A BRIEF REVIEW OF METHODS OF COLLECTING AND EXAMINING WATER BIRD NESTS

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Abstract. Aquatic birds, especially migratory birds, are considered bioindicators of the state of the environment. The nest is a structure that has two functions: increases the probability of bird survival by protecting both young and parents, mainly during the reproductive season, and also functioning as a refuge during the non-reproductive season. Therefore, collecting and examining their nests provides and allows for the collection of life history data (e.g., clutch size, numbers of broods, numbers of nesting attempts, nesting success), which can give important insight into the vulnerability of species or perturbations. The objective of the current paper is to summarize the available literature on the collecting, monitoring and examination of nests. Analysis of the literature was done by querying the database of ISI quoted articles, Web of Science Core Collection, using specific keywords.

Keywords: aquatic birds, methods, nest, collecting methods, identifying nest.

Rezumat. O scurtă analiză a metodelor de colectare și examinare a cuiburilor de păsări acvatice. Păsările acvatice, în special păsările migratoare, sunt considerate bioindicatori ai stării mediului. Cuibul este o structură care are două funcții: crește probabilitatea de supraviețuire a păsărilor prin protejarea atât a juvenililor, cât și a părinților, în principal în timpul sezonului reproductiv, și funcționând, de asemenea, ca refugiu în timpul sezonului nereproductiv. Prin urmare, colectarea și examinarea cuiburilor lor oferă și permite colectarea de date despre istoria vieții (de exemplu, dimensiunea puietului, numărul de pui, numărul de încercări de cuibărit, succesul cuibării), care pot oferi o perspectivă importantă asupra vulnerabilității speciilor sau perturbărilor. Obiectivul prezentei lucrări este de a rezuma literatura disponibilă privind colectarea, monitorizarea și examinarea cuiburilor. Analiza literaturii de specialitate a fost realizată prin interogarea bazei de date de articole citate ISI, Web of Science Core Collection, folosind cuvinte cheie specifice.

Cuvinte cheie: păsări acvatice, metode, cuib, metode de colectare, identificare cuib.

INTRODUCTION

Wild birds play a crucial role in maintaining ecosystem health and human wellbeing. They provide essential ecological services such as controlling insects and rodents, pollinating plants, dispersing seeds, and contributing natural fertilisers. Bioindicators are organisms whose response to their environment provides valuable information about the state of the ecosystems they inhabit (DMOWSKI, 1999; BRYCE, 2006; PARMAR et al., 2016; MAZNIKOVA et al., 2024). They can indicate trends in environmental quality, including degradation and recovery (PHARAOH et al., 2023), and detect changes due to the presence of pollutants that may affect biodiversity (WALSH 1978; PETERSON 1986; GERHARDT 2002; HOLT & MILLER, 2010). Birds make effective bioindicators due to their visibility, ease of monitoring, and significant public interest in their presence (EGWUMAH et al., 2017).

Monitoring bird population, abundance, density, mortality rate, breeding success, and their interaction with stressors helps assess ecosystem health. Additionally, the presence and effects of stressors on birds and patterns of biological diversity are important factors. The diversity of bird species can indicate overall species richness within a natural ecosystem. Studying waterbird nests is crucial for understanding their reproductive success, population dynamics, breeding habits, habitat preferences, and environmental threats.

This information is essential for developing effective conservation strategies. Researchers use techniques such as direct observation, nest monitoring through cameras, and regular nest checks (PARMAR et al., 2016). GPS tracking and banding adult birds provides valuable data on nesting sites, breeding behaviours, nest usage, hatching success, and chick survival rates, essential for conservation and habitat management. Ethical guidelines must be followed to minimise disturbance to nesting birds and their habitats, including minimising nest visits, using non-invasive techniques, and consulting with local stakeholders for consent and understanding (PHARAOH et al., 2023).

MATERIALS AND METHODS

The methods used to conduct this brief classic method of literature review involved querying public databases (Web of Science, Google Scholar, Scopus) and then critically analysing the specialised literature. Keywords such as: waterbirds, methods, nest, collecting methods, identifying nest, importance of waterbirds, birds as bioindicators, ecosystem services provided by waterbirds, identification of waterfowl nests, examination of waterfowl nests, collecting waterfowl nests etc., were used to carry out the query stage. The scientific papers used were open-access or provided by the authors following requests made on certain platforms.

In parallel, a bibliometric application was used – VOSviewer. Of all the studied scientific works, only those that contained the information targeted in this study were included in the present paper. The bibliometric analysis was carried out with the help of the VOSviewer application. This analysis is used to identify key topics, important relationships between terms, and to understand the thematic structure of a particular research area. The publications were selected from the SCIENCE DIRECT scientific literature platform and the analyses were based on two important criteria:

1. keyword co-occurrence. Based on this criterion, VOSviewer generates maps based on keyword co-occurrence relationships, highlighting thematic connections and trends in the research field.

2. texts selected from the title and abstract. The VOSviewer application extracts relevant terms from titles and abstracts, building a term co-occurrence matrix.

3. keywords were used to select the publications: • Identification of waterfowl nests • Examination of waterfowl nests • Collecting waterfowl nests.

Based on the criteria listed above and using the three categories of keywords, namely, identification, examination and collection of waterfowl nests, the software generated 5 maps (graphics), one for each keyword and selection criterion. The figure generated by VOSviewer is a network graph that represents the relationships between specific keywords or terms based on their co-occurrence in a data set (usually scientific articles). Each node (bubble) in the graph represents a term, and the links between the nodes (lines) indicate how often those terms appear together in the same documents.

The principles of interpretation of network graphs are the following:

1. Bubble size. The size of each bubble is proportional to the frequency of the term in the data set. The bigger the bubble, the more frequently that term appears.

2. The colour of the bubbles. The colour indicates the grouping of terms into clusters, that is, terms that frequently appear together. Each cluster can represent a specific theme or topic within the dataset. For example, the red cluster can represent a specific topic related to "biodiversity" and "lake", while the green cluster can be associated with "concentration" and "colony".

3. Proximity between bubbles. The closer two bubbles are to each other, the more closely related the terms are, that is, the more frequently they appear together in the same document.

4. The lines between the bubbles. Lines or arcs between bubbles indicate a connection between two terms. The thicker or more numerous the line, the stronger the connection between these terms (that is, they appear together more frequently).

5. Keywords. The words or phrases represented by the bubbles are the most important or the most frequently used in the analysed data set.

RESULTS AND DISCUSSIONS

Monitoring nesting success and the vegetation associated with the nest helps identify crucial habitat features and understand habitat requirements and species coexistence better than traditional metrics like presence or abundance. Long-term nest monitoring can provide valuable breeding productivity data for multiple species, allowing for comparisons over time and space (MARTIN, 1992; 1993; MARTIN & LI, 1992; SHERRY & HOLMES, 1992; MARTIN & GEUPEL, 1993). Bird nests are the places or structures where birds lay eggs. They come in various forms, with different species crafting nests to suit their specific needs. A nest can range from an intricately woven structure to a simple scratch in the bare dirt. Most birds do not live year-round in their nests. Nesting materials can include sticks, leaves, moss, mud, feathers, and even human-made materials like fabric, plastic, etc. Birds select materials during nest construction for many reasons (DEEMING & MAINWARING, 2015), including sexual signalling (DUBIEC et al., 2013), defence from parasites or pathogens (DUBIEC et al., 2013), camouflage (KULL, 1977; BAILEY et al., 2015), insulation (HILTON et al., 2004; DHANDHUKIA & PATEL, 2012; MAINWARING et al., 2014b) or for their structural role (BAILEY et al., 2014; BIDDLE et al., 2015, 2017, 2018). Birds build nests in trees, bushes, grass, rocks, and various other locations.

In the literature we find various methods of data collection, but the most common method is direct observation, where researchers visit nesting sites and record data in real-time. Another approach involves using remote sensing technology, such as drones, to capture images and video from a distance without disturbing the birds (MARTINI & MILLER, 2021; SUGASAWA et al, 2021). While direct observation provides more detailed data, remote sensing can cover larger areas more efficiently and with less impact on the wildlife. Non-invasive techniques, such as using drones or remote cameras, photographs minimise disturbance to the birds and their habitat (RYAN, 2020). Researchers use non-invasive methods to gather data without stressing birds, covering larger areas more efficiently and preserving the natural environment. This approach provides accurate data on natural behaviours and allows for long-term nest monitoring without causing stress to the wildlife.

Investigations into nest building were sporadic throughout the 1900s, often with few experiments and small sample sizes. HEALY (2022) stipulated that notable exceptions include Peter Sargent's aviary experiments with zebra finches and the Collias' observational and experimental work in the 1960s. The two mentioned authors both concluded that while the birds' experience of building played some role in the nest they built, it was not a major one. Over time, research methods have diversified according to the interests of each researcher and what they intend to study in the nest, evolving to non-invasive methods and techniques as described above.

VOS maps created based on keywords selected from SCIENCE DIRECT publications

Keyword - identifying waterbirds nest. The results showed that 2911 terms were identified, from which the minimum number of occurrences of keywords (occurrence threshold) was set at 5. This is a method of filtering the results to exclude keywords that appear very rarely, ensuring that only the terms that have a relevant presence in the analysed literature. Thus, out of 2911 keywords found on the Science Direct scientific publication platform, only 89 keywords were selected that met the threshold – and, more precisely, they reached the minimum criteria established to be included in the final visualization of the maps (Fig. 1).

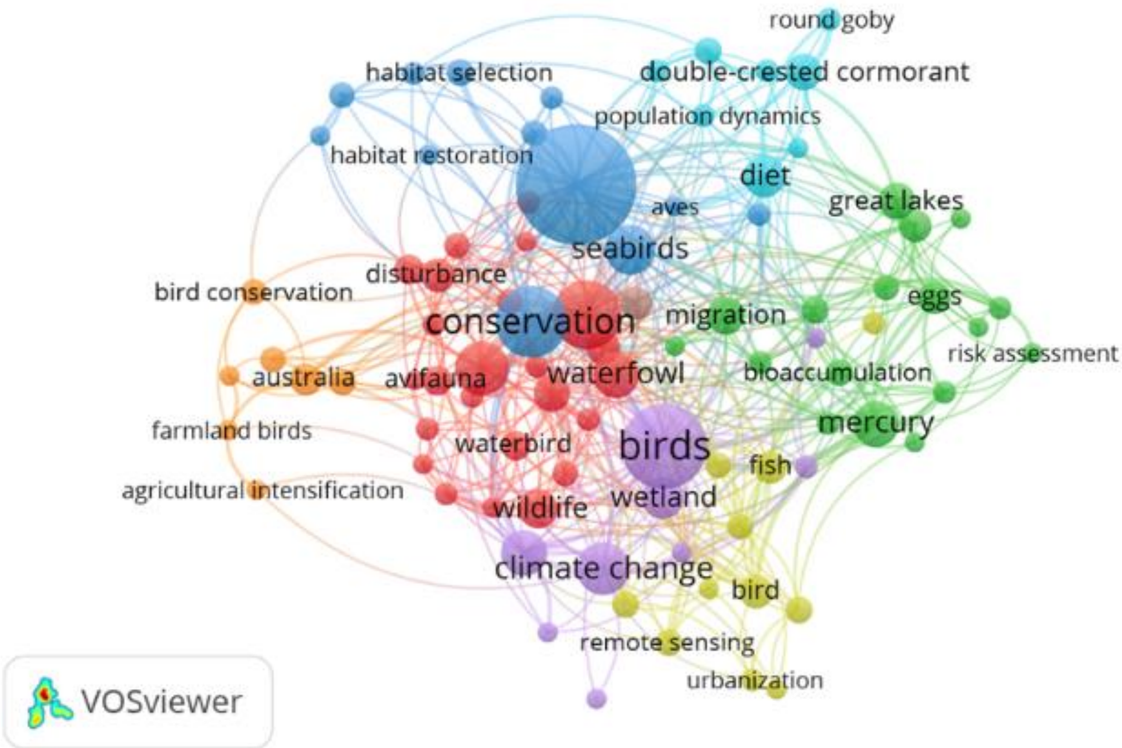

Figure 1. Network graph generated by searching bibliographic references with the keyword- identifying waterbirds nest.

The selected keywords were grouped into 8 clusters from which four important clusters stand out, marked with red, purple, blue and green. The grouping of terms that frequently appear together is shown with the same colour, for example red, also the proximity of two bubbles (nodes) indicates that the respective terms are more closely related. The literature analysis focusing on "identifying nests of waterbirds" emphasizes that numerous studies, particularly in Australia, link the conservation of waterbird species to two significant factors: the intensification of agriculture and the expansion of farms. Preserving birds, as well as wildlife in general, heavily relies on habitat restoration and the careful selection of nesting sites. Pollution from heavy metals, especially mercury, plays a crucial role in nesting. Metals and other substances accumulate in eggs, meat, feathers, and so on, largely influenced by the species' diet, which in turn impacts the dynamics of bird populations and their migration.

Keyword – examining waterbirds nests. In the case of publication searches based on the nested examination criterion, the VOS results showed 2101 associated keywords, of which, based on the minimum threshold of 5, only 64 results were considered relevant. The 64 items were classified into 8 clusters.

This graphic shows a fairly large dispersion of the different keywords found in the publications, and the size of the nodes is approximately similar, being associated with several clusters. The conclusion that emerges is that, in terms of examination methods, they are associated with several fields, such as climate change, biodiversity, conservation, birds, waterbirds, metals, diet...etc. (Fig. 2).

Keyword - collecting waterbird nests. 1067 keywords were obtained based on the established threshold, but 18 were relevant in the analysis. There were 4 weakly connected clusters. Of the 18 selected items, 2 were not associated with any cluster and were eliminated (Fig. 3).

The graph shows that, in this type of search, bibliographic references for methods of collecting waterfowl nests are quite poor. There are two main clusters, the first one based on conservation and climate change, and the second on lead pollution issues.

Vos maps were created on the basis of the texts selected from the title and abstract from publications in SCIENCE DIRECT.

Keyword - Examination of waterbirds nests. The threshold for the occurrence of an item was 10. 16788 terms were identified, of which 507 reached the established threshold. The processing of the results eliminated part of the results based on the relevance score and thus the map was created based on 304 items (Fig. 4).

Unlike the analysis performed on the examination of the same word in the case of the keyword category, in the present case, with *examination* selected in the title and abstract, a larger size of the network nodes is observed, but also a tighter connection between domains. The answer of this analysis shows that the examination methods are more visible in the titles and summaries of ScienceDirect publications. Large clusters of 123 items are revealed, with domains such as concentration, conservation, nest, waterbird.

Keyword - Collecting waterfowl nests. The minimum number of occurrences of the term found in the publication was established at 10. The VOS result indicated 8227 terms extracted, of which only 199 met the threshold, and of which only 119 terms were kept for the vos maps based on their relevance (Fig. 5).

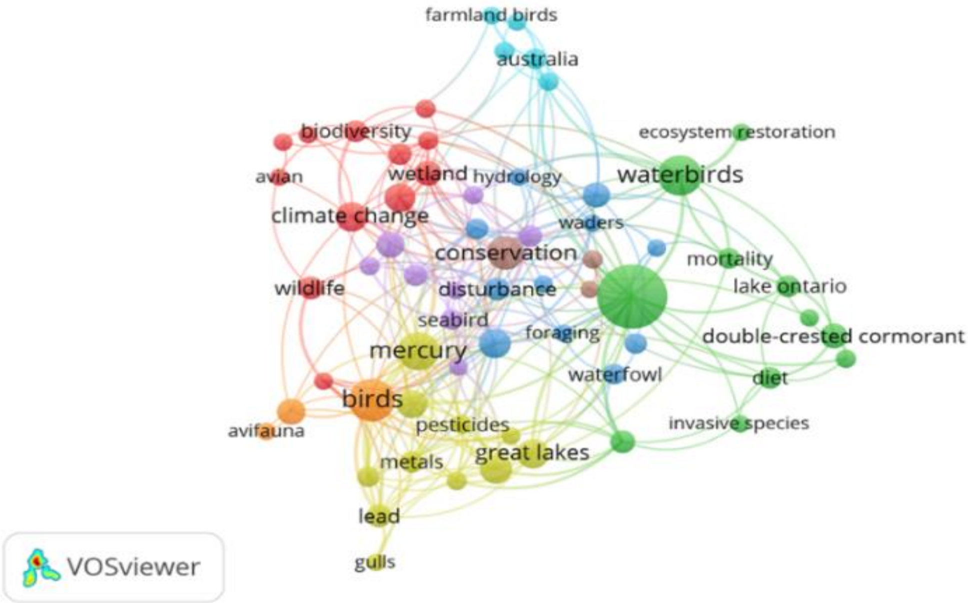

Figure 2. Network graph generated by searching bibliographic references with the keyword - examining waterbird nests.

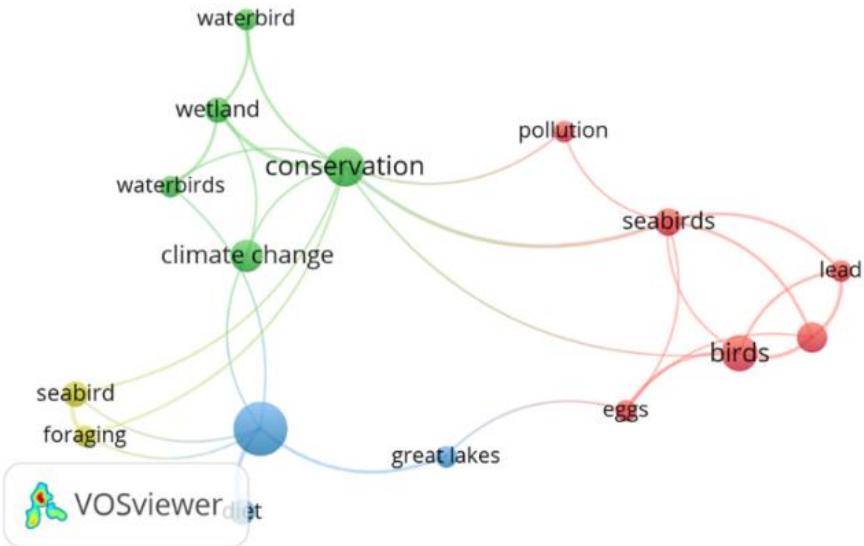

Figure 3. Network graph generated by searching bibliographic references with the keywords - collecting waterbird nests.

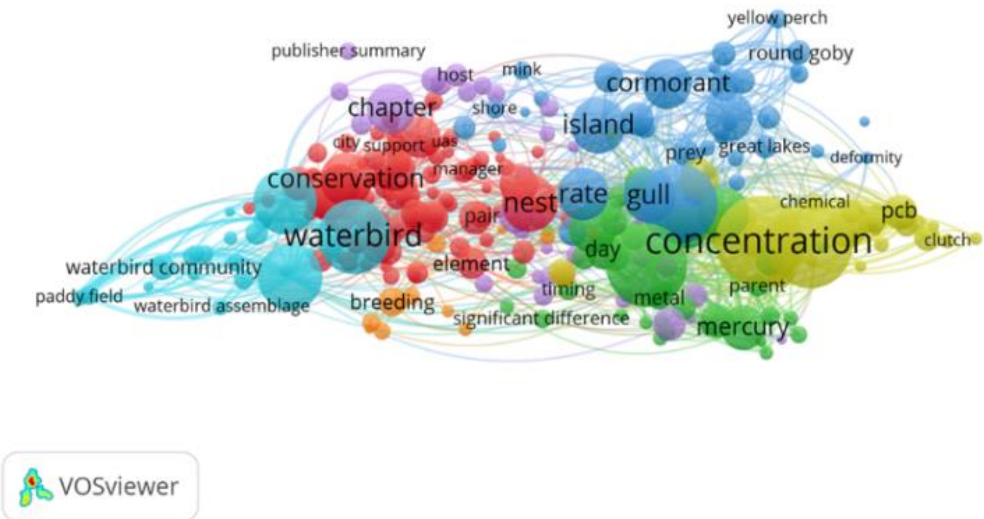

Figure 4. Network graph generated by searching bibliographic references with the keywords - examining waterbirds nests.

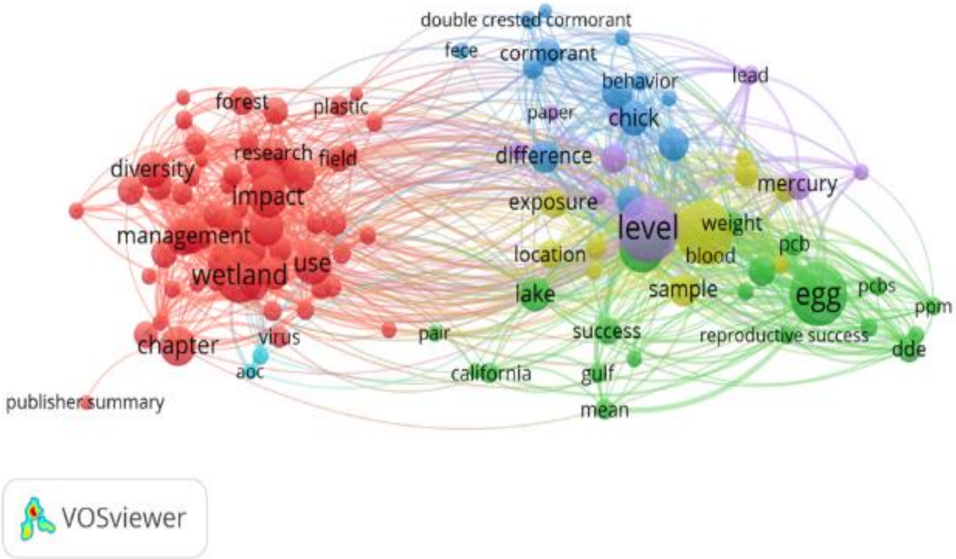

Figure 5. Network graph generated by searching bibliographic references with the keywords - collecting of waterbird nests.

In Figure 5, the search for the selected term in the title and abstract resulted in the generation of 6 distinct clusters. Each cluster represents a specific field of research and shows strong relationships within the cluster and weaker relationships between clusters. The main terms in the red cluster focus on management, diversity, wetland, and impact. In the green cluster, the collected data is related to issues concerning waterfowl, including eggs, gulf, lakes, and reproductive success.

CONCLUSION

Birds play a very important role in ecosystems, as they contribute to all four types of ecosystem services. Bird populations are indirectly also directly helpful to human health by serving as bio-indicators, pollinators, seed dispersers, predators, scavengers, and ecosystem engineers through their behaviour and the services provided by bird products (SEKERCIOGLU, 2006; WENNY et al., 2011). The monitoring of nesting success and associated vegetation can help us understand habitat requirements and species coexistence better. It has become clear since 1900 that the experience of birds in building nests is very important for survival. The research methodology has evolved from destructive to non-invasive methods over time. However, there is still a lack of discussion on this topic. In future research, policies should focus more on the conservation and examination of avifauna, restoration, and management of their habitats. Conserving and maintaining healthy bird populations and their habitats would preserve diverse ecosystem services by benefiting many living species and human welfare.

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