The Mid Kent Downs Countryside Partnership

KRAG

A Methodology for Identifying Pond Creation Sites to Benefit Great Crested Newts

Kent Reptile & Amphibian Group

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KRAG

Contents

This report was compiled on behalf of KRAG by the Mid Kent Downs Countryside Partnership

The Mid Kent Downs Countryside Partnership

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Introduction to the Kent Reptile & Amphibian Group

The Kent Reptile & Amphibian Group (KRAG) is a not for profit group that seeks to conserve the herpetofauna of the Watsonian vice county of Kent. The aims of the group are to:

- Record the herpetofauna of Kent.
- To actively participate in the conservation of herpetofauna by supporting the creation and management of reptile and amphibian friendly habitat.
- To raise awareness of amphibians and reptiles through attendance at events, guided walks, talks and training workshops.

KRAG manage a database of Kent herpetofauna that contains over 20,000 records of native and introduced species. It is this database that allows KRAG to determine population distribution of the widespread species in the county and to identify key areas for these species.

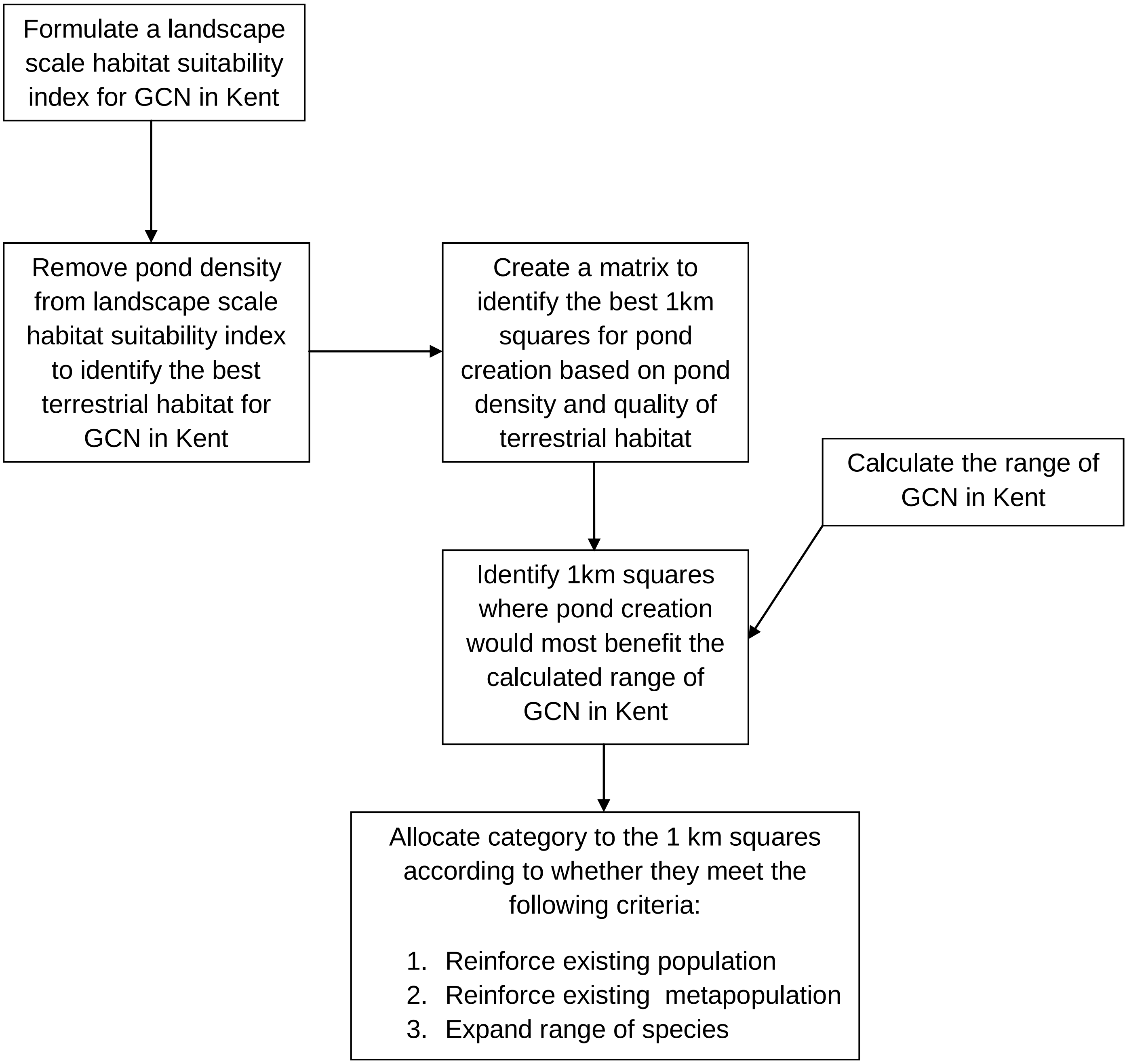
Rationale and Processes

A Great Crested Newt Pond in Bedgebury Woods

Wildlife corridors, living landscapes and other concepts designed to link populations allowing species to move through the landscape have been given increased importance in recent years. Climate change and habitat fragmentation have both been cited as reasons for needing to consider suitable habitat at a landscape level. This is particularly true for amphibians which have poor powers of dispersal. Suitable breeding ponds situated in appropriate places can provide a vital resource for amphibians to not only reinforce populations but potentially to expand the range of existing populations.

Whilst this study focuses on the great crested newt (Triturus cristatus) the same methodology can be used for other amphibian species. By calculating the suitability of habitat for great crested newts across the Watsonian vice counties of East and West Kent as well as the maximum predicted population dispersal distance and the existing range of the species it is possible to identify the most suitable 1km squares for situating new ponds for great crested newts (GCN).

The processes used to identify optimum pond sites can be illustrated as follows:



Datasets and Software

The data used in this study was obtained from the following sources:

The Kent Reptile & Amphibian Group Recording Database

The county database (maintained and designed by Lee Brady) for all amphibian and reptile species is maintained and validated by KRAG. This database contains species, location, species count, recorder and date information for just under 30,000 separate records of herpetofauna in the Watsonian vice counties of East and West Kent (correct as of March 2011)

Habitat Coverage

The Corrine Land Cover data (2000) provided at a 1km square resolution provides the percentage cover of different habitat types. This data was used in preference to the more recent Kent Habitat Survey of 2003 as the dataset is available for the whole of Europe making the methodology used in this study easy to replicate in other areas. A link to this data can be found in Further Sources of Information.

Pond Data

This data was derived by Phil Williams of Natural England from the Kent Habitat Survey of 2003 by removing linear features from original pond data. Grid references for the 17,823 ponds were calculated by Laura Wood from the Durrell Institute for Conservation and Ecology. This dataset covers the political county of Kent and the unitary authority of Medway.

The software used for this project is outlined below:

FileMaker Pro

A database used to create the Kent Reptile and Amphibian Group Recording Database. The package allowed the recording database to be designed according to the needs of KRAG and was also used to analyse both the habitat coverage data and pond data. The database was also used to automate the output of maps for Google Earth.

Google Earth

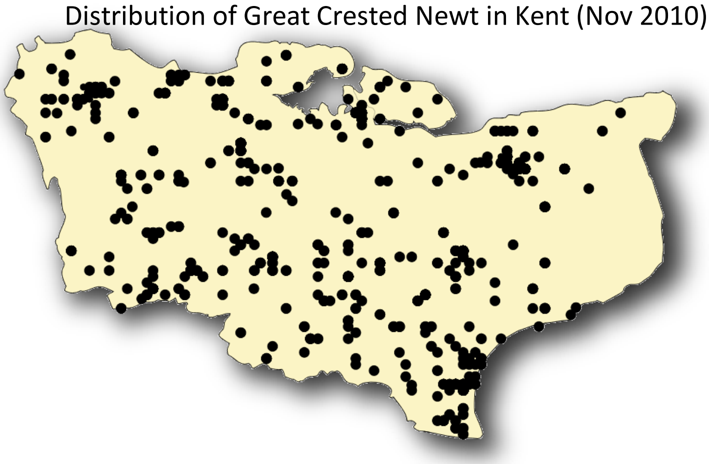
A mapping tool that has the flexibility to display and interrogate the results of the project without the need for end users to have access to specialist Geographical Information System (GIS) software.

Section One: The Range of the Great Crested Newt in Kent

Introduction

Whilst there has been considerable survey effort in Kent to identify where GCN occur the picture is not a complete one. It has been estimated, based on the number of ponds in the county and the percentage of ponds occupied by GCN that there may be over 7000 ponds occupied by GCN. Therefore, it can safely be assumed that there are many more GCNs present in Kent than are currently known. One way to deal with this issue is to predict the range of the species. In other words, where is it likely to be found?

Distribution of Great Crested Newt in Kent (Nov 2010)



Methodology

A nearest neighbour analysis of GCN records can be used to predict the range of the species. This is achieved by calculating the nearest neighbour of all GCN records in Kent and ordering the distances from the nearest to the furthest. For example, the closest distance between separate records may only be a few metres and the furthest may be up to 7km away. Only one record was used for each 100 metre square to help prevent bias from ponds with more than average survey effort. This methodology allows the user to make some assumptions about the dispersal range of a species and assess the likelihood of the presence of a particular species. These distances are then used to calculate the following ranges for GCN:

- Core range – nearest neighbour distance within which 75% of all records fall.
- Predicted range – nearest neighbour distance within which 95% of all records fall.
- Maximum expected range – distance from most isolated record to its nearest neighbour.

Only validated records are used to calculate these scores and records within the same 100m square are ignored as there is a strong possibility that these records may have come from the same pond but been recorded at a slightly different location or at a different level of precision.

Results

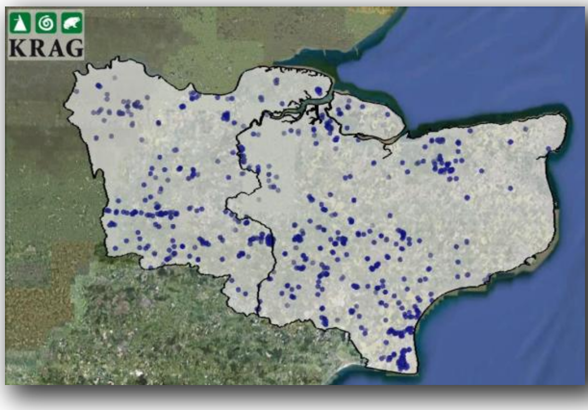
Core Range: 0.57km

Predicted Range: 2.06km

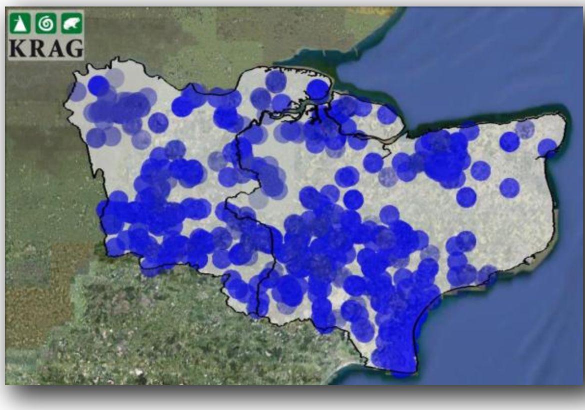
Maximum Range: 7.12km

The following maps have been produced to show the calculated range of great crested newts:

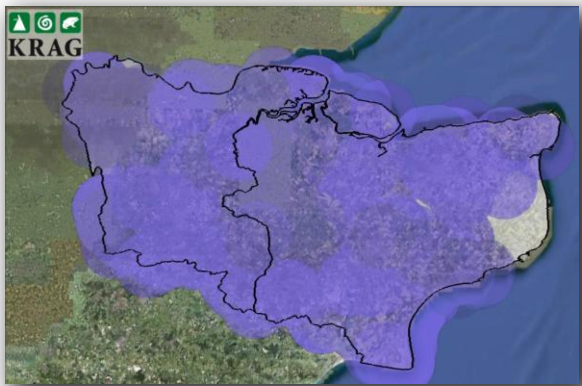
Core range of GCN



Predicted range of GCN



Maximum expected range of GCN



Conclusions and Discussion

The maps show the areas where GCNs are likely to be found based on the calculated ability of the species to disperse. The core areas are those that are close to existing records with a very high likelihood that GCNs are present. The predicted range shows where GCNs may well be present and the maximum expected range is where GCNs could occur. Ground truthing is currently taking place and preliminary results show that the likelihood of encountering GCNs based on these models reflects the predictions made. Therefore, it is likely that GCNs will be encountered anywhere that habitat is favourable across the Weald of Kent, Romney Marsh and North Kent but least likely to be encountered on the higher altitude chalk of the Kent Downs or in the East of the county.

However, there are limitations as to the use of this data:

- Kent is not an isolated county and those records that occur near the county border may well have nearest neighbours from outside Kent.
- Where survey effort in a particular area within Kent is low the ranges may reflect the lack of survey effort rather than the likely presence of the species. In other words, gaps in the calculated distribution may reflect a lack of survey work rather than a lack of animals.
- Outliers (isolated or introduced populations) may over estimate the maximum range in particular.
- The presence of any species is dependent upon there being suitable habitat. Even in areas within the core range of GCNs, they are unlikely to be present if there are no ponds and terrestrial habitat does not afford feeding and sheltering opportunities. Hence, it is necessary to look at habitat suitability.

Section Two: A Landscape Scale Habitat Suitability Index for Great Crested Newts

Introduction

Rob Oldham has developed a habitat suitability index for great crested newts that allows individual ponds to be assessed with respect to their suitability for great crested newts using simple to measure environmental factors (Oldham et al, 2000). This has been used successfully to predict the presence of great crested newts in ponds. Whilst this tool is useful for assessing and managing individual ponds the next logical step is to produce a habitat suitability index that can be used to predict the likelihood of great crested newts being present across the whole of the landscape. In order to do this, a range of land cover types were assessed according to the presence or absence of great crested newts and the land cover types that favour the presence of great crested newts were identified. These variables could then be used to produce a map showing landscape scale habitat suitability for the whole of Kent at a resolution of 1km^2.

Methodology

The land cover data used for this model is provided by the European Environment Agency and provides information on percentage land cover for a range of habitat types at a resolution of 1km^2. The land cover types identified by this data are:

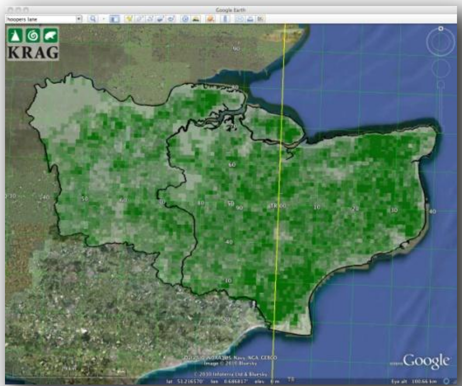
- arable
- broadleaved woodland
- built up
- coniferous woodland
- improved grassland
- open water
- semi-natural
- upland

For every km^2 the percentage cover of each of these land cover types is provided. For example, a square may contain 40% broadleaved woodland, 20% open water and 40% improved grassland. At first glance, these land cover types appear to be very broad but are available across the whole of Europe making this study repeatable over large areas and, as can be seen in the results.

For the Kent study, a further habitat variable was used. This was the pond count for each square kilometre derived from an adjusted dataset from the Kent Habitat Survey of 2003.

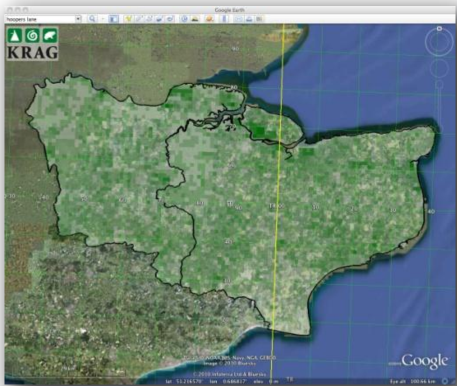
The first step was to produce maps that show the percentage cover of each of the land cover types for each unique square kilometre of Kent. The figures below show examples of these maps for three of the different land cover types. The darker the green colours on the map, the higher the percentage cover of the chosen land cover type. From these maps it is easy to identify the urban areas from the built up map.

Arable



Built up

Semi-natural



The next step was to identify whether there is a relationship between land cover type and the occupancy of great crested newts. To achieve this, the average percentage cover across the county for each of the land cover types was calculated with the exception of pond numbers where the average number of ponds per km^2 was calculated. This provides a baseline against which, the values for kilometre squares where GCNs are present can be measured against.

Table 1: Summary of Land Cover Types in Kent

	Minimum	Mean	Maximum	Standard Deviation
Ponds per km^2	0	4.11	81	7.28
Improved Grassland	0	16.09%	82.7	14.90
Broadleaf Woodland	0	12.42%	94.2	14.71
Built Up	0	15.82%	98.0	23.05
Arable	0	34.33%	100	27.13
Conifer	0	0.98%	71.7	3.99
Upland	0	0.69%	30.6	1.92
Semi-natural	0	12.64%	93.0	12.08
Open Water	0	0.62%	54.8	3.26

The mean percentage of each land cover type for km^2 where GCN have been recorded in the last 20 years was then calculated. This is represented by (mean present)
The mean percentage of each land cover type for km^2 where GCN had not been recorded but surveys had taken place was calculated. This is represented by (mean absent)
These values are then compared with the mean value for the land cover type (mean county) to create an overall suitability value for the land cover type. For example, as the mean number of ponds where GCN occur is greater than the mean for the county and the mean number of ponds where GCN are absent is less than the county mean then a positive value results. In other words, areas with ponds have a positive impact on the presence of GCN. For a more detailed explanation of this process see appendix 1. The same process takes place for each land cover type and a score for each land cover type is generated.

To calculate the Habitat Suitability Index for each individual km^2 the value for each land cover type is compared to the county mean. The 'suitability of land cover score' is then multiplied according to how far the value for the land cover type varies from the county mean as follows:

Range (SD = standard deviation)	Multiplier
>2 SDs below the county mean	-2
>1.5 and <=2 SDs below the county mean	-1.5
>1 and <=1.5 SDs below the county mean	-1
<1 SD below the county mean	-0.5
<1 SD above the county mean	0.5
>1 and <=1.5 SDs above the county mean	1
>1.5 and <=2 SDs above the county mean	1.5
>2 SDs above the county mean	2

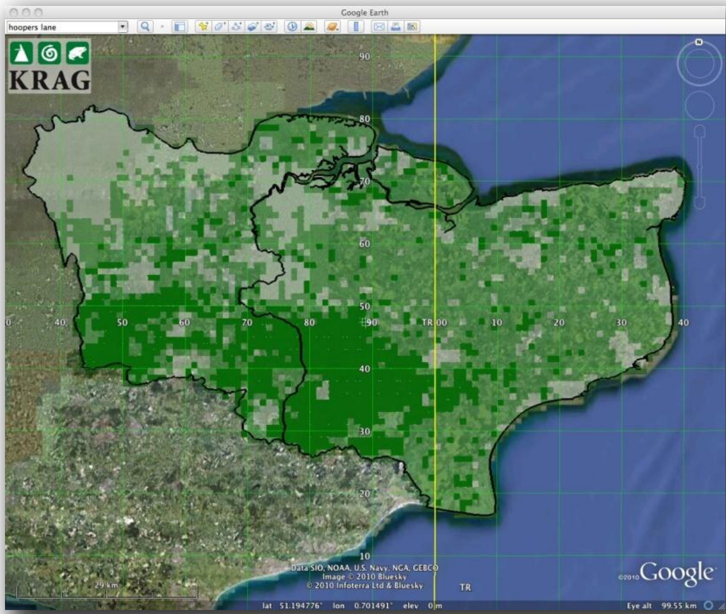
The scores for each of the land cover types are summed to give an overall HSI score for the km^2. This data can be used to map the relative habitat suitability for each km^2 by allocating the km^2 to a category depending upon the distance the overall HSI for the km^2 is from the mean county HSI score as illustrated below:

Range (SD = standard deviation)	Category
>=0.5 SDs below the mean HSI score	least favourable
Within 0.5 SDs of the mean HSI score	intermediate
>=0.5 SDs above the mean HSI score	most favourable

Results

The landscape scale habitat suitability index map is reproduced below:

Habitat Suitability Index for great crested newt



The dark green colour represents the most favourable kilometre squares for GCNs; the light green has intermediate favourability and the unshaded squares represent the areas that are least favourable for GCNs. It is important to note that these colours represent the most favourable areas for GCNs and not the absolute likelihood of encountering GCNs.

Conclusions and Discussion

As can be seen from the map above, the landscape habitat suitability index offers a high degree of correlation with the recorded distribution of GCNs shown on page 5. The Low Weald area of Kent has the highest percentage of suitable habitat with urban areas showing the lowest percentage of suitable habitat. However, there are areas within the calculated range of GCNs that appear to have poor habitat suitability as well as areas outside the calculated range that have apparently good habitat.

The methodology is not restricted to use with GCNs and has been repeated for all of Kent's native amphibian species. An advantage of using the recording database to generate the habitat suitability maps is that the results are dynamic. As more GCN records are added to the database the habitat suitability maps will be updated to reflect the improved knowledge of the distribution of the species.

One of the limitations of this dataset becomes apparent upon examination of the part of the vice county of Kent that is found within Greater London. This area has no pond data as it falls outside the administrative boundary of Kent County Council and, partly as a consequence of this; the habitat suitability indices for this area are low. However, GCNs are present and much of it is within the calculated range of GCNs. Obtaining pond data for the whole of the vice county of Kent remains a priority.

Having assessed habitat and the likely range of the species, the remaining task is to use this data to identify areas where pond creation will have the greatest benefit to both the consolidation and expansion of existing populations. This will be addressed in the next section.

Section Three: Identifying Pond Creation Sites to Benefit Great Crested Newts

Introduction

Pond creation can be expensive and if their creation is to support a particular species it is very useful to have a strategy for identifying the best areas. This section attempts to formulate just such a strategy for the great crested newt. By targeting areas with suitable terrestrial habitat it is possible to ensure that any new ponds have a terrestrial habitat that can support not only the terrestrial phase of the animals but the passage of animals from one pond to another. The creation of a new pond or ponds needs to make a difference to the GCN population. Therefore, new ponds in an area of extremely high pond density are unlikely to have a beneficial impact but equally, creating a new pond many kilometres from the nearest pond is unlikely to be colonised by GCNs and so not beneficial.

The model proposed aims to combine the range of GCNs with the habitat suitability index described previously as well as pond density to identify the best kilometre squares to create new ponds.

Methodology

Step1: Remove pond density from the HSI model

The landscape scale HSI model described in section two was used to identify areas where great crested newts were most likely to exist. This model included pond density as a factor but as the aim of this section is to identify the most suitable areas to create ponds the first step is to remove pond density from the HSI process. The result of this intermediate step is a map of the most and least favourable areas of terrestrial habitat for

GCN. As with the landscape scale HSI, the most favourable areas were more than 0.5 standard deviations above the mean score and the least favourable areas were more than 0.5 standard deviations below the mean score.

Step 2: Develop a matrix to help identify the best km^2 for creating new ponds

The next step is to develop a matrix that allows the favourable terrestrial habitat to be measured against pond density to create a scoring system that identifies the best areas for new ponds. To do this a scoring system for pond density needs to be devised. The rationale is based upon the pond density score within Oldham's pond habitat suitability index (see ARG UK Advice Note 5) and detailed in Lee Brady's Recording Blog.

Pond Creation Matrix

	Habitat	Least favourable	Average	Most favourable
Pond Density	Score	(1)	(2)	(3)
High	(1)	1	2	3
Medium	(2)	2	4	6
Low	(3)	3	6	9

The matrix now scores the kilometre squares that have the best habitat but the least ponds most highly. Kilometre squares that score 6 and over (shaded red) are considered to be within the high priority areas for pond creation. Scores of 3 and 4 (orange) are in areas of medium priority and scores of 1 and 2 (yellow) are low priority.

Step 3: Introduce the range of the species

Depending upon whether great crested newts are found at , near to or nowhere near a pond creation site will influence the not only the likelihood of that pond being colonised but also how it will impact upon existing populations. Therefore, the range (described in section one) of the centre point of each kilometre square is used to categorise the kilometre squares identified in step 2.

Core Range	=	reinforce existing population
Predicted Range	=	reinforce existing metapopulation
Maximum Range	=	expand range of species

Those kilometre squares that lie outside the maximum range of great crested newts were rejected as they are highly unlikely to be of benefit to GCNs (though they may be highly beneficial to other species)

Step 4: Tweaking the model

The model identified does have several weaknesses that can be addressed by tweaking some of the variables to eliminate prioritised kilometre squares that do not fulfil the aims of the categories identified in step 3. These are:

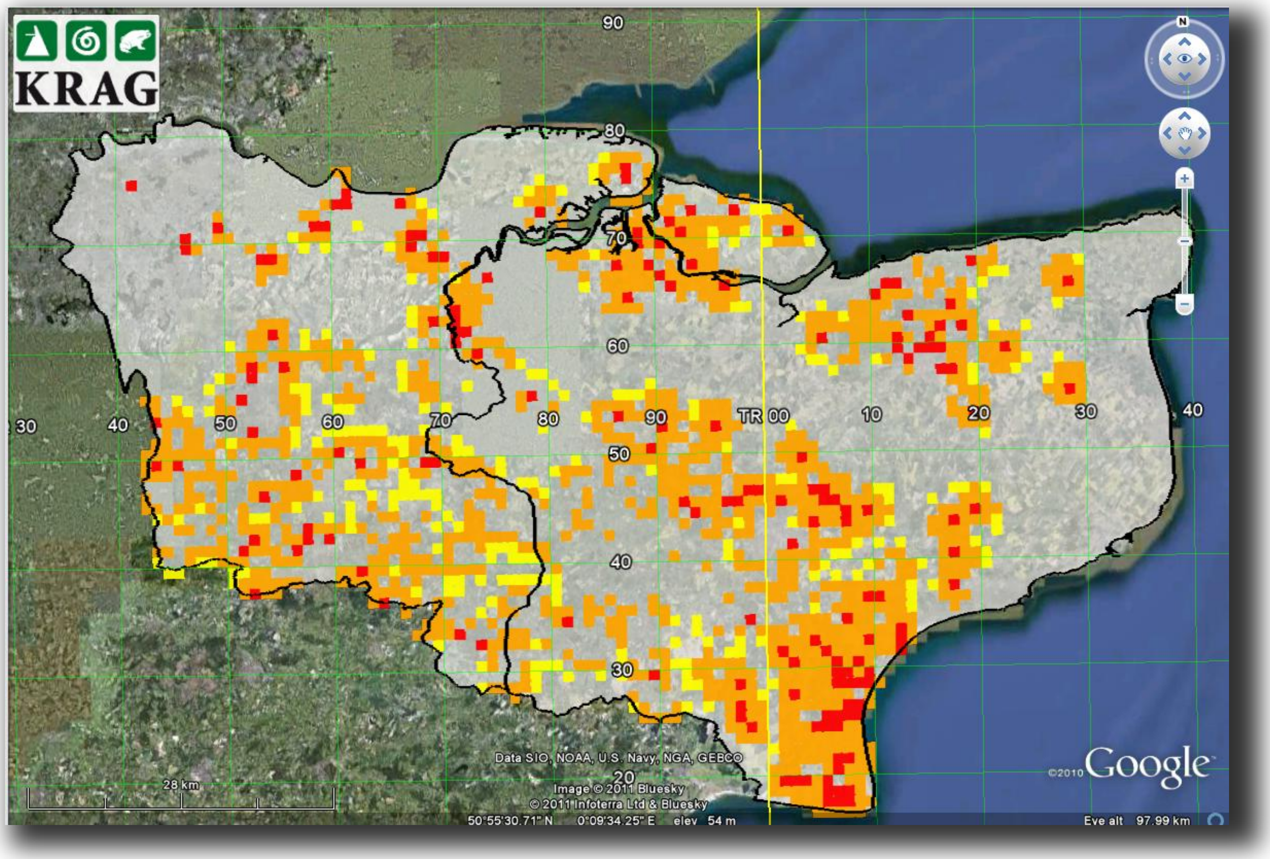
1. Restricting those kilometre squares prioritised within the maximum range of GCNs to those within one kilometre of predicted range. This prevents creating high priority squares in areas that are highly unlikely to be colonised by great crested newts.
2. Kilometre squares within the core range but with low pond density are prioritised irrespective of the quality of the terrestrial habitat. This can be justified as great crested newts that are in isolated waterbodies can be vulnerable to the loss of just a single pond. Additional ponds will definitely reinforce the existing population.
3. Kilometre squares within the core range with medium pond density are given medium priority irrespective of terrestrial habitat for the same reason as point 2.
4. Kilometre squares in the maximum range but with less than 2 ponds are dropped to low priority as without an existing network of ponds, new ponds are unlikely to be colonised by GCNs.

Results

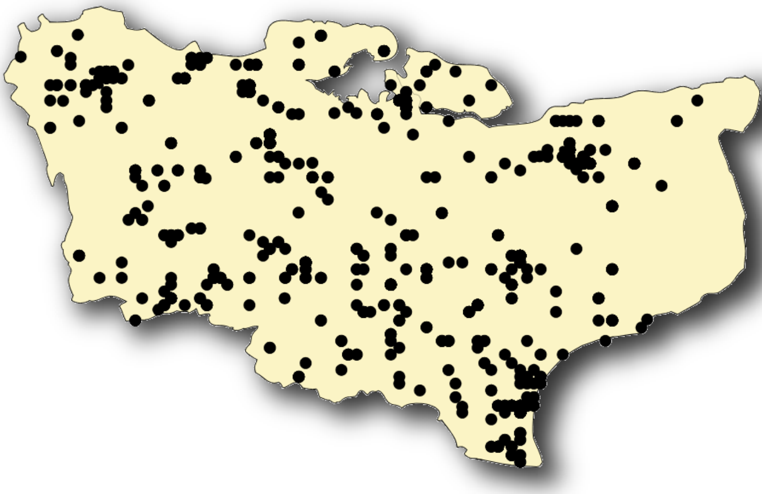
The final map of priority squares is shown overleaf and is compared with the distribution map for great crested newts and pond density. Only the kilometre squares with high priority are shown and the colour scheme is as follows:

Red	Reinforce existing populations
Orange	Reinforce existing metapopulation
Yellow	Expand range of species

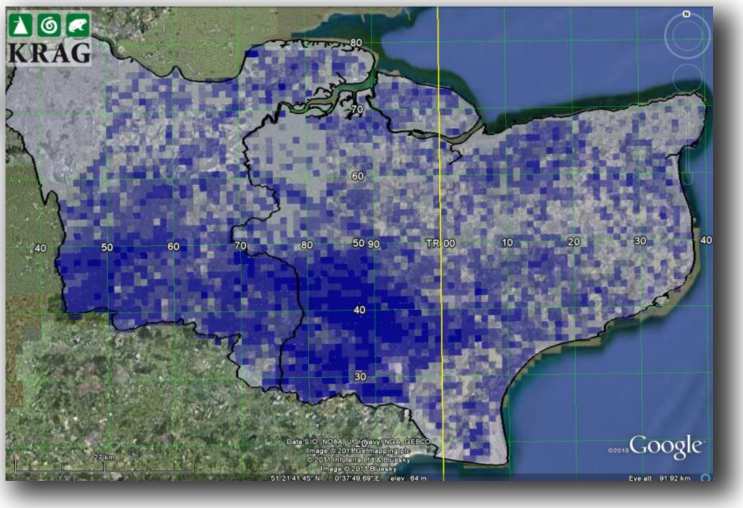
Priority Pond Creation Areas for Great Crested Newt



Distribution of Great Crested Newt in Kent (Nov 2010)



Pond Density in Kent



Conclusions and Discussion

The map of priority areas for pond creation sites is a useful tool for identifying and assessing potential sites for new ponds. The criteria utilised for identifying the priority areas restricts new pond sites to within approximately 3.5km of an existing great crested newt record. Hence, there is a similarity between the pond creation site map and the distribution map. However, it is the differences between these maps that are most revealing. The broad areas of the map that contain very few pond creation sites are the Kent Downs AONB and parts of the Low Weald. The Kent Downs are characterised by having few ponds and subsequently, few GCN records. These factors combined would suggest that this is not the best area for creating new GCN ponds. The opposite is the case in the Low Weald with very high pond numbers and the highest concentration of great crested newt records. As pond density is already so high it is not a limiting factor to GCNs dispersing or breeding successfully so pond creation in the Low Weald will not be of great benefit to GCNs.

The limitations of this model are based upon the quality of the data that are used to create the model. The pond count data is derived from the Kent Habitat Survey of 2003 and there are errors in this dataset. Some of the ponds are not actually present and others that do exist are not shown. The other limitation is lack of survey effort. As the areas that are prioritised are based upon the proximity to great crested newt records this will be impacted upon if no survey work has been done in a particular area. This will also lead to some of the prioritised kilometre squares being prioritised for slightly different reasons. For example, a kilometre square that has been categorised as a priority area for ponds as it will reinforce an existing metapopulation may actually be priority squares as they reinforce the population of a nearby pond that contains GCNs but has not been surveyed.

However, this tool allows conservation organisations the ability to objectively assess the likely impact of a pond construction project on great crested newts as well as to target areas for future pond creation projects to benefit a key species. This tool can be used as evidence to possible funders that the pond construction project is benefiting a specific priority Biodiversity Action Plan species and is likely to result in a priority pond as described in the pond Habitat Action Plan being created.

Further Sources of Information

The following sources were used either used to help compile this report or provide additional, relevant subject material.

Corine Land Cover 2000 (European Environment Agency) – A Europe-wide dataset providing information on land cover. http://www.eea.europa.eu/data-and-maps/data#c5=all&c11=&c17=CLC2000&c0=5&b_start=0

Lee Brady's Recording Blog – A regularly updated blog with many references to the work that underpins this report. http://calumma.typepad.com/lee_bradys_recording_blog/

Nearest Neighbour Analysis (Barcelona Field Studies Centre) – An introduction to nearest neighbour analysis. http://geographyfieldwork.com/nearest_neighbour_analysis.htm

Oldham, R. et al (2000) – 'Evaluating the Suitability of Habitat for the Great Crested Newt', *Herpetological Journal*, Vol 10, No 4, pp.143-156