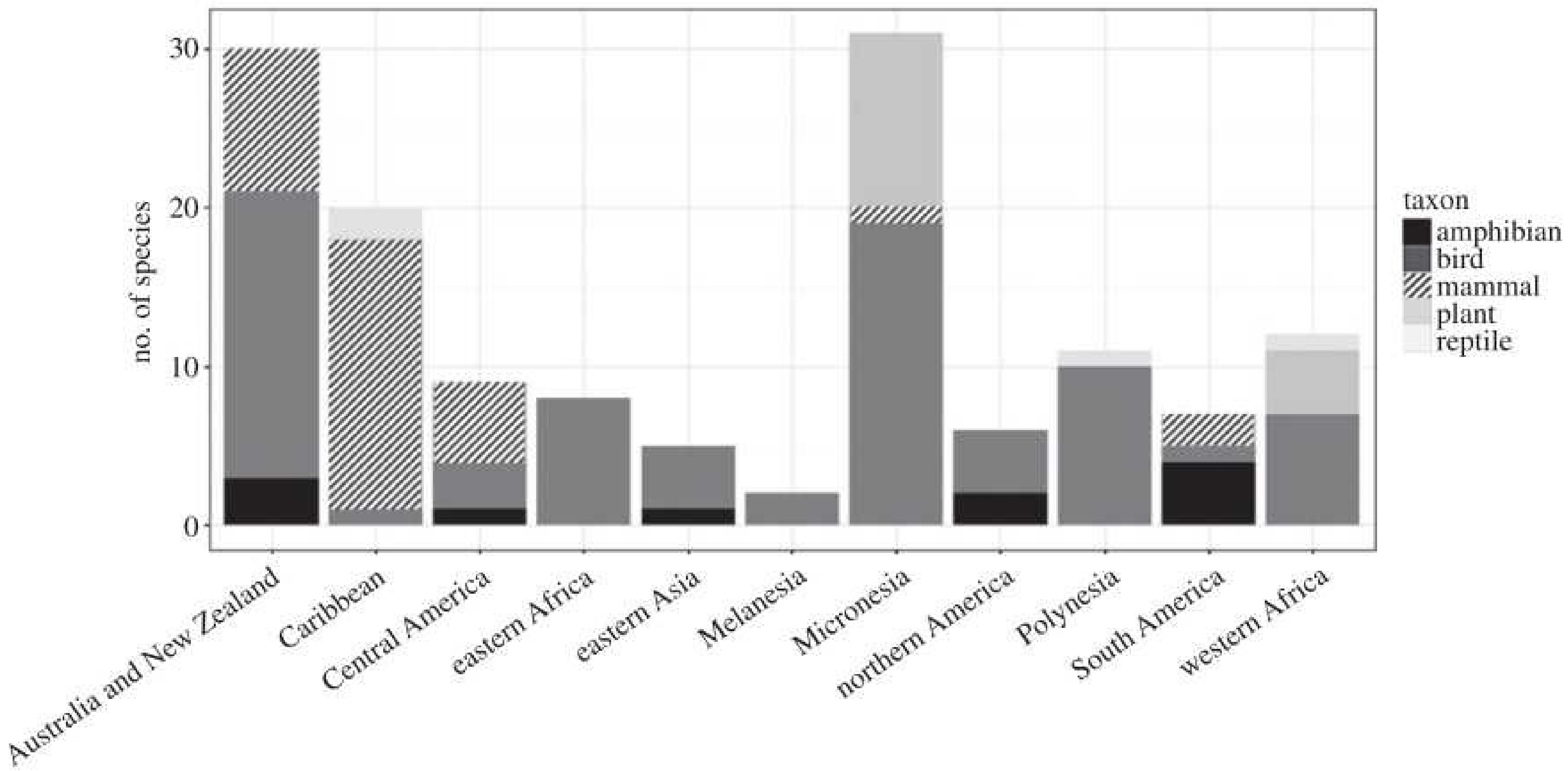


Figure 1. The locations of the (now lost) native ranges of the 134 extinct (EX + EW) species for which alien species are listed as a driver.

Fuente: Bellard et al. (2016) Biology Letters 12: 20150623

Especies exóticas

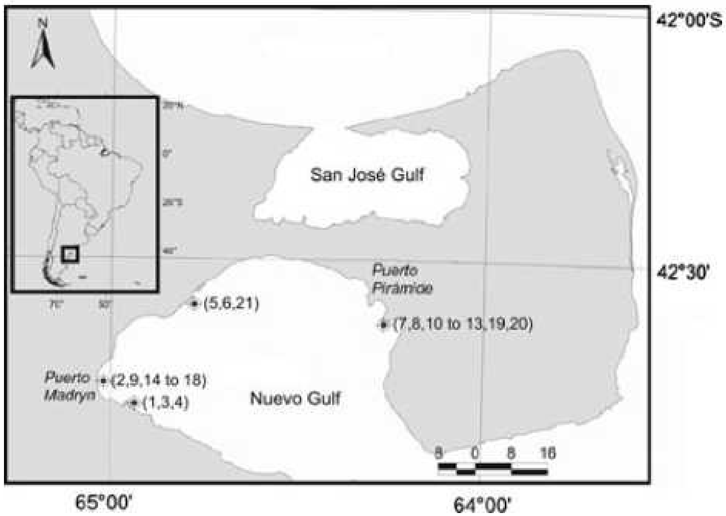


Fig. 1 *Left* South America. *Right* Valdes Peninsula. Censused reefs are numbered from 1 to 21; circles indicate four areas were reefs are distributed

Wakame
(*Undaria pinnatifida*)

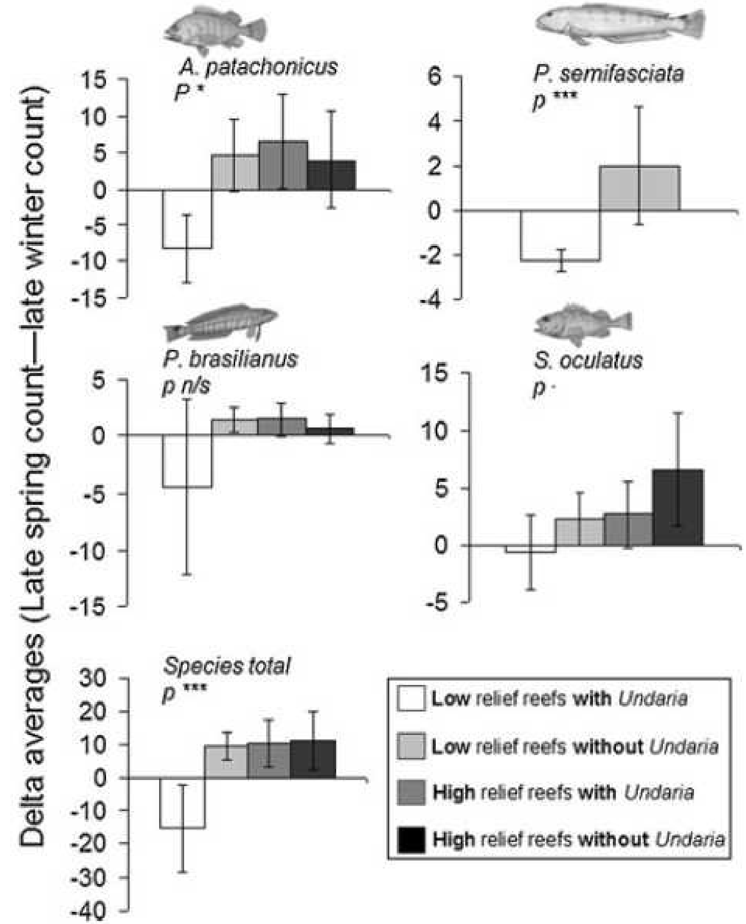


Fig. 3 Delta averages (± SD) between late-spring and late-winter counts of each species and of all species combined. *White bars* represent low-relief reefs with *Undaria*, soft grey represent low-relief reefs without *Undaria*, *gray bars* represent high-relief reefs with *Undaria* and *black bars* represent high-relief reefs without *Undaria*. Significance of the differences between low-relief reefs with *Undaria* and all the other combinations of factors is indicated by: • marginally significant, * significant, *** highly significant and n/s no significant ($P_{\alpha=0.05}$)

Fuente: Irigoyen et al. (2010) Biol. Cons.

Especies exóticas

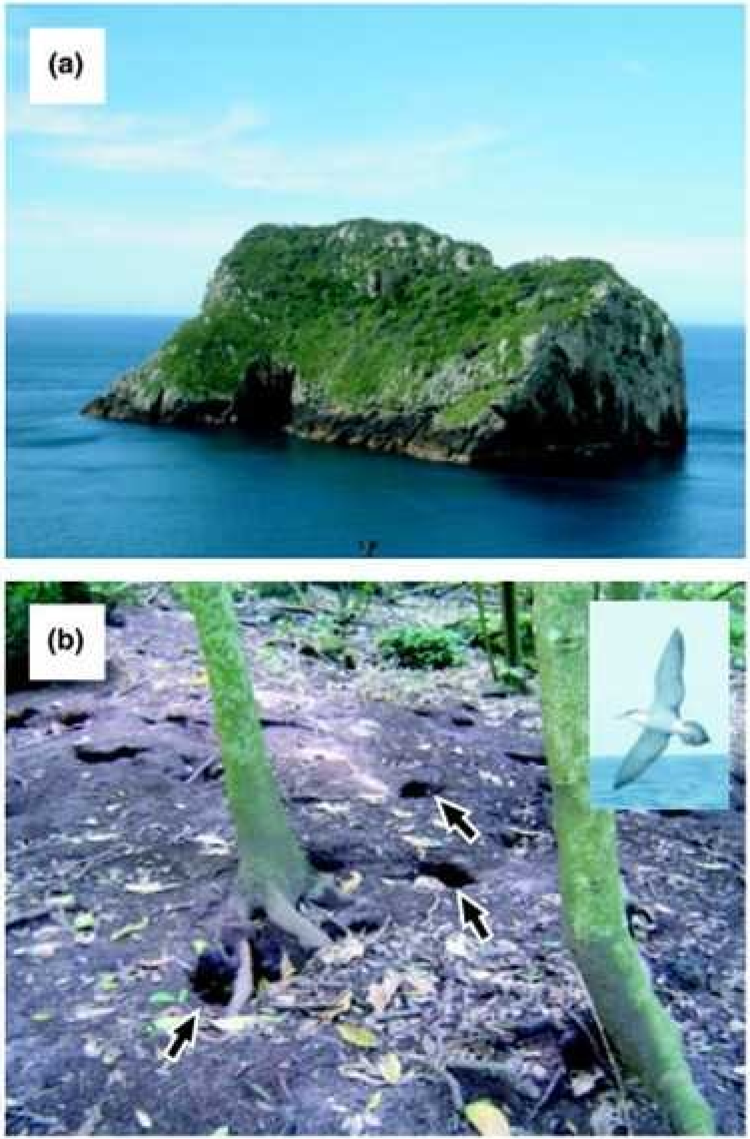


Figure 1 Study system. (a) Aorangaia (5.6 ha), a typical island used in this study. (b) Forest floor on Tawhiti Rahi, a rat-free island. (c) Forest floor on Aiguilles, a rat-invaded island. Rat-free islands are characterized by dense seabird burrows on forest floor (such as those of Buller's shearwater, *Puffinus bulleri*, shown in b). Burrow entrances are about 20–50 cm wide, some of which are indicated by arrows in (b). Rat-free islands are in sharp contrast to rat-invaded islands, where seabird burrows are virtually non-existent owing to rat predation of seabirds (c).

Rattus rattus

Rattus norvegicus

Fuente: Fukami et al. (2006) Ecology Letters 9: 1299-1307

Especies exóticas

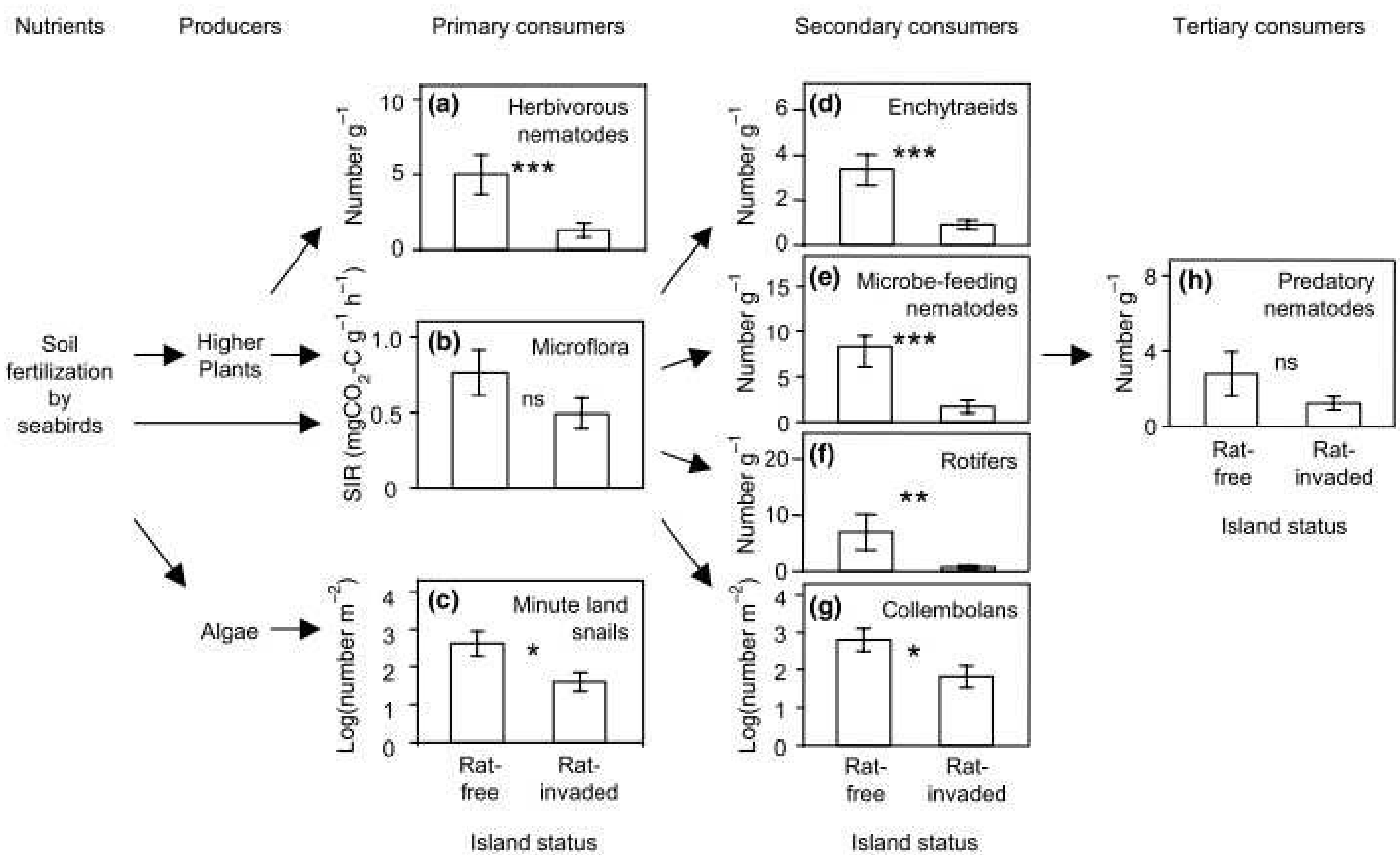


Figure 2 Response of belowground trophic groups to rat invasion of islands. Arrows indicate directions of nutrient flow (note that only a subset of the soil food web is shown). Results are shown as means ± SEM ($n = 9$ rat-free and 9 rat-invaded islands). * $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$; ns, non-significant; SIR, substrate-induced respiration in litter and soil.

Rattus rattus

Rattus norvegicus

Fuente: Fukami et al. (2006) Ecology Letters 9: 1299-1307

Contaminación

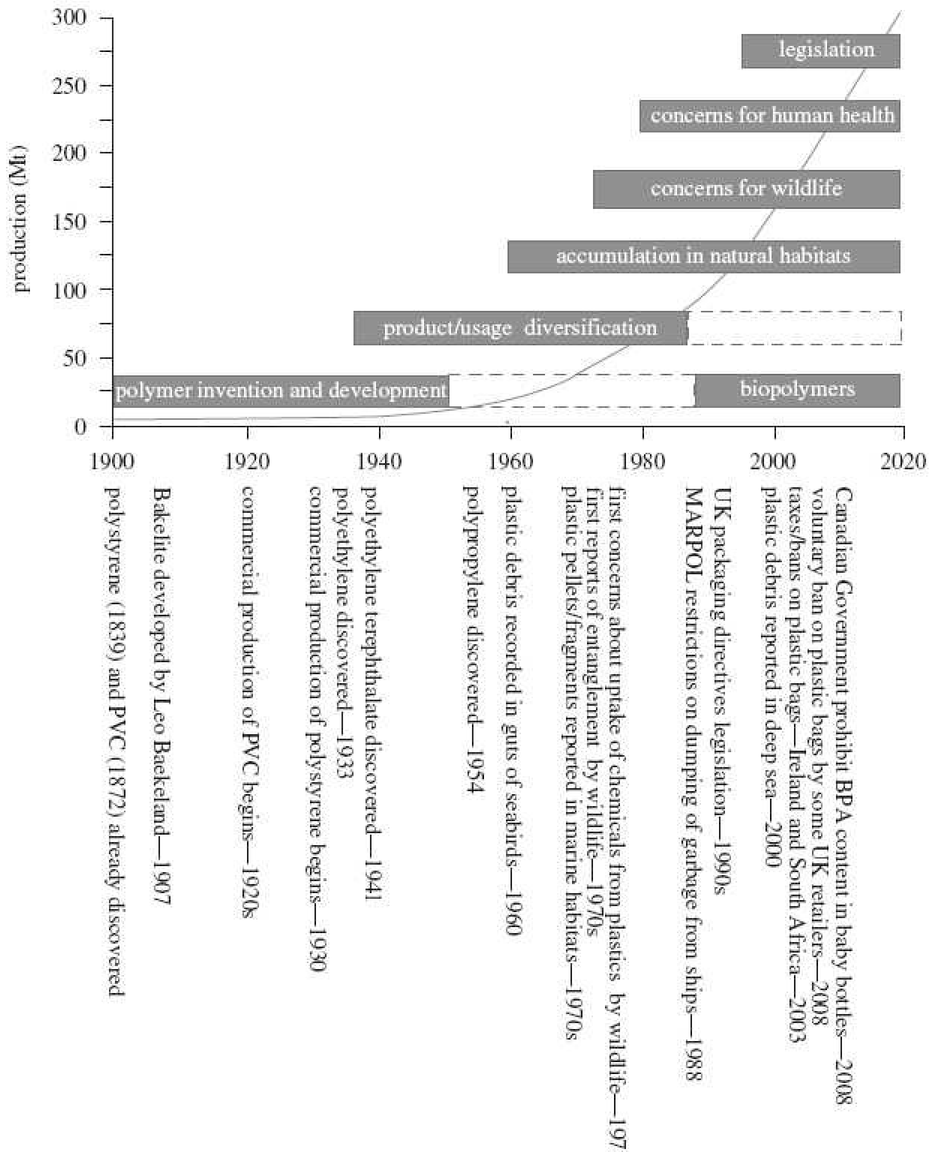


Figure 1. Summary illustrating historical stages in the development, production and use of plastics together with associated concerns and legislative measures (numerous sources). Solid red line shows plastic production in millions of tonnes (Mt). Reproduced with permission from APME (2006). BPA, bisphenol A; PVC, polyvinyl chloride.

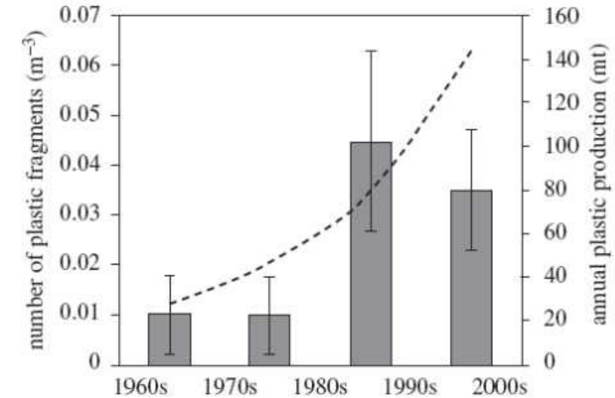


Figure 8. Microscopic plastic in surface waters, collected with continuous plankton recorder, revealed a significant increase in abundance when samples from the 1960s and 1970s were compared with the 1980s and 1990s ($F_{3,3} = 14.42$, $p < 0.05$). Global production of plastic overlain for comparison (APME 2006). Grey boxes, number of plastic fibres (m^{-3}); dashed line, plastic produced per year (million tonnes). (Reproduced with permission from Thompson *et al.* 2004.)

Figure 1. Debris (mainly plastic) collected during an annual beach clean at Mason Bay, South Island, New Zealand.

Fuente: Thompson et al., Barnes et al., Gregory (2009) Ph. Trans. R. Soc. B 364: 1985-

Contaminación

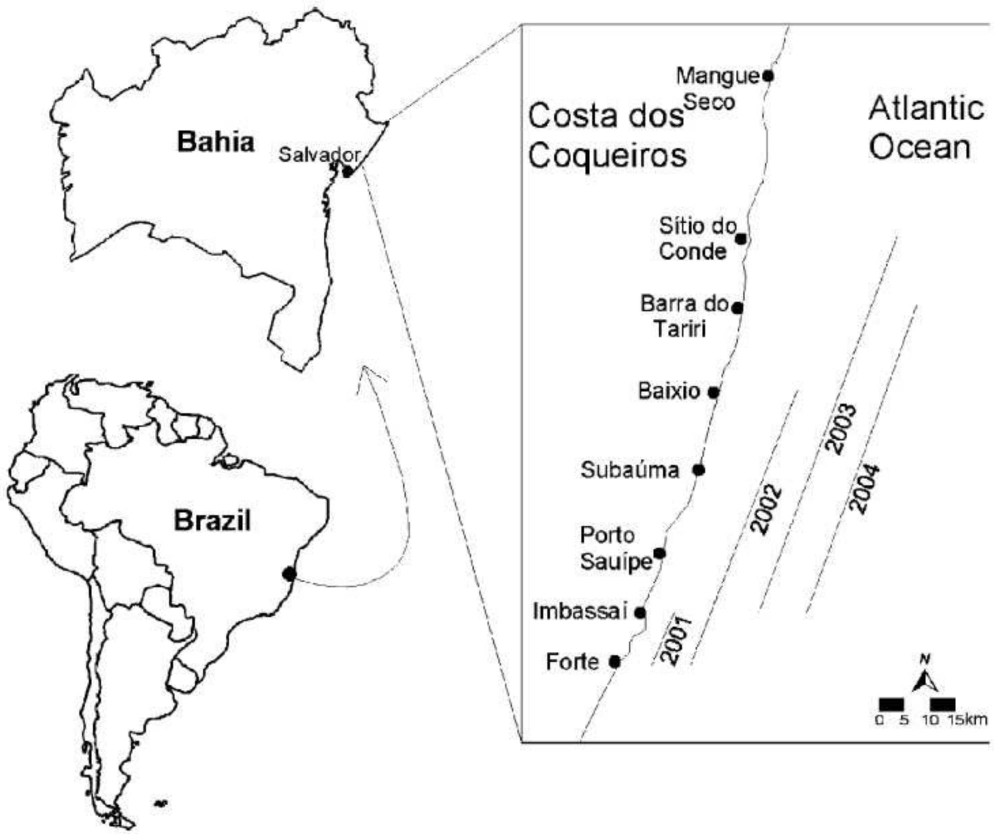


Fig. 1. Map of the study area and beach sectors sampled between 2001 and 2004.

Table 2
Percentage of original content of containers found on Costa dos Coqueiros beaches

Product	2001	2002	2003	2004	Total
Mineral water	22.3	37.9	30.5	38.2	35.3
Milk/juice	21.3	11.2	13.8	11.3	12.4
Cosmetics/toiletries	13.8	10.5	8.6	8.1	9.4
Household cleaners	16.0	10.7	14.2	9.9	11.6
Food	11.7	12.2	11.5	14.6	12.8
Insecticides	8.5	1.6	4.4	1.8	2.7
Soft drinks	3.2	4.9	6.9	6.7	5.9
Alcoholic drinks	0.0	1.2	2.9	1.3	1.6
Drugs	0.0	1.0	1.0	1.9	1.2
Lubricating oil	1.1	0.0	3.4	2.9	1.9
Others/not identified	2.1	8.6	2.7	3.3	5.1
Total	100	100	100	100	100

Table 3
Percentage of country of origin of containers found on Costa dos Coqueiros beaches

Country	2001	2002	2003	2004	Total
USA	10.6	13.7	14.8	8.6	12.2
Italy	3.2	9.6	3.8	9.2	7.6
South Africa	9.6	6.2	5.2	7.2	6.4
Argentina	5.3	4.2	5.2	8.9	6.0
Germany	8.5	5.9	5.7	4.6	5.6
United Kingdom	6.4	4.4	5.9	3.5	4.6
Taiwan	4.3	7.3	2.1	2.9	4.4
Singapore	0.0	1.4	5.7	5.1	3.6
Spain	4.3	4.0	3.6	3.0	3.6
Malaysia	3.2	2.9	1.9	4.5	3.1
Others	38.3	33.7	38.9	33.3	35.2
Unidentified	6.4	6.8	7.1	9.2	7.6
Total	100	100	100	100	100

Fuente: Santos et al. (2005) Mar. Poll. Bull. 50: 778-786

Contaminación

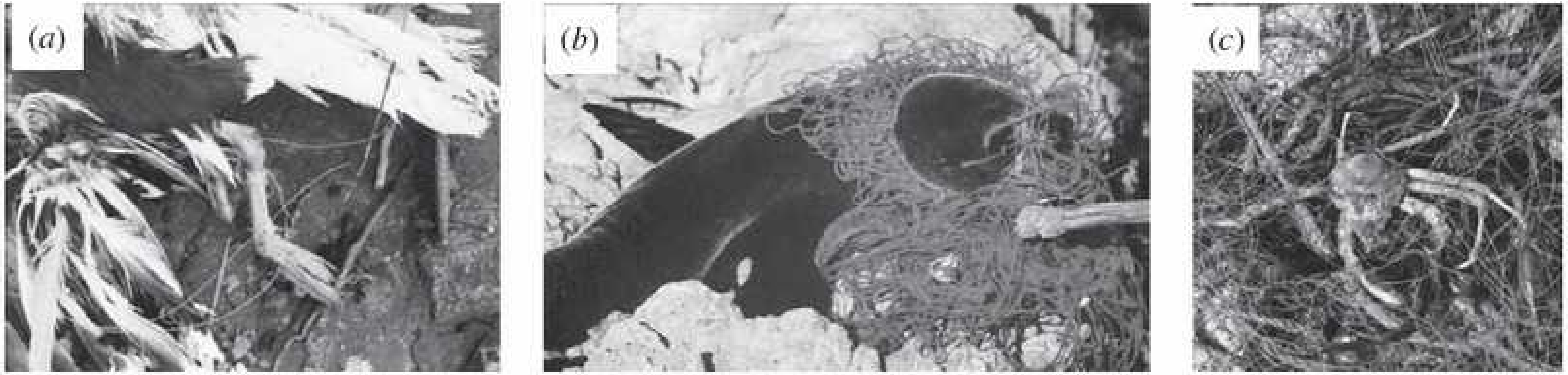


Figure 2. Examples of entanglement from New Zealand that draw immediate public sympathy and anger: (*a*) Karoro (southern black-backed gull, *Larus dominicanus*) caught and hooked in nylon filament fishing line; (*b*) a New Zealand fur seal trapped in discarded netting and (*c*) Ghost fishing—derelict fishing gear dredged from >100 m on the Otago shelf.

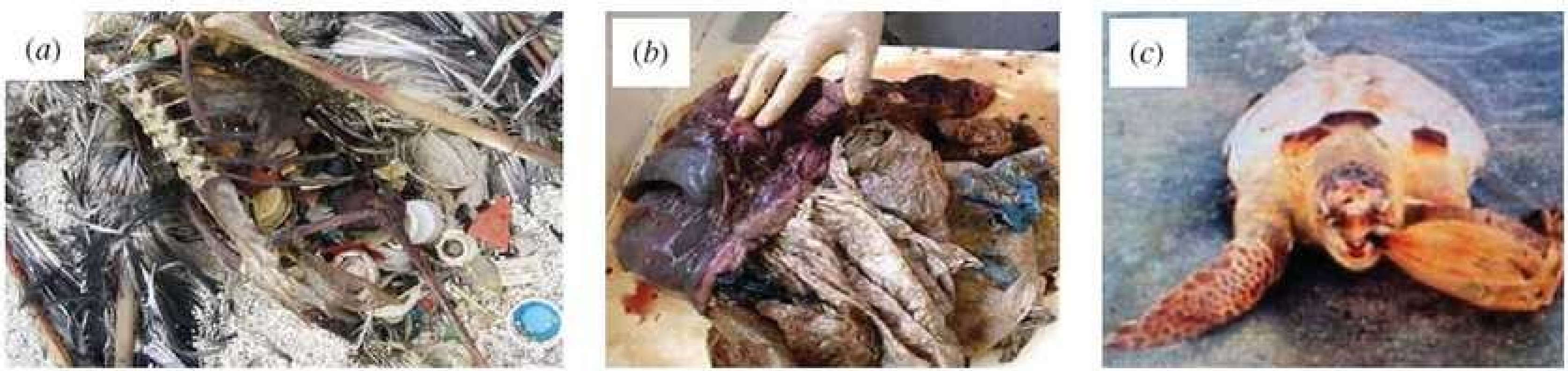


Figure 3. Examples of ingestion: (*a*) Laysan Albatross (*Phoebastria immutabilis*, at Kure Atoll, Courtesy of AMRF); (*b*) plastic from the stomach of a young Minke whale (*Balaenoptera acutorostrata*) that had been washed ashore dead in France (Courtesy of G. Mauger & F. Kerleau, Groupe d'Études de Cétacés du Cotentin GECC) and (*c*) stranded sea turtle disgorging an inflated plastic bag. One infers that it has been mistaken for an edible jellyfish (medusoid).

Fuente: Gregory (2009) Ph. Trans. R. Soc. B 364: 2013-2025

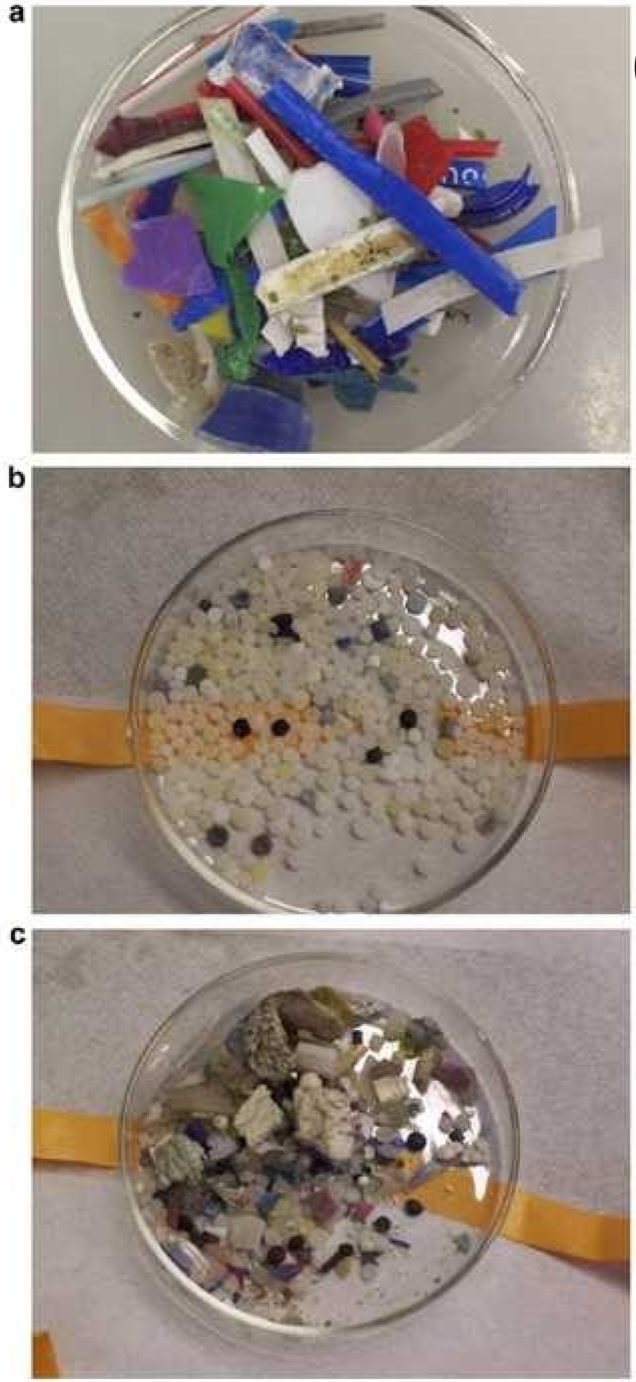


Fig. 2. Typical post-consumer plastic fragments and pre-production thermoplastic resin pellets from samples. (a) Plastic fragments, (b) plastic pellets, (c) mixed plastic (fragments and pellets).

Contaminación

Table 2
Persistent organic pollutants on samples from Beaches

Sample ID	∑PAH (ng/g)	∑PCBs (ng/g)	∑DDTs (ng/g)
Kamilo Beach (Hawaii)	nd	55	nd
Kualua Beach (Hawaii)	nd	nd	22
Tern Island (Hawaii)	500	70	nd
Tern Island II (Hawaii)	nd	980	nd
Albatross (Guadalupe Island, Mexico)	640	nd	nd
Hermosa Beach (California, USA)	nd	nd	140
Redondo Beach (California, USA)	1400	730	nd
Golden Shore Marine Reserve beach (California, USA)	1700	27	nd
San Gabriel River (1) (California, USA)	1200	nd	1100
San Gabriel River (2) (California, USA)	6200	nd	1000

nd, not detected at detection limit. Limit detection PCBs 0.02–0.15 ng/g, PAHs 0.05–0.8 ng/g and pesticides 0.03–2.03 ng/g.

Table 3
Persistent organic pollutants on samples from Industrial sites

Sample ID	∑PAH (ng/g)	∑PCBs (ng/g)	∑DDTs (ng/g)
CCHW1(a)	39	nd	nd
CCHW2 (a)	360	nd	nd
LB1311 (a)	150	nd	nd
LB1312 (a)	3900	nd	nd
LARHW1 (a)	1700	nd	nd
LARHW2 (a)	210	nd	nd
SB1309 a	1800	nd	nd
SB 1310 a	770	nd	170
Industry TRM-1	12,000	nd	1900
Industry TRM-2	88	nd	42
Industry TRM-3	74	nd	nd
Industry TRM-4	6100	nd	7100
Site No. 6-1	1800	nd	nd
Site No. 6-2	2600	nd	nd
Site No. 6-3	390	nd	nd
Surface sea water	9200	nd	nd

nd, not detected at detection limit. Limit detection PCBs 0.02–0.15 ng/g, PAHs 0.05–0.8 ng/g and pesticides 0.03–2.03 ng/g.

Fuente: Rios et al. (2007) Mar. Poll. Bull. 54: 1230-1237

Contaminación

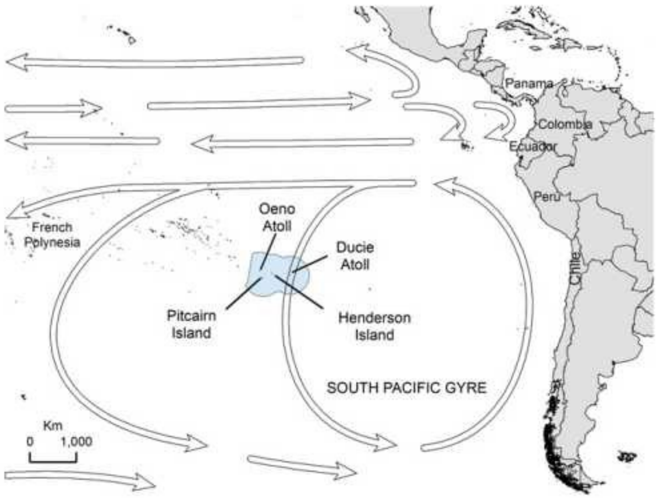


Fig. 1. The location of Henderson Island. The boundary of the Pitcairn Islands Exclusive Economic Area is shown in light blue. Arrows indicate the direction of major oceanic currents and the South Pacific Gyre.

Fig. 3. (*A*) Plastic debris on East Beach of Henderson Island. Much of this debris originated from fishing-related activities or land-based sources in China, Japan, and Chile (Table S5). (*B*) Plastic items recorded in a daily accumulation transect along the high tide line of North Beach. (*C*) Adult female green turtle (*Chelonia mydas*) entangled in fishing line on North Beach. (*D*) One of many hundreds of purple hermit crabs (*Coenobita spinosa*) that make their homes in plastic containers washed up on North Beach.

Fuente: Lavers & Bond (2017) PNAS

Contaminación

Tsunami-driven rafting: Transoceanic species dispersal and implications for marine biogeography

James T. Carlton,[1,2*] John W. Chapman,[3] Jonathan B. Geller,[4] Jessica A. Miller,[3] Deborah A. Carlton,[1] Megan I. McCuller,[1†] Nancy C. Treneman,[5] Brian P. Steves,[6] Gregory M. Ruiz[6,7]

The 2011 East Japan earthquake generated a massive tsunami that launched an extraordinary transoceanic biological rafting event with no known historical precedent. We document 289 living Japanese coastal marine species from 16 phyla transported over 6 years on objects that traveled thousands of kilometers across the Pacific Ocean to the shores of North America and Hawai'i. Most of this dispersal occurred on nonbiodegradable objects, resulting in the longest documented transoceanic survival and dispersal of coastal species by rafting. Expanding shoreline infrastructure has increased global sources of plastic materials available for biotic colonization and also interacts with climate change–induced storms of increasing severity to eject debris into the oceans. In turn, increased ocean rafting may intensify species invasions.

Fig. 1. Japanese tsunami marine debris rafts and associated biota. (**A**) Fisheries dock (JTMD-BF-1) (*4*) from the Port of Misawa, Aomori Prefecture, washed ashore 5 June 2012 on Agate Beach, near Newport, Lincoln County, Oregon (photograph by J. W. Chapman). (**B**) A fishing vessel (JTMD-BF-2), washed ashore at Ilwaco, Pacific County, Washington, 15 June 2012, heavily covered with the pelagic gooseneck barnacle *Lepas*; living Japanese fauna included barnacles, isopods, amphipods, and mussels (photograph by A. Pleus). (**C**) Japanese barred knifejaw fish *Oplegnathus fasciatus* in the stern well of the fishing vessel 斎勝丸 (*Sai-shō-Maru*) (JTMD-BF-40) from Rikuzen-takata, Iwate Prefecture, washed ashore 22 March 2013, on Long Beach Peninsula, Pacific County, Washington (photograph by A. Pleus). (**D**) Post-and-beam wood (JTMD-BF-297) from Tōhoku coast, Honshu, washed ashore 1 April 2013, at Bandon, Oregon, and heavily bored by the Japanese shipworm *Psiloteredo* sp. (photograph by N. C. Treneman). (**E**) Buoy (JTMD-BF-207), found floating inside the Charleston Boat Basin in Coos Bay, Coos County, Oregon, on 17 May 2014; living Japanese limpet *Siphonaria sirius* in center, next to dead Japanese oyster *Crassostrea gigas* (photograph by L. K. Rasmuson). (**F**) Buoy (JTMD-BF-216), washed ashore at Dunes City, Lane County, Oregon, with large foliaceous living colonies of the Japanese bryozoan *Biflustra grandicella* (photograph by A. Marohl).

Fuente: Carlton et al. (2017) Science 357: 1402-1406

Contaminación

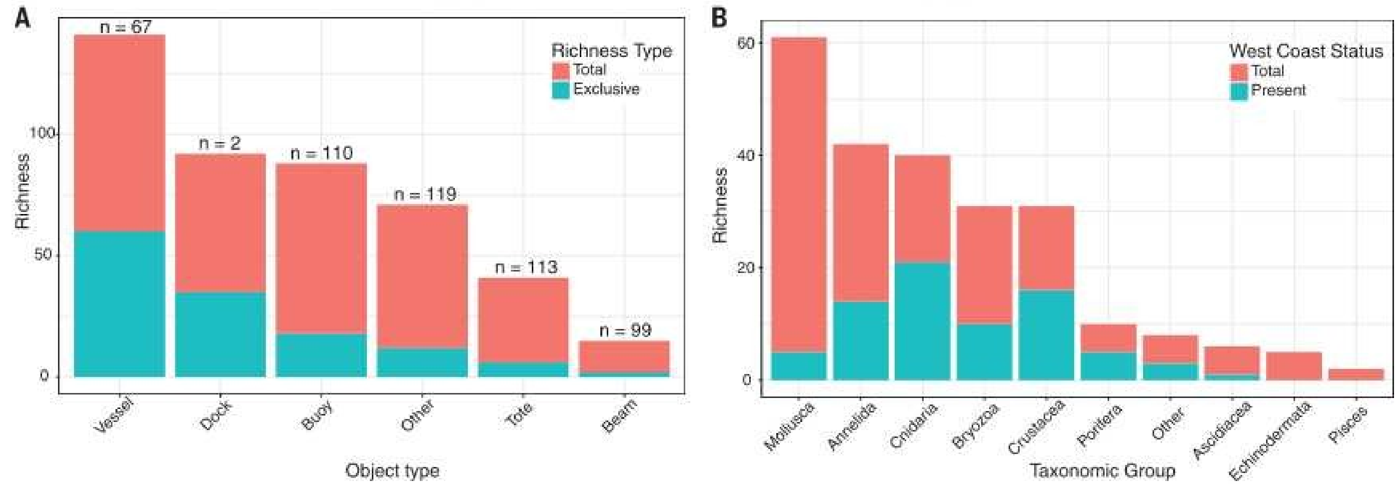


Fig. 3. Living Japanese macroinvertebrate and fish species richness by object type and taxonomic group. (**A**) Total richness by object type landing from Alaska to California and Hawai'i, as described in Fig. 2; number of species exclusive (unique) to a given object type are in blue; "n" is the number of objects in each category of the total 510 items (excluding 124 items on which only dead individuals or algae were documented). (**B**) Species diversity by taxonomic group. Number of species already present (due to natural distribution or previous introductions) on the west (Pacific) coast of North America is in blue. "Other" taxa are Nemertea, Sipuncula, Insecta (Diptera), Pycnogonida, Acarina, and Kamptozoa.

Fuente: Carlton et al. (2017) Science 357: 1402-1406

Sobreexplotación

Acopio de madera de algarrobo dulce (Prosopis flexuosa),
Estación del ferrocarril, Chepes, La Rioja, 1916

Sobreexplotación

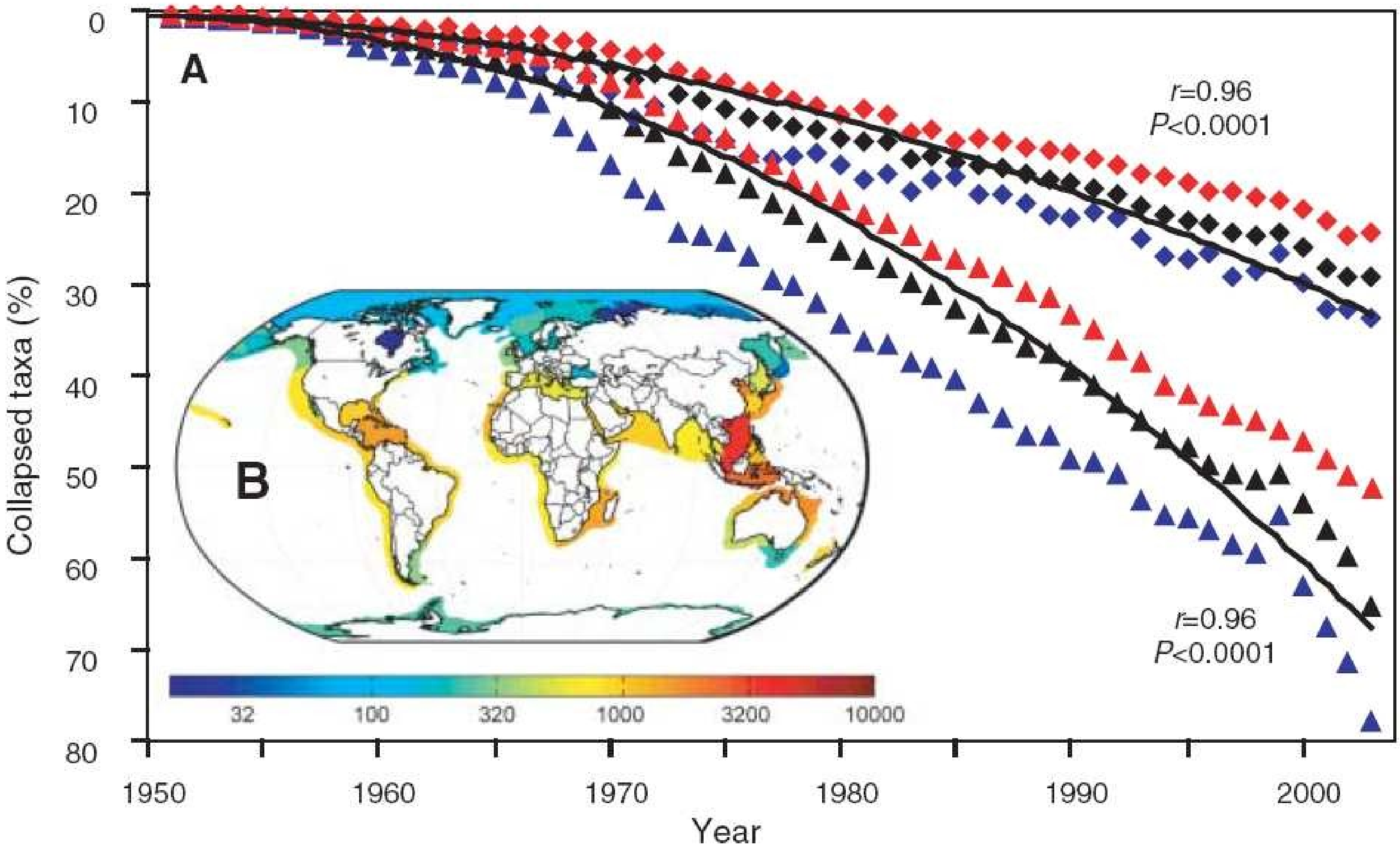


Fig. 3. Global loss of species from LMEs. (**A**) Trajectories of collapsed fish and invertebrate taxa over the past 50 years (diamonds, collapses by year; triangles, cumulative collapses). Data are shown for all (black), species-poor (<500 species, blue), and species-rich (>500 species, red) LMEs. Regression lines are best-fit power models corrected for temporal autocorrelation. (**B**) Map of all 64 LMEs, color-coded according to their total fish species richness. (**C**) Proportion of collapsed fish and invertebrate taxa, (**D**)

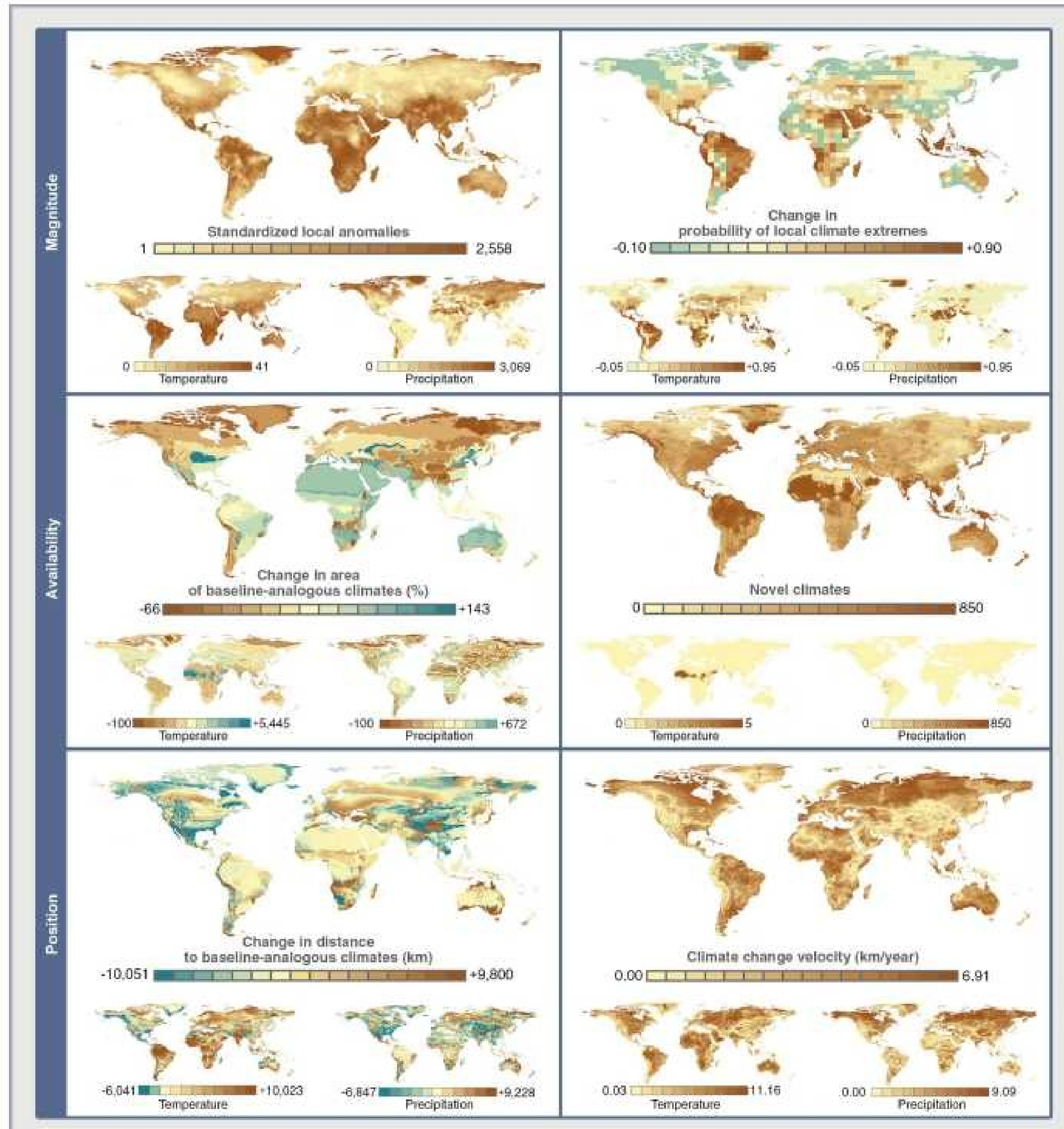
Fuente: Worm et al. (2006) Science 314: 787-790

Cambio climático

Políticos discutiendo sobre el cambio climático, Berlín

Cambio climático

Fig. 1. Projected global climate change according to six metrics. The maps show projections of change in mean annual temperature and total annual precipitation between the baseline and an end-of-century multimodel ensemble under the A1B emissions scenario (*120*). The metrics illustrated characterize three dimensions of climate change: the magnitude of local changes in average or extreme climates [standardized climate anomalies (*23*) and change in the probability of extreme climates (*117*)], changes in the regional availability of climatic conditions [change in area of analogous climates (*34*, *118*), and novel climates (*23*)], and regional shifts in the position of climatic conditions [change in distance to analogous climates (*34*, *118*), and climate change velocity (*9*, *16*)]. Among the several methodologies available to compute these metrics (table S1), we selected methodologies that are commonly used. Pairwise spatial correlation between these metrics was significant but generally low (table S2). In each panel, the main maps show changes for temperature and precipitation combined, and the smaller maps show changes for each climate parameter individually. The scales were defined using quantiles and reflect a gradient from small changes (light brown shades) to large changes (dark brown shades), or from favorable changes (blue shades) to adverse changes (brown shades). Local anomalies, novel climates, and climate change velocity values were converted to logarithmic scale for visualization. See figs. S1 and S2 for analysis of sensitivity to alternative climate models.



Fuente: García et al. (2014) Science 344: 1247579

Cambio climático

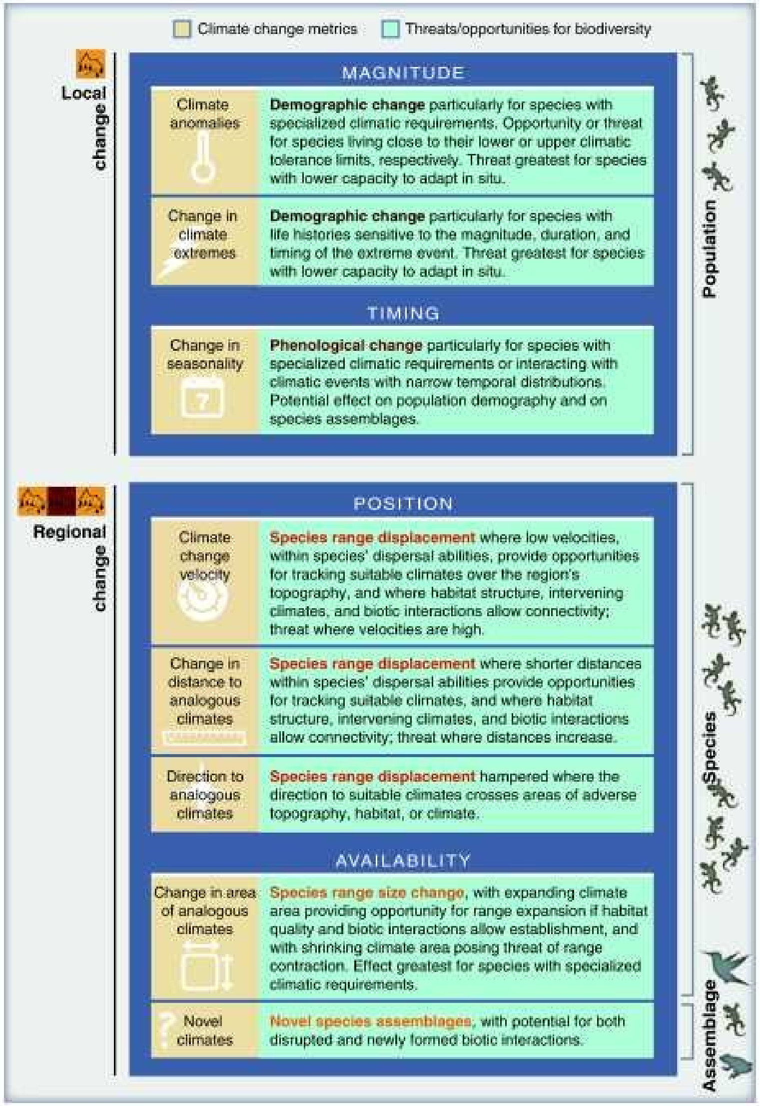


Fig. 3. Metrics of climate change and associated threats and opportunities for species. Metrics of climate change are grouped into four dimensions of change, and they either quantify changes at local (locality) level or at regional (set of localities) level (see Box 1). Links are established between metrics and potential threats and opportunities for population dynamics, species occurrence, and species assemblages.

Fuente: García et al. (2014) Science 344: 1247579

Cambio climático

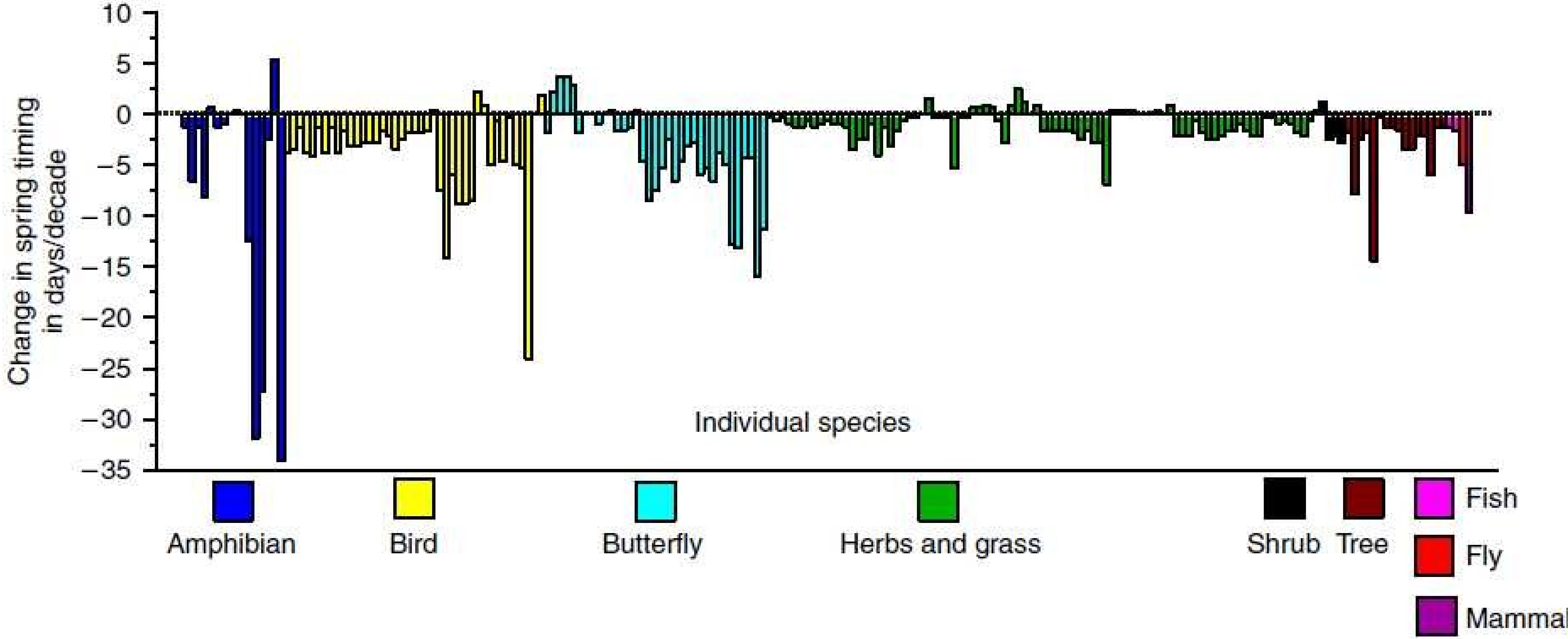


Fig. 2 Changes in timing of spring events in days decade^{-1} for individual species grouped by taxonomy or functional type for the combined dataset. Each bar represents a separate, independent species. Negative values indicate advancement (earlier phenology through time) while positive values indicate delay (later phenology through time).

Fuente: Parmesan (2007) *Global Change Biology* 13: 1860-1872

Cambio climático

THE ROYAL SOCIETY

Proc. R. Soc. Lond. B (1998) 265, 1867–1870
Received 22 May 1998 Accepted 1 July 1998

Warmer springs lead to mistimed reproduction in great tits (*Parus major*)

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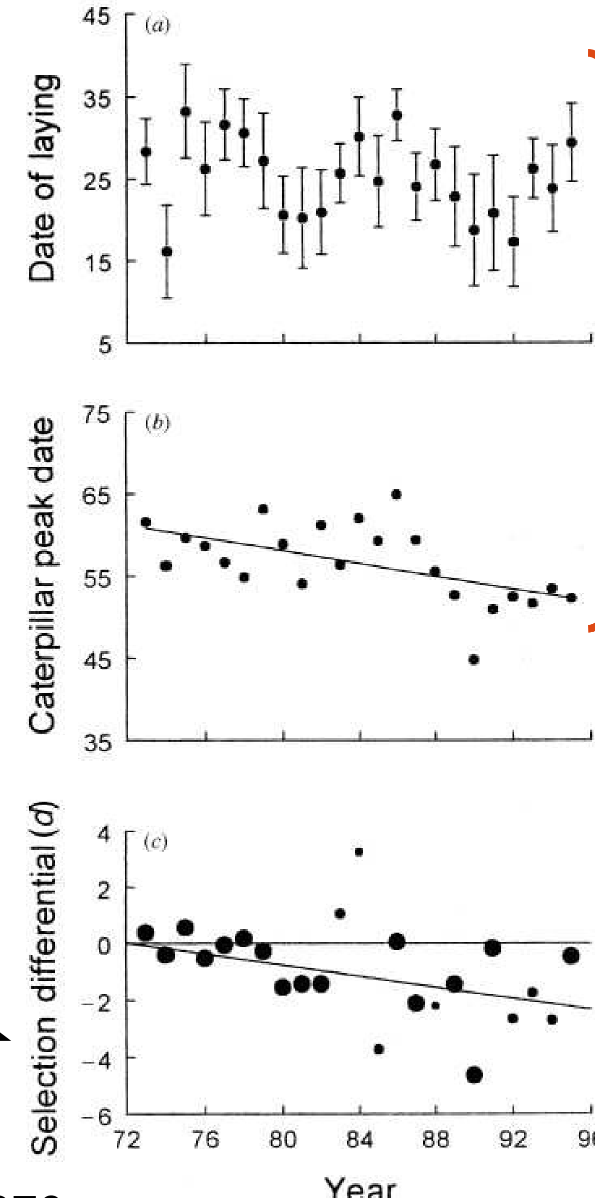
[2] *Zoological Laboratory, Groningen University, PO Box 14, 9750 AA Haren, The Netherlands*

Great tit (*Parus major*)

Consequences of mismatch for the bird
(negative values mean negative consequences)



Increasing mismatch

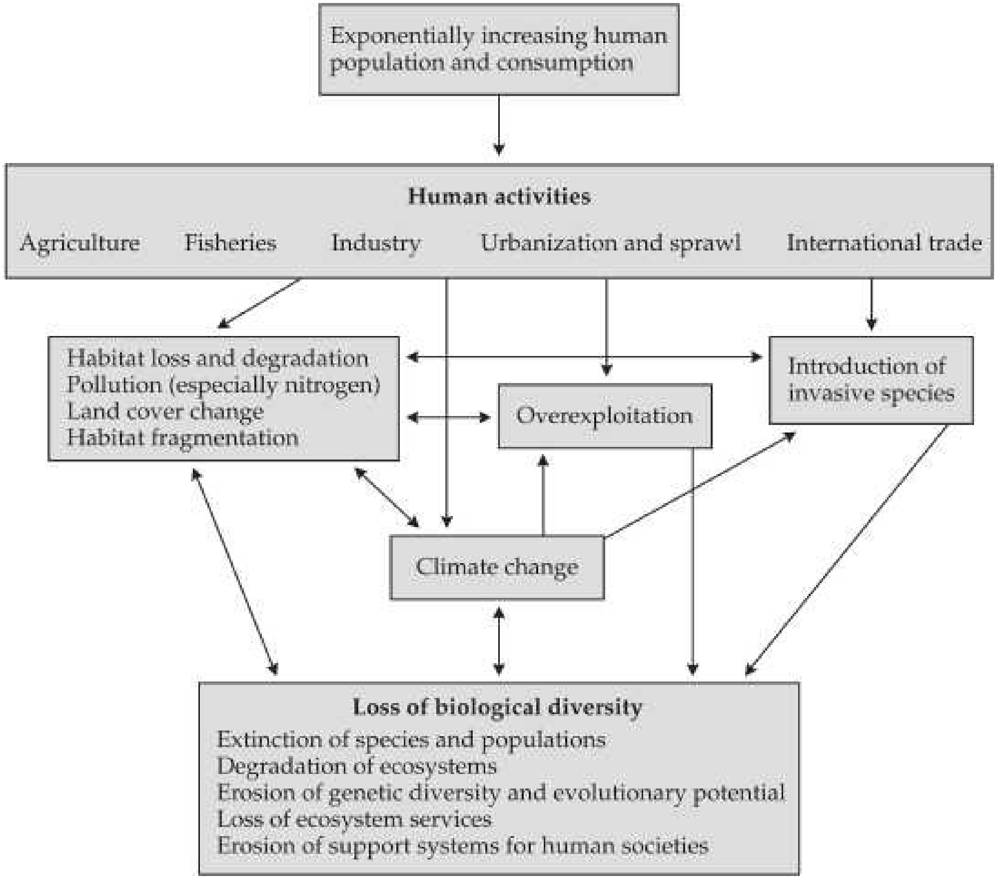
Fuente: Visser et al. (1998) Proc. R. Soc. B 265: 1867-1870

Esquema de la charla

- La historia del dodo.
- La amenaza de extinción en números.
- Principales factores de amenaza a la extinción de las especies.
- Interacciones entre factores de amenaza.

Principales factores de amenaza y sus interacciones

Figure 3.1 Major forces that threaten biological diversity. All arise from increases in human population and consumption levels, often mediated through our activities on the land and sea. Extinction and severe ecosystem degradation generally result from multiple impacts and from synergistic interactions among these threats.



Fuente: Groom et al. (2006) Principles of Conservation Biology, Sinauer

Principales factores de amenaza y sus interacciones

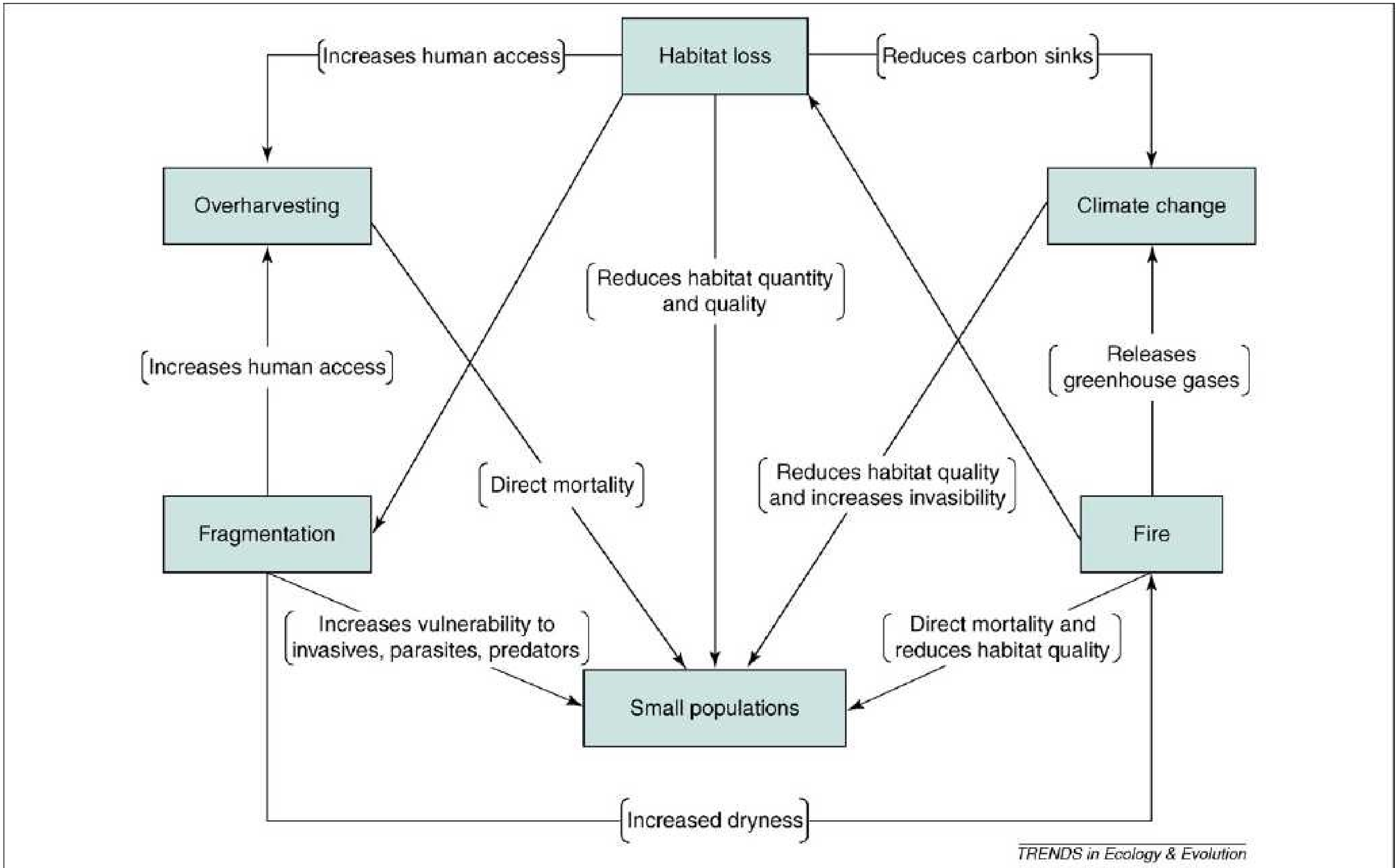


Figure 3. An example of the synergistic feedbacks which threaten species in disturbed tropical rain forests [1,20,28,55].

Fuente: Brook et al. (2008) TREE 4: 453-460

Efectos en cascada

Ecological Meltdown in Predator-Free Forest Fragments

John Terborgh,[1*] Lawrence Lopez,[2] Percy Nuñez V.,[3] Madhu Rao,[4,5] Ghazala Shahabuddin,[6] Gabriela Orihuela,[7] Mailen Riveros,[8] Rafael Ascanio,[9] Greg H. Adler,[11] Thomas D. Lambert,[10] Luis Balbas[12]

SCIENCE VOL 294 30 NOVEMBER 2001 1923

Table 2. Tree species diversity and density of saplings and mature leaf-cutter ant colonies on medium and large Lago Guri landmasses.

Parameter	Landmass								
	Medium				Large				
	Ambar	Chota	Lomo	Pano	DM-15	DM-12	Grande	TF-1	TF-2
Area (ha)	8	5	11	12	350	350	150	∞	∞
No. tree species per 300 stems ≥ 10 cm DBH	63	42	49	51	50	55	46	51	50
No. stems ≥ 1 m tall, <1 cm DBH/500 m^2	214	311	375	236	304	–	379	340	–
No. leaf-cutter colonies	2	1	2	2	=4	≥4	≥2	–	–
No. leaf-cutter colonies/ha	0.25	0.20	0.18	0.17	=0.01	≥0.01	≥0.01	≤0.04	≤0.04

Efectos en cascada

Mesopredator release and avifaunal extinctions in a fragmented system

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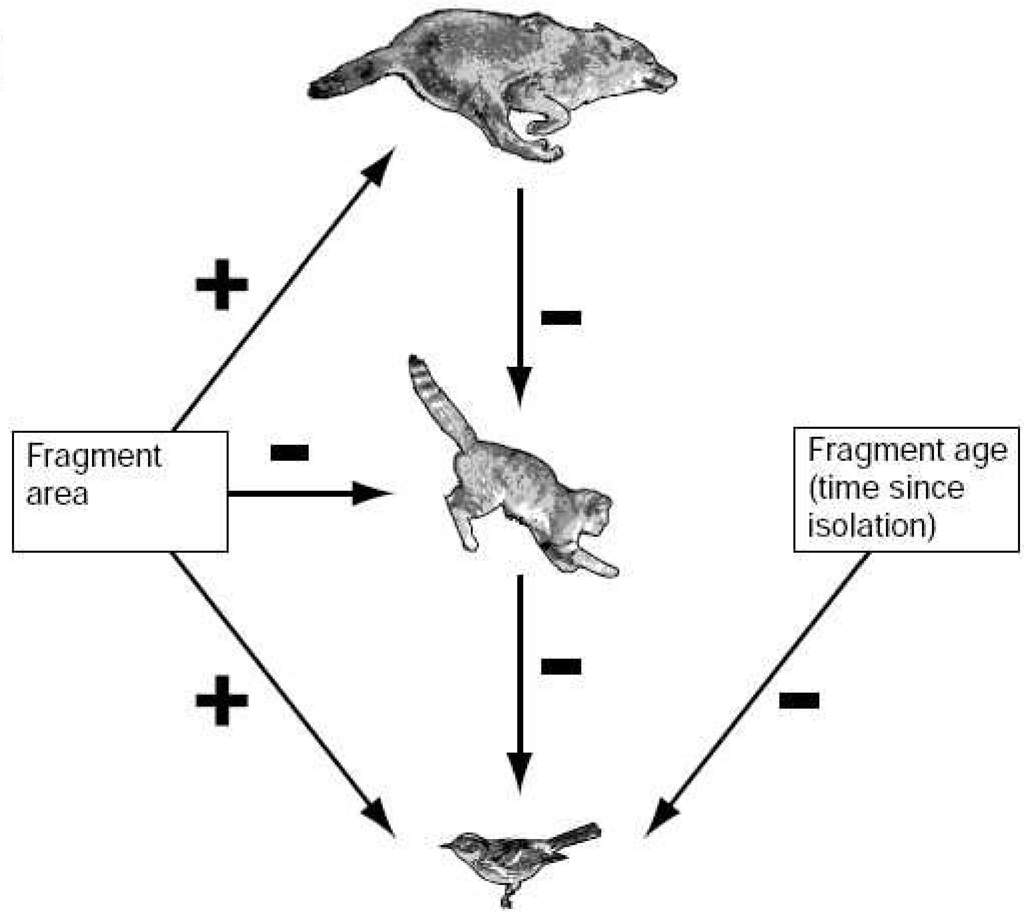

Figure 1 Model of the combined effects of trophic cascades and island biogeographical processes on top predators (for example, coyote), mesopredators (domestic cat) and prey (scrub-breeding birds) in a fragmented system. Direction of the interaction is indicated with a plus or minus.

Resumen de la charla

- La causa última de la extinción en la rareza.
- Las tasas de extinción actuales son sustancialmente superiores a las prehistóricas.
- Los principales factores de amenaza de extinción de las especies son la destrucción del hábitat, la sobreexplotación, las especies exóticas, la contaminación y el cambio climático.
- Los factores de amenaza de interactúan entre sí de manera compleja.