SYSTEMATIC MAP | Open Access

Existing evidence on the outcomes of wildlife translocations in protected areas: a systematic map

Joseph Langridge, Romain Sordello* and Yorick Reyjol

Biological Conservation

Nature strikes back: biodiversity recovery after forest management abandonment in the world's boreal, temperate, and Mediterranean forests. An evidence-based approach

Joseph Langridge, Sylvain Delabye, Olivier Gilg, Yoan Paillet, Yorick Reyjol, Romain Sordello, Julien Touroult, Frédéric Gosselin

"Under review"

Webinar III: Wildlife translocation and Forest management abandonnement as conservation measures in the face of climate change

Joseph Langridge, Scientific project officer « systematic reviews and syntheses »

The French Foundation for Biodiversity Research

EUROPARC FEDERATION

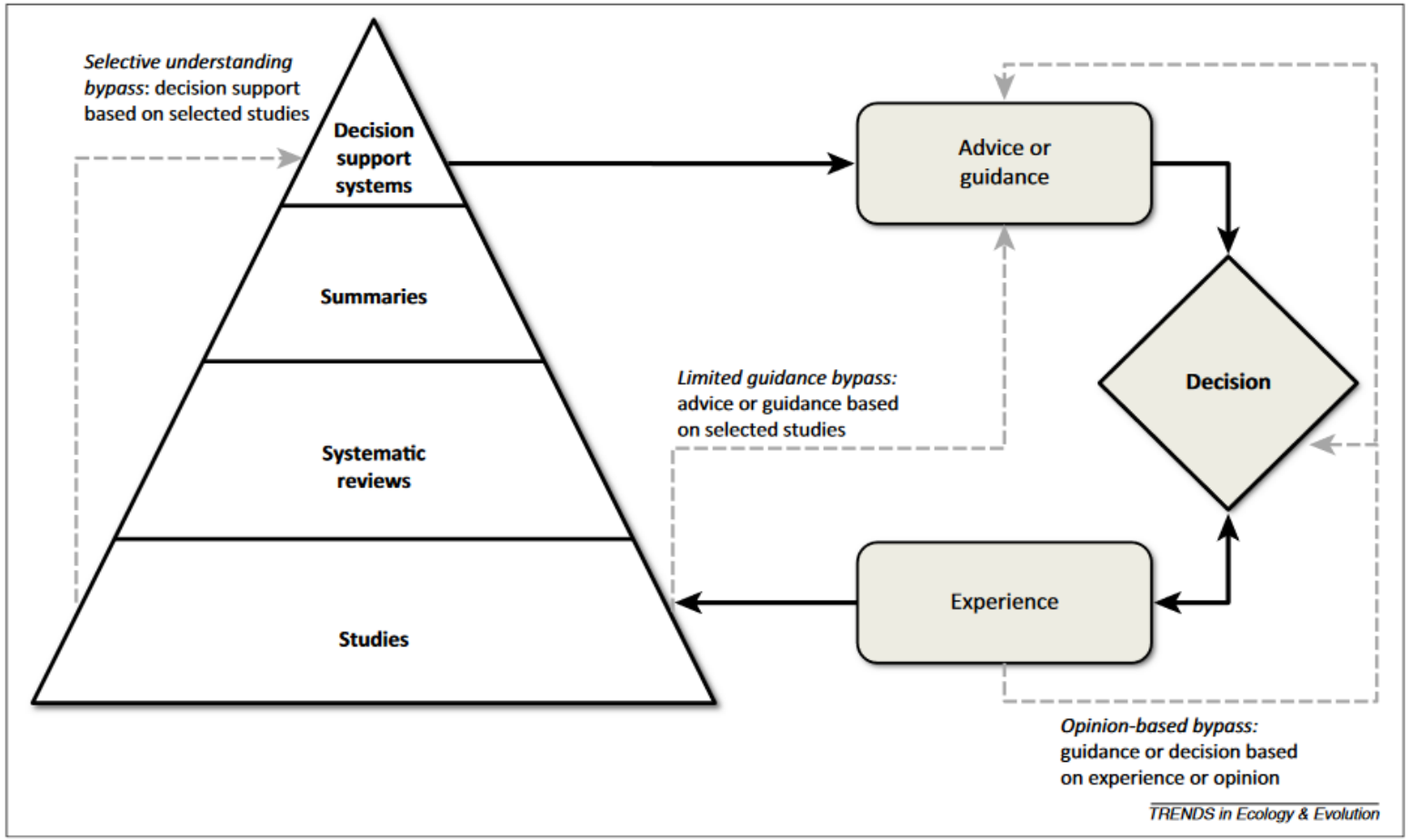
❖ **Need for knowledge transfer from research to stakeholders, managers, decision-makers etc.**

Biodiversity crisis => need to take informed decisions (management, strategy, ...) Decisions should be based on scientific knowledge (i.e. 'evidence-informed conservation').

However,

- A growing body of literature: how to deal with this mass in a objective and exhaustive way?
- Sometimes contradictory results across primary studies: how to distinguish the general trend from the specific case?
- 'Operational actors' who may make little use of research work: evidence syntheses ensures quality/robust knowledge transferred to managers, helping to inform their decision-making.

- **Summaries** integrate evidence from studies and systematic reviews
- **Environmental decisions** are based on the best-available evidence, combined with the expertise and local knowledge of the practitioner or policymaker ('Experience' box)



Source: Dicks *et al*. (2014) *Trends in Ecology and Evolution* **29**, 607-613. https://www.cell.com/trends/ecology-evolution/fulltext/S0169-5347(14)00199-2





A worldwide systematic map of species translocations involving protected areas





Stakeholder engagement

The project “Natur’Adapt”, a **European LIFE programme** coordinated by the French Nature Reserves Network (RNF)

<u>Formulating the question and subject</u> :
The selection of the evidence synthesis subjects was made in cooperation with :

- RNF coordination team,
- The French Natural History Museum (FR acronym : MNHN), Paris,
- Reserve managers of the pilot sites

- **Translocation** was chosen as it was considered **a necessary conservation action plan**.
- After **numerous discussions** (meetings, round tables,…), a systematic map was chosen as a central reference tool.

Coordinateur du projet

Réserves Naturelles de France

Grâce au soutien financier de

Fondazione Capellino

Contact : naturadapt@rnfrance.org / 03.80.48.91.00

Partenaires engagés dans le projet

EUROPARC FEDERATION · Muséum National d'Histoire Naturelle · Tela Botanica · LPO · AGIR pour la BIODIVERSITÉ · Asters Conservatoire d'espaces naturels Haute-Savoie · Réserves Naturelles CATALANES · Parc naturel régional du Morvan · Parc naturel régional des Volcans d'Auvergne · Petite Camargue Alsacienne

Financeurs du projet

Life · Ministère de la Transition écologique (Liberté Égalité Fraternité) · OFB Office français de la biodiversité

Objectives of the Map

A catalogue of evidence :

Synthesizing all existing outcomes of **wildlife translocations** (animals, plants, fungi) carried out in the context of protected areas.

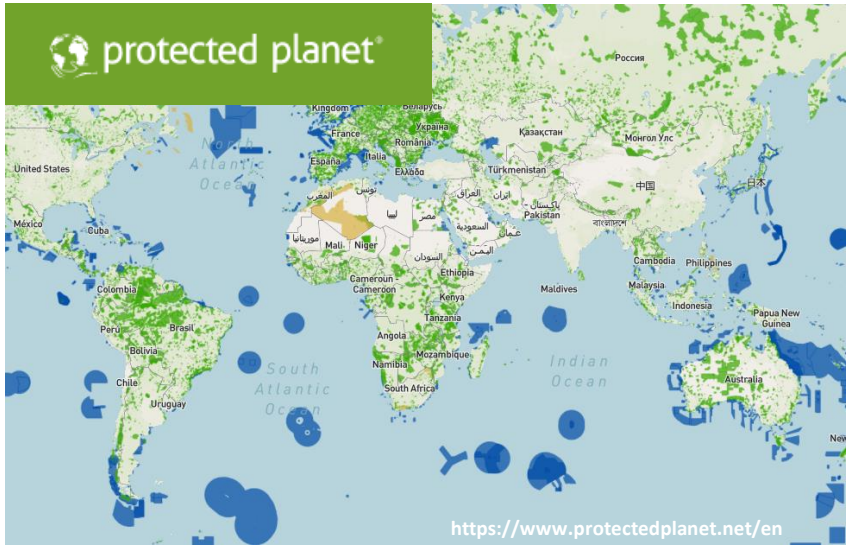
What type of translocations :

- **Supplementation** = “the intentional manual transfer/movement and release of an organism into the existing distribution of a population of conspecifics” (IUCN, 2013)*
- **Reintroduction** = “the intentional manual transfer/movement and release of an organism inside its indigenous range/historical distribution but from which it has disappeared […]” (IUCN, 2013)*
- **Introduction** = “intentional manual transfer/movement and release of an organism outside of its indigenous range/historical distribution” (IUCN, 2013)*

Source and release sites :

❖ **All** types of Protected Areas (PA) considered, définitions according to the IUCN :

Strict reserves for the protection of nature (Ia)
Wilderness areas (Ib)
National Parks (II)
Natural monuments (III)
Management areas (IV)
Protected landscapes (V)
Protected areas with sustainable use of natural resources (VI)



* Citation: IUCN. Guidelines for reintroductions and other conservation translocations. IUCN; 2013. https://portals.iucn.org/library/node/10386

Worldwide results

841 translocation operations were catalogued in this Evidence Map, from 1969 to 2020 (498 publications) !

- They concern animals (81.5%), plants (17.5%), and fungi (1%)

- For Animals, in total, at least **140,000 individuals** have been manually relocated (through 686 translocation operations), from 1969 to 2020. This includes :
  - >70,000 mammals (through 383 operations)
  - >13,000 birds (175 operations)
  - > 14,000 fish (28 operations)

- For plants and fungi, in total, at least **60,000 individuals** have been manually relocated (through 155 translocation operations).
  - >50,000 Magnoliopsida sp. individuals (125 operations)
  - >2000 Liliopsida. sp individuals (16 operations)

Citation: Langridge, J., Sordello, R., Reyjol, Y., 2021. Existing evidence on the outcomes of wildlife translocations in protected areas: a systematic map. Environ. Evid. 10, 29. https://doi.org/10.1186/s13750-021-00236-w

What were the motivations for translocating species ?

Taxonomic kingdom X Programme motivation	Intervention type						
	Intro+suppl	Introduction	Reintro+suppl	Reintroduction	Supplementation	Unknown	Total
Animalia	**6**	**6**	**176**	**158**	**158**	**182**	**686**
Conservation (improving status of focal species)	6	4	158	123	110	88	489
Experimental or trial translocations		1	4	12	13	16	46
Human-wildlife conflict				5	11	17	33
Rewilding (restoring natural functions)			3	3		2	8
Unknown		1	9	11	9	33	63
Wildlife rescue operation			2	4	15	26	47
Fungi				**4**	**3**		**7**
Wildlife rescue operation				4	3		7
Plantae		**4**	**10**	**11**	**41**	**82**	**148**
Conservation (improving status of focal species)		3	10	9	39	72	133
Experimental or trial translocations		1		2	2	5	10
Unknown						1	1
Wildlife rescue operation						4	4
Total	**6**	**10**	**186**	**173**	**202**	**264**	**841**

Largely motivated by conservation i.e. increasing population numbers

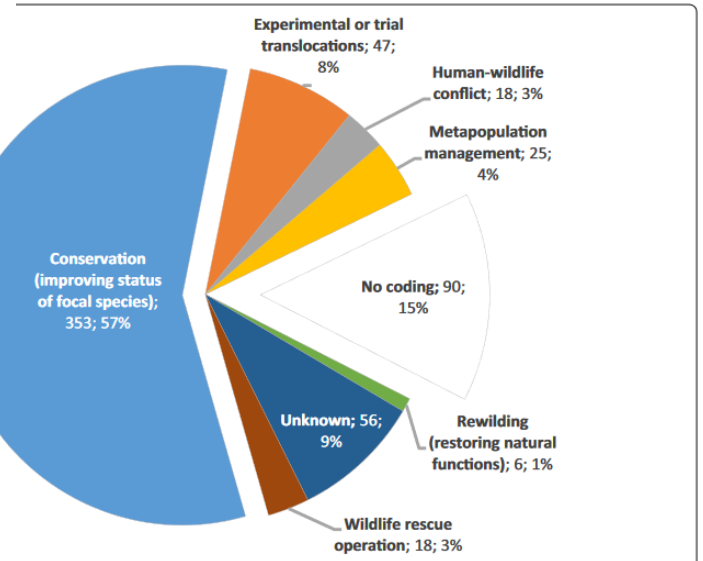
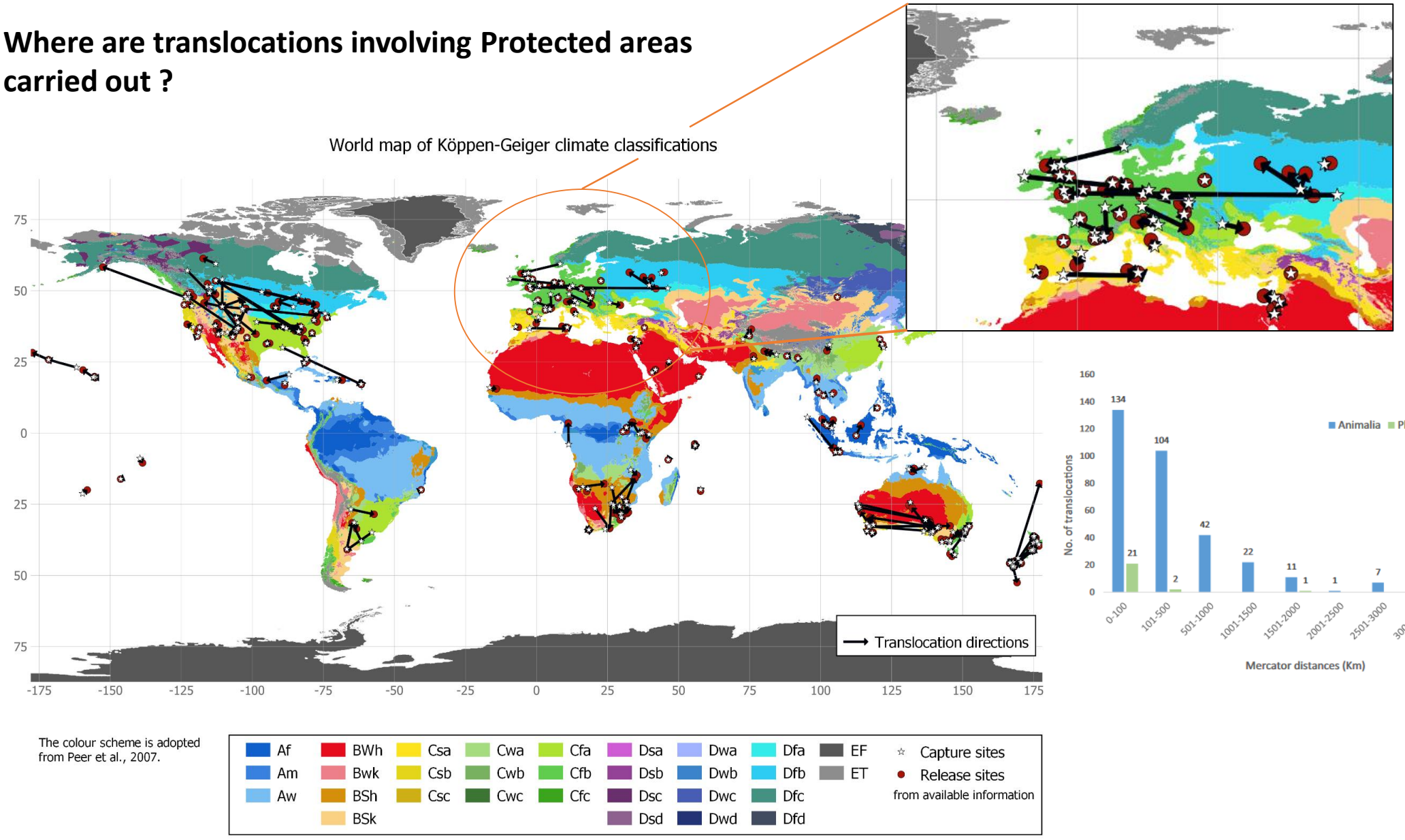


Fig. 4 Illustrating the 6 main motivating reasons for translocations. This combines all translocations interventions (introductions, reintroductions, and supplementations). Figures describe motivation by number of retained publications (thus "no coding" refers to the 90 review publications where metadata for motivation was not extracted, and "metapopulation management" refers to 25 publications where individual translocation were not extracted)

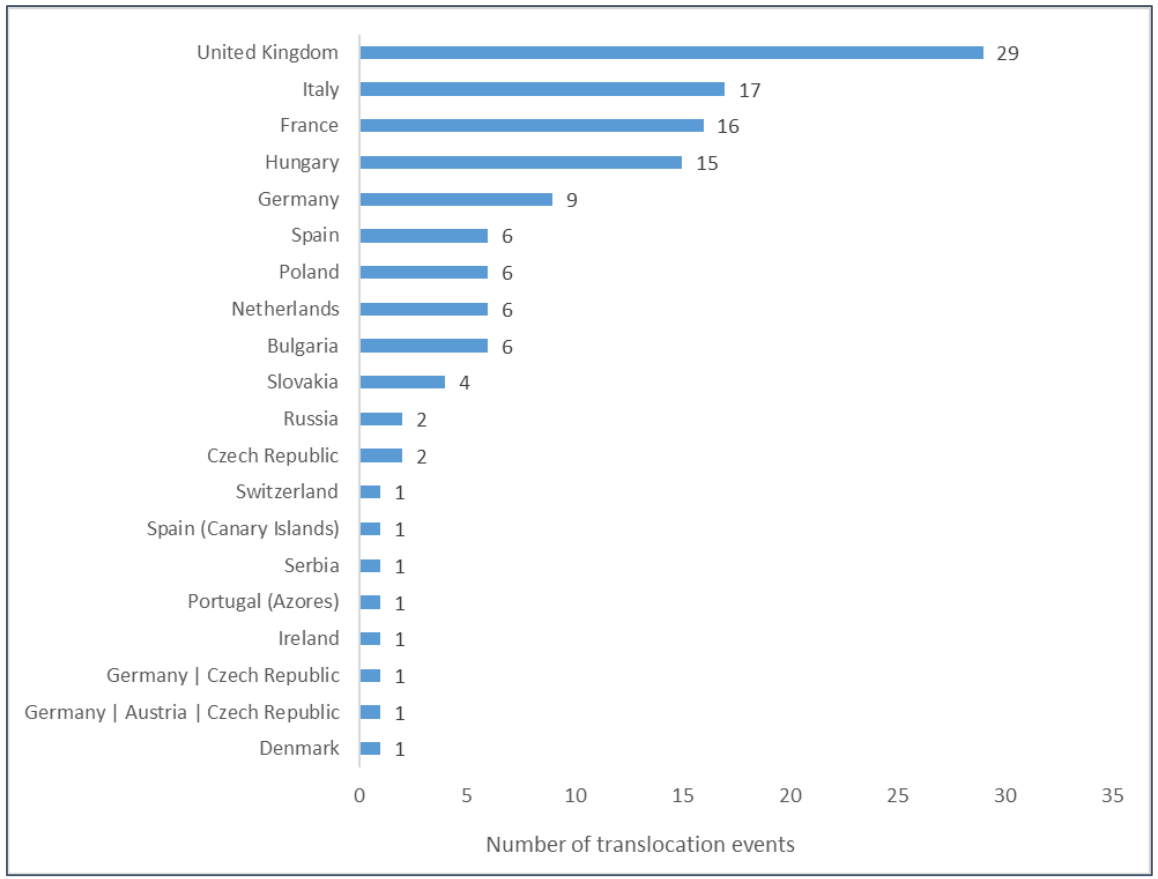
Citation: Langridge, J., Sordello, R., Reyjol, Y., 2021. Existing evidence on the outcomes of wildlife translocations in protected areas: a systematic map. Environ. Evid. 10, 29. https://doi.org/10.1186/s13750-021-00236-w

Where are translocations involving Protected areas carried out ?

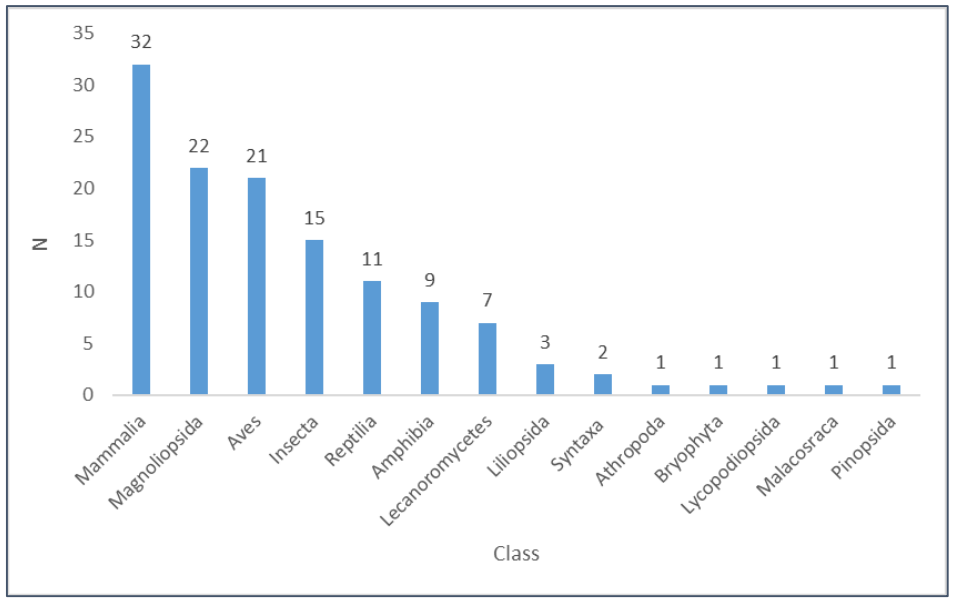


Focus: Europe

126 translocation operations in Europe



Source: gisgeography



Focus: Europe

Contents lists available at ScienceDirect

Journal for Nature Conservation

journal homepage: www.elsevier.de/jnc

A 'successful' case study: *Castor fiber*

Species distribution models as a tool to predict range expansion after reintroduction: A case study on Eurasian beavers (*Castor fiber*)

Sonia Smeraldo[a,1], Mirko Di Febbraro[b,1], Duško Ćirović[c], Luciano Bosso[a], Igor Trbojević[d], Danilo Russo[a,e,*]

- From **Germany** to **Serbia** (distance 1090km)
- From an *Unknown wild site* to the « Obedska Bara and Zasavica Special Reserve » (IV – IUCN)
- Study intervention: one-off reintroduction
- **75** indivuduals translocated between 2004-2005

- **Objective**: home range size
- **Main result**: 2004–2013 beavers expanded their range at a mean colonization speed of 70.9 ± 12.8 km/year.

Citation: Smeraldo, S., Di Febbraro, M., Ćirović, D., Bosso, L., Trbojević, I., Russo, D., 2017. Species distribution models as a tool to predict range expansion after reintroduction: A case study on Eurasian beavers (Castor fiber). J. Nat. Conserv. 37, 12–20. https://doi.org/10.1016/j.jnc.2017.02.008

Focus: Europe

A 'successful' case study: *Gypaetus barbatus*

HABITAT USE BY A REINTRODUCED POPULATION OF BEARDED VULTURES (*GYPAETUS BARBATUS*) IN THE ITALIAN ALPS

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- From *captivity* to « Argentera Natural Park, Italy » and « Mercantour Natural Park, France »
- Study intervention: one-off reintroduction
- **29** indivuduals translocated 1993

- **Objective**: habitat use and selection.
- **Main result:** from 1997 to 2006 -> 33 wild-born fledglings **;** number of sightings per year in "Gran Paradiso National Park » increased from **7** in 1989 to a maximum of **321** in 2001.

Citation: Bogliani, G., Viterbi, R., Nicolino, M., 2011. Habitat Use by a Reintroduced Population of Bearded Vultures (Gypaetus barbatus) in the Italian Alps. J. Raptor Res. 45, 56–62. https://doi.org/10.3356/JRR-09-69.1

Lessons for protected areas

Protected areas are both providers and recipients of translocated individuals.

- Main role is to **receive** individuals: **70% of translocations** are transfers from *unprotected sites* to *protected sites* (with one third of these experiences coming from *captivity* and another third from *the wild*).
- **23% of translocations** took place from one *protected site* to *another* and some translocations (about 5%) took place *within the same protected area*.

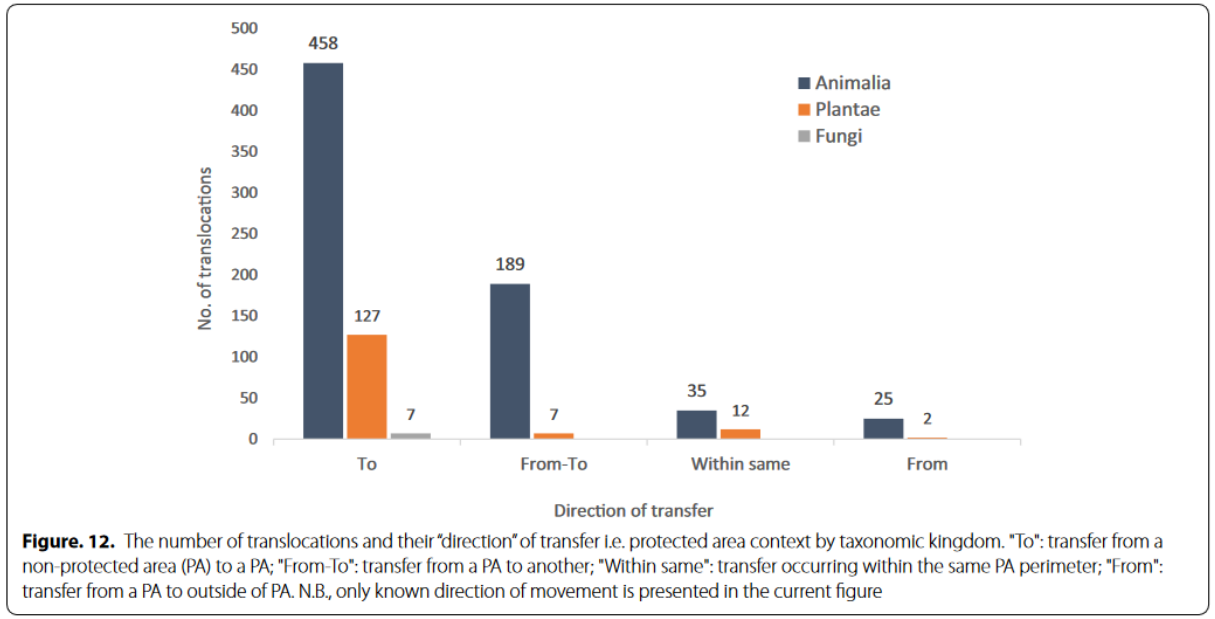


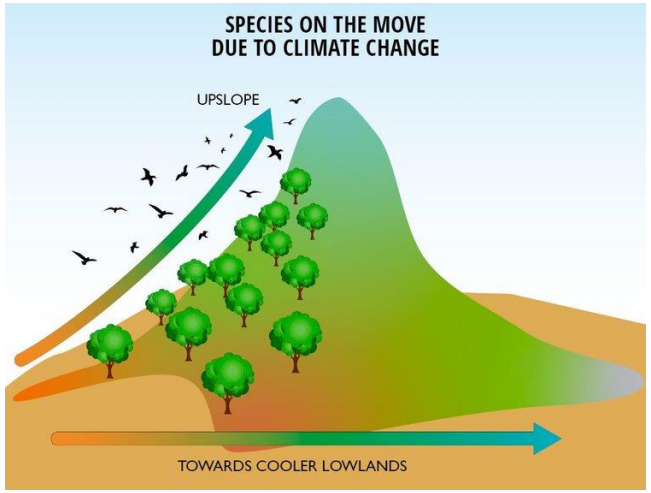
Figure. 12. The number of translocations and their "direction" of transfer i.e. protected area context by taxonomic kingdom. "To": transfer from a non-protected area (PA) to a PA; "From-To": transfer from a PA to another; "Within same": transfer occurring within the same PA perimeter; "From": transfer from a PA to outside of PA. N.B., only known direction of movement is presented in the current figure

Translocation can be a **useful tool** for protected areas, with the aim of conserving species.

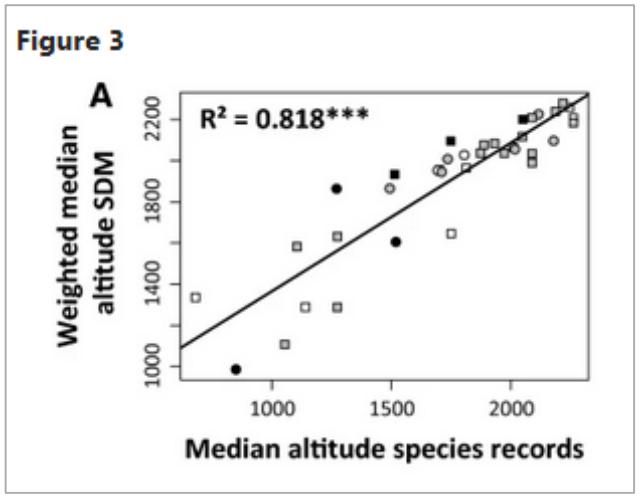
Citation: Langridge, J., Sordello, R., Reyjol, Y., 2021. Existing evidence on the outcomes of wildlife translocations in protected areas: a systematic map. Environ. Evid. 10, 29. https://doi.org/10.1186/s13750-021-00236-w

Focus: climate change

- Species are moving in response to climate change
- As temperature and precipitation change, plants and animals move to track suitable climate
- **Altitudinal changes**
- **Latitudinal changes**



Source: SPARC



Rôdder et al. 2021 in *Scientific reports*.
DOI: https://doi.org/10.1038/s41598-021-93826-0

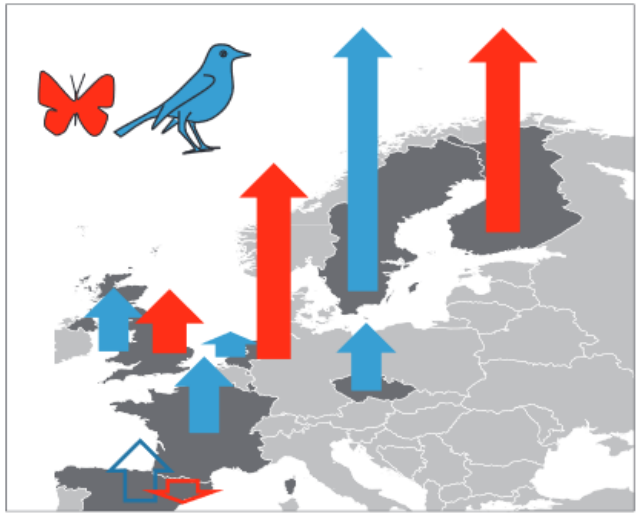


Figure 3 | European variations in the temporal trend of bird and butterfly CTI. The map shows the temporal trend of bird and butterfly CTI for each country. The height of a given arrow is proportional to the temporal trend and its direction corresponds to the sign of the slope (from south to north for positive slopes). The arrow is opaque if the trend is significant.

Devictor et al. 2012 in *Nature*.
DOI: https://doi.org/10.1038/nclimate1347

Focus: climate change

ECOLOGICAL MONOGRAPHS
ECOLOGICAL SOCIETY OF AMERICA

Review | Open Access

Shifting the conservation paradigm: a synthesis of options for renovating nature under climate change

Suzanne M. Prober, Veronica A. J. Doerr, Linda M. Broadhurst, Kristen J. Williams, Fiona Dickson

'Climate-targeted Option' (Prober et al., 2019): an interventionist's approach!

- **BUILD ADAPTIVE CAPACITY: ENHANCE THE CAPACITY OF SPECIES, ECOSYSTEMS AND LANDSCAPES TO WITHSTAND OR RESPOND TO CHANGE**
  - ✓ *Assist species to reach and establish in projected suitable environments:* Actively assist dispersal and colonization
  - ✓ *Functional introductions*: resilient local native species for plantings (transplantations)

In our database : 7 were motivated by climate change

Citation: Prober, S.M., Doerr, V.A.J., Broadhurst, L.M., Williams, K.J., Dickson, F., 2019. Shifting the conservation paradigm: a synthesis of options for renovating nature under climate change. Ecol. Monogr. 89, e01333. https://doi.org/10.1002/ecm.1333

Focus: climate change

A Climate-targeted Option:
Case study Lepidoptera

LETTER

Assisted colonization in a changing climate: a test-study using two U.K. butterflies

Stephen G. Willis[1], Jane K. Hill[2], Chris D. Thomas[2], David B. Roy[3], Richard Fox[4], David S. Blakeley[5], & Brian Huntley[1]

[1] Institute of Ecosystem Sciences, School of Biological & Biomedical Sciences, University of Durham, South Road, Durham, DH1 3LE, UK
[2] Department of Biology, P.O. Box 373, University of York, York YO10 5YW, UK
[3] NERC Centre for Ecology & Hydrology, Maclean Building, Benson Lane, Crowmarsh Gifford, Wallingford, Oxfordshire, OX10 8BB, UK
[4] Butterfly Conservation, Manor Yard, East Lulworth, Wareham, Dorset, BH20 5QP, UK
[5] Centre for Biodiversity and Conservation, School of Biology, University of Leeds, Leeds, LS2 9JT, UK

- *Melanargia galathea* (marbled white)
- *Unnamed wild sites* to « Wingate Quarry Local Nature Reserve, Durham" (IV – IUCN)
- Study intervention : assisted colonization (introductions beyond current range margins)
- 500 adults translocated in July 2000

- **Objective**: population growth
- **Main result:** population increased. The distribution extent of *M. galathea* increased from 7.2 to 17.8 ha over 6 years

Citation: Willis, S.G., Hill, J.K., Thomas, C.D., Roy, D.B., Fox, R., Blakeley, D.S., Huntley, B., 2009. Assisted colonization in a changing climate: a test-study using two U.K. butterflies. Conserv. Lett. 2, 46–52. https://doi.org/10.1111/j.1755-263X.2008.00043.x

Conclusions et perspectives

- Many articles remain poorly detailed by the authors. For example, the exact nature of the intervention remains *unknown* for 264 translocations listed (i.e. more than 30%).
- This lack of detail in articles is a handicap for the constitution of complete and comprehensive databases.
- The systematic map work stops at the **catalogue**, no formal statistical analyses are done.
- We did not look at the **success** *per se* of the translocations recorded: this work may be done at a later stage (with meta-analytical methods).
- The notion of success **remains complex**. Indeed, how to conclude that such or such a translocation has worked is challenging (What indicator ? Survival of translocated individuals, or their offspring, for how long, etc.).

Transferring knowledge

Worldwide Evidence Map

Stakeholder engagement

Objectives

Results and findings

Discussion and conclusions

Question time

Worldwide meta-analysis

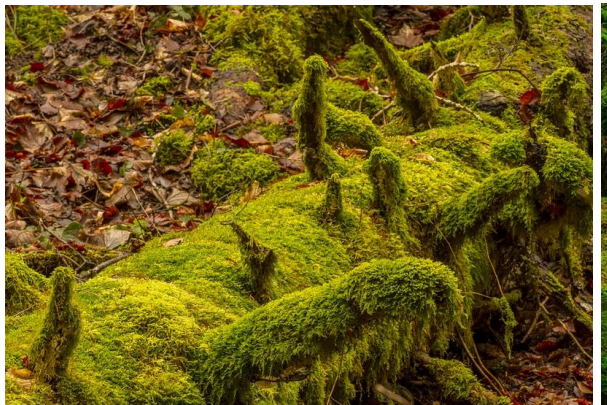
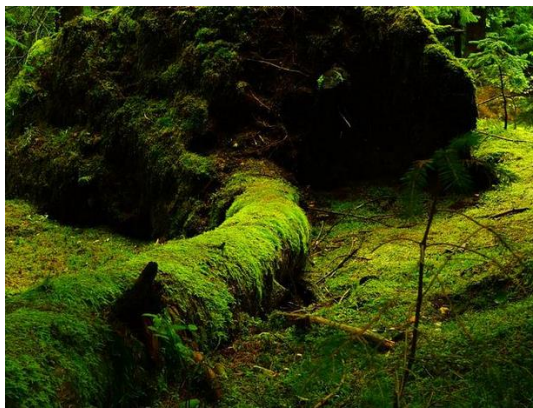
break





A global meta-analysis on the effects of forest management cessation on biodiversity



Stakeholder engagement

The project “Natur’Adapt”, a **European LIFE programme** coordinated by the French Nature Reserves Network (RNF)

- The project was initially born out of the “GNB: Gestion forestière, Naturalité et Biodiversité” project run by **INRAE**, ONF & RNF (EN: Forest Management, Naturalness and Biodiversity)

<u>(Re)formulating the question</u> :

The selection of the evidence synthesis subjects was made in cooperation with:

- RNF coordination team,
- The French Natural History Museum (FR acronym : MNHN), Paris,
- Reserve managers of the pilot sites

INRAE FRB CESAB

Objectives of the meta-analysis

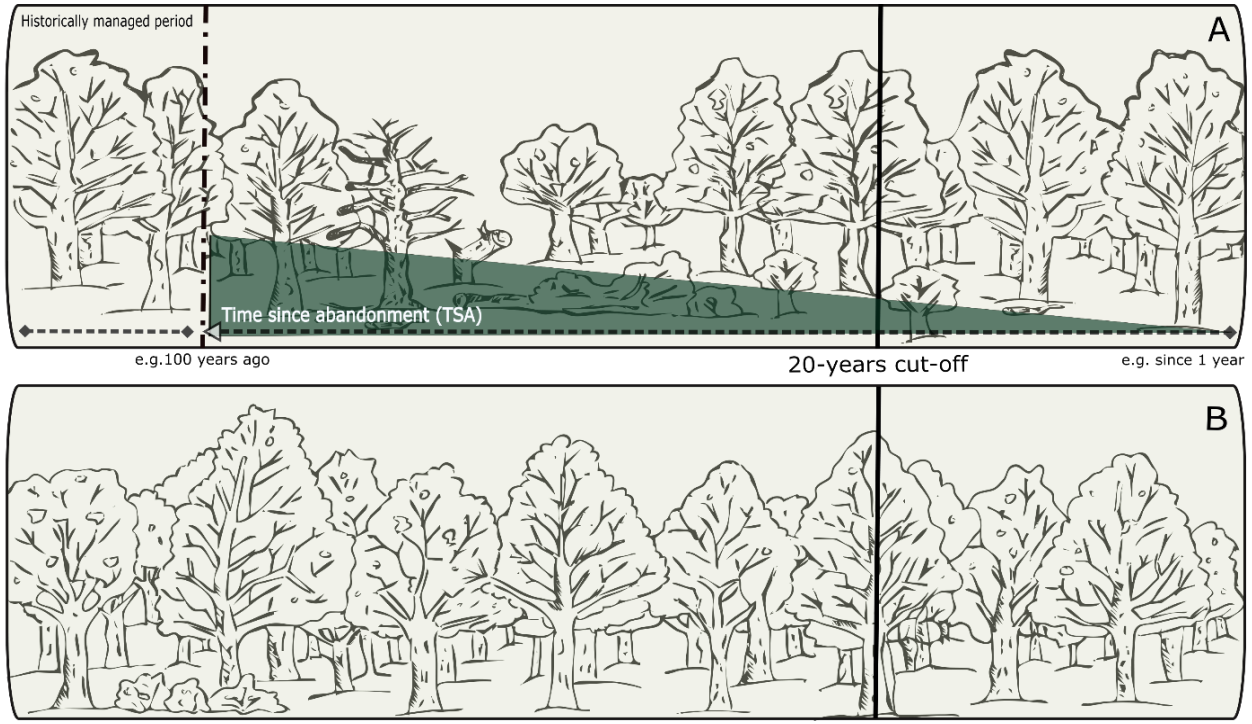
(i) A worldwide scope: **boreal, temperate, and Mediterranean biomes**;

(ii) A particular focus on **no longer managed forests** (but historically managed) in order to adopt a clearer restoration perspective in terms of the potential of management abandonment as a restoration tool;

(iii) Climatic covariates: an analysis of variations in the effects of the abandonment of harvesting on biodiversity depending on the **climatic context**;

(iv) Inclusion of total richness and total abundance metrics;

(v) A systematic-review approach: a critical appraisal of studies to lessen possible publication and/or statistical biases



Worldwide results

Species richness: comparison between managed and no longer managed sites

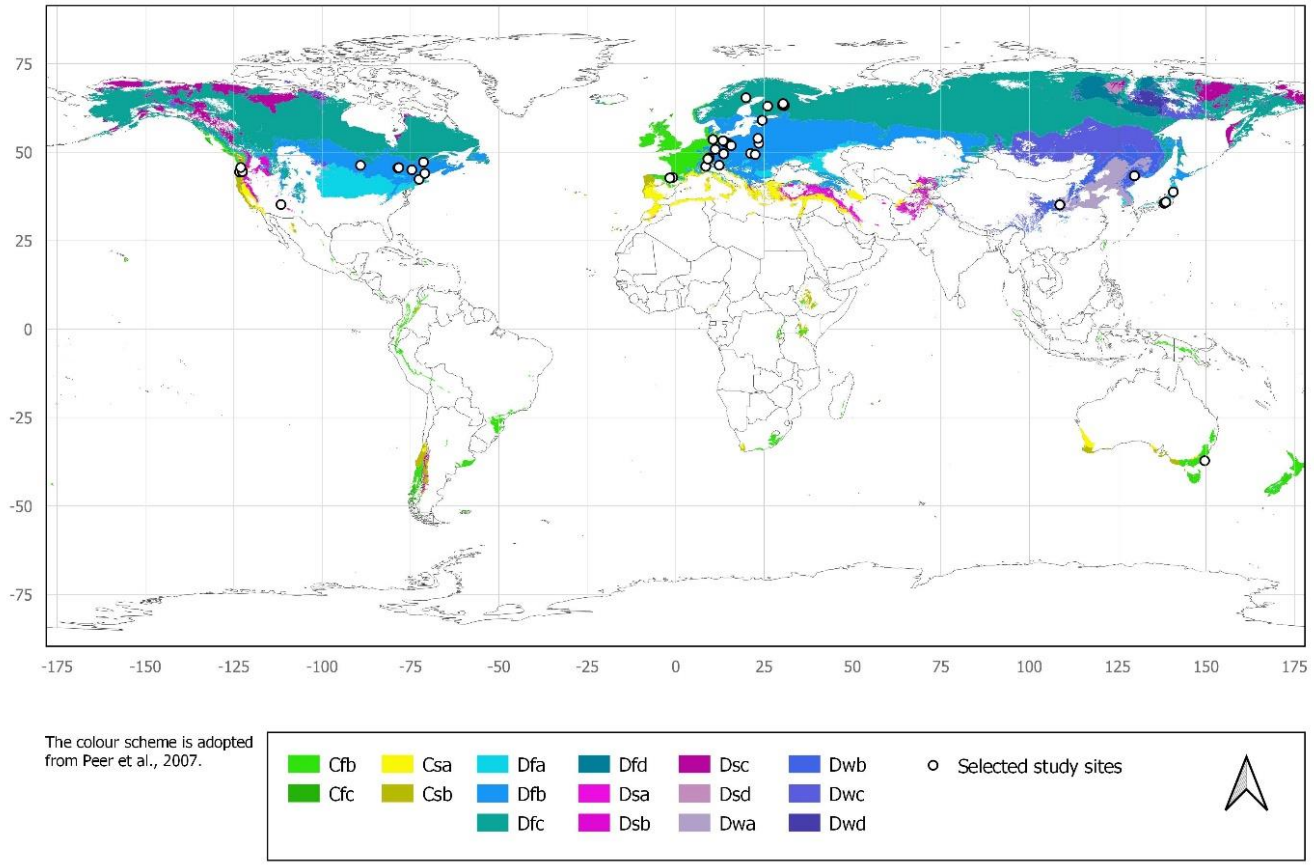
- 131 studies retained: Europe (78), Asia (28), North America (24), and one study in Oceania.

Taxonomic distribution:

- Plants (68 studies) of which 58 studies on vascular plants and 10 on bryophytes;
- Fungi s.s. (20 studies) and lichens (16 studies);
- Birds (14 studies);
- Arthropods [other than saproxylic beetles and carabids] (12 studies).

Biome distribution:

- boreal forests (62);
- temperate forests (59);
- Mediterranean forests (10).



The effect of stopping forest management

1st analysis

Meta-analysis of the effects of forest management abandonment on species richness in temperate, boreal, and Mediterranean forests (observations with SD>0.5 removed : **n = 131, i.e. number of comparisons**).

	estimate	SE	CI.lw	CI.up	p	stars	%
Birds	0.1346	0.0858	-0.0337	0.3028	0.1169	ns	14.4
Bryophytes	0.1024	0.1025	-0.0985	0.3033	0.3179	ns	10.8
Fungi s.s	0.1402	0.0863	-0.0288	0.3093	0.104	ns	15.1
Lichens	0.0951	0.0773	-0.0564	0.2466	0.2184	ns	10
Other Arthropods[a]	0.0089	0.0757	-0.1394	0.1572	0.9061	ns	0.9
Vascular Plants	**-0.1546**	**0.0588**	**-0.2698**	**-0.0394**	**0.0085**	**	**-14.3**
Biome Medit	**-0.252**	**0.1225**	**-0.4921**	**-0.0119**	**0.0396**	*	**-22.3**
Biome Temperate	-0.0146	0.0686	-0.149	0.1198	0.8315	ns	-1.4

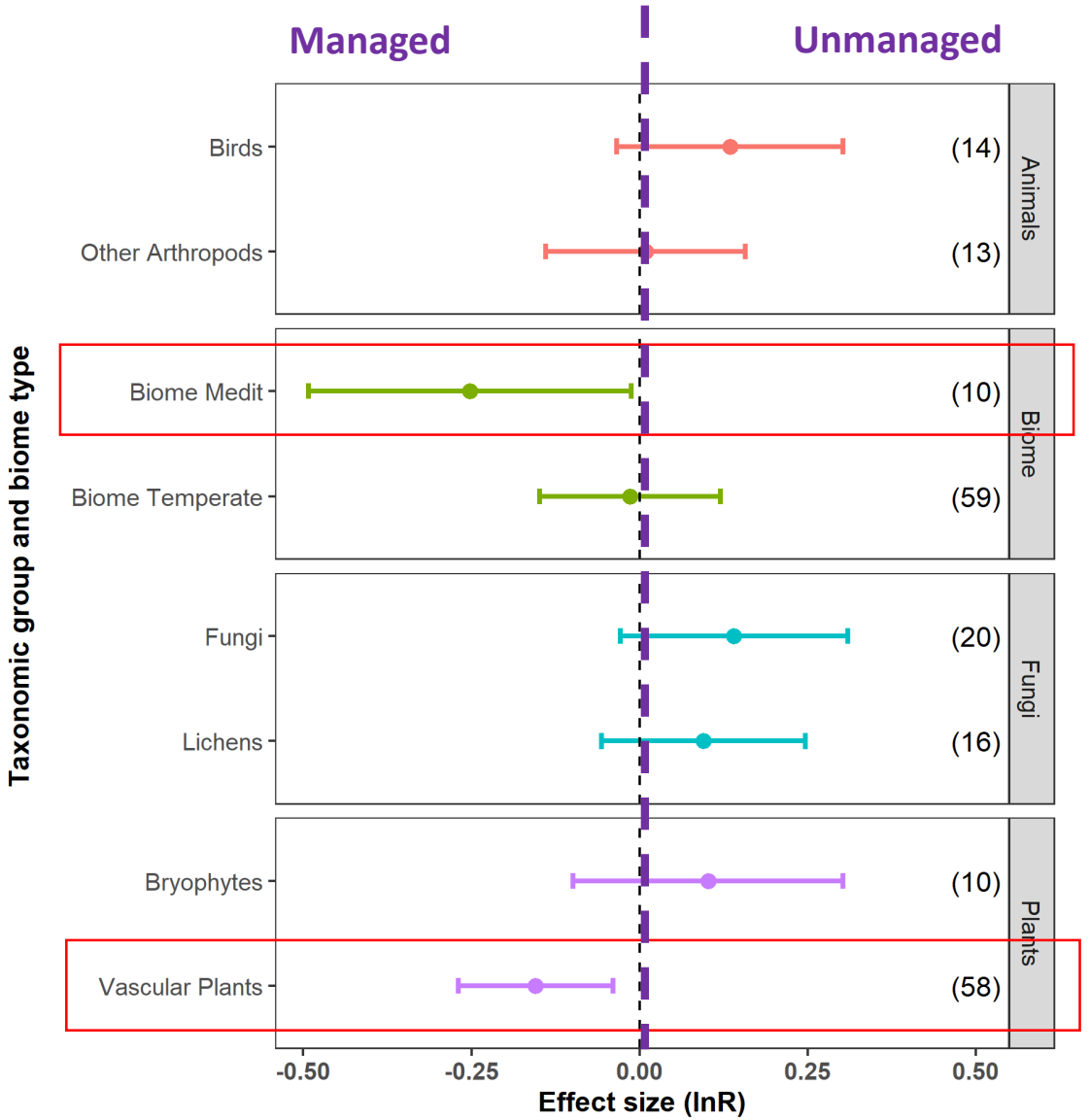
The effect of stopping forest management

1st analysis:

- Emerging trends, but not always statistically significant.

Statistically significant results:

- Overall richness greater in mediterranean managed stands
- Vascular plants richness higher in managed stands.



Comparison of species richness between no longer and currently managed forests

The effect of Time since abandonnement of management

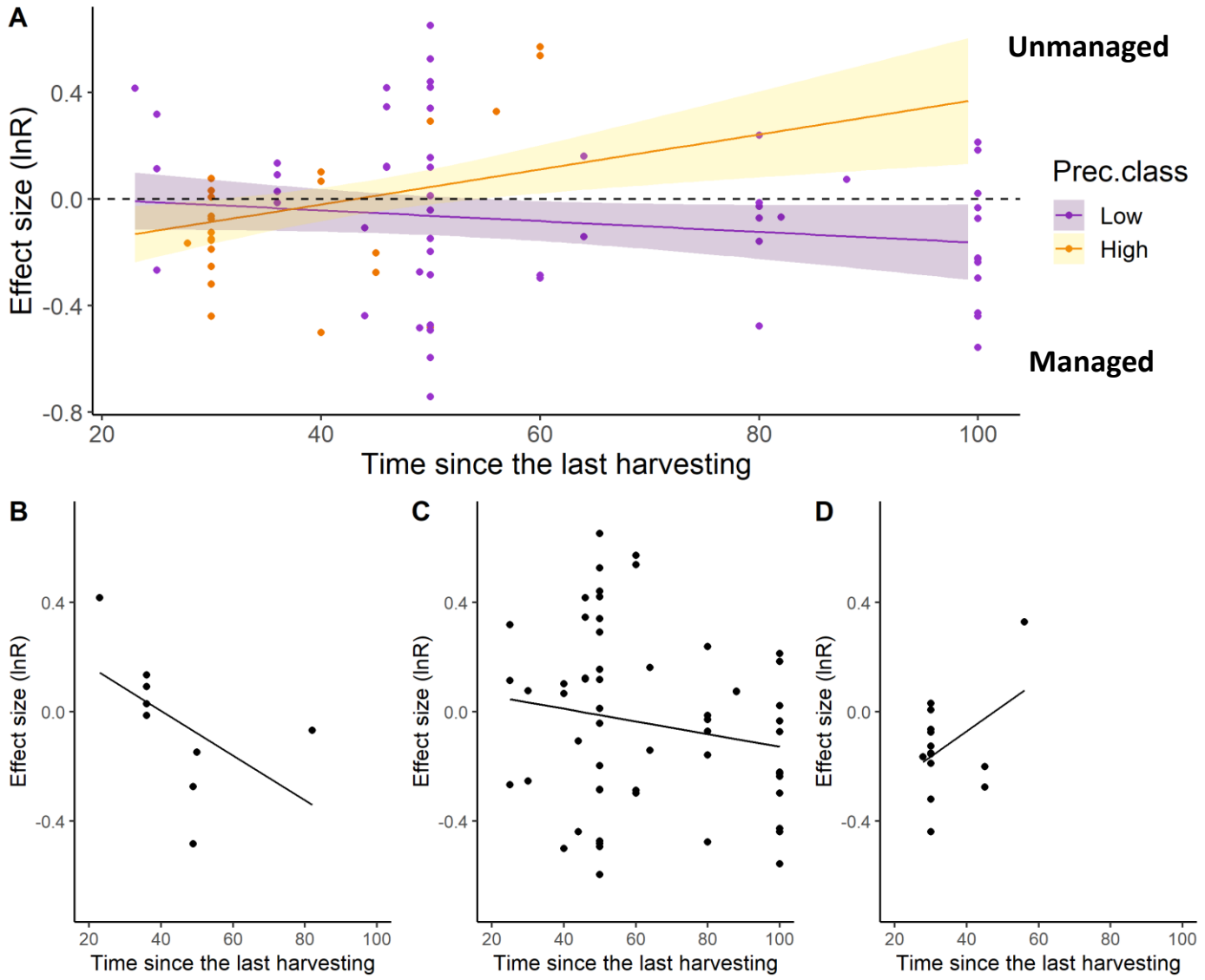
2nd analysis:

Meta-analysis of the effects of time since abandonment (TSA) of management on species richness in temperate and boreal forests (**n = 107, i.e. number of comparisons**)

	estimate	SE	CI.lw	CI.up	p	stars	%
Birds	0.121	0.09	-0.0553	0.2974	0.1786	ns	12.9
Fungi	**0.226**	**0.0937**	**0.0423**	**0.4097**	**0.0159**	*****	**25.4**
Lichens	**0.2062**	**0.0897**	**0.0305**	**0.3819**	**0.0214**	*****	**22.9**
Vascular Plants	**-0.1336**	**0.0573**	**-0.2459**	**-0.0212**	**0.0198**	*****	**-12.5**
Scaled TSA.UNM	0.0514	0.0325	-0.0123	0.1152	0.1138	ns	5.3
Scaled Precipitation	0.0995	0.0548	-0.0078	0.2069	0.0692	(*)	10.5
Scaled TSA.UNM X Precipitation	**0.1506**	**0.0386**	**0.075**	**0.2262**	**1e-04**	*****	**16.3**

The effect of time since the last harvesting operation and precipitation

- A positive response of effect sizes to TSA in humid climates.
- the opposite—but on a smaller magnitude—being true for drier sites.



The role of time since forest management abandonment in biodiversity restoration

A case for <u>fungi</u> and <u>lichen</u> restoration

Fungi:

- Species richness **significantly higher** once harvesting has been abandoned.
- Fungal diversity has been shown to be positively related to tree species diversity (Tomao et al., 2020*) => commonly higher in no longer managed stands.
- Trunk rotters constitute an important group of habitat specialists that depend on decaying logs (Heilmann-Clausen et al., 2014).
- Basidiomycetes also show preferences for well-decayed wood.

Lichen:

- Lichens prefer old large-diameter trees and large-diameter deadwood with specific hydrological properties (Kaufmann et al., 2018).
- Larger logs, which hold more moisture, may decay quicker than smaller deadwood (Humphrey et al., 2002).

*Citation: Tomao, A., Antonio Bonet, J., Castaño, C., de-Miguel, S., 2020. How does forest management affect fungal diversity and community composition? Current knowledge and future perspectives for the conservation of forest fungi. Forest Ecology and Management 457, 117678. https://doi.org/10.1016/j.foreco.2019.117678

Implications for management/conservation policy

- Our study confirms that different species groups are associated differently to management abandonment
- Some groups being more diverse in still managed forests (**vascular plants**) and others in no longer managed (**fungi & lichens**).
- A robust argument for **passive restoration** (i.e. stopping of exploitation) in managed forests (i.e. setting aside) (Sabatini et al., 2020)*.
- In wetter climates, forest harvesting abandonment could be **an appropriate management choice** to buffer the negative effects of direct anthropogenic disturbance.

*Citation: Sabatini, F.M., Keeton, W.S., Lindner, M., Svoboda, M., Verkerk, P.J., Bauhus, J., Bruelheide, H., Burrascano, S., Debaive, N., Duarte, I., Garbarino, M., Grigoriadis, N., Lombardi, F., Mikoláš, M., Meyer, P., Motta, R., Mozgeris, G., Nunes, L., Ódor, P., Panayotov, M., Ruete, A., Simovski, B., Stillhard, J., Svensson, J., Szwagrzyk, J., Tikkanen, O.-P., Vandekerkhove, K., Volosyanchuk, R., Vrska, T., Zlatanov, T., Kuemmerle, T., 2020. Protection gaps and restoration opportunities for primary forests in Europe. Divers. Distrib. 26, 1646–1662. https://doi.org/10.1111/ddi.13158

Questions