iNaturalistUK Observation Records (2008 – 2023)

Analysis Report

01 – August - 2025

In partnership with

Contents

Introduction

This report presents the results of the data analysis of the iNaturalistUK observation records from 2008 to 2023.

The study was carried out as part of doctoral research within the RENEW project (https://renewbiodiversity.org.uk), funded by the Natural Environment Research Council (NERC) at the University of Exeter. The study was conducted in collaboration with the National Biodiversity Network Trust (NBN Trust).

The findings, accompanied by relevant figures, are detailed in four main sections:

- **Section 1** - User engagement and behaviour patterns
- **Section 2** - Spatiotemporal patterns
- **Section 3** - Taxonomic patterns
- **Section 4** - Quality grades, licensing, geoprivacy, and accuracy

Each section outlines the objectives of the analysis and explains the results.

iNaturalist is a global, community-driven platform that enables users to record, share, and identify observations of biodiversity. iNaturalist was introduced in 2008 and started as a platform and has been widely used since 2018, with broader use in the United Kingdom beginning after 2020. A key milestone was the launch of iNaturalistUK in April 2021, when the NBN Trust became the official lead organisation for the UK node of the iNaturalist network.

All analyses were conducted using the iNaturalistUK observation record dataset shared by the NBN Trust in February 2024. The initial dataset contained 5.6 million records. Since the study focused exclusively on observations recorded within the UK, any made by iNaturalistUK users outside the UK were excluded. Consequently, the analyses utilised a total of 4.8 million observation records, with the most recent observation recorded on December 5th, 2023. Both observation date and record upload date were used, depending on the requirements of the specific analysis.

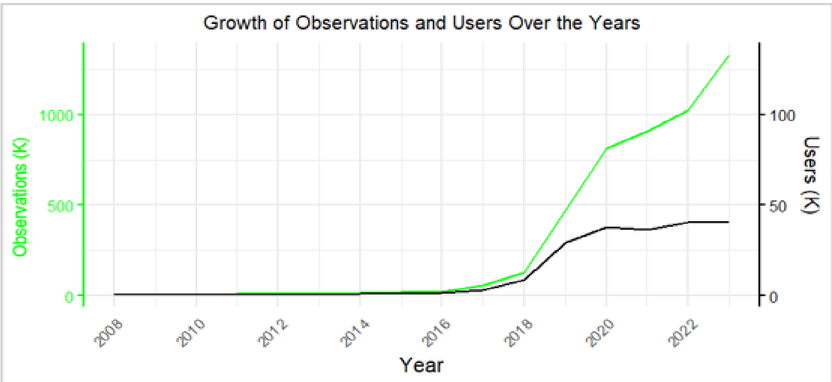
Additionally, other spatial data for the UK, such as land cover classification, population density, and multiple deprivation (IMD) ranks, were also incorporated to enhance the analyses. All analyses were performed using R version 4.3.3 (R Core Team, 2021).

Results

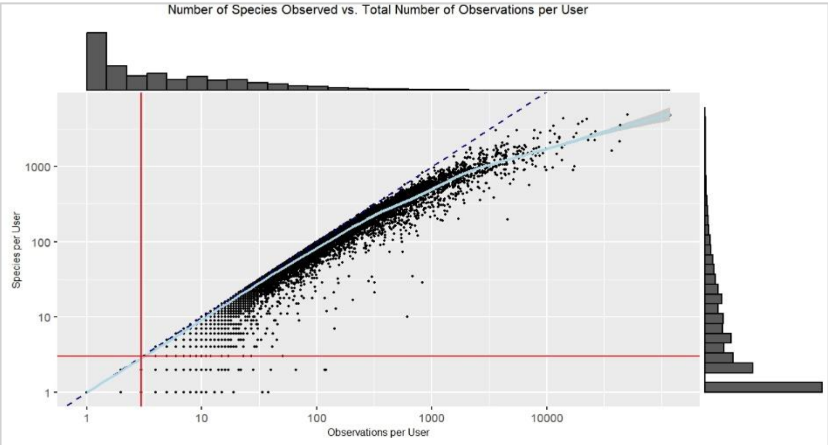
Section 1 - User Activity Patterns and Engagement in iNaturalistUK

Aim	Area	Queries
To understand the patterns of user activity and engagement on iNaturalistUK.	User behaviour and engagement	1.1. Growth of users and observations over time? 1.2. The number of species observed and the total number of observations per user? 1.3. Distribution of observations? 1.4. Difference between when observations are recorded and uploaded? 1.5. Time between first and last observation?

Results for each Query

Results	Description
1.1.  	The number of observation records has surged since iNaturalist launched as a platform in 2018, accumulating over 4.8 million total records by December 2023. The number of users has also increased since 2018, resulting in over 126,000 total users by December 2023. iNaturalist began to see broader use in the UK after 2020, and a key milestone was the launch of iNaturalistUK in April 2021, when the NBN Trust became the official UK lead.

1.2.



This figure illustrates the relationship between the number of species observed (determined by the distinct Taxon IDs assigned to each observation) and the total number of observations recorded by each user.

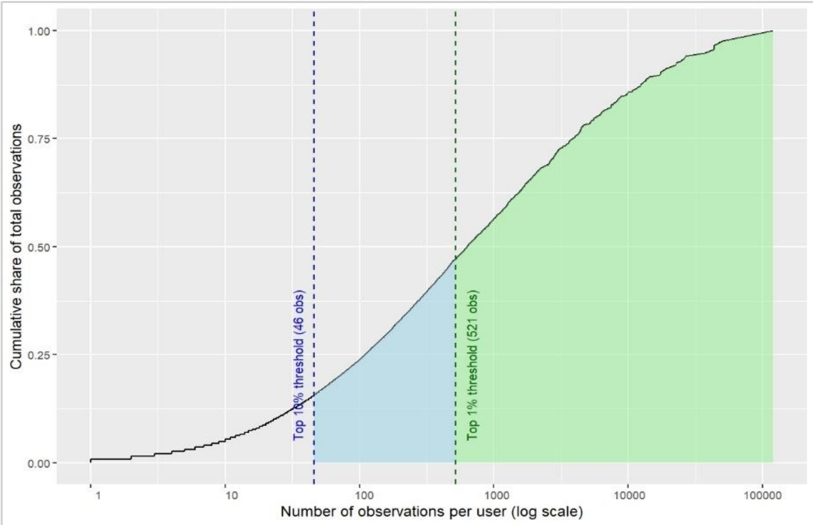
The dark blue dashed line represents a one-to-one relationship, where each observation corresponds to a different species. The light blue line shows a smoothed trend fitted using a Generalised Additive Model (GAM) with a Gaussian distribution and an identity link function. The shaded area around the GAM line indicates the 95% confidence interval. Marginal histograms show the distribution of observations and species per user, with red lines indicating the median values for each axis.

Most users made relatively few observations, with a large proportion contributing only a single observation of a single species. The median user recorded five observation records of five different species.

The results show that users who make more records tend to observe more species. While the number of species increases with user activity, the relationship is sublinear; as total observations increase, users are more likely to record repeat sightings of the same species.

This is shown by the GAM curve gradually flattening below the one-to-one line. In simpler terms, for every tenfold increase in observations, the number of unique species recorded increases by less than tenfold.

1.3.

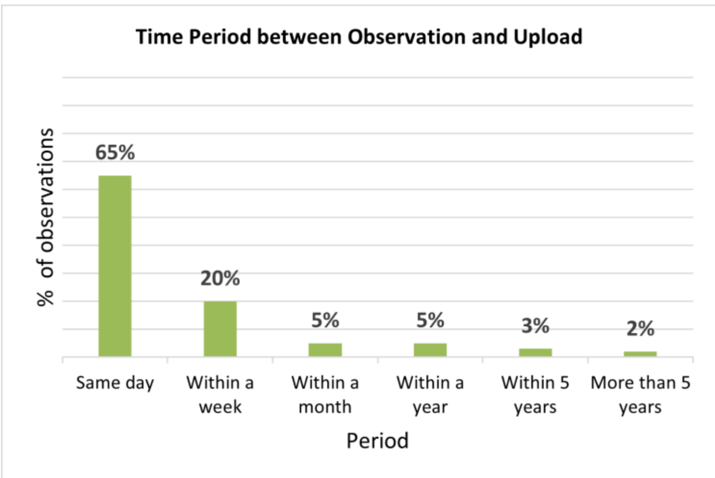


This figure shows the cumulative share of total observation records contributed by users on iNaturalistUK between 2008 and 2023, based on the number of observation records uploaded per user.

The distribution shows a strong skew, with a small proportion of highly active users contributing the majority of the data. Users with more than 46 observations, representing the top 10% of contributors, accounted for approximately 85% of all records. Within this group, the top 1% of users (those with more than 521 observations) alone contributed around 53% of all records.

The entire shaded region (blue and green combined) represents the top 10% of users, while the green area indicates the top 1%. The blue area captures the remaining 9% of top contributors, those with 46 to 520 observations. Vertical dashed lines at 46 and 521 observations mark the thresholds for these groups.

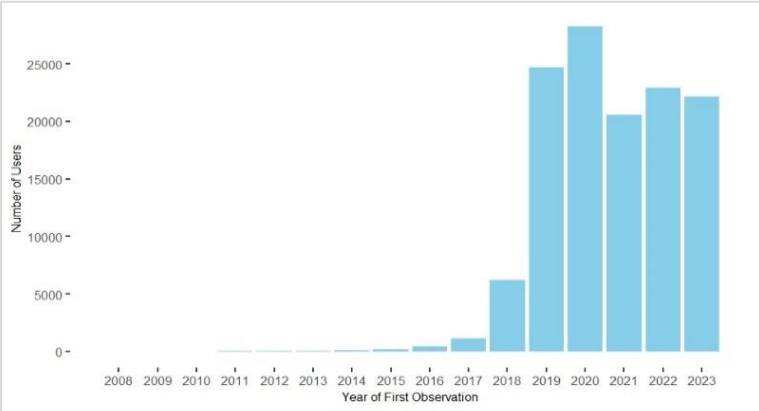
1.4.



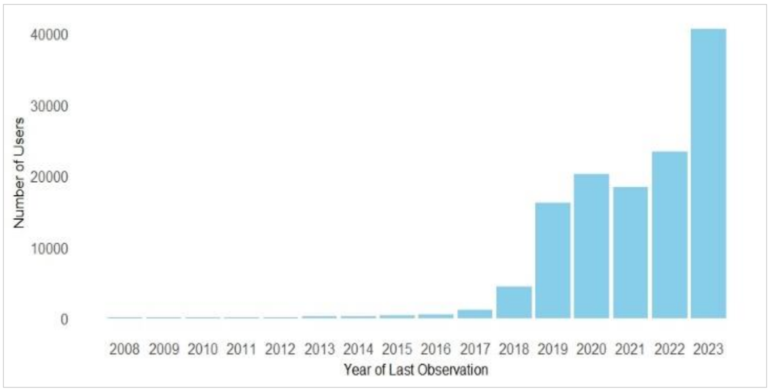
65% of the total observations (n = 3,176,827) were uploaded to the iNaturalist platform on the same day they were observed. 20% of the observations (n = 997,589) were uploaded within a week after being observed. 5% of the total observations (n = 235,820) were uploaded within a month. 10% of the total observations (n = 467,181) were uploaded within a year or more, indicating that users are also uploading historical data.

1.5.

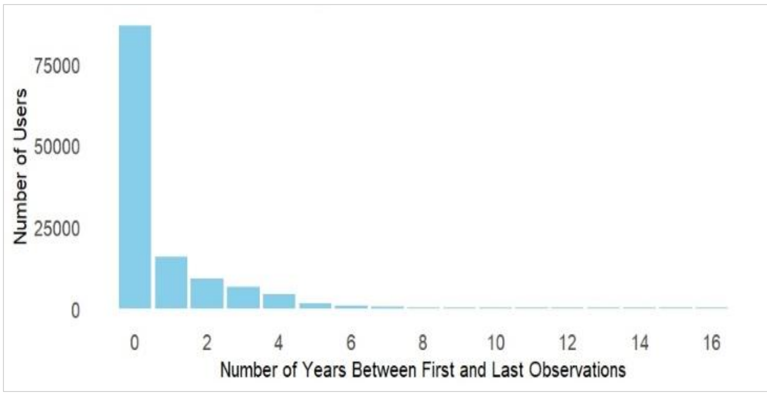
i)



ii)



iii)



Users were grouped by (i) the year in which they uploaded their first observation, (ii) the year in which they uploaded their last observation, and (iii) the number of years between their first and last observations.

The grouping results from (i) and (ii) reflect the number of observers entering and exiting iNaturalist each year.

Over the years, the number of entering and exiting observers both increased. There was a sharp rise in the number of observers entering iNaturalist in 2019, followed by a slight decrease in 2021.

The majority of users contributed observations only within the year they joined, as evidenced by the distribution of users based on the number of years between their first and last observations.

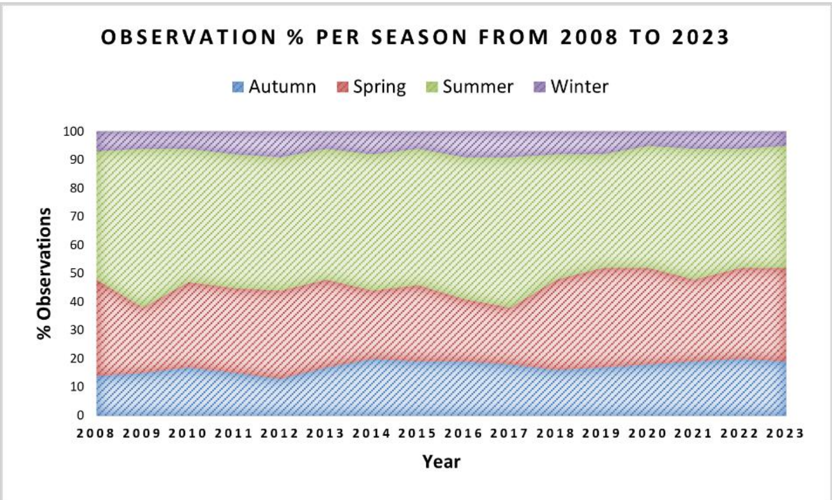
This suggests an initial engagement but low long-term retention, with user activity diminishing sharply after the first year.

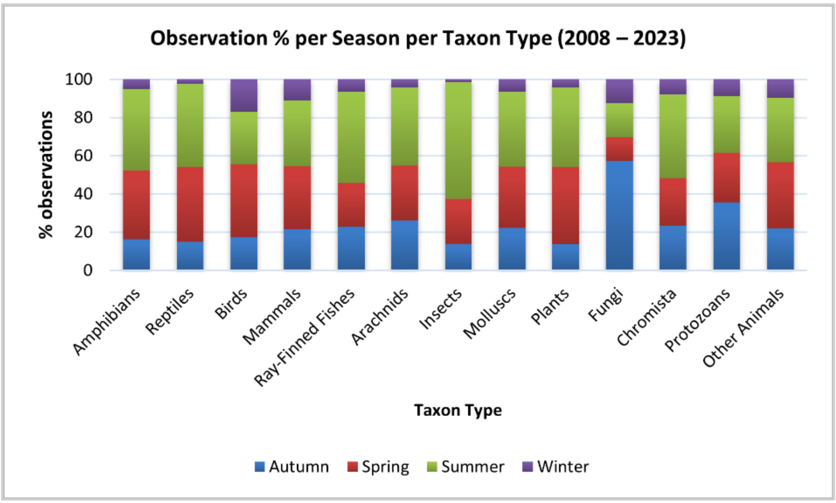
Section 2 - Spatiotemporal Patterns in iNaturalistUK

Aim	Area	Queries
To understand how observations are distributed across different locations and times. This could reveal spatial biases (hot and cold spots), seasonal trends, and variations.	2.1. When they observed	2.1.1. Time of year? 2.1.2. Days of the week? 2.1.3. Time of day?
	2.2. Observations by geographical area	2.2.1. Is there a bias in recording species by area?

Results for each Query

<table>
<tr><th>Results</th><th>Description</th></tr>
<tr><td>
2.1.1.





</td><td>
The first chart illustrates the percentage of observations across four seasons from 2008 to 2023.

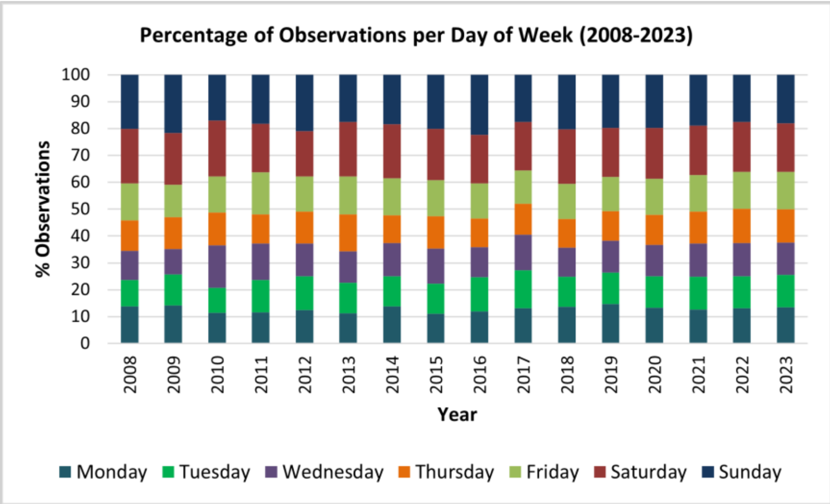
It shows that summer consistently has the highest percentage of observations. Winter has the lowest percentage, generally around 10% to 20%.

The seasonal distribution remains largely unchanged over the years, without significant shifts.

The second chart provides a detailed breakdown of the percentage of observations by season and taxon type over the same period.

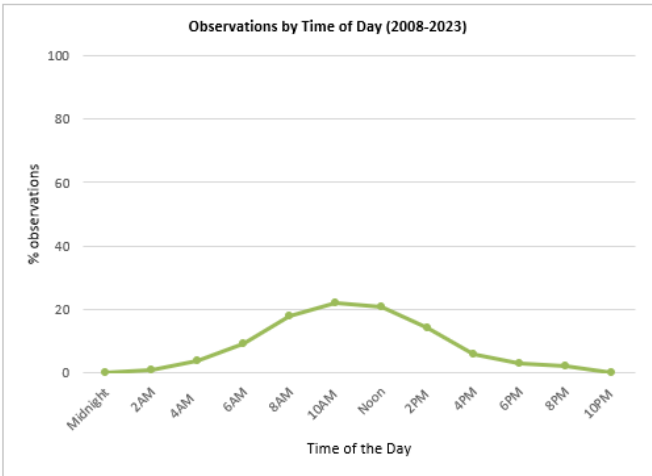
It shows that the highest percentage of observations was during the summer across most taxa. Observations of specific taxa show distinct seasonal preferences, such as more observations of Fungi and Protozoans in Autumn, and Birds and Other animals in Spring.
</td></tr>
</table>

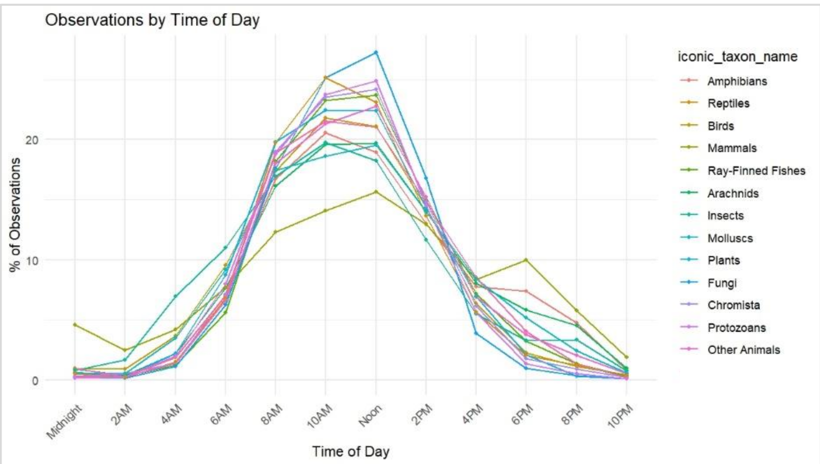
2.1.2.



The figure illustrates that higher percentages of observations occurred during weekends compared to weekdays from 2008 to 2023. Weekdays exhibit a more even distribution of observations without significant long-term changes, although Monday and Friday had more observations compared to other weekdays in most years.

2.1.3.





The highest percentage of observations occurs between 8 am and 2 pm, peaking around 10 am with 22% of the total observations.

In contrast, there are minimal observations (less than 10%) recorded during the early morning hours (midnight to 4 am) and late evening (6 pm to 10 pm).

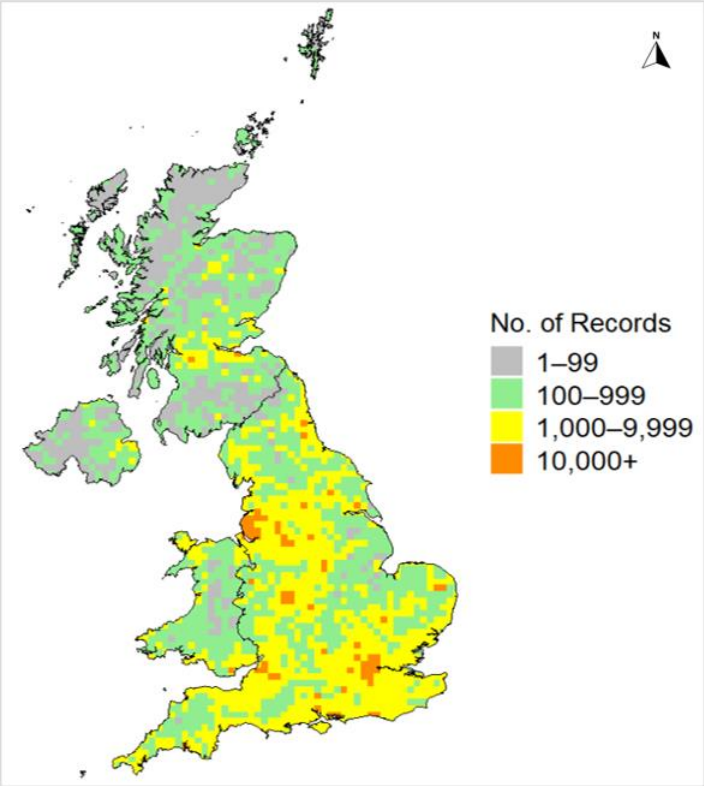
The second figure demonstrates the distribution of observations by time of day across 13 taxonomic types.

Observations for all taxa exhibit a similar pattern, with the highest percentages occurring between 8 am and 2 pm. Observations are notably minimal during the early morning hours (midnight to 4 am) and late evening (6 pm to 10 pm).

This trend underscores the influence of human activity patterns, as these times align with when people are most active, rather than necessarily reflecting the actual behaviour or presence of the observed taxa.

2.2.1.

- Spatial distribution of observation records (2008-2023)

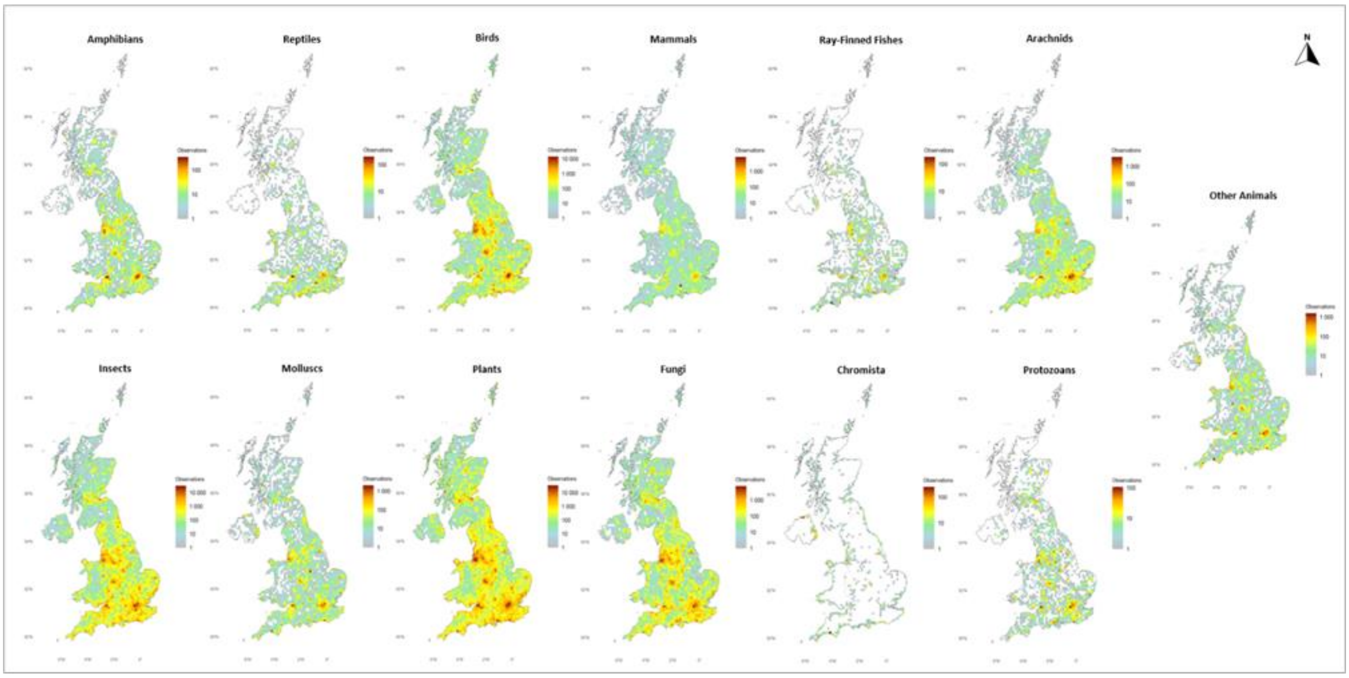


The map illustrates the spatial distribution of observation records from the years 2008 – 2023 across the UK at 10km resolution with a colour gradient indicating the number of observations from 1 to 10,000+.

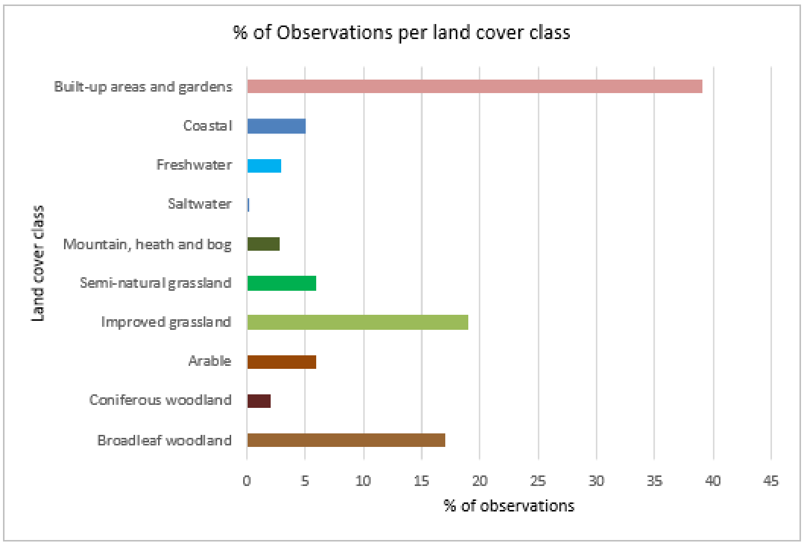
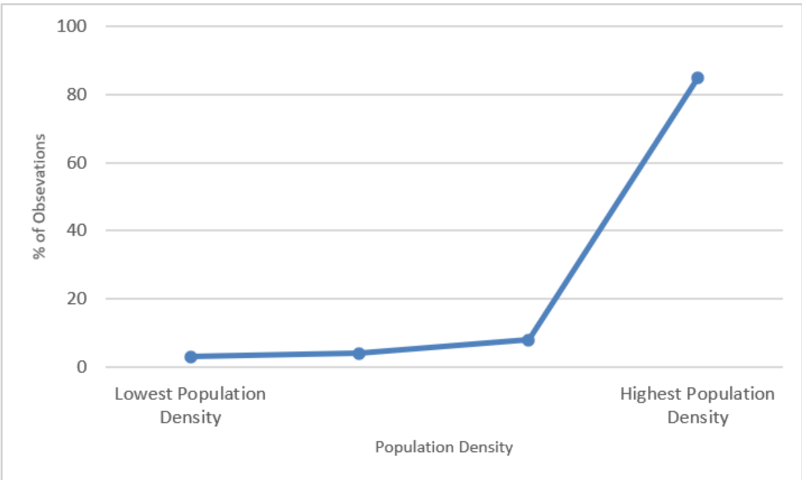
The highest concentration of observations (10,000 and above) is mainly in the cities of England, particularly in London and the surrounding area, the Midlands, and the Northwest, shown in orange.

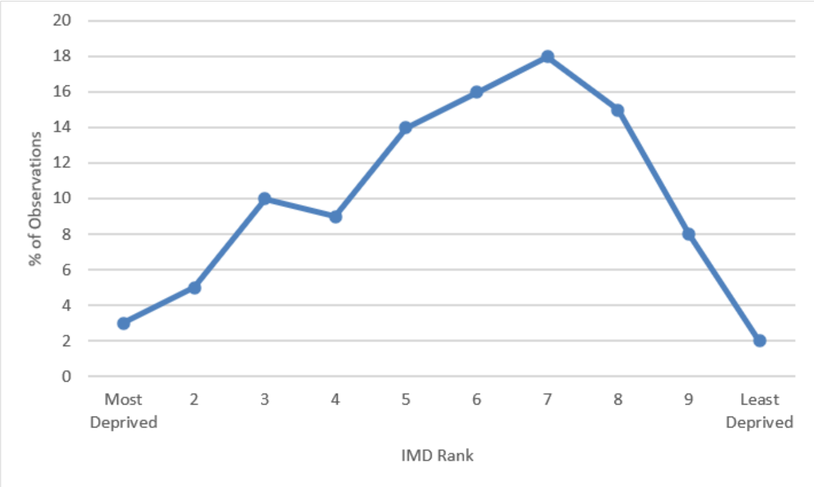
In contrast, the northern regions of Scotland and Northern Ireland exhibit significantly fewer observations (1-99), shown by the grey colour.

- Spatial distribution of observations by taxon type (2008-2023)



The series of maps displays the spatial distribution of observations across the UK at a 10 km resolution for all 13 taxonomic groups. Each map reveals that the highest number of observations are concentrated in England, particularly around urban and suburban areas. In contrast, the northern parts of Scotland and Northern Ireland show markedly fewer observations across all taxonomic groups.

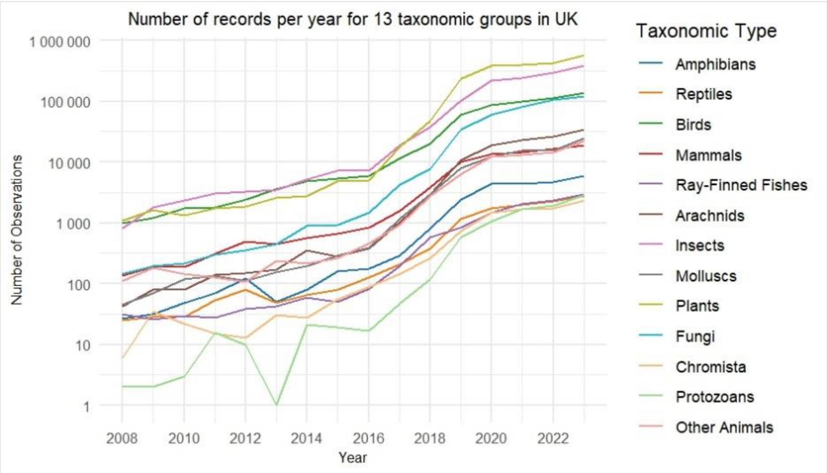
➢ Land cover classification of observations 	The bar chart shows the percentage of observations per land cover class based on the UKCEH Aggregate Land Cover Classification (2021). 39% of total observations were recorded in built-up areas and gardens, indicating a strong bias towards urban and suburban environments. Improved grassland areas have the second highest observation percentage (19%), followed by broadleaf woodland (17%). Other land cover classes, such as coastal, freshwater, saltwater, mountain, heath and bog, and coniferous woodland, have significantly fewer observations, each contributing less than 5% to the total.
➢ Observations by population density 	The line chart shows a clear trend where the percentage of observations increases dramatically with higher human population densities. More than 80% of observations are from areas with high population densities (more than 250 people) in the UK. Less than 10% of observations are from areas with low population densities (fewer than 50 people) in the UK. This pattern highlights a significant bias in observation recording, heavily influenced by human population distribution.

➢ Observations by area of deprivation 	The line chart illustrates the percentage of observations across different ranks of the unified metric of the Index of Multiple Deprivation (IMD) in the UK, where 1 represents the most deprived areas and 10 represents the least deprived. The chart shows the highest percentage of observations (18%) recorded in the areas with rank 7. This distribution suggests that observations are more prevalent in moderately deprived areas (between ranks 5 to rank 8) rather than the extremes of deprivation (less than 5%).

Section 3 - Taxonomic Patterns in iNaturalistUK

Aim	Area	Queries
To understand the patterns of interest among users, whether users tend to specialise in specific taxonomic groups or if their observations span a wide range of species.	3.1. Taxonomic patterns	3.1.1. Taxon split of observations. 3.1.2. What species are being observed?

Results for each Query

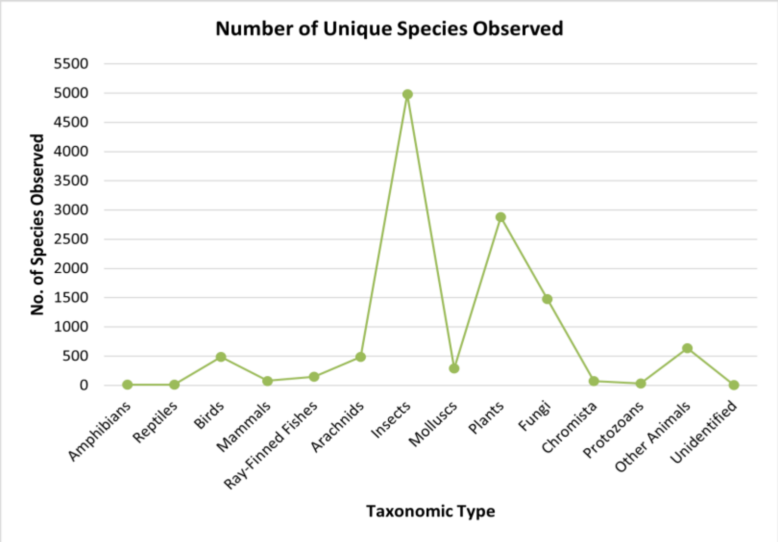
<table>
<tr><th>Results</th><th>Description</th></tr>
<tr><td>3.1.1.

</td><td>The chart illustrates an overall increase in the number of observations across all taxonomic groups.

Plants and Insects have the highest number of observations, exceeding 100,000 records in 2023, followed by Birds, Fungi, and Arachnids.

Lower recorded groups include Protozoans and Chromista. A noticeable increase in observations began around 2016–2018 and further across many taxonomic groups, likely driven by the rising use of iNaturalist, which officially launched as a platform in 2018.

While most groups show steady growth, some exhibit more complex fluctuations in their yearly records.</td></tr>
</table>

3.1.2.



The chart displays the number of unique species observed across 13 taxonomic types from 2008 - 2023.

This analysis was conducted referring to the UK Species Inventory (Last updated 2021). This inventory includes both UK wild and escaped species. Only research-grade observations were considered for this analysis.

The chart highlights substantial variability in observation frequency among different taxa.

Insects are the most observed taxonomic group, with 4,979 species recorded, followed by Plants with 2,876 species. Other groups, such as Fungi (1,475 species) and Other animals (634 species), also have significant observation counts but are much lower compared to Insects and Plants. In contrast, other taxonomic types have relatively low observation numbers, generally under 500 species each.

This distribution indicates a strong interest in Insects and Plants or may reflect the relative ease of capturing images of these groups with mobile phones. In contrast, other taxa are observed and recorded less frequently, possibly due to the difficulty in photographing them.

- Five least recorded species per taxon group

Scientific Name	Common Name	Taxon Type	No. of Observations
Engraulis encrasicolus	European Anchovy	Actinopterygii	1
Thunnus albacares	Yellowfin Tuna	Actinopterygii	1
Brama brama	Ray's Bream	Actinopterygii	1
Acipenser baerii	Siberian Sturgeon	Actinopterygii	1
Acipenser gueldenstaedtii	Russian Sturgeon	Actinopterygii	1
Lithobates catesbeianus	American Bullfrog	Amphibia	2
Pelophylax esculentus	Edible Frog	Amphibia	4

The table presents the five least recorded species per taxonomic group from 2008 to 2023, based exclusively on research-grade observations.

It includes each species' scientific name, common name, taxonomic group, and the total number of research-grade observation records.

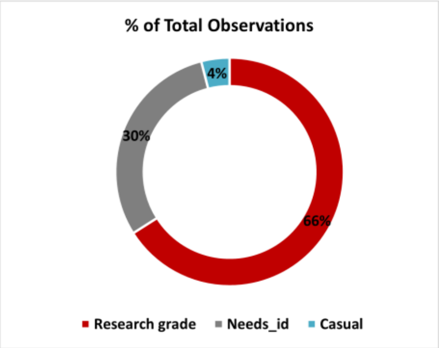
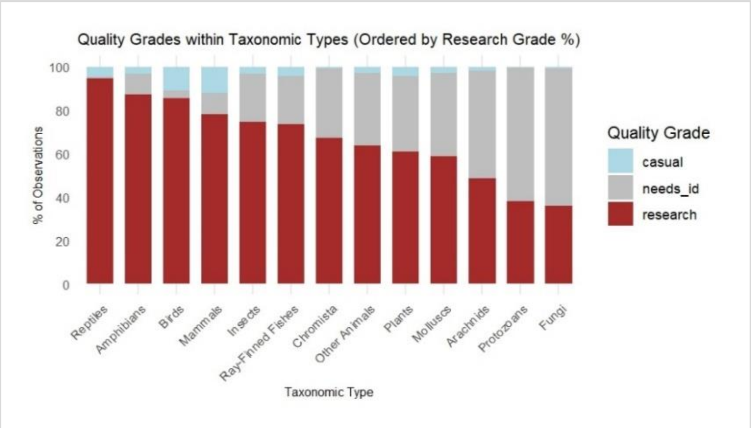
Pelophylax lessonae	Pool Frog	Amphibia	6	It is important to note that this table shows a selection of the bottom five species per group and does not capture all species with equally low observation counts. In cases where many species share the same minimum number of records (e.g., only one observation), only five have been displayed. As such, the table should be viewed as a representative summary rather than a comprehensive list of all under-recorded species.
Alytes obstetricans	Common Midwife Toad	Amphibia	7	
Ichthyosaura alpestris	Alpine Newt	Amphibia	25	
Myxine glutinosa	Atlantic Hagfish	Animalia	1	
Sertularia argentea		Animalia	1	
Ophiopholis aculeata	Daisy Brittle Star	Animalia	1	
Triops cancriformis	European Tadpole Shrimp	Animalia	1	
Hybocodon prolifer		Animalia	1	
Trombidium holosericeum		Arachnida	1	
Steatoda triangulosa	Triangulate Combfoot	Arachnida	1	
Myrmarachne formicaria		Arachnida	1	
Phlegra fasciata		Arachnida	1	
Erigone atra	Post Dwarf Weaver	Arachnida	1	
Tetrax tetrax	Little Bustard	Aves	1	
Porzana carolina	Sora	Aves	1	
Callipepla californica	California Quail	Aves	1	
Streptopelia orientalis	Oriental Turtle-Dove	Aves	1	
Sula sula	Red-footed Booby	Aves	1	
Chordaria flagelliformis		Chromista	1	
Asperococcus fistulosus		Chromista	1	
Spongonema tomentosum		Chromista	1	
Colpomenia sinuosa	Oyster thief	Chromista	1	
Stentor polymorphus		Chromista	1	
Russula sanguinaria	Bloody Brittlegill	Fungi	1	
Phyllotopsis nidulans	Stinking Orange Oyster	Fungi	1	
Tremellodendropsis tuberosa	ashen coral	Fungi	1	
Coprinopsis stercorea		Fungi	1	
Mycena purpureofusca	purple-edge bonnet	Fungi	1	
Lasioderma serricorne	Tobacco Beetle	Insecta	1	
Daphnis nerii	Oleander Hawkmoth	Insecta	1	
Mantis religiosa	European Mantis	Insecta	1	
Alphitobius diaperinus	Lesser Mealworm	Insecta	1	
Trichodes apiarius	Bee-eating Beetle	Insecta	1	
Plecotus austriacus	Grey Long-eared Bat	Mammalia	1	
Nyctalus leisleri	Lesser Noctule	Mammalia	1	
Lagenorhynchus albirostris	White-beaked Dolphin	Mammalia	1	
Balaenoptera borealis	Sei Whale	Mammalia	1	
Myotis bechsteinii	Bechstein's bat	Mammalia	1	
Pseudanodonta complanata	depressed river mussel	Mollusca	1	
Columella edentula	Toothless Chrysalis-snail	Mollusca	1	
Stagnicola corvus		Mollusca	1	
Rossia macrosoma	Stout Bobtail	Mollusca	1	
Sphaerium rivicola	River Orb-mussel	Mollusca	1	
Magnoliopsida	dicots	Plantae	1	

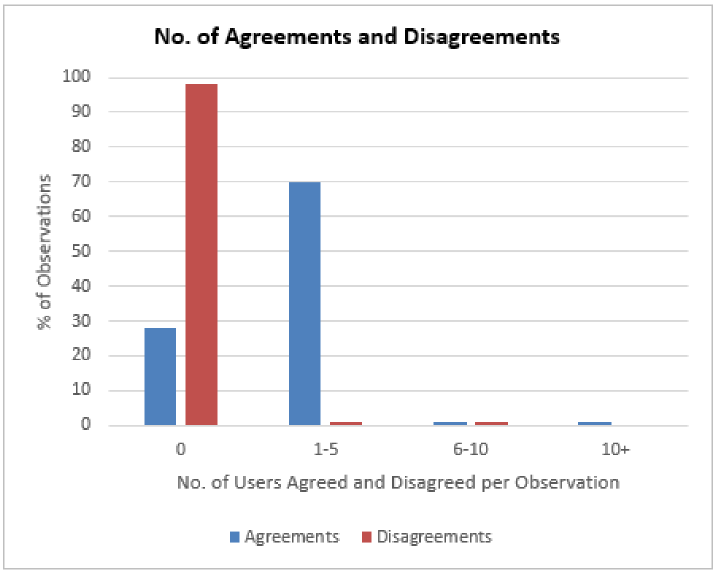
Sequoia sempervirens	coast redwood	Plantae	1
Clethra arborea	Lily of the Valley Tree	Plantae	1
Capsicum annuum	chili pepper	Plantae	1
Spiraea tomentosa	Hardhack	Plantae	1
Comatricha nigra		Protozoa	1
Diderma hemisphaericum		Protozoa	1
Reticularia splendens		Protozoa	1
Hemitrichia calyculata	Push Pin Slime Mold	Protozoa	1
Craterium leucocephalum		Protozoa	1
Pelodiscus sinensis	Chinese Softshell Turtle	Reptilia	1
Lacerta bilineata	Western Green Lizard	Reptilia	2
Emys orbicularis	European Pond Turtle	Reptilia	2
Zamenis longissimus	Aesculapian Snake	Reptilia	24
Coronella austriaca	Smooth Snake	Reptilia	42

Section 4 - Quality Grade, Licencing, Geoprivacy, and Accuracy of iNaturalistUK Observation Records

Aim	Area	Queries
To understand the quality of data collected	4.1. Quality grade of observations	4.1.1. Observations by casual / Needs ID / Research? 4.1.2. Number of users agreeing/disagreeing with ID? 4.1.3. ID gaps and causes e.g., not possible, lack of photos?
	4.2. Licencing	4.2.1. Observations by licence and research grade observations by licence (including no licence assigned)? 4.2.2. Users with no licence assigned, users with unusable licence e.g., SA, and users with NC licence? 4.2.3. The users with no licence, when were they last active?
	4.3. Accuracy ranges	4.3.1. Location precision?
	4.4. Geolocation	4.4.1. Observations via Private / Obscured / Open?

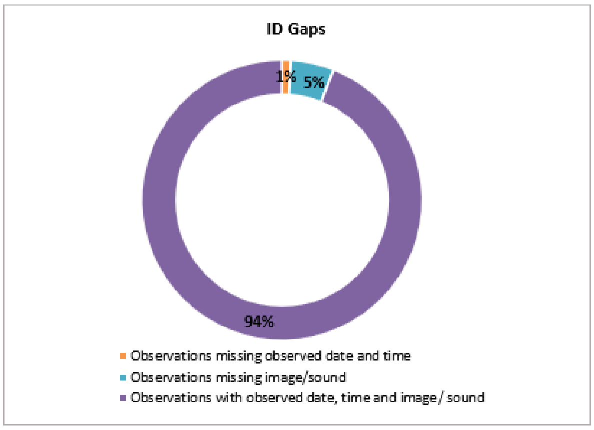
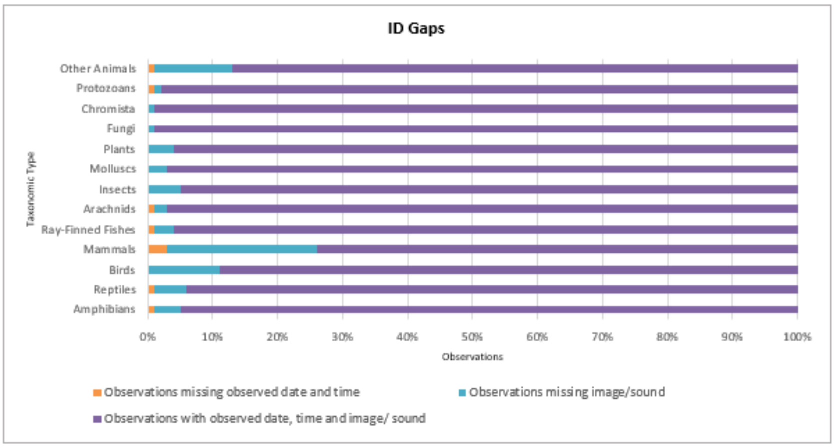
Results for each Query

Results	Description
4.1.1.  	66% of the total observations from 2008 to 2023 are classified as Research grade. The Needs ID category comprises 30% of the total observations. Casual observations form the smallest segment, accounting for 4% of the total observations. This analysis excludes observations of captive/cultivated. The second chart illustrates the distribution of observation quality grades across 13 taxonomic groups. Reptiles, Amphibians, and Birds have the highest percentage of research-grade observations, exceeding 80%. Arachnids, Protozoans, and Fungi have a higher percentage of observations needing ID. Mammals and Birds have a notable percentage of casual observations. This

<table>
<tr><td></td><td>analysis also excludes observations of captive/cultivated animals, and entries consist of humans.</td></tr>
<tr><td>4.1.2.
</td><td>The chart indicates that none of the users disagreed with the majority (over 90%) of the observations.

For a very small number of observations, there is at least one user who disagreed.

In terms of agreements, around 70% of observations have between 1 to 5 users agreeing on them.

Observations with 6 to 10 or more than 10 agreements are minimal, each accounting for less than 5% of the total.</td></tr>
<tr><td>4.1.3.

</td><td>94% of the observations include both date and time information, along with image or sound.

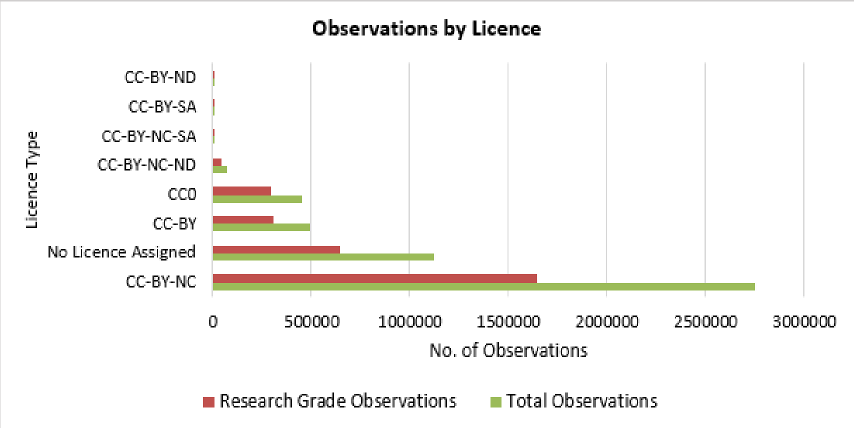
However, 5% of observations lack either images or sounds, and 1% are missing observed date and time, indicating a minor but critical gap in temporal data.

This distribution highlights that the most prevalent data gap is the lack of imagery/ sound evidence.

Observations of Mammals (27%), Birds (11%), and Other animals (12%) show the highest percentage of missing image or sound data.

For taxon groups such as Amphibians, Reptiles, Mammals, Ray-finned fishes, Arachnids, Protozoans, and Other animals, the missing date and time observations remain relatively low, generally under 4%.</td></tr>
</table>

4.2.1.



The bar chart compares the number of total observations and research grade observations across different licence types.

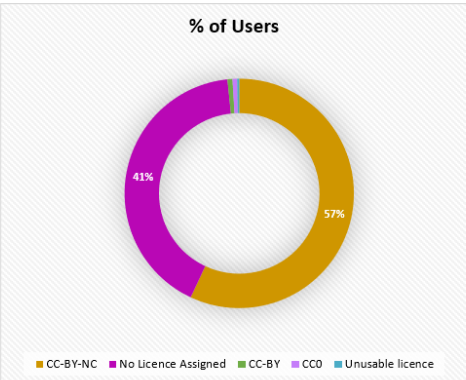
Most total observations and research grade observations fall under the CC-BY-NC licence (default license) type.

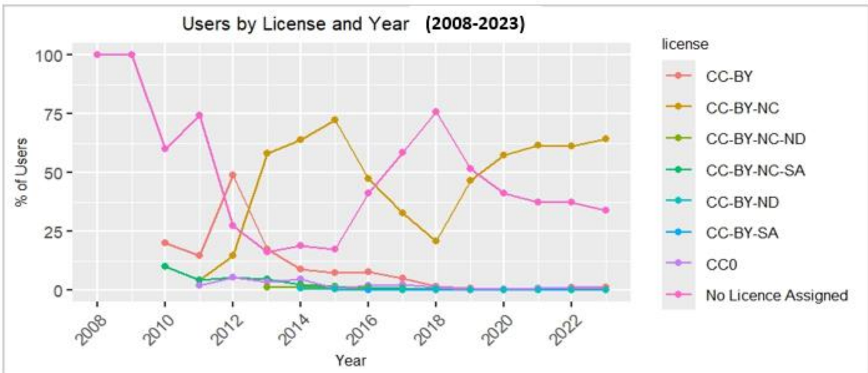
The next most common category is observations with no licence assigned, highlighting a significant portion of data without specified usage rights.

The CC-BY and CC0 licence has about 0.5 million total observations and a substantial number of research-grade observations as well.

Other licences such as CC-BY-SA, CC-BY-NC-SA, CC-BY-NC-ND, and CC-BY-ND have significantly fewer observations.

4.2.2.

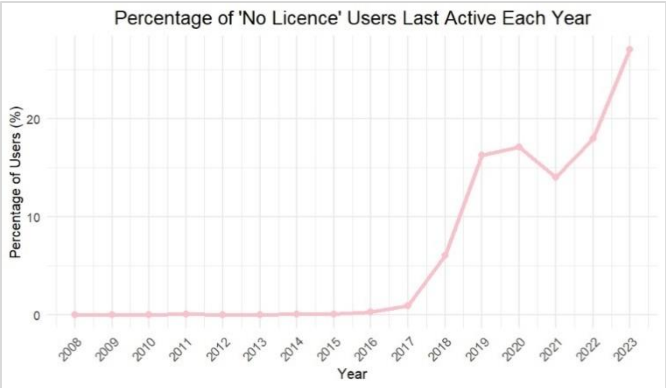
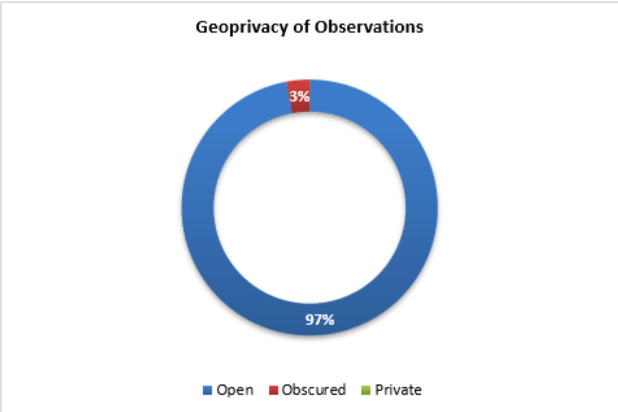
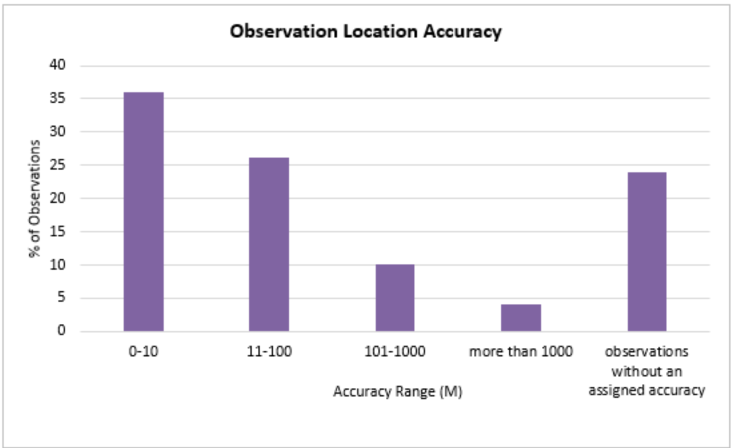




57% of users use the CC-BY-NC licence. 41% of users have not assigned any licence to their observations. A small percentage (2%) of users opt for the CC-BY licence and the CC0 licence.

The line chart illustrates the trends in licencing preferences among users over time.

Initially, nearly 100% of users had no licence assigned to their observations in 2008. The CC-BY-NC license has seen steady growth since 2012. Other licences have remained relatively low and stable, each below 10%.

4.2.3. 	The figure shows the distribution of the last recorded year of activity for users who have not been assigned a licence. The largest percentage, 27% (n = 14,387), of users without a licence were last active in 2023.
4.3.1. 	97% of the total observations are classified as open. A small portion, 3%, is obscured.
4.4.1. 	35% of total observations fall within the 0-10 meters accuracy range, indicating high precision in location reporting. The 11-100 meters range accounts for approximately 25% of total observations, followed by around 10% in the 101-1000 meters range and a small percentage, about 5%, for accuracy beyond 1000 meters. Notably, a significant portion (24%) consists of observations without an assigned accuracy.

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