Outcomes of wildlife translocations in protected areas: what is the type and extent of existing evidence? A systematic map protocol

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Environmental Evidence

SYSTEMATIC MAP PROTOCOL

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Abstract

Background: Conversion, fragmentation, and loss of natural habitats are among the main causes of declining species' populations worldwide. Protected areas are therefore crucial for biodiversity as they provide refuge and ensure key ecological processes. Wildlife translocations, defined as "the deliberate movement of organisms from one site for release in another", have been used in conjunction as a conservation tool for a number of decades as wild populations become increasingly fragmented and endangered. Not only are translocations used to bolster the viability of imperiled species but are also recommended for improving population resilience and adapting species' ranges in response to climate change. Despite translocation being a recognised conservation tool, it remains complex with variable results due to the different factors that can determine its success. Accordingly, the Map will investigate the existing evidence on the links between different types of wildlife translocation interventions and factors that may be important to consider for planning. This will provide an overview of relevant studies for possible future syntheses, and may help to inform management decisions.

Method: We will perform a thorough search of peer-reviewed journal articles and grey literature sources documenting the occurrence of translocations in the context of protected areas. Two databases will be used: Web of science core collection and Scopus, with a supplementary search in Google Scholar. Multiple key specialized websites will also be used. All bibliographic data will be extracted, managed, and screened in Microsoft excel. Three screening stages will be undertaken (title, then abstract, then full texts) against predefined inclusion criteria. The retained relevant literature will be subjected to coding and meta-data extraction. No formal validity appraisal will be undertaken. The Map will particularly highlight translocation operations in terms of origin and destination (i.e. translocating from one protected area to another, within the same area, and from and to non-protected areas) by taxonomic group, among other important factors (e.g. number of individuals, age class, release strategy, distance between capture and release sites etc.). Finally, a database will be provided along with a Map narratively describing the evidence with summary figures and tables of pertinent study characteristics.

Keywords: Managed relocations, Reintroduction, Supplementation, Introduction, Conservation areas

Background

Modification, fragmentation, and loss of natural habitats are among the main causes of declining species' populations worldwide [1–4]. In the face of such threats, extinction rates have been accelerating and biological diversity diminishing for the last several decades [5–7]. Accordingly, protected areas such as national parks, nature and

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biosphere reserves play vital roles in maintaining refuge and ensuring fundamental ecological mechanisms such as dispersal and gene exchange [5, 8–11]. Further, not only do they provide key habitat and conserve biodiversity from various human pressures [8, 10] but they are able to maintain higher species population levels, including threatened species, better than other management approaches [10, 11].

Translocation is an umbrella term referring to the "deliberate movement of organisms from one site for release in another" [12]. Indeed, it may occur in different contexts such as reintroduction in which organisms are transported and released into their historical native range but from which they have become extirpated or extinct, or supplementation (also known as reinforcement), which refers to the addition of individuals to an existing population of conspecifics [12]. Thirdly, introduction, which from a conservation perspective is often referred to as assisted colonization [12–14], attempts to establish a species outside of its recorded historical distribution but within appropriate habitat and biogeographical area. Each strategy sharing the ultimate goal of population persistence [14].

Historically, the intentional movement and release of species has occurred for millennia [12, 15], but the use of translocations to address species-focused conservation objectives is more recent [15]. For example, between 1973 and 1989 more than 700 translocations were estimated to have taken place per year across the USA, Australia, and New Zealand in order to restore and enhance populations [5]. Latterly, interest in assisted colonization has been driven by predicted habitat and climate changes [13, 15]. In 1985, Peters and Darling [16] suggested that climate change might alter habitat suitability for species confined within protected areas, effectively stranding them as habitat becomes increasingly unfavourable [15]. They proposed the translocation of individuals into new reserves encompassing habitat that was or would become appropriate [16], therefore potentially compensating for the fixed nature of perimeters [17, 18]. More recently, the concept of rewilding has emerged [15, 19]. Originally based on the keystone role played by wide-ranging predators and their ability to maintain ecosystem equilibrium through top-down trophic interactions [15], the concept has since harmonized with the current conservation translocation framework to include the role of species reintroduction to restore ecological processes [15, 19], and to a broader extent, the restoration of ecosystem functions by means of introducing ecological replacements [15].

In the current context of the biodiversity crisis, translocations and particularly reintroductions of threatened species are more numerous [20]. They are also used in conjunction with conservation areas more regularly as populations become progressively more fragmented and endangered [21]. Even though past efforts have not been entirely uniform with a notably marked taxonomic bias towards birds and mammals (e.g. [5, 22]) and an apparent prioritization for larger more charismatic species [15, 22, 23], attention being paid to other groups has rapidly increased since the early 2000s (e.g. English Nature's Species Recovery Programme involving 62 species, of which only 11 were birds or mammals) [22]. Thus, for management purposes, the need to synthesize this profuse information is apparent. Moreover, concerning success, studies regularly identify the value of habitat quality at recipient sites and the importance of species being relocated to non-degraded habitats [5, 20, 24, 25]. Indeed, in a previous review on plant reintroductions, Godefroid et al. [26] confirmed that reintroducing species to protected areas significantly increased survival rate. Equally, regarding vertebrate translocations, several papers highlight the positive effects of protected habitat (e.g. [27]), and in a number of canid translocations protected areas were regularly chosen as release sites [28–30]. With the overarching pressure of climate change, several authors have continued to propose translocations as a viable means to enhance the resilience of threatened species, improve ecosystem integrity, and assist migration to favourable habitats [9, 14, 24, 31, 32].

Despite the number of translocations rapidly growing and it increasingly being recognized as a key conservation measure, implementation is often complex and different programs have had varying results. From a biological perspective, this is notably due to the numerous different factors that influence its success [33, 34] such as the number of translocated individuals [35], the distances involved [36], whether acclimatisation strategies (e.g. protective enclosures or supplemental feeding) are used [37], and what levels of habitat quality individuals are faced with at release sites [25, 26]. From a social perspective, interventions are still considered controversial: cost, feasibility, and political acceptability remain the principal influencing factors [38].

Although previous overviews exist (e.g. [23, 34]), and while others have explored the effectiveness of anti-predator training and conditioning interventions (e.g. [37]), there appears to be a deficit in terms of systematic literature assessments on the role of protected areas. Hence, our aim is to map evidence of translocation operations carried out in the context of protected areas detailing the distribution and abundance of relevant studies in relation to key factors that influence success. This will provide an evidence base for possible future reviews, and should

help to inform eventual management and stakeholder decisions.

Stakeholder engagement

The current systematic map will be conducted as part of a wider European LIFE programme (the EU's funding instrument for environment and climate action). The LIFE project, entitled "Natur'Adapt", is coordinated by the French Nature Reserves Network (*Les Réserves Naturelles de France* (RNF)), and co-financed by the French Ministry of Ecology and the French Office of Biodiversity (OFB). RNF is accompanied by nine other beneficiaries, including The French National Natural History Museum (*Muséum National d'Histoire Naturelle* (MNHN)), who will be responsible for the mapping process.

The project's principal aim is to align conservation efforts in protected areas to the challenges associated with climate change, in France and across Europe. Subsequently, the progressive development of an adaptation plan will be undertaken based, firstly, on six "experimental" nature reserves then progressively made adaptable to all protected areas in France and Europe. The MNHN is responsible for a key LIFE action: to provide evidence syntheses. This will help reserve managers build their adaptation plan by transferring scientific knowledge to them in an accessible and summarized form. As a first step, several working groups were conducted between RNF, MNHN, and reserve managers. This was an opportunity for reserve managers to define all relevant conservation strategies, in the context of climate change, of which they were most in need of scientific evidence to support decision-making. At the end of this process, translocation, among other measures, was retained as it was considered a necessary conservation action plan. As a result of numerous discussions, a systematic map was chosen as a central reference tool. Further workshops were held to specifically learn the stakeholders' needs and involve them in the definition of the Map's meta-data variables.

Objectives of the review

The main objective is to systematically map translocation operations within the context of protected areas (i.e. operations from, to or within a protected area). The IUCN protected area management categories will be used for this as they represent a global standard for defining conservation areas. In agreement with the specific aims of the LIFE project, this Map will consider translocations for species conservation—where the primary goal is to improve the status of the focal species through supplementation, reintroduction, or assisted migration. Translocation for rewilding—where the initial motive is to restore natural ecosystem functions will be included. In accordance with Seddon et al. [15], translocation rewilding will only entail (i) population restoration through reintroduction, where release within the indigenous range aims at reestablishing some ecological function, or (ii) in the form of a conservation introduction through ecological replacement [15, 19]. Neither invasive species nor historical introductions for hunting purposes will be included. We will aim to provide a comprehensive overview of the distribution of studies by taxonomic group and type of translocation, in conjunction with other key drivers (e.g. age class, release strategy, distance between capture and release sites, number of individuals initially translocated etc.) that may influence various biological outcomes i.e. success of wildlife translocation operations.

Therefore, the primary question for this Map protocol is as follows: What type, extent, and distribution of evidence exists on the outcomes of wildlife translocations carried out in protected areas?

Components of the primary question in Table 1.

Methods

Searching for articles

Our search strategy has been designed in order to retrieve a broad range of articles covering the topic of wildlife translocations in protected areas. Indeed, the systematic map will follow the Environmental Evidence Guidelines and conforms to the ROSES standards (see Additional file 1 for our declaration and checklist of adherence to the ROSES guidelines).

Search terms and languages

All searches will be performed using English terms only. Hence, all relevant studies published in English will be included in this systematic map. This will include diverse bibliographic documents (e.g. books conference proceedings, journal articles, theses, technical reports etc.)

Search strings

Firstly, a scoping exercise was conducted in the Web of Science Core Collection database to explore the efficiency of chosen words and the number of articles returned. In accordance with our main objective, we combined all search terms relating to protected areas and wildlife translocations. Concerning protected areas, the chosen key words represent synonyms of the different types of reserves and management categories that exist.

Thus, the search string that produced the highest efficiency is presented below (see Additional file 2 for test list details and Additional file 3 for information of the building process of the search string).

Table 1 Components of the systematic map

Population (P)	All plant and animal species of wild or captive source			
Intervention (I)	*Type of interventions*	*Definition of interventions*		*Conservation aim of intervention*
	Introduction	This refers to the intentional manual transfer/movement and release of an organism outside of its indigenous range/historical distribution [12]	*(i) Assisted migration*: this refers to the intentional manual transfer/movement and release outside of the indigenous range, to primarily avoid extinction of populations of the focal species [12]	This occurs if the persistence of a species in its indigenous range is threatened from current or future impacts than at alternative sites [12]
			(ii) Ecological replacement: This refers to the intentional manual transfer/movement and release of an organism outside its indigenous range/historical distribution, to perform a specific ecological function [12]	This is used to re-establish an ecological function lost through extinction; involving the most suitable existing sub-species, or a close relative of the extinct species [12]
	Reintroduction	This refers to the intentional manual transfer/movement and release of an organism inside its indigenous range/historical distribution but from which it has disappeared or become extinct locally, regionally, or otherwise (No conspecifics are present in situ) [12]		The conservation aim is to re-establish a viable population of the focal species within its historical range [12]
	Supplementation	This refers to the intentional manual transfer/movement and release of an organism into the existing distribution of a population of conspecifics [12]		The aim is to enhance and reinforce population viability e.g. by increasing population size, or by increasing genetic diversity [12]
Comparator (C)	Studies will not be required stricto sensu to have a comparator. Although in certain cases the study design may translate as a time series comparison (before and after translocation)			
Outcomes (O)	All relevant outcomes related to the translocated population, including space use, demography, survival, reproduction, feeding, behaviour, genetics, and physiology (*cf.* Table 3 for full typology)			
Context (C)[a]	*Type of protected areas*	*Definitions of protected areas*		
	Strict reserves for the protection of nature (Ia)	Areas set aside to strictly protect biodiversity where human visitation, use, and impacts are strongly limited [39]		
	Wilderness areas (Ib)	Areas that are largely unmodified, retaining their natural character, and free of inappropriate or excessive human use or presence [39]		
	National Parks (II)	Protected areas of large natural or near natural areas set aside to protect large-scale ecological processes [39].		
	Natural monuments (III)	Protected areas set aside to protect a specific natural feature in the landscape [39].		
	Management areas (IV)	Specific protected areas that aim to safeguard a particular species or habitat. Consequently, the management reflects this priority [39]		
	Protected landscapes (V)	A protected area where humans and nature together over time have produced an area of significant ecological, biological, cultural and scenic value [39]		
	Protected areas with sustainable use of natural resources (VI)	Protected areas which conserve ecosystems and habitats together with associated cultural values and traditional natural resource management and use [39]		

[a] Concerning context, this will equate to all interventions from, to, or within these types of protected areas

TS = ("protected area$" OR "protected landscape$" OR "protected site$" OR "receptor site$" OR "reintroduction site$" OR "natur* reserve$" OR "national park$" OR "regional park$" OR "national reserve$" OR "biological reserve$" OR "biosphere reserve$" OR "regional reserve$" OR "wilderness area$" OR "natural monument$" OR "management area$" OR sanctuar*) AND TS = ("assisted colonization" OR "assisted population migration" OR "assisted migration" OR "assisted gene flow" OR "managed relocation$" OR transloc* OR reintroduc* OR reinforc* OR "assisted range expansion$" OR "assisted long-distance migration$" OR rewilding OR "wild release").

Estimating the comprehensiveness of the search

A test list of 40 scientific articles was established and used to assess the comprehensiveness of the search string. The test list was composed of relevant scientific articles identified by the review team prior to the mapping process. The overall comprehensiveness was 100%. [Two additional files provide further details (see Additional files 2 and 3)].

Publication databases to be searched

All published material will be collected from the following databases (and managed in excel).

- Web of Science (WOS) core collection. The entire database i.e. all citation indexes will be searched by Topic i.e. using the "TS" field tag, which searches for key words in the title, abstract and key-words of published documents (see Additional file 4 for Web of Science subscription details).
- Scopus. We will equally search for all published documents. We will use the field tag "TITLE-ABS-KEY", which operates in the same way as the "TS" tag in WOS.

These databases were chosen as they provide comprehensive citation data for numerous different academic disciplines. The English search string detailed above will be used for both literature sources. The search string will be adapted as necessary to account for the differences in the use of field tags and Boolean characters [an additional file provides details on number of search hits and dates of searches (see Additional file 5)].

Internet searches to be conducted

A supplementary retrieval of publications will be undertaken using web-based search engines.

- Google Scholar (https://scholar.google.com/). We used the same key words in the software programme Publish or perish (version 6) to retrieve all academic citations. The software's use of Boolean characters differs from WOS and Scopus. As a result, the search string was broken down into eight separate searches, in order to achieve a similar comprehensiveness, as only a single term can be included in the field "all of the words". Consequently, each sub-search was limited to the first 200 search hits, in line with recommendations [40]. (Refer to Additional file 5.)
- A retrieval of theses will also be done using UK Theses and Dissertations (https://ethos.bl.uk). We will search for theses using the intervention key words only. We will search using five key words: "reintroduction" OR "reinforcement" OR "introduction" OR "translocation" OR "rewilding". Hits limited to 200.
- Conservation Evidence (https://www.conservationevidence.com/)—we will collect primary research using the Journal's "Advanced search". Use of five key words: "reintroduction", "reinforcement", "introduction", "translocation", or "rewilding" will be used for collecting individual studies. We will extract the first 40 hits per keyword search (total hits: 200).

Specialist searches

The following specialist organisations will be searched for reports which contain translocations to, from and within protected areas.

- US Federal Science database (https://www.science.gov/).
- US Fish and wildlife service (https://www.fws.gov/).
- Office National de la Chasse et de la Faune Sauvage (http://www.oncfs.gouv.fr/).
- IUCN Conservation Planning Specialist Group's document library (http://www.cpsg.org/document-repository).
- Association of Zoos & Aquariums (https://www.aza.org/). Including the European Association (https://www.eaza.net/).
- Rewilding Europe (https://rewildingeurope.com/).

Supplementary searches

A call for literature will be made through the professional networks of *Les Réserves Naturelles de France* (RNF) and EuroParc. An advert will be

published in the monthly newsletter of RNF. EuroParc, who act as a federation of protected areas at the European continental scale will also solicit their network. Since translocations programs are often carried out without being published in the form of scientific articles this will provide further opportunity to gather additional grey literature such as PhD and MSc theses, various technical reports, and other documentation. AirTable, which works like a database will be the specific software used to acquire the documents sent via the stakeholders' contacts.

Article screening and study eligibility criteria

Screening process

In accordance with the pre-defined screening and study eligibility criteria (detailed in "Eligibility criteria" section), study selection will follow a three-stage filtering process carried out by two members of the mapping team. Firstly, all titles will be screened, followed by abstracts and thirdly full texts. During screening, we will choose to take a conservative approach. Hence, if the qualifying information is not detailed sufficiently to reject or to retain with certainty, then the article in question will be kept for assessment at the next eligibility stage in the overall filtering process. In addition, articles or grey literature that qualify after title screening but do not contain an abstract will pass by default to the full-text screening stage. Lastly, should our search string retrieve, in addition, any relevant published material in French it will also be incorporated into the mapping process because these are the two languages spoken and understood by all members of the map team.

Consistency checking

To fully assess whether both reviewers adhere to the eligibility criteria, a Kappa test will be performed at the start of each filtering stage. Accordingly, 10% of retained titles, 10% of retained abstracts, and 10% of retained full texts will be pre-screened to check for agreement. Kappa scores should be equal to or greater than 0.6. If differences of opinion occur, the process will be repeated with new samples until a score of 0.6 or greater is reached. Even if statistical agreement is reached, all (if any) remaining disagreements will be discussed before beginning the screening process. A consistency check for meta-data extraction will also be undertaken based on training articles representing 10% of the retained corpus. All eventual disagreements will be discussed between the reviewers.

Eligibility criteria

Different eligibility criteria will be applied at each filtering stage. Table 2 describes a summary description of the eligibility criterion.

Title

Inclusion criteria Firstly, all titles will be retained if presence of the terms reintroduction, supplementation (and its common synonyms i.e. reinforcement, augmentation, re-stocking, enhancement) and introduction (and its common synonyms i.e. assisted migration, managed relocation etc.). Secondly, any title containing compatible synonyms such as, re-wilding, release, range-shifts, transfer, restoration etc., will also be retained. In cases where none of the above words are present, a title would still meet eligibility if it strongly implies a translocation event (i.e. reference to captive of wild stock) or metapopulation management. *Nb.* At title screening stage, all types of literature (including review, meta-analyses and relevant discussion and opinion articles) will be retained.

Exclusion criteria clear absence of the above key words. Translocation in a genetic context, e.g. chromosomal translocation, will also be excluded.

Abstract

Inclusion criteria Presence of words related to survival, mortality, space use, genetics and all other relevant biological outcomes (*cf.* Table 3). The abstract will also be retained if it contains words confirming a translocation event to, from, within or away from protected area perimeters. Additionally, for the purpose of the Map, if the translocation event has occurred to solve human-wildlife conflicts then this will also satisfy the inclusion criteria.

Exclusion criteria If no obvious description of intervention exists.

Full text

Inclusion criteria Primarily but not exclusively, if the outcome has been obtained from field studies (e.g. individuals equipped with radio-collars at time of release, reported number of individuals surviving after a predetermined time-scale). However, discussion and review articles will be retained if presence of PICO elements is sufficiently described. Also, if the article presents evidence of comparison of release strategies. All articles that clearly state that population/individuals (plants or animals) are of captive or wild stock and have been transferred to, from, or within protected areas.

Exclusion criteria Similar to those applied for title or abstract screening, or information informing that the translocated population is invasive or introduced

Table 2 Systematic map inclusion and exclusion criteria, and PICO definitions for the three-stage screening process

Criteria	Description	PICO definition(s)
Inclusion criteria		
Eligible population	Any terrestrial, marine, or aquatic plant or animal species of wild or captive source	IN: Wild—free-ranging species from natural environments; not domesticated or cultivated Captive—species born, bred, or cultivated in captive setting (e.g. zoos, nurseries)
Eligible intervention	Conservation-based translocation operations (i.e. reintroduction, supplementation and introduction) (see Table 1 for definitions)	IN: Conservation-based interventions—where the aim is improving viability and persistence of translocated population. Regarding introduction, this will also include ecological replacement and assisted migration [14]
Eligible comparator	Studies will not be required stricto sensu to have a comparator present	*NA*
Eligible outcomes	All relevant biological outcomes related to the subject population, including space use, demography, survival, reproduction, trophic, behaviour, genetics, and physiology	IN: For full description and definitions (*cf.* Table 3)
Exclusion criteria		
Ineligible population	Invasive species or population historically introduced for hunting purposes	OUT: Invasive alien species outside of its natural distribution area and that threatens biological function and diversity of native populations Game/Hunting purposes: if transfer of species is for hunting purposes
Ineligible intervention	Non conservation-based introductions (e.g. historically introduced animals for hunting purposes or accidental introductions)	OUT: Non-conservation based transfer of species—where persistence or conservation of individuals is not the motivation (e.g. sport/game hunting) Accidental introductions: any documentation reporting on accidental invasions, pathways, and risks etc.
Ineligible outcomes	Sources not studying one of either Space use, Demography, Survival, Reproduction, Feeding, Behaviour, Genetics, Physiology	OUT: Non-relevant outcomes that would not enable any interpretation of success. Trophic cascades will not be retained

Table 3 Outcome categories and corresponding descriptions

Outcome category	Description	Example references (from test list or scoping exercise)
Space use	Studies measuring all movement/dispersal of translocated individuals. This will include notably home range measurements, or euclidean distance travelled	[43]
Demography	Studies outlining the changes in number of individuals, males/females, of the translocated population i.e. population growth overtime	[44, 45]
Survival	Studies illustrating precisely the proportion of individuals alive or level of mortality since translocation	[46]
Reproduction	Any impacts on reproduction, expressed by number of young born since translocation, or specifically the survival rate of offspring	[47]
Feeding	All impacts specifically on diet and feeding of translocated individuals. (*Nb.* cascade effects will not be included as an outcome)	[48, 49]
Behaviour	Studies measuring changes in terms of communication (e.g. vocal), social structure, or anti-predator behaviour i.e. stress/vigilance levels, of translocated individuals	[50, 51]
Genetics	Studies relating to the genetic structure of the translocated species	[52]
Physiology	All biological or physiological impacts measured at the molecular, cellular or organic level (e.g. hormone activity)	[53]

for hunting purposes. We will provide a list of articles excluded at full text with reasons for exclusion.

Study validity assessment

No formal validity appraisal of included studies will be performed. All studies that are deemed eligible at the full text stage based on the Population, Intervention, Outcomes, and Context criteria/screening stages will be included in the Map. Thus, this Systematic Map will be considered a thorough narrative synthesis ahead of any review providing a comprehensive and robust overview of the existing evidence.

Data coding strategy

A thorough meta-data extraction for the Map will be performed by the same two members of the mapping team. Each selected article will be double coded. If, due to resource limitations, true double coding is not possible, a posteriori cross-check will be carried out and potential disagreements will be discussed until a consensus is reached. Concerning missing data, if data is not sufficiently detailed or simply unknown, it will be coded as such. The following meta-data will be extracted from all articles retained after completion of the screening process [an additional file is provided with full explanations (see Additional file 6)]:

Bibliographic information

- Authors of article.
- Title and abstract.
- Year of publication.
- Publication source (name of journal).
- Full-text language (English, French or other).
- Document type (journal article, book, conference object, thesis (Phd, or Msc), technical documentation, or other).
- Study content (study, review, meta-analysis, discussion paper, modelling, or other).

Study characteristics

- Study country.
- Capture and release site locality coded as two separate fields (name and geographic coordinates will be recorded if given).
- Capture and release site climate types coded as two separate fields (under the Köppen-Geiger Climate Classification).
- IUCN protected area management categories coded for each protected area. (This will be achieved by accessing the IUCN PAs database via http://www.protectedplanet.net, and then matching each PA with the PAs in the database based on NAME).
- Protected area (this will be coded in order to decipher if individuals are translocated from-to different protected areas, to, from, or within same protected area).

  i. From-to: transfer from one protected area (PA) to another.
  ii. To: transfer from a non-protected habitat i.e. outside of PA perimeter to a PA.

iii. From: transfer from a PA to a non-protected habitat i.e. outside of PA perimeter.
iv. Within same: transfer occurring within the same PA perimeter.

- Study area biome (as stated by article authors). But regrouped into 6 broad categories (Additional file 6 gives explanations on chosen habitat classes):

i. Forest/wooded.
ii. Savannah.
iii. Open habitats.
iv. Wetland/humid.
v. Marine.
vi. Aquatic.

- Study release strategy. Two release strategies will be coded as follows:

i. Soft release: studies having sufficiently described methods to acclimatize individuals at the recipient site. Two key methods will define soft release: use of protective enclosures, and use of supplemental feeding [41, 42].
ii. Hard release: immediate release (no acclimatization and no supplementary food) [41].

- Study cost (in the rare case that such information is reported, we will record figures stated by article authors).
- Distance between capture and release site (coded *à posteriori* with recorded geographic coordinates and use of geographic software).

Population characteristics

- The lowest taxonomic rank will be recorded if sufficiently detailed i.e. species name. Otherwise, higher taxonomic classification will be used e.g. genus, family or Order.
- Source and destination (wild-to-wild, captive-to-wild, breeding-to-wild). If transferred individuals are bred at specific sites, then released to wild this will be coded as "breeding-to-wild".
- Study sample size (number of individuals initially translocated, as stated by article authors).
- Study age class at release (adult, juveniles or both, as stated by authors). However, concerning plant translocations it will be appropriate to detail life stage at translocation e.g. seed, seedling, and adult plant.

Intervention characteristics

- Study interventions (supplementation, reintroduction, or introduction). 5 possible intervention categories will be coded as follows:

i. Introduction—if a study is based on a single one-off intervention i.e. assisting the migration of a given species to suitable habitat outside of its historical distribution.
ii. Intro + Suppl—an introduction intervention followed for the supplementation of the same introduced population.
iii. Reintroduction—a single one-off reintroduction event (not followed by supplementation).
iv. Reintro + Suppl—a reintroduction followed by the supplementation of the same reintroduced population.
v. Supplementation—where a given study only reports on the supplementation of an already threatened species.

- Duration of intervention i.e. "translocation period" (number of years). This will be relevant for cases where an initial reintroduction event is followed by several supplementations.
- If translocation is climate motivated or not.
- Programme motivation (this will outline the overall motive of the manual transfer/movement of the species in question).

i. Conservation (improving status of focal species).
ii. Rewilding (restoring natural functions).
iii. Experimental or trial translocations.
iv. Human-wildlife conflict.
v. Wildlife rescue operations (from human development projects/urbanisation).
vi. Metapopulation management.

Outcome characteristics

- The following biological outcomes will be recorded: space use, demography, survival, reproduction, feeding, behaviour, genetics, and physiology (*cf.* Table 3 for full descriptions).

Study mapping and presentation

A systematic map database will be provided, detailing all included articles from the full text screening stage. The

systematic map will include all the metadata coded for each article. For the cases where more than one study is reported in the same article, each study will be recorded as a unique entry in the excel database with its corresponding geographical coordinates, if given, and a unique study ID. This database will be available as an open access excel spreadsheet and included as an appendix to the systematic map publication.

The map database will be described in the map publication with summary figures and tables of the relevant study characteristics. A geographic map will present the location of each translocation event/study. Possible knowledge gaps (under-represented subtopics that warrant further primary research) and knowledge clusters (well-represented subtopics for full synthesis by a systematic review) will be identified by cross-tabulating key meta-data variables (e.g. biological groups and outcomes). Based on these results, recommendations will be made on priorities for future research concerning translocation and protected areas. Recommendations will also be made to inform management. To this end, regarding the specific objectives of the LIFE project, all Map results will be transferred to reserve managers. In addition, a practitioner brief will be provided to reserve managers with the aim of summarizing key results in an operational manner in order to aid decision making. Workshops are already planned for this.

Supplementary information

Supplementary information accompanies this paper at https://doi.org/10.1186/s13750-020-00199-4.

Additional file 1. Our declaration and checklist of adherence to the ROSES guidelines.

Additional file 2. Test list and overall comprehensiveness of search string.

Additional file 3. Illustrating the building process of the search string.

Additional file 4. Web of Science Core Collection database subscription details.

Additional file 5. Corresponding number of Search hits from Web of Science core collection, Scopus, and supplementary search in google scholar and organisation websites.

Additional file 6. A Codebook outlining the meta-data extraction methods.

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Authors' contributions
JL and RS wrote the protocol. JL, RS and YR conceived the literature search strategy including the key word equation. RS contributed to the initial round-table and integration of the systematic review methods into the LIFE project, and provided overall assistance concerning methods and CEE guidelines. YR provided overall scientific expertise and proof-reading. All authors read and approved the final manuscript.

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Availability of data and materials
Data sharing is not applicable to the publication of the review protocol. All datasets associated with the Systematic Map will be made available as open access files (Additional file 6).

Ethics approval and consent to participate
No ethics agreement was required.

Consent for publication
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Competing interests
Authors declare having no competing interests.

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