Recent Research to Improve the Great Crested Newt Habitat Suitability Index

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Summary
A recent study (Seccombe & Salgeuro-Gómez, 2024[1]) investigated the great crested newt Habitat Suitability Index (HSI), through a literature review, a survey of 288 HSI users, and ecological data analysis of over 9,000 ponds. The study identified issues with the existing HSI and proposed improvements with regard to its accuracy in assessing suitability of the species' habitat and its usability. Our findings provide useful insight of use to professional ecologists conducting site assessments and monitoring habitats, and to conservation practitioners managing ponds.

Three key outputs were produced:
- greater insight into the current HSI's limitations;
- a modified HSI which better reflects great crested newt presence/absence;
- a list of further potential modifications warranting additional research, including potential changes to the guidance accompanying the HSI.

The modified HSI should be easier to conduct due to simpler calculation, having fewer sub-indices (SIs), the provision of new graphs, and the provision of calculation formulae.

Accompanying this briefing is a spreadsheet tool which provides a calculator for the new and original indices to facilitate comparison, as well as providing accompanying graphs and basic usage notes. The new HSI can be applied to existing data, if there is information on the underlying environmental variables, facilitating comparison of HSI scores over time. Field usage of this newly proposed HSI is welcomed, as is sharing of findings (such as ease of use or comparison with existing datasets) with the researchers.

The following sections of this briefing detail the need for an accurate habitat assessment tool in the current development and conservation context and describe the study's methods and key findings.

Full details can be found in the paper, [linked here](), published in the British Herpetological Journal.

1) Background context of the great crested newt HSI

Britain is described as a stronghold for great crested newts[2, 3], with populations of international importance[4]. However, the population is estimated to have annual rates of decline of 5%[5]. Great crested newts are described in the media and in political discourse as causing delays in the development and construction industries[6, 7]. This conflict results from the species' protected status, which requires developers to avoid damage to individuals or their habitat[8].

Given the conservation status of great crested newts and the development pressure to create more homes, it is essential that scientists, ecologists, and conservationists are able to provide accurate information about their habitat. Such evidence is necessary to ensure that the species receives sufficient protection and suitable conservation management.

The current method for assessing a pond's suitability for great crested newt breeding is the Habitat Suitability Index (HSI) developed by Oldham et al. (2000)[9]. This HSI is extensively used in a wide range of applications, including in development and conservation contexts[8, 10, 11, 12, 13] and as an integral component of great crested newt monitoring efforts[14], at national[15], and international levels[10, 16].

Despite its management implications and widespread applications, there are significant concerns over the HSI's accuracy. Now over twenty years old, the HSI was mainly informed by expert opinion and data from the 1991 National Amphibian Survey, and it had limited validation[9, 17]. The original HSI paper acknowledges the amount of conjecture involved in its creation, noting that the HSI "can be upgraded easily as knowledge of crested newt habitat requirements improves"[9].

An improved great crested newt HSI, informed by the findings of the study detailed in this note, could significantly benefit the species' conservation management. Firstly, it would allow more accurate monitoring of habitat trends, leading to more accurate assessment of great crested newt conservation status. Secondly, it would enable improved assessment of habitat created to mitigate development-related losses or through conservation projects.

2) Identification of issues with the HSI and potential improvements through a user survey and ecological data analysis

From the literature review, survey, and ecological analysis, a set of potential actions to improve the HSI was proposed. These recommendations include changes to the HSI and improvements to the guidance.

In the new study[1], researchers carried out a survey of HSI users to gain insight into the index's usage, understand its limitations and identify suggestions for improvement. There were 288 respondents, of which 86% were professional ecologists.

Respondents gave quantitative ratings of accuracy of records of the HSI and its components (sub-indices, SIs). Qualitative information was also gathered on the limitations of SI accuracy, additional factors for inclusion and other suggestions for improving the HSI.

SI1 (location) and SI9 (terrestrial habitat) were perceived as more accurate and SI4 (water quality) as less accurate. Common themes regarding HSI recording accuracy included subjectivity, lack of clear guidance, difficulties resulting from a single visit, and the need for records to be taken at certain times of year.

Furthermore, the survey suggested the HSI was still used to indicate great crested newt abundance, despite the existing advice, demonstrating the need for stronger guidance and appropriate usage. There was a clear call for improved guidance on the usage of the HSI.

Additionally, the researchers[1] sourced several large ecological datasets with environmental and species data and analysed these to test the relationships between ecological variables and great crested newt presence/absence. The sources were Natural England, ARC (the National Amphibian and Reptile Recording Scheme) and Cofnod, totalling over 9,000 pond records.

Errors in HSI calculation were identified, such as incorrectly calculating pond density scores (SI8) or incorrectly calculating the geometric mean to give the overall HSI score.

The ecological data analysis suggested that the original HSI has limited ability to differentiate great crested newt suitability as inferred from presence/absence: many ponds with great crested newts present score in low HSI categories ('Poor' or 'Below Average'), and many ponds in high HSI categories ('Good or 'Excellent') have great crested newts recorded as absent.

3) Formulation and assessment of a new HSI

Various modifications were tested in isolation and in combination. Results suggested that the HSI could be improved by removing the indices for SI4 (water quality) and SI6 (waterfowl), combining the index values with an arithmetic (rather than geometric) mean, and creating a new scoring scheme for SI2 (pond area).

Additionally, a new graph was created for pond density (SI8) to avoid the need to divide by pi. The graphs for continuous sub-indices were replotted due to the survey respondents noting difficulties reading the original graphs and formulae were provided to allow easy calculation.

Quantitative assessment of the new HSI was undertaken by comparing the frequency distribution of occupied and non-occupied ponds amongst the five HSI categories. According to this method, the new HSI is better than the original at distinguishing great crested newt habitat suitability (see Figure 1 and the paper for statistical details).

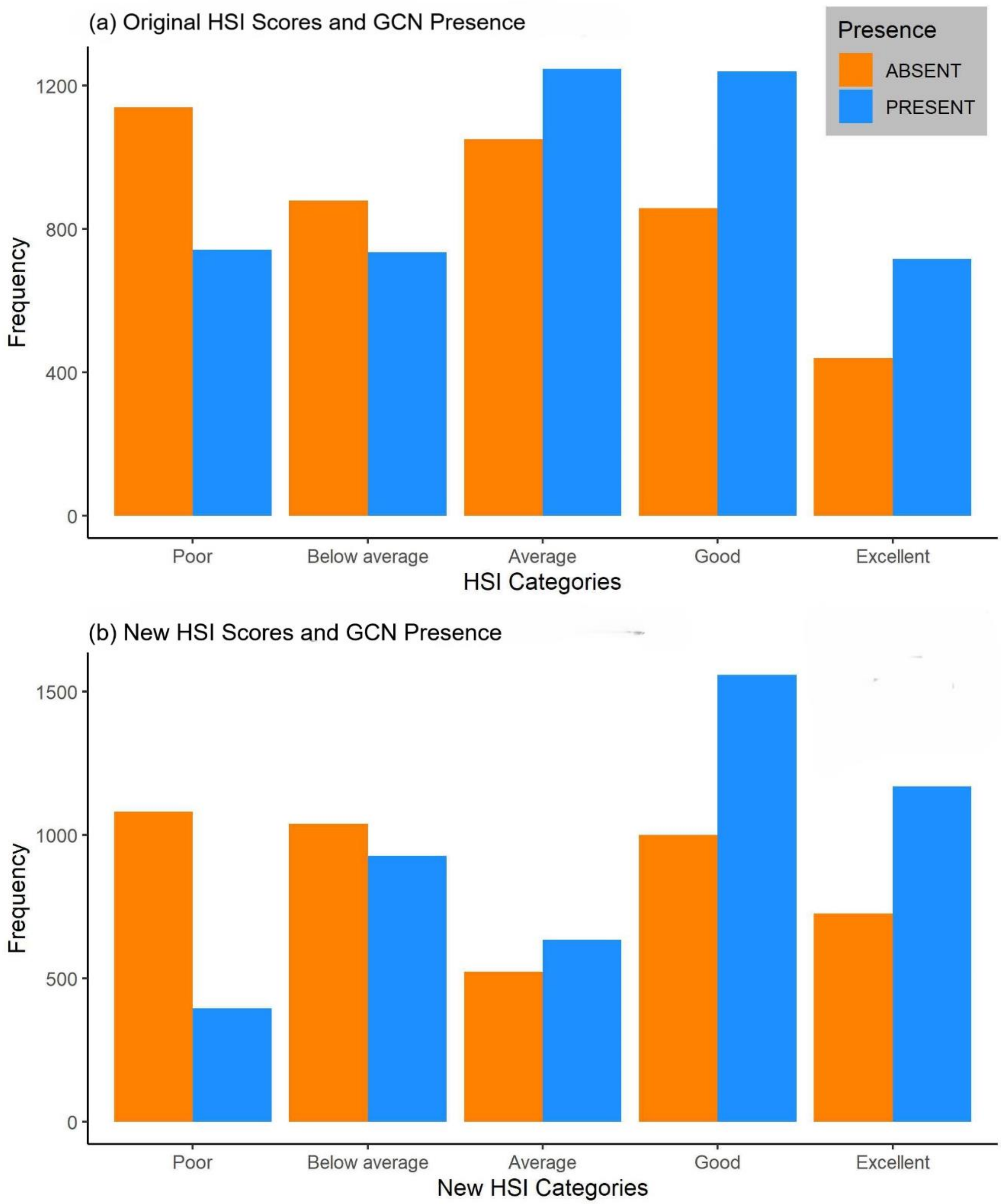

Figure 1: HSI scores (in categories) are shown for sites with (orange) or without (blue) great crested newts. (a) The top bar chart shows categories using the HSI calculated with the original formula from Oldham et al., (2000)[9] and boundaries from ARG UK (2010)[18]. (b) The lower bar chart shows categories using the newly proposed HSI and boundaries from

Seccombe & Salguero-Gómez (2024)[1]. Figure adapted from Seccombe & Salguero-Gómez, 2024, see paper for further details.

4) Example Comparison

To demonstrate the changes to the HSI proposed, we present an example comparison of scores for a hypothetical pond.

	Raw value example	**Original HSI Score**	**Modified HSI Score**	**Notes**
Location	Area A (read from map)	1	1	No change from original HSI
Size	500m2	1	0.99	New scoring relationship
Permanence	Unknown /unrecorded	NA	NA	No change from original HSI
Water Quality	Moderate	0.67	0.67	No change from original HSI
Shade	20% of shoreline	1	1	No change from original HSI
Waterfowl	Minor impact	0.67	NA	Not included in new HSI
Fish	Possible	0.67	NA	Not included in new HSI
Pond Count	2 ponds within 1km	0.55	0.55	New graph removes the need to divide by pi.
Terrestrial Habitat	Good	1	1	No change from original HSI
Macrophytes	60% cover	0.9	0.9	No change from original HSI

In the original HSI, all non-NA SIs are multiplied, then taken to the power of 1/n where n is the number of SIs recorded, 9 in this example.
Original HSI score: (1 * 1 * 0.67 * 1 * 0.67 * 0.67 * 0.55 * 1 * 0.9) ^ (1/9) = 0.85
Under the original scoring brackets, this gives a category of "Excellent".

In the modified HSI, all non-NA SIs are added then divided by the number of SIs recorded, 7 in this example.
Modified HSI score: (1 + 0.99 + 0.67 + 1 + 0.55 + 1 + 0.9) / 7 = 0.87
Under the new scoring brackets, this gives a category of "Excellent".

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