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Effects of conservation interventions on coral reefs: a protocol for subject-wide evidence synthesis

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Abstract

Globally, coral reefs face multiple threats, including pollution (chemical, nutrient, noise, light, etc.), ocean acidification, fishing, over-exploitation, invasive species, anchor and dredge damage, and disease, and many reefs are declining rapidly. With the pressure of these threats combined with the impacts of climate change, such as thermal stress, heat waves, and increased storm intensity, there is an urgent need for evidence-based conservation and restoration of coral reefs. Reviewing the evidence is a time-consuming and costly exercise. In general, the assessment of the evidence-base is approached on a case-by-case basis and different stakeholders independently conduct evidence reviews relative to their specific application or enquiry. This approach is counter to the philosophy of ‘produce once and use many times over’ and is a highly inefficient use of time and resources. Here, we use a subject-wide synthesis approach: a systematic method of reviewing and synthesising evidence for broad subject areas (such as the conservation of entire taxa). The methods outlined in this protocol are designed to simultaneously collate and summarise the evidence for the effectiveness of the entire range of potential conservation interventions for all coral reefs (fringing, barrier, patch, and atoll in tropical, temperate, or deep-sea environments). A conservation intervention is any action taken to protect, manage, enhance, or restore coral reefs. The wording used throughout this protocol is standard for a subject-wide Conservation Evidence synthesis.

Key Words: subject-wide evidence synthesis, coral reefs, tropical, temperate, mesophotic, deep-sea, zooxanthellae, hard coral, soft coral, conservation, intervention, restoration, management

Background

Coral reefs (Phylum: Cnidaria) are found in a diverse range of marine habitats in tropical, temperate, and arctic waters from shallow coasts all the way down to the deep sea. The synopsis will consider all coral reefs including fringing, barrier, patch, and atoll reefs (see below for further details). Despite covering just 0.2% of the ocean floor, coral reefs are believed to support more than 25% of marine species (Souter et al. 2021). Coral reefs are threatened by anthropogenic impacts such as land-use change (urban, industrial and agricultural), nutrient enrichment, chemical and noise pollution, resource exploitation, damage from fishing gear and destructive fishing activity, invasive species, disease, and declining water quality (Souter et al. 2021). Climate change and increasing levels of atmospheric greenhouse gases continue to have serious direct and indirect effects including ocean acidification, more frequent bleaching events and increasing frequency and intensity of storms (Hein et al. 2020). A recent report, Status of the Coral Reefs of the World 2020, by the Global Coral Reef Monitoring Network (GCRMN) reported that between 2009 and 2018 there was a loss of 14% of the global average cover of hard coral on the world’s coral reefs (Souter et al. 2021).

Although all coral reefs face broadly similar threats, actions aimed at conserving or restoring coral reefs will vary depending on species and where the reef is located. Actions can be considered within three broad themes i) protection of healthy reefs (e.g. use of marine protected areas), ii) measures to reduce impact of threats (e.g. fisheries management, pollution control), and iii) active restoration (e.g. ex-situ cultivation, transplanting). As coral reefs can take many years or even centuries to recover from damage (Boch et al. 2019), the

priority should be effective measures to protect existing reefs, followed by measures to mitigate anthropogenic impacts and threats. Restoration should work in conjunction with protection and mitigation (Montero-Serra et al. 2019; Boström-Einarsson et al. 2020; Souter et al. 2021). All these measures must be combined with global efforts to tackle climate change and reduce the devastating impact on the world's coral reefs such as a rise in ocean temperature and increased ocean acidification, as well as the equally deleterious impacts of excess nutrient input and eutrophication (Silbiger et al. 2018).

Evidence-based knowledge is key for planning successful conservation and/or restoration strategies and for the cost-effective allocation of scarce resources for conservation and restoration programmes. However, there is considered to be a paucity of evidence within the literature for the effectiveness of interventions aimed at coral reef conservation or restoration (Shaver et al. 2018). Reviews of some conservation actions (e.g. marine protected areas) have been carried out (e.g. Pendleton et al. 2018; Montero-Serra et al. 2018, NAS 2019, Boström-Einarsson et al. 2020). However, the evidence for the effectiveness of all interventions targeting coral reef conservation or restoration has not yet been synthesised and assessed under a formal review.

Here, we use a subject-wide evidence synthesis approach (Sutherland & Wordley 2018, Sutherland et al. 2019) to simultaneously summarize the evidence for the wide range of interventions dedicated to the conservation or restoration of all coral reefs (fringing, barrier, patch, and atoll in tropical, temperate, or deep-sea environments). By simultaneously targeting the entire range of potential interventions, we can review the evidence for each intervention cost-effectively, and the resulting synopsis can be updated periodically and efficiently to incorporate new research. The synopsis will be freely available at www.conservationevidence.com and, alongside the *Conservation Evidence* online database (comprising all summarized information from the synopsis along with expert assessment scores), should be a valuable asset to the toolkit of practitioners and policy makers seeking sound information to support coral reef conservation and restoration.

Scope of the review

1. Review subject

This synthesis will collate global evidence for the effectiveness of conservation and restoration interventions for all coral reefs (fringing, barrier, patch, and atoll in tropical, temperate, or cold-water environments). We will include coral reefs that inhabit shallow waters through the mesophotic zone (reduced light penetration at 30 m – 150 m depth) down to the deep sea. This subject has not yet been covered using subject-wide evidence synthesis. This is defined as a systematic method of reviewing and synthesising evidence that covers broad subjects (in this case conservation or restoration of coral reefs) at once, including all closed review topics within that subject at a fine scale, and analysing results through study summary and expert assessment, or through meta-analysis. The term can also refer to any product arising from this process (Sutherland et al. 2019). The topic is therefore a priority for the discipline-wide Conservation Evidence database.

Evidence for the effectiveness of interventions targeting the conservation of other aquatic or semi-aquatic species that rely on coral reef habitats (such as fishes, invertebrates, etc.) are covered in separate synopses.

In relation to active restoration interventions, we will not include evidence from the substantial literature on the commercial cultivation of coral species solely for the aquarium trade. However, we will include these interventions where they are relevant to the conservation of wild declining or threatened species (e.g. cultivation and propagation of coral species for the purpose of reintroductions or gene banking (for future release). We will also include actions designed to restore coral reef habitat by transplanting ex-situ nursery cultivated coral on to man-made structures (e.g. frames) or natural surfaces (e.g. existing dead coral, rocks, or crevices on the sea floor); a process known as ‘coral gardening’. Actions relating to enhancing artificial structures in the marine environment, other than for the purposes of coral reef conservation or restoration, are published in other synopses and will not be considered here. For this synthesis, conservation and restoration interventions will include management measures or interventions that aim to protect, conserve, or restore coral reefs and reduce or remove the negative effects of threats. The output of the project will be an authoritative, transparent, freely accessible evidence-base of summarised studies and expert assessment scores that will support coral reef management decisions and help to achieve conservation outcomes.

2. Advisory board

An advisory board made up of international conservationists and academics with expertise in coral reef conservation and restoration has been formed. These experts will input into the evidence synthesis at three key stages: a) reviewing the protocol including identifying key sources of evidence, b) developing a comprehensive list of conservation interventions for review and c) reviewing the draft evidence synthesis. The advisory board is listed above, although additional experts may be added during the production of the synopsis. The final list will be published in the synopsis document and online (<https://www.conservationevidence.com/content/page/119>).

3. Creating the list of interventions

At the start of the project, a comprehensive list of interventions will be developed by searching the literature and in partnership with the advisory board. The list will also be checked by Conservation Evidence to ensure that it follows the standard structure. The aim is to include all interventions that have been carried out or advised to support coral reef conservation or restoration, whether evidence for the effectiveness of an intervention is available or not. During the synthesis process further interventions may be discovered, which will be integrated into the synopsis structure.

The list of interventions will be organized into categories based on the IUCN classifications of direct threats (<https://www.iucnredlist.org/resources/threat-classification-scheme>) and conservation actions (<https://www.iucnredlist.org/resources/conservation-actions-classification-scheme>).

For interventions with a large literature, the intervention may be split into different methods of implementation (e.g. different designs, implementation in different seasons, different methods for growing coral, etc.), different types of coral, or broad habitats, if relevant to do so and provided that each has five or more studies testing it.

Depending on the amount of available evidence, it may not be possible to summarise the evidence for all interventions within the time frame of this project. Under those circumstances, once the comprehensive list of interventions has been produced, we will

prioritise those interventions associated with coral reef restoration for completion. We will then ask the advisory board to prioritise interventions/group of interventions and summarise the evidence starting with that for the highest priorities and then work down the priority list.

Methods

1. Literature searches

Literature will be obtained from the Conservation Evidence discipline-wide literature database, and from searches of additional subject specific literature sources. The Conservation Evidence discipline-wide literature database is compiled using systematic searches of journals and organisational reports; relevant publications describing studies of conservation interventions for all species groups and habitats are saved from each search and are added to the database.

a) Global evidence

Evidence from all around the world will be included.

b) Languages included

A recent study on the topic of language barriers in global science indicates that approximately 35% of conservation studies may be in non-English languages (Amano et al. 2016). Therefore, journals published in a total of 17 languages have been searched and relevant papers extracted by Conservation Evidence:

- Arabic (12 journals)
- Chinese, simplified (61 journals)
- Chinese, traditional (14 journals)
- English (over 330 journals)
- French (13 journals)
- German (39 journals)
- Hungarian (4 journals)
- Indonesian (1 journal)
- Italian (7 journals)
- Japanese (20 journals)
- Korean (5 journals)
- Persian (9 journals)
- Polish (10 journals)
- Portuguese (29 journals)
- Russian (12 journals)
- Spanish (61 journals)
- Turkish (27 journals)
- Ukrainian (3 journals)

Journals listed as “English” are either published in English or at least carry English summaries (Appendix 1). Non-English-language journals are listed in Appendix 2. All relevant papers were added to the Conservation Evidence discipline-wide literature database (see below).

c) Journals searched

i) From Conservation Evidence discipline-wide literature database

All of the journals (and years) listed in Appendix 1 and Appendix 2 have already been searched and relevant papers have been added to the Conservation Evidence discipline-wide literature database. An asterisk indicates the journals most relevant to this synopsis. Others are less likely to have included papers relevant to this synopsis, but if they did, they will be summarised.

For the English language papers, all of the marine invertebrate papers will be scanned at title (and abstract if necessary) for studies relevant to this synopsis. For the non-English papers, we conducted a key-word search of the titles and in most cases abstracts for translations of ‘coral’; ‘reef’; ‘zooxanthellae’; ‘fringe’; ‘barrier’; ‘atoll’; ‘marine invertebrate’; ‘deep-sea’; and ‘mesophotic’. All suitable articles will be translated then summarised.

ii) Update searches

Due to time constraints, we will not be updating journal searches. However, we will be undertaking new searches of more relevant journals (see list below).

iii) New searches

In addition to the list of journals in Appendix 1, focused searches of journals relevant to the conservation of coral reefs listed below will be undertaken. These journals were identified through expert judgement by the project researchers and the advisory board and ranked in order of relevance, to prioritise searches that were considered likely to yield higher numbers of relevant studies. Journals with large numbers of papers each year, or that are long-running may not be searched from the first year of publication; instead, searches will be undertaken backwards from the end of 2020 for 30 years for long-running journals. It may not be possible to search all of the journals listed within the time frame of this project. Journals will be searched in the order presented below.

- Coral Reefs
- Bulletin of Marine Science
- Ecological Engineering
- Marine Biology
- Marine Policy
- Ocean and Coastal management
- Estuarine Coastal and Shelf Science
- Western Indian Ocean Journal of Marine Science
- Deep Sea Research II
- Marine Biodiversity

d) Reports from specialist websites searched

i) From Conservation Evidence discipline-wide literature database

All of the report series (and years) shown in Appendix 3 have already been searched for the Conservation Evidence project. An asterisk indicates the report series most relevant to this synopsis. Others are less likely to have included reports relevant to this synopsis, but if they did they will be summarised.

ii) Update searches

Due to time constraints, we will not be updating report searches. However, we will be undertaking new searches of more relevant reports (see list below)

iii) New searches

New searches will target specialist reports relevant to coral reef conservation and restoration as listed below. These searches will review every report title and abstract or summary within each report series (published before the end of 2020) and add any relevant report to the project database. It may not be possible to search all of those listed within the time frame of this project. Reports will be searched in the order presented below.

- Global Coral Reef Monitoring network (GCRMN): Status of coral reefs of the world reports 1998- 2020 (<https://gcrmn.net/?s=status+of+coral+reefs+of+the+world>)
- International Council for the Exploration of the Sea (ICES) Expert Groups (<https://www.ices.dk/community/groups/Pages/default.aspx>) reports from Working Group on Deep-water Ecology (WGDEC) Volume 2: Issue 62 (2020) and Volume 1: Issue 56 (2019) (<https://www.ices.dk/community/groups/Pages/WGDEC.aspx>)

The following resource has published over 9,000 reports and therefore systematic searches of every title will not be possible within the time frame of this project. Instead, key-word searches (for ‘coral’, ‘reef’, ‘atoll’, ‘zooxanthellae’) will be carried out within the topic.

- National Academies Press Reports (<https://www.nap.edu/>)

e) Other literature searches

The online database www.conservationevidence.com will be searched for relevant publications that have already been summarised.

Where a systematic review is found for an intervention, if the intervention has a small literature (< 20 papers), all publications including the systematic review will be summarised individually. If the intervention has a large literature (≥ 20 papers), then only the systematic review will be summarised as will any publications published since the review or not included within it. Where a non-systematic review (or editorial, synthesis, preface, introduction etc.) is found for an intervention, all relevant publications referenced within it will be included, but the review itself will not be summarised. However, if the review also provides new/collective data, then the review itself will also be included/summarised (indicating which other summarized publications it includes). Relevant publications cited in other publications summarised for the synopsis will not be included (due to time restrictions).

f) Supplementary literature identified by advisory board or relevant stakeholders

Additional journal or specialist website searches, and relevant papers or reports suggested by the advisory board or relevant stakeholders will also be included, where time permits.

Additional searches may be added during the production of the synopsis. The final list of evidence sources searched for this synopsis will be published in the synopsis document (including a summary using Appendix 4), and the full list of journals and report series searched published online (<https://www.conservationevidence.com/journalsearcher/synopsis>).

g) Search record database

A database will be created of all relevant publications found during searches. Reasons for exclusion will be recorded for all those included during screening that are not summarised for the synopsis.

2. Publication screening and inclusion criteria

A summary of the total number of evidence sources and papers/reports screened will be published in the synopsis using the diagram in Appendix 4.

a) Screening

To ensure consistency/accuracy when screening publications for inclusion in the literature database, an initial test using the Conservation Evidence inclusion criteria (provided below) and a consistent set of references was carried out by authors, compared with the decisions of the experienced core Conservation Evidence team. Results were analysed using Cohen's Kappa test (Cohen 1960). Where initial results did not show 'substantial' ($K=0.61-0.8$) or 'almost perfect' agreement ($K=0.81-1.0$), authors were given further training. A second Kappa test will be used to assess the consistency/accuracy of article screening for the first two years of the first journal searched by each author. Again, where results do not show 'substantial' ($K=0.61-0.8$) or 'almost perfect' agreement ($K=0.81-1.0$), authors will receive further training before carrying out further searches.

Authors of other synopses who have searched journals and added relevant publications to the Conservation Evidence literature database since 2018, and all other searchers since 2017 have undertaken the initial paper inclusion test described above; searchers prior to that have not. Kappa tests of the first two years searched have been carried out for all new searchers who have contributed to the Conservation Evidence literature database since July 2018.

We acknowledge that the literature search and screening method used by Conservation Evidence, as with any method, will result in gaps in the evidence. The Conservation Evidence literature database currently includes relevant papers from over 330 English language journals as well as over 320 non-English journals. Additional journals are frequently added to those searched, and years searched are often updated. It is possible that searchers will have missed relevant papers from those journals searched. Publication bias will not be taken into account, and it is likely that additional biases will result from the evidence that is available, for example there are often geographic biases in study locations.

b) Inclusion criteria

The following Conservation Evidence inclusion criteria will be used.

Criteria A: Conservation Evidence includes studies that measure the effect of an intervention that might be done to conserve biodiversity

1. Does this study measure the effect of an intervention that is or was under the control of humans, on wild taxa (including captives), habitats, or invasive/problem taxa? If yes, go to 3. If no, go to 2.
2. Does this study measure the effect of an intervention that is or was under the control of humans, on human behaviour that is relevant to conserving biodiversity? If yes, go to Criteria B. If no, the study will be excluded.
3. Could the intervention be put in place by a conservationist/decision maker to protect, manage or restore wild taxa or habitats, reduce impacts of threats to wild taxa or habitats, or control or mitigate the impact of the invasive/problem taxon on wild taxa or habitats? If yes, the study will be included. If no, the study will be excluded.

Explanation:

1.a. Study must have a measured outcome on wild taxa, habitats or invasive species: excludes studies on domestic/agricultural species, theoretical modelling or opinion pieces. See Criteria B for interventions that have a measured outcome on human behaviour only.

b. Intervention must be carried out by people: excludes impacts from natural processes (e.g. wave action, natural storms), impacts from background variation (e.g. sediment type, climate change), correlations with habitat types, where there is no test of a specific intervention by humans, or pure ecology (e.g. movement, distribution of species).

2. Study must test an intervention that could be put in place for conservation. This excludes assessing impacts of threats (interventions which remove threats would be included). The test may involve comparisons between sites/factors not originally put in place or modified for conservation but which could be (e.g. fished vs unfished sites, dredged vs undredged sites – where the removal of fishing/dredging is as you would do for conservation, even if that was not the original intention in the study).

If the title and/or abstract are suggestive of fulfilling our criteria, but there is not sufficient information to judge whether the intervention was under human control, the intervention could be applied by a conservationist/decision maker or whether there are data quantifying the outcome, then the study will be included. If the article has no abstract, but the title is suggestive, then a study will be included.

We sort articles into folders by which taxon/habitat they have an outcome on. If the title/abstract does not specify which species/taxa/habitats are impacted, then the full article will be searched and then assigned to folders accordingly.

The outcome for wild taxa/habitats can be negative, neutral or positive, does not have to be statistically significant but must be quantified (if hard to judge from abstract, then it will be included). It could be any outcome that has implications for the health of individuals, populations, species, communities or habitats, including, but not limited to the following:

- Individual health, condition or behaviour, including in captivity: e.g., growth, size, weight, stress, disease levels or immune function, movement, use of natural/artificial habitat/structure, range, or predatory or nuisance behaviour that could lead to retaliatory action by humans
- Breeding: egg/sperm production, sperm motility/viability after freezing, artificial fertilization success, mating success, birth rate, litter size, calf/pup condition, ‘overall recruitment’
- Genetics: genetic diversity, genetic suitability (e.g. adaptation to local conditions, use of correct flyways for migratory species, etc.)
- Life history: age/size at maturity, survival, mortality
- Population measures: number, abundance, density, presence/absence, biomass, movement, cover, age-structure, species distributions (only in response to a human action), disease prevalence, sex ratio
- Community/habitat measures: species richness, diversity measures (including trait/functional diversity), community composition, community structure (e.g. trophic structure), area covered (e.g. by different habitat types), physical habitat structure (e.g. rugosity, height, basal area)

Interventions within the scope of Conservation Evidence include:

- Clear management interventions: e.g. closing an area to fishing, modifying fishing gear to reduce bycatch, controlling invasive species, creating or restoring habitats
- International or national policies
- Reintroductions or management of wild species in captivity
- Interventions that reduce human-wildlife conflict
- Interventions that change human behaviour, resulting in an impact on wild taxa or habitats

See <https://www.conservationevidence.com/data/index> for more examples of interventions.

Note on study types:

Literature reviews, systematic reviews, meta-analyses or short notes that review studies that fulfil these criteria will be included.

Theoretical modelling studies will be excluded, as no intervention has been taken. However, studies that use models to analyse real-world data, or compare models to real-world situations will be included (if they otherwise fulfil these criteria).

Criteria B: Conservation Evidence includes studies that measure the effect of an intervention that might be done to change human behaviour for the benefit of biodiversity

1. Does this study measure the effect of an intervention that is or was under human control on human behaviour (actual or intentional) which is likely to protect, manage or restore wild taxa or habitats, or reduce threats to wild taxa or habitats? If yes, go to 2. If no, the study will be excluded.
2. Could the intervention be put in place by a conservationist, manager or decision maker to change human behaviour? If yes, the study will be included. If no, the study will be excluded.

Explanation:

1. a. Study must have a measured outcome on actual or intentional human behaviour including self-reported behaviours: excludes outcomes on human psychology (tolerance, knowledge, awareness, attitude, perceptions or beliefs).
1. b. change in human behaviour must be linked to outcomes for wild taxa and habitats, excludes changes in behaviour linked to outcomes for human benefit, even if these occurred under a conservation program (e.g. we would exclude a study demonstrating increased school attendance in villages under a community based conservation program).
1. c. Intervention must be under human control: excludes impacts from climatic or other natural events.
2. Study must test an intervention that could be put in place for conservation: excludes studies with no intervention e.g. correlating human personality traits with likelihood of conservation-related behaviours.

The human behaviour outcome of the study can be negative, neutral or positive, does not have to be statistically significant but must be quantified (if hard to judge from abstract, then it will be included). It could be any behaviour that is likely to have an outcome on wild taxa and habitats (including mitigating the impact of invasive/problem taxon on wild taxa or habitats). Interventions include, but are not limited to the following:

- Change in adverse behaviours (which directly threaten biodiversity) e.g. unsustainable fishing (industrial, artisanal or recreational), urban encroachment, creating noise, entering sensitive areas, polluting or dumping waste, clearing or habitat destruction, introducing invasive species
- Change in positive behaviours e.g. uptake of alternative/sustainable livelihoods, number of households adopting sustainable practices, donations
- Change in policy or conservation methods e.g. placement of protected areas, protection of key habitats/species
- Change in consumer or market behaviour e.g. purchasing, consuming, buying, willingness to pay, selling, illegal trading, advertising, consumer fraud
- Behavioural intentions to do any of the above

Interventions which are particularly likely to have a behaviour change outcome include, but are not limited to the following:

- **Enforcement:** Closed seasons, size limits, fishing gear/hunting restrictions, auditable/traceable reporting requirements, market inspections, increase number of rangers, patrols or frequency of patrols in, around or within protected areas, improve fencing/physical barriers, improve signage, improve equipment/technology used by guards
- **Behaviour Change:** promote alternative/sustainable livelihoods, payment for ecosystem services, ecotourism, poverty reduction, increased appreciation or knowledge, debunking misinformation, altering or re-enforcing local taboos, financial incentives
- **Governance:** Protect or reward whistle-blowers, increase government transparency, ensure independence of judiciary, provide legal aid
- **Market Regulation:** trade bans, taxation, supply chain transparency laws
- **Consumer Demand Reduction:** Increase awareness or knowledge, fear appeals (negative association with undesirable product), benefit appeal (positive association with desirable behaviour), worldview framing, moral framing, employing decision defaults, providing decision support tools, simplifying advice to consumers, promoting desirable social norms, legislative prohibition
- **Sustainable Alternatives:** Certification schemes, captive bred or artificial alternatives, sustainable alternatives
- **New policies for conservation/protection**

We allocate studies to folders by their outcome. All studies under Criteria B go in the 'Behaviour change' folder. They are additionally duplicated into a taxon/habitat folder if there is a specific intended final outcome of the behaviour change (if none mentioned, they will be filed only in Behaviour change).

c) Relevant subject

Studies relevant to the synopsis subject will include those focused on the conservation or restoration of coral reefs.

d) Relevant types of intervention

An intervention has to be one that could be put in place by a manager, conservationist, policy maker, advisor or consultant to protect, manage or restore coral reefs or reduce the impacts of threats to them. Alternatively, interventions may aim to change human behaviour (actual or intentional), which is likely to protect, manage or restore coral reefs or reduce threats to them. See inclusion criteria above for further details.

If the following two criteria are met, a combined intervention will be created within the synopsis, rather than duplicating evidence under all the separate interventions: a) there are five or more publications that use the same well-defined combination of interventions, with very clear description of what they were, without separating the effects of each individual intervention, and b) the combined set of interventions is a commonly used conservation strategy.

e) Relevant types of comparator

To determine the effectiveness of interventions, studies must include a comparison, i.e. monitoring change over time (typically before and after the intervention was implemented), or for example at treatment and control sites. Alternatively, a study could compare one specific intervention (or implementation method) against another. For example, this could be comparing a coral reef before and after the closure of an area to bottom trawling or measuring the effectiveness of coral restoration or ‘gardening’ using different types of structures. Exceptions, which may not have a control but will still be included, are for example the effectiveness of ex-situ coral cultivation.

f) Relevant types of outcome

Below we provide a list of anticipated metrics; others will be included if reported within relevant studies.

- Community response
 - Community composition
 - Richness/diversity
 - Extent/cover
- Population response
 - Abundance/cover: number, density, presence/absence, spatial distribution, age-structure
 - Reproductive success: larvae production, overall recruitment, larvae settlement
 - Survival: survival, mortality
 - Condition: growth, size, condition factors, biochemical ratios, stress, energetics, disease levels
 - Survival and growth of restored species
 - Establishment of new growth/larval settlement on restored reef
- Other
 - Reef soundscape
 - Change in human behaviour

g) Relevant types of study design

The table below lists the study designs included. The strongest evidence comes from randomized, replicated, controlled trials with paired sites and before-and-after monitoring.

Table 1. Study designs

Term	Meaning
Replicated	The intervention was repeated on more than one individual or site. In conservation and ecology, the number of replicates is much smaller than it would be for medical trials (when thousands of individuals are often tested). If the replicates are sites, pragmatism dictates that between five and ten replicates is a reasonable amount of replication, although more would be preferable. We provide the number of replicates wherever possible. Replicates should reflect the number of times an intervention has been independently carried out, from the perspective of the study subject. For example, 10 plots within a mown field might be independent replicates from the perspective of plants with limited dispersal, but not independent replicates for larger motile animals such as birds. In the case of translocations/release of captive bred animals, replicates should be sites, not individuals.
Randomized	The intervention was allocated randomly to individuals or sites. This means that the initial condition of those given the intervention is less likely to bias the outcome.
Paired sites	Sites are considered in pairs, within which one was treated with the intervention and the other was not. Pairs, or blocks, of sites are selected with similar environmental conditions, such as water quality or adjacent land use. This approach aims to reduce environmental variation and make it easier to detect a true effect of the intervention.
Controlled*	Individuals or sites treated with the intervention are compared with control individuals or sites not treated with the intervention. (The treatment is usually allocated by the investigators (randomly or not), such that the treatment or control groups/sites could have received the treatment).
Before-and-after	Monitoring of effects was carried out before and after the intervention was imposed.
Site comparison*	A study that considers the effects of interventions by comparing sites that historically had different interventions (e.g. intervention vs no intervention) or levels of intervention. Unlike controlled studies, it is not clear how the interventions were allocated to sites (i.e. the investigators did not allocate the treatment to some of the sites).
Review	A conventional review of literature. Generally, these have not used an agreed search protocol or quantitative assessment of the evidence.
Systematic review	A systematic review follows structured, predefined methods to comprehensively collate and synthesise existing evidence. It must weight or evaluate studies, in some way, according to the strength of evidence they offer (e.g. sample size and rigour of design). Environmental systematic reviews are available at: www.environmentalevidence.org/index.htm
Study	If none of the above apply, for example a study looking at the number of people that were engaged in an awareness raising project. Or a study measuring change over time in only one site and only after an intervention.

* Note that “controlled” is mutually exclusive from “site comparison”. A comparison cannot be both controlled and a site comparison. However, one study might contain both controlled and site comparison aspects e.g. study of bycatch by fishers using modified nets (e.g. with a smaller mesh size) and unmodified nets (controlled), and fishers using an alternative net modification, e.g. stiffened nets (site comparison).

3. Study quality assessment & critical appraisal

We will not quantitatively assess the evidence from each publication or weight it according to quality. However, to allow interpretation of the evidence, we make the size and design of each study we report clear.

We will critically appraise each potentially relevant study and will exclude those that do not provide data for a comparison to the treatment, do not statistically analyse the results (or if included this will be stated in the summary paragraph) or have obvious errors in their design or analysis. A record of the reason for excluding any of the publications included during screening will be kept within the synopsis database.

4. Data extraction

Data on the effectiveness of the relevant intervention (e.g. reduction in damage after removal of bottom trawling inside compared to outside a protected area; species survival > 1 year post-restoration; growth rate of species attached to different frame structures > 1 year post-installation) will be extracted from, and summarised for publications that include the relevant subject, types of intervention, comparator and outcomes outlined above. A summary of the total number of evidence sources and papers/reports searched and the total number of publications included following data extraction will be published in the synopsis using the diagram in Appendix 4.

In addition to ensuring consistency/accuracy when screening publications for inclusion in the discipline-wide literature database (see above), for a set of publications, relevant data will be extracted by a member of the core Conservation Evidence team as well as the author to ensure agreement for inclusion in the synopsis. Also, at the start of each month, authors will swap three summaries with another author to ensure that the correct type of data has been extracted and that the summary follows the Conservation Evidence standard format.

5. Evidence synthesis

a) Summary protocol

Each publication will usually have just one paragraph for each intervention it tests describing the study in (usually) no more than 150 words using plain English. Each summary will be in the following format:

A [TYPE OF STUDY] in [YEARS X-Y] in [HOW MANY SITES] in/of [HABITAT] in [REGION and COUNTRY] [REFERENCE] found that [INTERVENTION] [SUMMARY OF ALL KEY RESULTS] for [SPECIES/HABITAT TYPE]. [DETAILS OF KEY RESULTS, INCLUDING DATA]. In addition, [EXTRA RESULTS, IMPLEMENTATION OPTIONS, CONFLICTING RESULTS]. The [DETAILS OF EXPERIMENTAL DESIGN, INTERVENTION METHODS and KEY DETAILS OF SITE CONTEXT]. Data was collected in [DETAILS OF SAMPLING METHODS].

Type of study - use terms and order in Table 1.

Site context - for the sake of brevity, only nuances essential to the interpretation of the results are included. The reader is always encouraged to read the original source to get a full understanding of the study site (e.g. history of management, physical conditions).

For example:

A replicated, paired, site comparison study in 2002 of two coastal coral reefs in the Philippines (1) found that establishing a marine reserve closed to fishing resulted in higher density and biomass of species of fish taken by local fishers within the reserve compared to a fished area in one of two cases. For species taken by fishers, density and biomass inside reserve one was higher (density: 68 fish/500 m²; biomass: 89 kg) than outside (27/500 m²; 25 kg), but not significantly different inside and outside reserve two (density inside and outside: 41/500 m²; no biomass data provided). For fish species not subject to fishing, density was higher inside both reserves compared to outside; however, statistical tests showed this was mainly due to habitat variation not protection status (reserve one: 146 fish/250 m² inside, 113/250 m² outside; reserve two: 93/250 m² inside, 32/250 m² outside). No-take reserves approximately 450 m long (protected for 20 years) and 650 m long (protected for 15 years) off two islands were each compared to fished areas approximately 500 m away. Fish were surveyed in November and December 2002. Divers surveyed fish at six (reserve one) and eight (reserve two) coral reef slope sites inside and outside each reserve. Counts were along 50 x 10 m transects for fish taken by fishers and 50 x 5 m transects for fish not fished. Transects were surveyed twice.

(1) Abesamis R.A., Russ G.A., Alcala A.C. (2006) Gradients of abundance of fish across no-take marine reserve boundaries: Evidence from Philippine coral reefs. *Aquatic Conservation: Marine and Freshwater Ecosystems*, 16, 349–371.

A replicated, randomized, controlled, before-and-after study in 1993–1999 of five harvested hardwood forests in Virginia, USA (2) found that harvesting trees in groups did not result in higher salamander abundances than clearcutting. Abundance was similar between treatments (group cut: 3; clearcut: 1/30 m²). Abundance was significantly lower compared to unharvested plots (6/30 m²). Species composition differed before and three years after harvest. There were five sites with 2 ha plots with each treatment: group harvesting (2–3 small area group harvests with selective harvesting between), clearcutting and an unharvested control. Salamanders were monitored on 9–15 transects (2 x 15 m)/plot at night in April–October. One or two years of pre-harvest and 1–4 years of post-harvest data were collected.

(2) Knapp S.M., Haas C.A., Harpole D.N. & Kirkpatrick R.L. (2003) Initial effects of clearcutting and alternative silvicultural practices on terrestrial salamander abundance. *Conservation Biology*, 17, 752–762.

A replicated, randomized, paired, controlled study in 1936–2009 in eight sagebrush steppe sites in Oregon, USA (3) found that increasing the number of livestock decreased grass and herb cover, but did not significantly alter shrub cover. Grass and herb cover in grazed areas were lower (grass: 9%, herb: 17%) than in areas that were not grazed (grass: 18%, herb: 24%). However, shrub cover was not significantly different in grazed (16%) and ungrazed (16%) areas. Eight 2 ha fenced areas excluding livestock were established in 1936. Areas adjacent to the fenced areas were grazed by cattle from 1936–2008. In summer 2009, four 20 m transects were established in each study area and vegetation cover was assessed using a line intercept method.

(3) Davies K.W., Bates J.D., Svejcar T.J. & Boyd C.S. (2010) Effects of long-term livestock grazing on fuel characteristics in rangelands: an example from the sagebrush steppe. *Rangeland Ecology & Management*, 63, 662–669.

b) Terminology used to describe the evidence

Unless specifically stated otherwise, results reflect statistical tests performed on the data, i.e. we will only state that there was a difference if it was supported by the statistical test used, and otherwise state that there was no difference or that outcomes were similar.

If there is a good reason to report differences between treatments and controls that were not tested for statistical significance, it will be made clear within the summary that statistical tests were not carried out. Table 1 above defines the terms used to describe the study designs.

c) Dealing with multiple interventions within a publication

When separate results are provided for the effects of each of the different interventions tested, separate summaries will be written under each intervention heading. However, when several interventions were carried out at the same time and only the combined effect reported, the result will be described with a similar paragraph under all relevant interventions. The first sentence will make it clear that there was a combination of interventions carried out, i.e. ‘.....(REF) found that [x intervention], along with [y] and [z interventions] resulted in [describe effects]’. Within the results section we will also add a sentence such as: ‘It is not clear whether these effects were a direct result of [x], [y] or [z] interventions’, or ‘The study does not distinguish between the effects of [x], and other interventions carried out at the same time: [y] and [z].’

d) Dealing with multiple publications reporting the same results and reviews

If two publications describe results from the same intervention implemented in the same space and at the same time, we will only include the most stringently peer-reviewed publication (i.e. journal of the highest impact factor). If one includes initial results (e.g. after year one) of another (e.g. after 1–3 years), we will only include the publication covering the longest time span. If two publications describe at least partially different results, we will include both but make clear they are from the same project in the paragraph, e.g. ‘A controlled study... (Gallagher et al. 1999; same experimental set-up as Oasis et al. 2001)...’.

Basic (i.e. not systematic) reviews will only be summarised if they provide new/collective data; the individual publications will also be summarised to provide full details of each study. Publications identified in all other basic reviews will be obtained and summarised individually (where time allows). Where there is a systematic review of an intervention with a large associated literature (≥ 20 papers), the systematic review will be summarised along with any papers/reports published since the systematic review. If the intervention has a small literature (< 20 papers), all publications including the systematic review will be summarised.

e) Taxonomy

Taxonomy will not be updated but will follow that used in the original publication. Where possible, common names and Latin names will both be given the first time each species is mentioned within each summary.

f) Key messages

Each intervention will have a set of concise, bulleted key messages at the top, written once all the literature has been summarised. These will include information such as the number, design and location of studies included.

The first bullet point will describe the total number of studies that tested the intervention and the locations of the studies, followed by key information on the relevant metrics presented under the headings and sub-headings shown below (with number of relevant studies in parentheses for each).

- **X studies** examined the effects of [INTERVENTION] on [TARGET POPULATION]. Y studies were in [LOCATION 1]^{1,2} and Z studies were in [LOCATION 2]^{3,4}. *Locations will usually be countries (and water bodies/seas where relevant), ordered based on chronological order of studies rather than alphabetically, i.e. USA¹, Australia² not Australia², USA¹. However, when more than 4-5 separate countries, they may be grouped into regions to make it clearer e.g. Europe, North America. The distribution of studies amongst habitat types may also be added here if relevant.*

COMMUNITY RESPONSE (x STUDIES)

- **Community composition (x studies):**
- **Richness/diversity (x studies):**

POPULATION RESPONSE (x STUDIES)

- **Abundance (x studies):**
- **Reproductive success (x studies):**
- **Survival (x studies):**
- **Condition (x studies):**

USAGE (x STUDIES)

- **Uptake (x studies):**
- **Use (x studies):**
- **Behaviour change (x studies):**

OTHER (x STUDIES) (*Included only for interventions/chapters where relevant*)

- **[Sub-heading(s) for the metric(s) reported will be created] (x studies):**

If no evidence is found for an intervention, the following text will be added in place of the key messages above:

- We found no studies that evaluated the effects of [INTERVENTION] on [TARGET POPULATION].

'We found no studies' means that we have not yet found any studies that have directly evaluated this intervention during our systematic journal and report searches. Therefore we have no evidence to indicate whether or not the intervention has any desirable or harmful effects.

6. Dissemination/communication of evidence synthesis

The information from this evidence synthesis will be available in three ways:

- A synopsis pdf, downloadable from www.conservationevidence.com, will contain the study summaries, key messages and background information on each intervention.
- The searchable database at www.conservationevidence.com will contain all the summarized information from the synopsis, along with expert assessment scores.
- A chapter in *What Works in Conservation*, available as a pdf to download and a book from www.conservationevidence.com/content/page/79, will contain the key messages from the synopsis as well as expert assessment scores on the effectiveness and certainty of the synopsis, with links to the online database.

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APPENDIX 1. English language journals (and years) searched

Journals (and years) searched and for which relevant papers have been added to the Conservation Evidence discipline-wide literature database. An asterisk indicates the journals most relevant to this synopsis

An asterisk indicates the journals most relevant to this synopsis.

Journal	Years searched	Topic
Acrocephalus	2009-2018	All biodiversity
Acta Chiropterologica	1999-2019	All biodiversity
Acta Herpetologica	2006-2018	All biodiversity
Acta Oecologica	1990-2018	All biodiversity
Acta Theriologica	1977-2000	All biodiversity
African Bird Club Bulletin	1994-2017	All biodiversity
African Journal of Ecology*	1963-2016	All biodiversity
African Journal of Herpetology	1990-2018	All biodiversity
African Journal of Marine Science*	1983-2018	All biodiversity
African Primates	1995-2012	All biodiversity
African Sea Turtle Newsletter	2014-2018	All biodiversity
African Zoology	1979-2013	All biodiversity
Agriculture, Ecosystems & Environment	1983-2020	All biodiversity
Ambio	1972-2019	All biodiversity
American Journal of Primatology	1981-2019	All biodiversity
American Naturalist	1867-2019	All biodiversity
Amphibia-Reptilia	1980-2012	Amphibian Conservation
Amphibia-Reptilia	2013-2014	Reptile Conservation
Amphibia-Reptilia	1980-2018	All biodiversity
Amphibian & Reptile Conservation	1996-2006	Amphibian Conservation
Amphibian & Reptile Conservation	1996-2018	All biodiversity
Animal Biology	2003-2013	All biodiversity
Animal Conservation	1998-2019	All biodiversity
Animal Nutrition	2015-2019	All biodiversity
Animal Welfare	1992-2019	All biodiversity
Animals	2011-2019	All biodiversity
Annales Zoologici Fennici	1964-2013	All biodiversity
Annales Zoologici Societatis Zoologicae Botanicae Fennicae Vanamo	1932-1963	All biodiversity
Annual Review of Ecology, Evolution, and Systematics (formerly Annual Review of Ecology and Systematics 1970-2002)	1970-2020	All biodiversity
Annual Review of Entomology	2000-2019	All biodiversity
Antarctic Science	1980-2018	All biodiversity
Anthrozoos	1987-2019	All biodiversity
Apidologie	1958-2009	All biodiversity

Applied Animal Behaviour Science	1984-2019	All biodiversity
Applied Herpetology	2003-2009	All biodiversity
Applied Vegetation Science	1998-2017	All biodiversity
Aquarium Sciences and Conservation	1997-2001	All biodiversity
Aquatic Biology	2007-2018	All biodiversity
Aquatic Botany	1975-2017	All biodiversity
Aquatic Conservation: Marine and Freshwater Ecosystems*	1991-2018	All biodiversity
Aquatic Ecology*	1968-2018	All biodiversity
Aquatic Ecosystem Health & Management*	1998-2018	All biodiversity
Aquatic Invasions*	2006-2016	All biodiversity
Aquatic Living Resources*	1988-2018	All biodiversity
Aquatic Mammals	1972-2018	All biodiversity
Arid Land Research and Management (formerly Arid Soil Research and Rehabilitation 1987-2000)	1987-2013	All biodiversity
Asian Herpetological Research	2010-2018	All biodiversity
Asian Primates	2008-2012	All biodiversity
Asiatic Herpetological Research	1993-2008	All biodiversity
Auk	1980-2016	All biodiversity
Austral Ecology	1977-2019	All biodiversity
Australasian Journal of Herpetology	2009-2012	All biodiversity
Australian Mammalogy	2000-2019	All biodiversity
Avian Conservation and Ecology	2005-2016	All biodiversity
Basic & Applied Herpetology	2011-2018	All biodiversity
Basic and Applied Ecology*	2000-2020	All biodiversity
Behavioral Ecology	1990-2013	All biodiversity
Behaviour	1948-2013	All biodiversity
Biawak	2001-2017	All biodiversity
Bibliotheca Herpetologica	1999-2017	All biodiversity
BioControl (formerly Entomophaga until 1998)	1956-2016	All biodiversity
Biocontrol Science and Technology	1991-1996	All biodiversity
Biodiversity	2000-2018	All biodiversity
Biodiversity and Conservation*	1994-2019	All biodiversity
Biological Conservation*	1981-2020	All biodiversity
Biological Control	1991-2017	All biodiversity
Biological Invasions*	1999-2017	All biodiversity
Biology and Environment: Proceedings of the Royal Irish Academy	1993-2017	All biodiversity
Biology Letters	2005-2018	All biodiversity
Biotropica	1990-2019	All biodiversity
Bird Conservation International	1991-2016	All biodiversity
Bird Study	1980-2016	All biodiversity
Boreal Environment Research	1996-2014	All biodiversity

Bulletin Français de la Pêche et de la Pisciculture	1986-2007	All biodiversity
Bulletin of the Chicago Herpetological Society	1990-2018	All biodiversity
Bulletin of the Maryland Herpetological Society	1980-2015	All biodiversity
Canadian Journal of Fisheries and Aquatic Sciences*	1901-2018	All biodiversity
Canadian Journal of Forest Research	1971-2018	All biodiversity
Caribbean Herpetology	2010-2018	All biodiversity
Caribbean Journal of Science*	1961-2013	All biodiversity
CCAMLR Science	1985-2016	All biodiversity
CEE (Collaboration for Environmental Evidence) Systematic Reviews	2004-2016	All biodiversity
Chelonian Conservation and Biology	1993-2018	All biodiversity
Chelonian Research Monographs	1996-2017	All biodiversity
Coastal Engineering*	2000-2018	All biodiversity
Collinsorum (formerly Journal of Kansas Herpetology)	2012-2018	All biodiversity
Colonial Waterbirds	1983-1998	All biodiversity
Community Ecology	2000-2012	All biodiversity
Conservation Biology*	1987-2019	All biodiversity
Conservation Evidence*	2004-2020	All biodiversity
Conservation Genetics	2000-2013	All biodiversity
Conservation Letters*	2008-2019	All biodiversity
Contemporary Herpetology	1998-2009	All biodiversity
Contributions to Primatology	1974-1991 (final published volume)	All biodiversity
Copeia	1910-2018	All biodiversity
Courrier Scientifique du Parc Naturel Régional du Luberon et de la Réserve de Biosphère Luberon-Lure	1997-2016	All biodiversity
Cunninghamia	1981-2016	All biodiversity
Current Herpetology (formerly Acta Herpetologica Japonica 1964-1971 and Japanese Journal of Herpetology 1972-1999)	1964-2018	All biodiversity
Dodo	1977-2001	All biodiversity
Ecological and Environmental Anthropology	2005-2008	All biodiversity
Ecological Applications*	1991-2019	All biodiversity
Ecological Entomology	1985-2018	All biodiversity
Ecological Indicators	2001-2007	All biodiversity
Ecological Management & Restoration*	2000-2019	All biodiversity
Ecological Restoration*	1981-2020	All biodiversity
Ecology*	1936-2019	All biodiversity
Ecology Letters*	1998-2019	All biodiversity
Ecosystems*	1998-2013	All biodiversity
Emu	1980-2016	All biodiversity

Endangered Species Bulletin	1966-2003	All biodiversity
Endangered Species Research	2004-2019	All biodiversity
Entomologia Experimentalis et Applicata	2015-2018	All biodiversity
Environmental Conservation*	1974-2019	All biodiversity
Environmental Entomology	1990-2018	All biodiversity
Environmental Evidence*	2012-2019	All biodiversity
Environmental Management*	1977-2019	All biodiversity
Environmentalist	1981-1988	All biodiversity
Estuaries and Coasts*	2013-2017	All biodiversity
Ethology Ecology & Evolution	1989-2014	All biodiversity
European Journal of Soil Science	1950-2012	Soil Fertility
European Journal of Wildlife Research (formerly Zeitschrift für Jagdwissenschaft 1955-2003)	2004-2019	All biodiversity
Evolutionary Anthropology	1992-2014	All biodiversity
Evolutionary Ecology	1987-2014	All biodiversity
Evolutionary Ecology Research	1999-2014	All biodiversity
Fire Ecology	2005-2016	All biodiversity
Fish and Fisheries	2000-2018	All biodiversity
Fisheries	2017-2018	All biodiversity
Fisheries Management and Ecology	1990-2018	All biodiversity
Fisheries Oceanography	1992-2018	All biodiversity
Fisheries Research	1990-2018	All biodiversity
Flora	1991-2017	All biodiversity
Folia Primatologica	1963-2014	All biodiversity
Folia Zoologica	1959-2013	All biodiversity
Forest Ecology and Management	1976-2019	All biodiversity
Freshwater Biology	1975-2016	All biodiversity
Freshwater Science (formerly Freshwater Invertebrate Biology; then Journal of the North American Benthological Society)	1982-2018	All biodiversity
Frontiers in Marine Science*	2017-2018	All biodiversity
Frontiers in Psychology	2019	All biodiversity
Functional Ecology	1987-2013	All biodiversity
Genetics and Molecular Research	2002-2013	All biodiversity
Geoderma	1967-2012	Soil Fertility
Gibbon Journal	2005-2011	All biodiversity
Global Change Biology*	1995-2017	All biodiversity
Global Ecology and Biogeography	1991-2014	All biodiversity
Global Ecology and Conservation	2014-2018	All biodiversity
Grass and Forage Science	1980-2017	All biodiversity
Herpetofauna	2003-2007	All biodiversity
Herpetologica	1936-2018	All biodiversity
Herpetological Conservation and Biology	2006-2018	All biodiversity

Herpetological Monographs	1982-2018	All biodiversity
Herpetological Review	1967-2018	All biodiversity
Herpetology Notes	2008-2018	All biodiversity
Herpetozoa	1988-2018	All biodiversity
Human Wildlife Interactions	2007-2019	All biodiversity
Hydrobiologia*	2000-2018	All biodiversity
Hystrix, the Italian Journal of Mammalogy (English, 1994-)	1994-2019	All biodiversity
Ibis	1980-2016	All biodiversity
ICES Journal of Marine Science*	1990-2018	All biodiversity
iForest	2008-2016	All biodiversity
Insect Conservation and Diversity	2008-2018	All biodiversity
Integrative Zoology	2006-2013	All biodiversity
International Journal of Pest Management (formerly PANS Pest Articles & News Summaries 1969 - 1975, PANS 1976-1979 & Tropical Pest Management 1980-1992)	1969-1979	All biodiversity
International Journal of Primatology	1980-2019	All biodiversity
International Journal of the Commons	2007-2016	All biodiversity
International Journal of Wildland Fire	1991-2016	All biodiversity
International Wader Studies	1970-1972	All biodiversity
International Zoo Yearbook	1960-2019	All biodiversity
Invasive Plant Science and Management	2008-2016	All biodiversity
Israel Journal of Ecology & Evolution	1963-2013	All biodiversity
Italian Journal of Zoology	1978-2013	All biodiversity
Journal for Nature Conservation*	2002-2019	All biodiversity
Journal of Animal Ecology	1932-2019	All biodiversity
Journal of Apicultural Research	1962-2009	All biodiversity
Journal of Applied Animal Nutrition	2012-2019	All biodiversity
Journal of Applied Animal Welfare Science	1998-2019	All biodiversity
Journal of Applied Ecology*	1964-2020	All biodiversity
Journal of Aquatic Plant Management (formerly Hyacinth Control Journal 1962-1975)	1962-2016	All biodiversity
Journal of Arid Environments	1993-2017	All biodiversity
Journal of Avian Biology (formerly Ornis Scandinavica 1970-1993)	1994-2016	All biodiversity
Journal of Cetacean Research and Management	1999-2018	All biodiversity
Journal of Coastal Research*	2015-2018	All biodiversity
Journal of Ecology*	1933-2019	All biodiversity
Journal of Ecology & Natural Resources	2017-2019	All biodiversity
Journal of Environmental Management*	1973-276)	All biodiversity
Journal of Experimental Marine Biology and Ecology*	2000-2018	All biodiversity
Journal of Field Ornithology	1980-2016	All biodiversity
Journal of Forest Research	1996-2019	All biodiversity

Journal of Great Lakes Research	1975-2017	All biodiversity
Journal of Herpetological Medicine and Surgery	2009-2018	All biodiversity
Journal of Herpetology	1968-2018	All biodiversity
Journal of Insect Conservation	1997-2018	All biodiversity
Journal of Insect Science	2003-2018	All biodiversity
Journal of Kansas Herpetology	2002-2011	All biodiversity
Journal of Mammalian Evolution	1993-2014	All biodiversity
Journal of Mammalogy	1919-2019	All biodiversity
Journal of Mountain Science	2004-2016	All biodiversity
Journal of Negative Results: Ecology & Evolutionary Biology*	2004-2016	All biodiversity
Journal of North American Herpetology	2014-2017	All biodiversity
Journal of Ornithology (formerly Journal für Ornithologie to 2004)	2004-2018	All biodiversity
Journal of Primatology	2012-2013	All biodiversity
Journal of Range Management	1948-2004	All biodiversity
Journal of Raptor Research	1966-2016	All biodiversity
Journal of Sea Research (formerly Netherlands Journal of Sea Research)*	1961-2018	All biodiversity
Journal of the Marine Biological Association of the United Kingdom*	1887-2018	All biodiversity
Journal of Tropical Ecology*	1986-2020	All biodiversity
Journal of Vegetation Science	1990-2017	All biodiversity
Journal of Wetlands Ecology	2008-2012	All biodiversity
Journal of Wetlands Environmental Management	2012-2016	All biodiversity
Journal of Wildlife Diseases	1965-2012	All biodiversity
Journal of Zoo and Aquarium Research	2013-2019	All biodiversity
Journal of Zoo and Wildlife Medicine	1970-2019	All biodiversity
Journal of Zoology	1966-2019	All biodiversity
Kansas Herpetological Society Newsletter	1974-2001	All biodiversity
Knowledge and Management of Aquatic Ecosystems	2008-2018	All biodiversity
Lake and Reservoir Management	1984 -2016	All biodiversity
Land Degradation and Development	1989-2016	All biodiversity
Land Use Policy	1984-2012	Soil Fertility
Latin American Journal of Aquatic Mammals	2002-2018	All biodiversity
Lemur News	1993-2012	All biodiversity
Limnologica - Ecology and Management of Inland Waters	1999-2018	All biodiversity
Mammal Research (formerly Acta Theriologica)	2001-2019	All biodiversity
Mammal Review	1970-2019	All biodiversity
Mammal Study	2005-2019	All biodiversity
Mammalia	1937-2019	All biodiversity
Mammalian Biology	2002-2018	All biodiversity

Mammalian Genome	1991-2013	All biodiversity
Management of Biological Invasions	2010-2016	All biodiversity
Mangroves and Salt Marshes	1996-1999	All biodiversity
Marine and Freshwater Research*	1980-2018	All biodiversity
Marine Ecology*	1980-2018	All biodiversity
Marine Ecology Progress Series*	2000-2018	All biodiversity
Marine Environmental Research*	1978-2018	All biodiversity
Marine Mammal Science	1985-2019	All biodiversity
Marine Pollution Bulletin*	2010-2018	All biodiversity
Marine Turtle Newsletter	1976-2018	All biodiversity
Mesoamerican Herpetology	2014-2017	All biodiversity
Mires and Peat	2006-2016	All biodiversity
Natural Areas Journal	1992-2017	All biodiversity
Nature Conservation	2012-2019	All biodiversity
NeoBiota	2011-2017	All biodiversity
Neotropical Entomology	2004-2018	All biodiversity
Neotropical Primates	1993-2012	All biodiversity
New Journal of Botany	2011-2013	All biodiversity
New Zealand Journal of Marine and Freshwater Research*	1967-2018	All biodiversity
New Zealand Journal of Zoology	1974-2019	All biodiversity
New Zealand Plant Protection	2000-2016	All biodiversity
Northwest Science	2007-2016	All biodiversity
Oecologia*	1969-2020	All biodiversity
Oikos	1949-2020	All biodiversity
Ornis Scandinavica	1980-1993	All biodiversity
Ornitologi-a Neotropical	1990-2018	All biodiversity
Oryx	1950-2020	All biodiversity
Ostrich	1980-2016	All biodiversity
Pacific Conservation Biology*	1993-2020	All biodiversity
Pakistan Journal of Zoology	2004-2013	All biodiversity
Phyllomedusa	2002-2018	All biodiversity
Plant Ecology (formerly Vegetatio 1948-1996)	1948-2007	All biodiversity
Plant Protection Quarterly	2008-2016	All biodiversity
Polish Journal of Ecology	2002-2013	All biodiversity
Population Ecology	1952-2013	All biodiversity
Preslia	1973-2017	All biodiversity
Primate Conservation	1981-2014	All biodiversity
Primates	1957-2013	All biodiversity
Rangeland Ecology & Management (previously Journal of Range Management 1948-2004)	2005-2016	All biodiversity
Raptors Conservation	2005-2016	All biodiversity
Regional Studies in Marine Science*	2015-2018	All biodiversity

Reptile Rap - Newsletter of the South Asian Reptile Network (SARN)	1999-2016	All biodiversity
Restoration Ecology*	1993-2020	All biodiversity
Riparian Ecology and Conservation	2013-2017	All biodiversity
River Research and Applications	1987-2016	All biodiversity
Russian Journal of Ecology (Springer - translated version)	1993-2013	All biodiversity
Russian Journal of Herpetology	1994-2018	All biodiversity
Salamandra (English 2005+)	2005-2018	All biodiversity
Slovak Raptor Journal	2007-2016	All biodiversity
Small Ruminant Research	1988-2017	All biodiversity
Soil Biology & Biochemistry	1969-2012	Soil Fertility
South African Journal of Botany	1982-2016	All biodiversity
South African Journal of Wildlife Research	1971-2014	All biodiversity
South American Journal of Herpetology	2006-2018	All biodiversity
Southern Forests	2008-2013	All biodiversity
Testudo	1978-2017	All biodiversity
The Canadian Field-Naturalist (formerly Ottawa Naturalist)	1887-2019	All biodiversity
The Condor	1980-2009	All biodiversity
The Herpetological Bulletin	2008-2018	All biodiversity
The Herpetological Journal	1985-2016	All biodiversity
The Journal of Wildlife Management	1945-2019	All biodiversity
The Open Ornithology Journal	2008-2016	All biodiversity
The Rangeland Journal	1976-2016	All biodiversity
The Southwestern Naturalist	1956-2018	All biodiversity
The Wilson Bulletin	1980-2005	All biodiversity
The Wilson Journal of Ornithology (formerly The Wilson Bulletin)	2006-2016	All biodiversity
Trends in Ecology and Evolution*	1986-2019	All biodiversity
Tropical Conservation Science*	2008-2018	All biodiversity
Tropical Ecology*	1960-2018	All biodiversity
Tropical Grasslands	1967-2010	All biodiversity
Tropical Zoology	1988-2018	All biodiversity
Turkish Journal of Zoology	1996-2014	All biodiversity
Ursus	1968-2019	All biodiversity
Vietnamese Journal of Primatology	2007-2009	All biodiversity
Wader Study Group Bulletin	1970-1977	All biodiversity
Waterbirds (formerly Colonial Waterbirds)	1999-2016	All biodiversity
Weed Biology and Management	2001-2016	All biodiversity
Weed Research	1961-2017	All biodiversity
West African Journal of Applied Ecology	2000-2016	All biodiversity
Western North American Naturalist	2000-2017	All biodiversity
Wetlands	1981-2016	All biodiversity
Wetlands Ecology and Management	1989-2016	All biodiversity

Wildfowl	1948-2018	All biodiversity
Wildlife Biology	1995-2013	All biodiversity
Wildlife Monographs	1958-2013	All biodiversity
Wildlife Research	1956-2012	Bat Conservation
Wildlife Research	1974-2019	All biodiversity
Wildlife Society Bulletin	1973-2019	All biodiversity
Zhurnal Obshchei Biologii	1972-2013	All biodiversity
Zoo Biology	1982-2019	All biodiversity
ZooKeys	2008-2013	All biodiversity
Zoologica Scripta	1971-2014	All biodiversity
Zoological Journal of the Linnean Society	1856-2013	All biodiversity
Zootaxa	2004-2014	All biodiversity

Appendix 2: Non-English language journals (and years) searched

Journal	Years searched	Language
Journal of Agricultural, Environmental and Veterinary Sciences مجلة العلوم الزراعية والبيئية والبيطرية	2018-2020	Arabic
Journal of Thi-Qar Science مجلة علوم ذي قار	2014-2018	Arabic
Journal of Marine Sciences and Environmental Techniques مجلة علوم البحار والتقنيات البيئية	2016-2019	Arabic
Journal of King Abdulaziz University: Environmental Design Science مجلة جامعة الملك عبد العزيز: علوم تصميم البيئة	2003-2017	Arabic
Journal of King Abdulaziz University: Marine Sciences مجلة جامعة الملك عبد العزيز: علوم البحار	2000-2018	Arabic
Afak Ilmia Journal مجلة آفاق علمية	2017-2020	Arabic
The Arab Journal for Arid Environments المجلة العربية للبيئات الجافة	2009-2018	Arabic
Baghdad Science Journal مجلة بغداد للعلوم	2004-2020	Arabic
Tishreen University Journal for Research and Scientific Studies: Biological Sciences Series مجلة جامعة تشرين للبحوث والدراسات العلمية _ سلسلة العلوم البيولوجية	2001-2020	Arabic
Journal of Plant Protection مجلة وقاية النبات العربية	1993-2019	Arabic
Journal of King Abdulaziz University: Economics and Administration مجلة جامعة الملك عبد العزيز: الاقتصاد والإدارة	2015-2020	Arabic
Marsh Bulletin مجلة الاهوار	2010-2020	Arabic
Revue d'Écologie (La Terre et La Vie) Earth and Life	2006-2018	French
Bulletin de la Société Zoologique de France Bulletin of the French Zoology Society	1973-2015	French
Le Naturaliste Canadien The Canadian Naturalist	2008-2018	French
VertigO	2009-2019	French
Biotechnologie, Agronomie, Société et Environnement Biotechnology, Agronomy, Society and Environment	2008-2020	French
Écoscience Ecoscience	1994-2019	French
Bois et Forêts des Tropiques Tropical Woodlands and Forests	2009-2020	French

Alauda	2000-2005	French
Ecologia Mediterranea Ecologia Mediterranea: International Journal of Mediterranean Ecology	2000-2019	French
Travaux Scientifiques du Parc National de Port- Cros Scientific Reports of the Port-Cros National Park	2000-2019	French
Travaux Scientifiques du Parc National de la Vanoise Scientific Reports of the Vanoise National Park	1986-2009	French
Naturae	2017-2020	French
Die Orchidee The Orchid	1949-2016	German
Mertensiella	1988-2017	German
Die Erde The Earth	1952-2004	German
Journal für Ornithologie (German: up to 2004) Journal of Ornithology (German: up to 2004)	1959-2003	German
Mitteilungen des Badischen Landesvereins für Naturkunde und Naturschutz Communications of the Baden Association for Natural History and Nature Conservation	1953-2015	German
Die Vogelwelt: Beiträge zur Vogelkunde Bird Life: Contributions to Ornithology	2005-2017	German
Zeitschrift für Jagdwissenschaft Journal of Hunting Science [Became European Journal of Wildlife Research (Springer) in 2004]	1955-2003	German
Freiberg Online Geoscience - FOG	1998-2017	German
Gesunde Pflanzen: Pflanzenschutz, Verbraucherschutz, Umweltschutz Healthy Plants: Crop Protection, Consumer Protection, Environment Protection	2002-2017	German
Vogelwarte: Zeitschrift für Vogelkunde Bird Observatory: Ornithology Journal	2005-2017	German
Die Bodenkultur: Journal of Land Management, Food and Environment Soil Culture: Journal for Land Management, Food and Environment	2016-2017	German
Waldökologie Online (until 2008) Forest Ecology Online	2004-2008(6)	German
RANA - Mitteilungen für Feldherpetologie und Ichthyofaunistik RANA - Communications for Field Herpetology and Ichthyofauna	Vol1(1983)- Vol17(2016) excluding special issues	German
Telma	1971-2019	German
Auenmagazin (Magazin des Auenzentrums Neuburg a. d. Donau) Floodplains Journal (Magazine of the Auenzentrums Neuburg a. d. Danube)	2010-2017	German

Biodiversität und Naturschutz in Ostösterreich Biodiversity and Conservation in Eastern Austria	2015-2018	German
The Bird Fauna Die Vogelwelt	2005-2017	German
Salamandra (German 1965-2004)	1965-2004	German
Insecta	1992-2014	German
Natur und Landschaft: Zeitschrift für Naturschutz und Landschaftspflege Nature and Landscape: Journal for Nature Conservation and Landscape Management	1990-2017	German
Bulletin de la Société des Naturalistes Luxembourgeois Bulletin of the Luxemburgian Naturalist Society	1950-2017	German
Tuexenia	1981-2016	German
Forstarchiv Forestry Archive	2007-2017	German
Zeitschrift für Feldherpetologie Journal for Field Herpetology	1994-2017	German
Naturschutz und Landschaftsplanung Conservation and Landscape Planning	2003-2017	German
Arachnologische Mitteilungen Arachnological Letters	1991-2017	German
Fachzeitschrift für Waldökologie, Landschaftsforschung und Naturschutz (formerly Waldökologie Online) Journal for Forest Ecology, Landscape Research and Nature Conservation	2008-2016	German
Silva Fera: Wissenschaftliche Nachrichten aus dem Wildnisgebiet Dürrenstein Silva Fera: Scientific News from the Dürrenstein Wilderness Area	2012-2017	German
Inatura Forschung Online Inatura Research Online	1996-2007	German
ABU-Info (Arbeitsgemeinschaft Biologischer Umweltschutz im Kreis Soest e.V.) ABU-Info (Working Group for Biological Environmental Protection in Soest District)	2006-2017	German
Libellula	1982-2016	German
Der Zoologische Garten: Zeitschrift für die Gesamte Tiergärtnerei (Neue Folge) The Zoological Garden: Journal for the Entire Zoo	2007-2017	German
Pulsatilla: Zeitschrift für Botanik und Naturschutz Pulsatilla: Journal of Botany and Nature Conservation	2000-2007	German
Hercynia	1963-2017	German
Der Ornithologische Beobachter Ornithological Observer	1950-2017	German

Allgemeine Forst- und Jagdzeitung Journal for Forestry and Forest Science	2000-2016	German
Nyctalus: Internationale Fledermaus- Fachzeitschrift Nyctalus: International Bat Journal	2005-2017	German
Ornithologischer Anzeiger Ornithological Journal	1951-2017	German
Archiv für Forstwesen und Landschaftsökologie Archive for Forestry and Landscape Ecology	2013	German
Botanik und Naturschutz in Hessen Botany and Nature Conservation in Hessen	1987-2018	German
ANLiegen Natur: Zeitschrift für Naturschutz und Angewandte Landschaftsökologie Concerning Nature: Journal for Nature Conservation and Applied Landscape Ecology	2006-2017	German
Természetvédelmi Közlemények Journal of Nature Conservation	2010-2019	Hungarian
Állattani Közlemények Journal of Zoology	2010-2019	Hungarian
Tájökológiai Lapok Journal of Landscape Ecology	2010-2019	Hungarian
Botanikai Közlemények Journal of Botany	2010-2020	Hungarian
Jurnal Primatologi Indonesia	2009	Indonesian
Avocetta	2000-2013	Italian
Rivista Italiana di Ornitologia Research in Ornithology	2010-2019	Italian
Picus	2004-2018	Italian
Forest@ - Rivista di Selvicoltura ed Ecologia Forestale Forest @ - Journal of Silviculture and Forest Ecology	2004-2020	Italian
Alula Alula	1992-2019	Italian
Biologia Ambientale Environmental Biology	1994-2018	Italian
Hystrix, the Italian Journal of Mammalogy (Italian 1986-1993)	1986-1993	Italian
Japanese Journal of Ornithology 日本鳥学会誌	1917-2015	Japanese
Mammalian Science 哺乳類科学	1961-2016	Japanese
Journal of the Japanese Forest Society (2005+) 日本森林学会誌	2005-2017	Japanese
The Journal of the Japanese Landscape Architectural Society 造園学雑誌	1925-1927	Japanese
Landscape Ecology and Management 景観生態学	2005-2016	Japanese

Japanese Journal of Ecology 日本生態学会誌	1954-2017	Japanese
Wildlife Conservation Japan 野生生物保護	1995-2013	Japanese
Doubutsugaku zasshi 動物学雑誌	1888-1983	Japanese
Bulletin of the Herpetological Society of Japan 爬虫両棲類学会報	1999-2008	Japanese
Landscape Research Japan Online ランドスケープ研究(オンライン論文集)	2008-2017	Japanese
Journal of the Japanese Institute of Landscape Architects (1934-1994) 造園雑誌	1934-1994	Japanese
Wildlife and Human Society 野生生物と社会	2013-2017	Japanese
Ecology and Civil Engineering 応用生態工学	1998-2017	Japanese
Japanese Journal of Conservation Ecology 保全生態学研究	1996-2016	Japanese
Journal of the Mammalogical Society of Japan 哺乳動物学雑誌	1959-1986	Japanese
Journal of the Japanese Institute of Landscape Architecture (1994+) ランドスケープ研究	1994-2017	Japanese
Reintroduction 野生復帰	2011-2019	Japanese
Bulletin of the International Association for Landscape Ecology-Japan 国際景観生態学会日本支部会報	2002-2003	Japanese
Strix ストリクス	1982-2017	Japanese
Journal of the Japanese Forestry Society (1919-2004) 日本林学会誌	1985-2004	Japanese
Korean Journal of Environmental Biology 환경생물	2002-2020	Korean
Korean Journal of Environment and Ecology 한국환경생태학회지	2001-2020	Korean
Journal of Wetlands Research 한국습지학회지	1999-2020	Korean
Korean Journal of Ornithology 한국조류학회지	1994-2020	Korean
Journal of Korean Society of Forest Science 한국산림과학회지(한국임학회지)	2002-2020	Korean

Iranian Journal of Natural Resources مجله منابع طبیعی ایران	2002-2009	Persian
Journal of Environmental Studies محیط شناسی	2009-2017	Persian
Journal of Natural Environment نشریه محیط زیست طبیعی	2010-2017	Persian
Environmental Researches پژوهش های محیط زیست	2010-2017	Persian
Experimental Animal Biology زیست شناسی جانوری تجربی	2012-2017	Persian
Journal of Animal Researches پژوهش های جانوری	2013-2017	Persian
Journal of Environmental Sciences علوم محیطی و محیط طبیعی	2004-2017	Persian
Iranian Journal of Applied Ecology بوم شناسی کاربردی	2012-2017	Persian
Journal of Animal Environment فصلنامه محیط زیست جانوری	2014-2017	Persian
Parki Narodowe i Rezerwaty Przyrody National Parks and Nature Reserves	2009-2015	Polish
Chrońmy Przyrodę Ojczystą Let's Protect Our Indigenous Nature	2004-2019	Polish
Ornis Polonica	2010-2020	Polish
Nature Conservation (English language Vol58 2001+; formerly in Polish as Ochrona Przyrody 1920-2000)	2001-2008	Polish
Studia Naturae Studia Naturae / Nature Studies	1987-2013	Polish
Notatki Ornitologiczne Ornithological Notes	1989-2009	Polish
Przegląd Przyrodniczy Nature Review	2010-2019	Polish
Naturalia	2012-2016	Polish
Nietoperze Bats	2000-2011	Polish
Kulon Stone Curlew	1996-2018	Polish
Biodiversidade Brasileira Brazilian Biodiversity	2011-2016	Portuguese
Revista de Gestão Costeira Integrada Journal of Integrated Coastal Zone Management	2007-2019	Portuguese
Arquipelago - Life and Marine Sciences	1980-2020	Portuguese
Ambiência	2005-2019	Portuguese
Evolução e Conservação da Biodiversidade Evolution and Conservation of Biodiversity	2010-2011	Portuguese
Megadiversidade Megadiversity	2005-2009	Portuguese
Revista Brasileira de Gestão Ambiental e Sustentabilidade	2014-2017	Portuguese

The Brazilian Journal of Environmental Management and Sustainability		
Acta Amazônica Amazon Record/Journal	1971-2019	Portuguese
Chiroptera Neotropical Neotropical Chiroptera	1995-2015	Portuguese
MG Biota	2008-2016	Portuguese
Revista Nordestina de Biologia Northeastern Journal of Biology	1978-2016	Portuguese
Bioikos	1987-2016	Portuguese
Portugaliae Acta Biologica	2000-2003	Portuguese
FLORAM - Revista Floresta e Ambiente Brazilian Journal of Forestry and Environment	1994-2020	Portuguese
Biotemas	1988-2018	Portuguese
Iheringia: Série Zoologia Iheringia: Zoology Series	2000-2018	Portuguese
Revista CEPSUL - Biodiversidade e Conservação Marinha CEPSUL Magazine - Marine Biodiversity and Conservation	2010-2017	Portuguese
Natureza & Conservação Brazilian Journal of Nature Conservation	2003-2009	Portuguese
Neotropical Biology and Conservation	2006-2017	Portuguese
Ciência & Ambiente Science and Environment	1990-2015	Portuguese
Revista de Biologia Neotropical Journal of Neotropical Biology	2004-2018	Portuguese
Revista de Ciências Agrárias (SCAP) Journal of Agricultural Sciences (SCAP)	2007-2019	Portuguese
Biodiversidade (UFMT)	2007-2019	Portuguese
Floresta	1969-2017	Portuguese
Revista Brasileira de Ecologia Brazilian Journal of Ecology	1997-2009	Portuguese
Biota Neotropica Neotropical Biodiversity	2001-2011	Portuguese
Boletim do Museu de Biologia Mello Leitão Bulletin of the Mello Leitão Biology Museum	2013-2018	Portuguese
Biota Amazônica Amazonian Biota	2011-2018	Portuguese
Boletim da Sociedade Brasileira de Mastozoologia Bulletin of the Brazilian Society of Mastozoology (mammalogy)	1985-2017	Portuguese
Zoologicheskii Zhurnal (Russian Journal of Zoology) Зоологический журнал	1939-2020(8)	Russian
Contemporary Problems of Ecology Сибирский экологический журнал	1994-2020	Russian

Bulletin of Moscow Society of Naturalists: Biological Series Бюллетень МОИП, серия биологическая	1935-2020	Russian
Steppe Bulletin Степной бюллетень	1998-2020	Russian
Russian Journal of Ornithology Русский орнитологический журнал	1993-2020	Russian
Journal of Ichthyology Вопросы ихтиологии	1961-2020	Russian
Herald of Game Management Вестник охотоведения	2007-2020(2)	Russian
Ekologiya (Russian Journal of Ecology) Экология	2000-2020(4)	Russian
Current Studies in Herpetology Современная герпетология	2000-2019	Russian
Biology Bulletin Известия РАН, серия биологическая	1957-2020	Russian
Povolzhsky Journal of Ecology Поволжский экологический журнал	2002-2020	Russian
Nature Conservation Research Заповедная наука	2016-2020(No.3)	Russian
Advances in Marine Science 海洋科学进展	1983-2017	Simplified Chinese
Journal of Fisheries of China 水产学报	1965-2017	Simplified Chinese
Asian Journal of Ecotoxicology 生态毒理学报	2006-2017	Simplified Chinese
China Environmental Science 中国环境科学	1981-2017	Simplified Chinese
Plant Diversity and Resources 植物分类与资源学报杂志	1975-2017	Simplified Chinese
Journal of Arid Land Resources and Environment 干旱区资源与环境	1987-2017	Simplified Chinese
Journal of Mountain Science/Research 山地学报	1983-2017	Simplified Chinese
Resources and Environment in the Yangtze Basin 长江流域资源与环境	1992-2017	Simplified Chinese
Pratacultural Science 草业科学	1984-2017	Simplified Chinese
Acta Ecologica Sinica 生态学报	1981-2016	Simplified Chinese

Bulletin of Soil and Water Conservation 水土保持通报	1981-2017	Simplified Chinese
Chinese Journal of Eco-Agriculture 中国生态农业学报	1993-2017	Simplified Chinese
Chinese Journal of Ecology 生态学杂志	1982-2016	Simplified Chinese
Journal of Plant Resources and Environment 植物资源与环境学报	1992-2016	Simplified Chinese
Chinese Bulletin of Botany 植物学报	2006-2016	Simplified Chinese
Chinese Bulletin of Life Science 生命科学	1988-2017	Simplified Chinese
Sichuan Journal of Zoology 四川动物	1996-2016	Simplified Chinese
Marine Sciences 海洋科学	1977-2017	Simplified Chinese
Acta Theriologica Sinica 兽类学报	1981-2018	Simplified Chinese
Zoological Systematics 动物分类学报	1964-2017	Simplified Chinese
Marine Environmental Science 海洋环境科学	1982-2017	Simplified Chinese
Chinese Journal of Applied and Environmental Biology 应用与环境生物学报	1995-2017	Simplified Chinese
Environmental Science 环境科学	1976-2017	Simplified Chinese
Acta Phytolacica Sinica 植物保护学报	1962-2017	Simplified Chinese
Bulletin of Botanical Research 植物研究	1959-2017	Simplified Chinese
Journal of Desert Research 中国沙漠	1981-2017	Simplified Chinese
Acta Hydrobiologica Sinica 水生生物学报	1997-2017	Simplified Chinese
Acta Agrestia Sinica 草地学报	1989-2017	Simplified Chinese
Soils 土壤	1958-2017	Simplified Chinese
Journal of Soil and Water Conservation 水土保持学报	1987-2017	Simplified Chinese

Plant Protection 植物保护	1963-2016	Simplified Chinese
Chinese Journal of Biological Control 中国生物防治学报	1985-2017	Simplified Chinese
Journal of Agro-Environment Science 农业环境科学学报	1981-2017	Simplified Chinese
Journal of China Agricultural University 中国农业大学学报	1955-2017	Simplified Chinese
Shanghai Environmental Science 上海环境科学	1982-2017	Simplified Chinese
Biodiversity Science 生物多样性	1993-2016	Simplified Chinese
Chinese Journal of Plant Ecology (formerly Acta Phytoecologica Sinica, Acta Phytoecologica et Geobotanica Sinica, Journal of Plant Ecology) 植物生态学报	1963-2016	Simplified Chinese
Resources Science 资源科学	1977-2016	Simplified Chinese
Ecological Science 生态科学	1982-2016	Simplified Chinese
Journal of Natural Resources 自然资源学报	1986-2016	Simplified Chinese
Current Zoology (formerly Acta Zoologica Sinica 1935-2008) 动物学报	1935-2008	Simplified Chinese
Chinese Journal of Wildlife 野生动物学报	1979-2016	Simplified Chinese
Journal of Biology 生物学杂志	1983-2016	Simplified Chinese
Urban Environment & Urban Ecology 城市环境与城市生态	1988-2016	Simplified Chinese
World Forestry Research 世界林业研究	1988-2017	Simplified Chinese
Scientia Silvae Sinicae 林业科学	1955-2017	Simplified Chinese
Acta Botanica Boreali-Occidentalia Sinica 西北植物学报	2012-2016	Simplified Chinese
Wetland Science 湿地科学	2003-2017	Simplified Chinese
Journal of Lake Sciences 湖泊科学	1989-2017	Simplified Chinese

Acta Pedologica Sinica 土壤学报	1948-2017	Simplified Chinese
Chinese Journal of Applied Ecology 应用生态学报	1990-2016	Simplified Chinese
Acta Prataculturae Sinica 草业学报	2008-2017	Simplified Chinese
Chinese Journal of Grasslands (formerly Grassland of China) 中国草地学报	1979-2016	Simplified Chinese
Chinese Journal of Microecology 中国微生态学杂志	1989-2017	Simplified Chinese
Journal of Ecology and Rural Environment (formerly Rural Eco-Environment) 生态与农村环境学报	1985-2017	Simplified Chinese
Chinese Journal of Zoology 动物学杂志	1957-2016	Simplified Chinese
Journal of Tropical and Subtropical Botany 热带亚热带植物学报	1992-2016	Simplified Chinese
Life Science Research 生命科学研究	1997-2016	Simplified Chinese
Zoological Research 动物学研究	1980-2016	Simplified Chinese
Journal of Hydroecology (formerly Reservoir Fisheries) 水生态学杂志	1981-2017	Simplified Chinese
Ecology and Environmental Sciences (formerly Ecology and Environment) 生态环境学报	1992-2016	Simplified Chinese
Cedamaz	2014-2018	Spanish
BioScriba	2008-2017	Spanish
Ecosistemas: Revista Científica de Ecología y Medio Ambiente Ecosystems: Scientific Journal of Ecology and Environment	2001-2018	Spanish
Notulas Faunísticas	2008-2018	Spanish
Animal Biodiversity and Conservation	2001-2019	Spanish
Folia Amazónica	1988-2018	Spanish
Caldasía	1940-2019	Spanish
El Hornero: Revista de Ornitología Neotropical	2003-2017	Spanish
Revista Española de Herpetología Spanish Journal of Herpethology	2003-2007	Spanish
Revista de Biología Tropical International Journal of Tropical Biology and Conservation	1976-2018	Spanish

Colombia Forestal	2000-2018	Spanish
Revista Chilena de Historia Natural Chilean Journal of Natural History	1897-2018	Spanish
Therya	2010-2019	Spanish
Ecología Austral Austral Ecology	2001-2018	Spanish
Ardeola	1954- 2019	Spanish
Hidrobiológica Hydrobiology	1991-2018	Spanish
Revista Mexicana de Mastozoología Mexican Journal of Mastozoology	1995-2017	Spanish
Madera y Bosques Wood and Forests	1995-2018	Spanish
Revista Chilena de Ornitología (formerly Boletín Chileno de Ornitología) Chilean Journal of Ornithology	2016-2018	Spanish
Galemys	1997-2017	Spanish
Novitates Caribaea	1999-2019	Spanish
Mediterránea: Serie de Estudios Biológicos Mediterranean: Biological Studies Series	1982-2015	Spanish
Revista Nicaragüense de Biodiversidad Nicaraguan Journal of Biodiversity	2015-2019	Spanish
Revista Mexicana de Biodiversidad Mexican Journal of Biodiversity	2005-2018	Spanish
Semiárida	2013-2018	Spanish
Boletín de la Real Sociedad Española de Historia Natural: Sección Biológica Bulletin of the Royal Spanish Society of Natural History: Biological Section	2003-2017	Spanish
Bosques Latitud Cero Forests Latitude Zero	2014-2018	Spanish
Anales de Biología	1984-2019	Spanish
Revista Peruana de Biología Peruvian Journal of Biology	1974-2019	Spanish
Edentata Edentata	1994-2018	Spanish
Boletín Científico Centro de Museos Bulletin of the Museum Scientific Center	1996-2019	Spanish
Revista Catalana d'Ornitologia Catalan Journal of Ornithology	2002-2018	Spanish
A Carriza: Sociedad Gallega de Ornitologia	2001-2009	Spanish
Gestión Ambiental	1999-2017	Spanish
Mastozoología Neotropical Neotropical Mammalogy	1994-2017	Spanish
Journal of Bat Research and Conservation (formerly known as Barbastella)	2017-2019	Spanish
Boletín de la Sociedad Argentina de Botánica Bulletin of the Argentinean Society of Botany	2013-2018	Spanish

Acta Zoológica Mexicana Mexican Zoological Record/Journal	1984-2019	Spanish
Biodiversity and Natural History (formerly Boletín de Biodiversidad de Chile) Biodiversity and Natural History (formerly Boletín de Biodiversidad de Chile)	2015-2017	Spanish
Ocelotlán	2003-2012	Spanish
Zoologica Baetica	1990-2015	Spanish
Mammalogy Notes	2014-2017	Spanish
Centros: Revista Científica Universitaria Centros: Scientific Journal of the University	2012-2018	Spanish
Huitzil: Revista Mexicana de Ornitología Huitzil: Journal of Mexican Ornithology	2000-2018	Spanish
Bioma (El Salvador)	2012-2016	Spanish
Barbastella	2000-2016	Spanish
Quebracho: Revista de Ciencias Forestales Quebracho: Journal of Forest Sciences	2008-2018	Spanish
Etología Ethology	1989-2003	Spanish
Historia Natural Natural History	2011-2018	Spanish
Arxius de Miscel·lània Zoològica Arxius de Miscel·lània Zoològica	2003-2019	Spanish
Agrociencia Uruguay Agroscience Uruguay	1997-2017	Spanish
Boletín de la Asociación Herpetológica Española Bulletin of the Spanish Herpetological Association	2004-2018	Spanish
Ecología Aplicada Applied Ecology	2002-2018	Spanish
Cuadernos de Herpetología Herpetology notes	2010-2018	Spanish
Orinoquia	2003-2018	Spanish
Butlletí del Grup Català d'Anellament Bulletin of the Catalan Ring Group	1981-2001	Spanish
Boletín Chileno de Ornitología Chilean Ornithology Bulletin	1994-2015	Spanish
Revista Internacional de Contaminación Ambiental International Journal of Pollution	1985-2018	Spanish
Revista Mexicana de Ciencias Forestales Mexican Journal of Forestry Sciences	2010-2018	Spanish
Boletín de Biodiversidad de Chile Bulletin of Biodiversity of Chile	2009-2014	Spanish
Studia Oecológica	1981-1995	Spanish
Grupo Jaragua	1997-2011	Spanish
Ecosistemas y Recursos Agropecuarios Ecosystems and Agropecuary Resources	1994-2018	Spanish

Notes and Newsletter of Wildlifers (Taiwan) 野生動物保育彙報及通訊	2005-2012	Traditional Chinese
Journal of Ecology and Environmental Sciences (Taiwan) 環境與生態學報	2008-2012	Traditional Chinese
Fungal Science (Taiwan)	1995-2019	Traditional Chinese
Chinese Bioscience (Taiwan) 生物科學	2003-2014	Traditional Chinese
Journal of National Park (Taiwan) 國家公園學報	1989-2019	Traditional Chinese
Taipei Zoo Bulletin 動物園學報	1989-2013	Traditional Chinese
Journal of Agriculture and Forestry (Taiwan) 農林學報	2000-2018	Traditional Chinese
Journal of the Experimental Forest of National Taiwan University 臺灣大學生物資源暨農學院實驗林研究報告	1987-2019	Traditional Chinese
Taiwan Journal of Forest Science 臺灣林業科學	1986-2020	Traditional Chinese
Journal of the National Taiwan Museum 國立臺灣博物館學刊	2005-2019	Traditional Chinese
Raptor Research of Taiwan 台灣猛禽研究	2003-2016	Traditional Chinese
Bio Formosa (Taiwan) 生物學報	1966-2014	Traditional Chinese
Quarterly Journal of Chinese Forestry (Taiwan) 中華林學季刊	2004-2019	Traditional Chinese
Taiwan Journal of Biodiversity 台灣生物多樣性研究	1999-2019	Traditional Chinese
Zeugma Biyolojik Bilimler Dergisi Zeugma Biological Science	2020	Turkish
Kommagene Biyoloji Dergisi Commagene Journal of Biology	2017-2019	Turkish
Akdeniz Üniversitesi Ziraat Fakültesi Dergisi Mediterranean Agricultural Sciences	2009-2019	Turkish
Deniz Bilimleri ve Mühendisliği Dergisi Aquatic Sciences and Engineering	2007-2020	Turkish
Bağbahçe Bilim Dergisi Journal of Bagbahce Science	2019	Turkish
Türk Coğrafya Dergisi Turkish Geographical Review	2000-2019	Turkish
Uluslararası Doga Bilimleri ve Biyoteknoloji Dergisi International Journal of Life Sciences and Biotechnology	2018-2019	Turkish

Kastamonu Üniversitesi Orman Fakültesi Dergisi Journal of Kastamonu University Faculty of Forestry	2001-2019	Turkish
Ege Üniversitesi Ziraat Fakültesi Dergisi Journal of Ege University Faculty of Agriculture	2014-2019	Turkish
Artvin Çoruh Üniversitesi Orman Fakültesi Dergisi Artvin Coruh University Journal of Forestry Faculty	2000-2020	Turkish
Doğu Coğrafya Dergisi Journal of Eastern Geography	2010-2019	Turkish
Atatürk Üniversitesi Ziraat Fakültesi Dergisi Atatürk University Journal of Agricultural Faculty	2008-2020	Turkish
Dumlupınar Üniversitesi Fen Bilimleri Enstitüsü Dergisi Journal of Dumlupınar University Institute of Science	2000-2019	Turkish
Orman Bilimleri Dergisi Turkish Journal of Forest Science	2017-2019	Turkish
Akademik Ziraat Dergisi Journal of Academic Agriculture	2012-2019	Turkish
Trakya University Journal of Natural Sciences Trakya University Journal of Natural Sciences	2000-2019	Turkish
İstanbul Üniversitesi Orman Fakültesi Dergisi (1951-2017; continues in English as Forestist from 2018) Journal of the Faculty of Forestry Istanbul University (continues in English as Forestist from 2018)	2009-2019	Turkish
Uluslararası Doğu Anadolu Fen Mühendislik ve Tasarım Dergisi Journal of International East Anatolia Science Engineering and Design	2019	Turkish
Dicle Üniversitesi Fen Bilimleri Enstitüsü Dergisi Journal of Dicle University Natural Sciences Enstitute	2019	Turkish
Doğanın Sesi Journal of Nature's Voice	2018-2019	Turkish
Anadolu Orman Araştırmaları Dergisi Anatolia Journal of Forest Research	2015-2019	Turkish
Toprak Bilimi ve Bitki Besleme Dergisi Journal of Soil Science and Plant Nutrition	2012-2019	Turkish
Bartın Orman Fakültesi Dergisi Journal of Bartın Faculty of Forestry	2000-2019	Turkish
Türk Tarım - Gıda Bilim ve Teknoloji Dergisi Turkish Journal of Agriculture - Food Science and Technology	2014-2019	Turkish

Su Ürünleri Dergisi Journal of Fisheries	2000-2019	Turkish
Türkiye Ormancılık Dergisi Journal of Turkey Forestry	2000-2019	Turkish
Iğdır Üniversitesi Fen Bilimleri Enstitüsü Dergisi Journal of Iğdır University Institute of Science	2019-2020	Turkish
Visnyk of Lviv University: Biological Series Вісник Львівського університету: Серія біологічна	2005-2019	Ukrainian
Nature Conservation (2013-2016) [formerly Nature Reserves in Ukraine (1995-2012)] Заповідна справа (2013-2016) [Заповідна справа в Україні (1995-2012)]	2013-2016	Ukrainian
Problems of Bioindication and Ecology Питання біоіндикації та екології	2008-2019	Ukrainian
Nature Reserves in Ukraine (1995-2012) [changed to Nature Conservation (2013-2016)] Заповідна справа в Україні (1995-2012) [Заповідна справа (2013-2016)]	1995-2012	Ukrainian

Appendix 3: Reports (and years) searched

Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and contiguous Atlantic area (ACCOBAMS)	45 numbered documents	Resolutions - Conservation actions (45 documents, numbered but not in order). Official reports not searched (http://www.accobams.org/documents-resolutions/official-reports/)
Amphibian and Reptile Conservation (ARC)	2021	Dated reports 2012-2021 at https://www.arc-trust.org/technical-reports
Amphibian Survival Alliance	1994-2012	"Froglog (Bulletin of the Amphibian Survival Alliance" magazine: Vol 9 - Vol 104
Back from the Brink: Shifting Sands	x5 documents dated 2021	All docs (x5 dated 2021) at this URL https://naturebftb.co.uk/the-projects/shifting-sands/
British Trust for Ornithology	1981-2016	BTO Research Reports: 1-687
Convention on the Conservation of Migratory Species of Wild Animals (CMS)	1998-2018	All documents 1998-2018 inclusive, including Technical Series reports TS no. 1-38 (some numbers missing: 6,28-30,36,37)
International Council for the Exploration of the Sea (ICES)	2011-2018	ICES Working Group on Bycatch of Protected Species (WGBYC) Expert Reports: 2011-2018 inclusive (www.ices.dk/publications/our-publications/Pages/Expert-Group-Reports.aspx)
International Council for the Exploration of the Sea (ICES)	2003-2018	ICES Working Group on Marine Mammal Ecology (WGMME) Expert Reports: 2003-2018 inclusive (www.ices.dk/publications/our-publications/Pages/Expert-Group-Reports.aspx)
International Society for Mangrove Ecosystems	1993–2014	Occasional Papers, and Technical Reports dated 1993–2014 searched at http://www.mangrove.or.jp/english/subpage/publications.html
IUCN-SSC Cetacean Specialist Group	1989-2018	Cetacean Specialist Group Reports. Dated reports at https://iucn-csg.org/downloads/
IUCN-SSC Crocodile Specialist Group	2006-2018	Crocodile Specialist Group Articles. Dated articles at http://www.iucncsg.org/pages/Publications.html
IUCN-SSC Crocodile Specialist Group	2005-2017	Crocodile Specialist Group Reports. Dated reports at http://www.iucncsg.org/pages/Publications.html

IUCN-SSC Freshwater Plant Specialist Group	2016-2018	IUCN-SSC Freshwater Plant Specialist Group Reports at https://www.iucn.org/commissions/ssc-groups/plants-fungi/plants/plants-a-g/freshwater-plant
IUCN-SSC Invasive Species Specialist Group	1995-2013	Aliens: The Invasive Species Bulletin (IUCN) Vol 1 - Vol 33
IUCN-SSC Marine Mammal Protected Area Specialist Group	2017-2018	Marine Mammal Protected Area Specialist Group Reports. Dated documents at https://www.marinemammalhabitat.org/downloads/
Joint Nature Conservation Committee (JNCC)	1991-2018	Report no.s 1-627
MedWet	1994-2017	All publications dated 1994–2017 at https://medwet.org/publications/
National Oceanic and Atmospheric Administration (NOAA)	1962-2018	Fisheries Science & Data Resource Reports. Science & Data>Research and Survey Resources (dated) for species categories: whales, dolphins and porpoises, seals and sea lions i.e. not all reports at this link checked (https://www.fisheries.noaa.gov/resources/all-science?title=&species%5B54%5D=54&species%5B1000000066%5D=1000000066&species%5B53%5D=53&field_species_vocab_target_id=&sort_by=created)
Natural England	1991-2018	Reports dated 1991-2018 listed at http://publications.naturalengland.org.uk/category/7002 & http://publications.naturalengland.org.uk/category/10002 at Sep 2019. Records about... Habitat and species group sub-categories; Records about... Species; Terrestrial habitats; Farming & land management; Coastal, Freshwater, Marine
NatureScot	2016-2018	Reports 1-945 (2004-2018)
North Atlantic Marine Mammal Commission	1998-2018	NAMMCO outputs (Scientific publication series Vol1(1998)–10(2018) at https://nammco.no/library/
Ramsar	1998-2017	Documents dated 1998-2017 at https://www.ramsar.org/search
Scientific Committee on Antarctic Research (SCAR)	2004-2018	4 dated reports (2014-2018) and list of 7 selected publications (https://www.scar.org/science/eg-bamm/)
Sea Mammal Research Unit (SMRU)	2012-2018	Marine Mammal Scientific Support to Scottish Government reports at http://www.smru.st-

		andrews.ac.uk/research-policy/reports-to-scottish-government/
Sea Mammal Research Unit (SMRU)	1990-2018	SMRU reports for funders at http://www.smru.st-andrews.ac.uk/reports/
Wetlands International	1980-2017	Publications, Case Studies dated 1980–2017 (including "Flamingo: Bulletin of the IUCN-SSC/Wetlands International Flamingo Specialist Group" magazine) at https://www.wetlands.org/resources/
Whale and Dolphin Conservation (WDC)	2001-2018	Dated reports 2001 - 2018 at https://uk.whales.org/policy/wdc-publications-and-reports/

APPENDIX 4. Literature reviewed for the Coral Reef Synopsis

The diagram below will be completed and included in the synopsis document to show the numbers of journals and report series searched, the total number of publications searched within those, and the number of publications that were summarized from each source of literature.

