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## 1 Introduction

Citizen science (CS) could be seen as the crowd-sourced science involving scientific work undertaken by the general public and professionals to achieve common goals (OED, 2014). With the internet development, online citizen science applications could facilitate the data exchange and communication in the projects. Among them, applications for crowdsourced spatiotemporal data collection also become more prevalent, increasing the possibility of geographical visualization. Due to the broad area involved in geographical projects, it is the most effective and efficient choice to design corresponding citizen science software and make rational use of collective wisdom.

Nielson (2006) has indicated the representative bias within crowdsourced applications and the 90:9:1 rule of participation could reflect the unfairness, namely that 90% of CS registered users only consume; 9% contribute occasionally and 1% contribute regularly. Better user experience (UX) referred in CS could improve this circumstance, engaging population with various background and promoting their contribution by efficient, effective, engaging, error tolerant and easy to learn interface features (Haklay & Zifiri, 2008). Therefore, this essay will compare the UX of two geographic citizen science applications and evaluate their ability on facilitating target users' contributions, applying heuristic evaluation and cognitive walkthrough methods, in order to find and provide potential suggestions on the existing website issues.

## 2 Methodology

### 2.1 Assessed Applications

The research will focus on the UX evaluation of two popular geographic citizen science applications, iNaturalist and iMapInvasives. According to Altrudi (2021) and Seltzer (2019), iNaturalist is an online social network for recording and organizing biodiversity information to observe the natural world. Through this platform, participants could engage in the synergistic collaborations, raise community awareness of local biodiversity and explore local environment. Similarly, iMapInvasives is an online GIS-based data management system for invasive species work, mapping and sharing invasive species locations, surveys and treatments and collaboratively making management decisions to protect the natural resources from the threat of invasive species (Wise, 2019). Their user audiences are anyone who have leisure time, especially people concerning environmental issues.

### 2.2 Heuristic Evaluation

Human computer interaction evaluation methods, including heuristic evaluation and cognitive walkthrough, will be implemented. Developed by Jakob Nielsen, the heuristic evaluation method has been widely applied in UX evaluation in CS projects to minimize the potential barriers for the engagement of public participants and ensure the effectiveness, efficiency and completeness of the proposed tasks. General heuristic evaluation of this research will focus on six categories for detecting website issues in a standard structure, further improving

the original evaluation criteria to adapt to the geographical citizen science projects, which are as follows:

- Basic features and design recommendations
- Design for Communication Functionality
- Design for Data Collection
- Design for Data Processing and Visualization
- Gamification Features
- User Privacy Issues (Skarlatidou et al., 2019)

Besides, design elements of user interface and mapping interface have been analyzed in detail as supplements, considering graphic design, structure design, content design and functionality design, since they are essential for geographical citizen science projects. The justification of the heuristic evaluation plan for improving contributions is in Appendix A.

To better understand the impacts of the potential problems, especially to quantify the evaluation, two rankings have been applied for the analysis, namely severity rating and difficulty in fixing the problem (see Figure 1 and 2). Among them, the severity ratings are relevant to the problems occur frequencies, persistence and possibility to overcome. Besides, the difficulties are mostly defined by the effort required from design and engineering teams and the influence on the holistic system structure by the changes. Detailed heuristic evaluation has been conducted for iNaturalist and iMapInvasives separately in the Appendix B and C, where each table cell has been highlighted by the corresponding colors for comparison.

Severity Rating	
Rating	Definition
High ↑ Low	<p><b>4</b> <i>Usability Catastrophe - It drives users away, needs to be fixed NOW (or yesterday)</i></p> <p><b>3</b> <i>Major Problem - Needs to be fixed as soon as possible</i></p> <p><b>2</b> <i>Minor Problem - It should be fixed when there is some time</i></p> <p><b>1</b> <i>Very Minor Problem - It doesn't matter if it isn't fixed</i></p> <p><b>0</b> <i>No usability problem at all</i></p>

Figure 1: severity rating and definitions (Source: Author's own)

Difficulty in fixing the problem	
Rating	Definition
Hard ↑ Easy	<p><b>4</b> <i>Usability Catastrophe - needs specific expertise; needs improvement definitely</i></p> <p><b>3</b> <i>Major Problem - can be fixed but will take longer; can be added but will take longer</i></p> <p><b>2</b> <i>Minor Problem - can be fixed in 1-3 days; can be added in 2-5 days</i></p> <p><b>1</b> <i>Very Minor Problem - can be fixed in a day; can be added in 1-2 days</i></p> <p><b>0</b> <i>No effort needed</i></p>

Figure 2: difficulty in fixing the problem and definitions (Source: Author's own)

### 2.3 Cognitive Walkthrough

Followed that, the cognitive walkthrough, considering several subjective critical questions in Appendix D, will also be completed considering the requirements of the persona (see Appendix F). The specific aims and tasks for detecting usability issues related to users' contributions have been listed in Table 1, while detailed justification of the tasks setting has been attached in Appendix E.

Table 1: Aims and tasks for cognitive walkthrough (Source: Author's own)

**Aims:**

- 1      *Evaluate how easy can novices to adapt to the new websites.*
- 2      *Evaluate to what extent the projects can improve motivation.*
- 3      *Evaluate how easy is to contribute new observations.*

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**Evaluation tasks:**

- 1      *Create an account and log in*
- 2      *View an observation following users' interest*
- 3      *Find information regarding an observation following users' interest*
- 4      *Upload an observation*

## 3 Results and Discussion

### 3.1 Heuristic Evaluation

The heuristic evaluation results have been represented in Figure 3. For each category, severity score and difficulty score are summarized respectively for iNaturalist and iMapInvasives, where higher score indicates that more problems should be tackled. These two applications have an overwhelming amount of usability problems in 'Basic features and design recommendations', 'Design for Data Processing and Visualization', 'User Interface' and 'Mapping Interface' categories, which need re-evaluation and repair, explicated in the subsequent paragraphs. Despite of similar performance on data processing and visualization, iMapInvasives needs more assistance on basic design and user interface, while perform better than iNaturalist on mapping interface. This result is consistent with their different purposes. INaturalist calls for public awareness of environmental protection through the popularization of biodiversity knowledge so that emphasizes information transmission, while iMapInvasives aims to timely detect the invasive species threats so that emphasizes practical online mapping functionalities. Though the evaluation process, general weaknesses for interface features affecting UX can be identified. In addition, the respective advantages can be used for reference to improve their usability mutually.

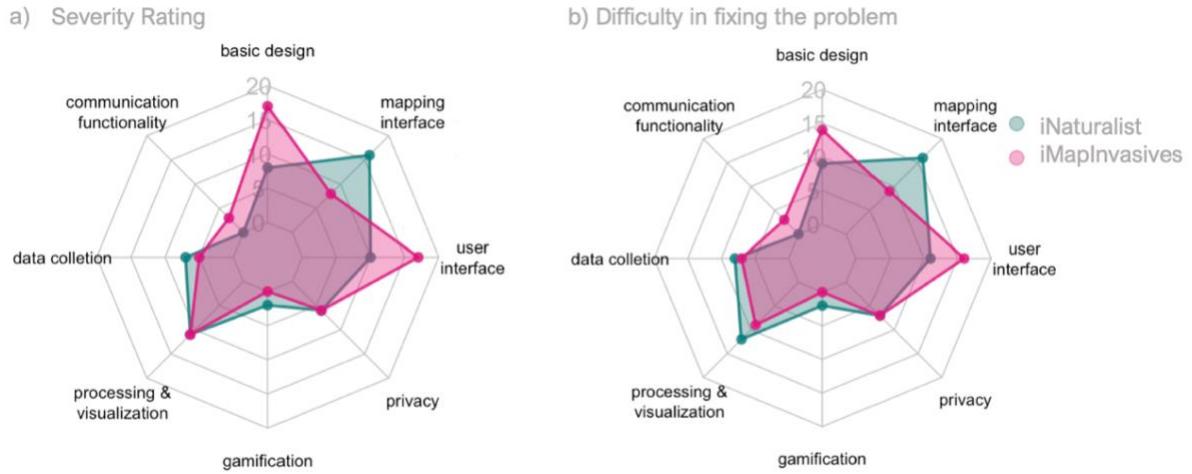


Figure 3: heuristic evaluation results of these eight design categories for iNaturalist and iMapInvasives (Source: Author's own)

Displayed in the tables, each problem is dually prioritized with the one having the highest severity and highest difficulty ranking on the top, pasted from Appendix B and C. Meanwhile, the performance of iNaturalist and iMapInvasives can be compared side by side.

Table 2 shows the evaluation results on basic design elements, which are mainly related to engagement of novices and non-experts. Overall, these applications all adopt inappropriate languages in interface design and lack customization tutorials for first-time users to reduce confusion. Apart from that, iNaturalist has the help documentation navigation bar hidden in the menu. Besides, iMapInvasives does not have proper descriptions for the projects and species records as well as forum, which is likely to make potential contributors feel 'out-of-their-depth' and not in a right position.

Therefore, pop-up tutorial for first-time users is mandatory, where they can skip the unnecessary steps. Besides, improving the visibility of help and forum sections is important to provide a sense of mutual support. Enriching the project pages with more information in various formats, like text, pictures, videos and links can also encourage non-experts to participate in environmental CS projects.

Table 2: Comparison of performance on ‘Basic features and design recommendations’ category (Source: Author’s own)

<b>Guidelines</b>	iNaturalist			iMapInvasives		
	<b>Severity</b>	<b>Difficulty</b>	<b>Problems</b>	<b>Severity</b>	<b>Difficulty</b>	<b>Problems</b>
Interface design follows popular name and navigation conventions (e.g., ‘forum’ instead of ‘talk’)	3	4	In the menu, there is ambiguous terminology that needs to be fixed as it might not make directly sense to the user, e.g., Taxa info.	3	2	Abbreviation of participating jurisdictions is difficult to understand, e.g., ‘AZ’, ‘ME’...
Provide a tutorial using pop-up windows	3	3	No pop-up windows, but tutorials and guides are in one webpage	3	3	No pop-up windows, but hyperlinks for tutorials and guides are in one page; each guide is a separate pdf; also have YouTube video links
Project’s main page contains information about project description; data collected; project outcomes; and links to news and external links for additional information				4	4	Project page & species record webpage only mention the basic information without species picture; limited external links also provide little information
Forum is a separate menu item				4	3	No forum
Sign up using social media is provided but it is not the only option				3	2	No option for signing up using social media
Help is a separate menu item	2	2	The tag is hidden, not visible in the main interface			

The more severe heuristic violations related to data processing and visualization are listed in Table 3, which could influence the effectiveness of regular usage of the websites. INaturalist and iMapInvasives have similar usability issues, including lack of search and filter options, as well as limited information acquired from map interface. Besides, iNaturalist has slight issue on map backgrounds provision, in which iMapInvasives performs well with ten different options.

It is recommended that the websites fulfill users’ demands by increasing detailed search options and filter options (such as location option) to assist data processing and collection processes. Besides, while browsing the map, location, species category, date and recorded pictures are better to be shown to allow audiences to glance all needed information conveniently.

Table 3: Comparison of performance on ‘Design for Data Processing and Visualization’ category (Source: Author’s own)

iNaturalist				iMapInvasives			
Guidelines	Severity	Difficulty	Problems	Severity	Difficulty	Problems	
If a map is provided - then search by location is an option	4	4	Cannot search by location; can only manually zoom-in or zoom-out to a specific area	4	3	No option for search by location	
filter data on the map using different variables	4	4	There is filter function for the whole map, but no filter options can be found in the map for specific project	4	3	Filter option also does not have location option	
read details of data collected while browsing the map interface	2	2	Can know observer, species category and date; better to include the location as well	3	3	When click a region and click detail, species names and numbers would be listed	
ability to switch between different map backgrounds	1	2	Limited options for the map backgrounds, only including terrain and satellite image				

For user interface category, the consistency between different webpages and design features are ignored by the applications, which might confuse audiences (see Table 4). Therefore, it is crucial for website designers to ensure consistent styling of tags, titles and buttons to improve engagement and effectiveness. Besides, the weaknesses in vocabulary selection and scientific terms explanation are identified in iMapInvasives website, also mentioned above in basic design elements.

Table 4: Comparison of performance on ‘User Interface’ category (Source: Author’s own)

iNaturalist				iMapInvasives			
Guidelines	Severity	Difficulty	Problems	Severity	Difficulty	Problems	
Provide links to navigate between different webpages	3	2	Navigation for observations and tutorials is confusing; allow navigate to the same webpage with different tags	2	1	Button do not give feedback on hovering; button does not respond to click	
The visualisation of interface design features should be consistent throughout the application	3	4	Different format of titles and buttons in sections; too much styling of copy				
Vocabulary should be easy to understand or should be explained				4	4	Species and projects are all not explained properly without pictures	
Explain scientific terms and provide interactivity options (e.g., hyperlinks, pop-up messages) so that people can refer to them easily				4	4	Limited information provided	

Mapping interface results in Table 5 are mainly relevant to the efficiency and trust of conducting the proposed tasks. These two applications waste viewers' time because of the inflexible filter box. Therefore, flexible filter box is needed for user to preview the filter results. Besides, the lack of undo features in iNaturalist also affect the efficiency, which should be added.

Considering the trust, they all neglect the explanations of the representation of spatial properties, particularly, the iNaturalist website even does not have the corresponding legend for different scales. Websites should provide more data accuracy-related information, including explanations for representations and verification processes, to improve trust and attract more users.

Table 5: Comparison of performance on 'Mapping Interface' category (Source: Author's own)

Guidelines	iNaturalist			iMapInvasives		
	Severity	Difficulty	Problems	Severity	Difficulty	Problems
Legends should not block the map Search box should be immediately visible from map page (ideally located next to the map)	4	3	The whole map has search box; maps for different projects do not have search box; filter box can block part of the map	3	3	Filter box will block the whole map and cannot be moved
Provide information about data accuracy issues (ideally located below the map)	3	4	No related information is provided	3	4	No related information is provided
Generalisation should not lead users to doubt map accuracy or make maps difficult to read	3	3	Grid representative without legend and explanation	2	2	Not provide explanation for the principle and application of hexagon
Legend should be of high quality and help interpret the map and all of its features. It should be simple and provide information of both map results and base map features	3	4	Some features do not have legend; the legend is not pertinent for the specific projects; not consistent			
An undo or cancel feature should be provided, if the application supports complex tasks	3	2	Cannot change the photo submitted			

### 3.2 Cognitive Walkthrough

For the cognitive walkthrough assessment, user interaction with the system can be observed and any usability issues missed in the heuristic evaluations can be discovered. The results are stated in Table 6, which indicates that generally the persona could complete the tasks successfully, although several elements should better be improved. Mentioned in

Methodology, Hannah as the persona is a potential contributor, who would like to spend her limited spare time to contribute to environmental protection. Because of her demanding work, iNaturalist might be more attractive for her, since it had more social media options for quick sign in, as well as convenient search function and structured knowledge frame for thoroughly understanding certain species within limited time. With the personality of thinking, judging and extrovert, the lack of comment function and information would ice her enthusiasm. Besides, the persona as a frequent user of Google Maps could probably be easier to accept 'Map' as the tag name rather than 'Explore'. In addition, to satisfy her dream to make effective action on environmental problems, the overall achievement should be able to be noticed.

Table 6: results of the cognitive walkthrough using the persona displayed in the Methodology section (Source: Author's own)

iNaturalist				iMapInvasives		
Task number	Success or not?	Problems in the process	Issues about the results	Success or not?	Problems in the process	Issues about the results
1	yes	yes, only can sign up via email, but can sign in via multiple channels	no	yes	yes, only can sign up via email; no social media options provided for sign in /sign up	yes, the process consumed more time
2	yes	yes, 'Explore' as the tag name leading to the whole map	no	yes	yes, no comment function for data verification; no data quality assessment process	yes, limited information can be acquired; miss information for identified species
3	yes	no	no	yes	yes, search bar in main page cannot search species; should use search bar under the tag 'Network Species List'	yes, limited information can be acquired, even without picture, descriptions and external links
4	yes	yes, two separate areas can edit observations; cannot change the uploaded pictures alone (should reedit all the information)	no	yes	yes, no prompt or suggestions pop up, when submitting observations without enough information	yes, cannot figure out personal contribution for environmental protection; require functionality that when click the observed species name, detailed information, including descriptions, distribution map, external links for further reading would all appear

### *3.3 Comparison of Methods*

In comparison, heuristic evaluation as a structured approach to assess UX can find more usability problems than cognitive walkthrough method. However, the latter one is more reliable, which can confidently identify more practical and unique problems focusing on specific subgoals, considering the personality, motivation and lifestyle of designed persona. Therefore, the combination of these two methods is suggested to evaluate the citizen science application.

## **4 Conclusion**

By conducting both heuristic evaluation and cognitive walkthrough, the essay has provided a thorough evaluation of iNaturalist and iMapInvasives websites. After the evaluation, the results of series findings and corresponding recommendations have been discussed and illustrated for further improvements of interface design (with executive summary in Appendix G). After the negative findings being repaired, the UX evaluation should be conducted iteratively until the target requirements of the applications have been met.

## 5 Reference List

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## 6 Appendices

### Appendix A: Justification for heuristic evaluation plan

Categories	Justification and link to users' contribution
<i>Basic features and design recommendations</i>	<i>Appropriate basic features and design elements can help users adapt to the projects and tasks easier with pleasure. It is essential to encourage users to return and participate into the projects again.</i>
<i>Design for communication functionality</i>	<i>Real-time forum topics and comments can make users feel part of citizen science community and create a feeling of common goal-reaching. The sense of mutual support can raise users' enthusiasm and make more contributions.</i>
<i>Design for data collection</i>	<i>Data collection step is one of the main process in citizen science projects. The convenience and freedom of this process can make contributors feel more engaged and in control of their experience. Besides, useful functions (e.g., text/picture prompt in drop-down lists) could make users feel confident to the data quality on the website.</i>
<i>Design for data processing and visualization</i>	<i>Data processing and visualization are relevant to the source of users' sense of achievement. The interesting observations and notable contributions or the overall contributions by the whole community can make user feel that it is worthy of time and effort.</i>
<i>Gamification features</i>	<i>Gamification features have potential to motivate users and increase numbers of contributions. Users would become more competitive in data collection process, and there will be more pleasurable interaction appearing.</i>
<i>User privacy issues</i>	<i>On the basis of ensuring the safety of personal information, users will provide data without any worries. Although trust of the data quality might be affected, public participation in the projects could be improved.</i>
<i>User interface</i>	<i>User interface design is essential for engaging novices and frequent users, as well as experts and non-experts. Flexibility should be satisfied in order to attract and fit people with different backgrounds. Besides, the aesthetics of the webpages could also contribute to engagement and effectiveness, therefore, users would be more likely to spend more time on the website.</i>
<i>Mapping interface</i>	<i>Functionalities for mapping interface should be convenient, effective and efficient, so that people can glance the results or make contributions within limited time, improving the productivity.</i>

## Appendix B: Heuristics Table – iNaturalist

Guidelines	Severity 0-4 (N/A if N/A)	Difficulty in fixing the problem (0-4 or N/A)	Describe problems/merits found	Screenshot	Comment on problems
<b>Category: Basic features and design recommendations</b>					
Interface design follows popular name and navigation conventions (e.g., 'forum' instead of 'talk')	3	4	In the menu, there is ambiguous terminology that needs to be fixed as it might not make directly sense to the user, e.g., Taxa info.		
Project's main page contains information about project description; data collected; project outcomes; and links to news and external links for additional information	0	0			
Forum is a separate menu item	0	0			
Help is a separate menu item	2	2	The tag is hidden, not visible in the main interface  Figure 1.1		Categorize the tags or make the regularly used tag not stacked (make full use of the space)
Sign up using social media is provided but it is not the only option	0	0			
A registration page is provided	0	0			
Provide a tutorial using pop-up windows	3	3	No pop-up windows, but tutorials and guides are in one webpage		
An option to skip the tutorial is provided	N/A	N/A	No pop-up window, so do not need to skip		

<b>Category: Communication Functionality</b>			
Provide (real-time) communication functionality - a forum is provided **pls comment on how heavily it is used**	0	0	
Map tagging/adding comments on map is provided	0	0	Have comments and compare tags
<b>Category: Data Collection</b>			
Real-time data collection is possible	0	0	Support many devices, including web
Data contributions are de-anonymised / anonymous *pls comment on applicability and problems in the context of the application *	0	0	Anonym act <i>Figure 1.2</i>
Application collect user's GPS location	N/A	N/A	Not applicable for web-based interface
The collection of various data types is supported such as numbers, videos, photographs, text, coordinates *pls note what types*	2	3	Cannot support videos <i>Figure 1.2</i>
Combining various data types derived from various sources is possible	3	4	Cannot merge the sound file and photo of the same species in one location; be submitted as separate observations <i>Figure 1.2</i>
Adding qualitative data to observations is supported	0	0	Space for users to add notes <i>Figure 1.2</i>
Adding photographs for data collection is supported	0	0	<i>Figure 1.2</i>

<i>Form design is simple - e.g. use of images and drop-down lists with options are provided instead of text fields</i>	0	0	<i>Provide drop-down lists with options</i>	<i>Figure 1.2</i>
<i>Fields not required to fill in are clearly marked</i>	2	1	<i>No marked fields; free to edit or not</i>	<i>Figure 1.2</i>
<i>Showing the location of the user to enable easier data collection *with symbology that stands out from the rest of the map*</i>	0	0	<i>The selected location will be marked by red circle</i>	
<i>Provision of additional reference points shown on the map</i>	0	0	<i>Google map is provided for location selection</i>	
<i>Supports data tailoring and personalisation</i>	0	0		
<i>Data validation functionality is provided</i>	0	0	<i>External links for species name checking; other people's comments</i>	
<b><i>Category: Data Processing and Visualisation</i></b>				
<i>Providing a data sharing and viewing option to view the data collected instantly</i>	0	0		
<i>A search function with autocomplete capabilities is provided</i>	0	0		
<i>If a map is provided - then search by location is an option</i>	4	4	<i>Cannot search by location; can only manually zoom-in or zoom-out to a specific area</i>	
<i>filter data on the map using different variables</i>	4	4	<i>There is filter function for the whole map, but no filter options can be found in the map for specific project</i>	<i>Figure 1.3, 1.4</i>
<i>map zooming and panning tools</i>	0	0		

<i>ability to switch between different map backgrounds</i>	1	2	<i>Limited options for the map backgrounds, only including terrain and satellite image</i>
<i>read details of data collected while browsing the map interface</i>	2	2	<i>Can know observer, species category and date; better to include the location as well</i>
<b>Category: Gamification</b>			
<i>**Comment on gamification elements **</i>	0	0	
<i>The option to skip 'gamification' features is provided</i>	2	2	<i>Project webpages have fixed sections to display personal contribution ranking</i>
<b>Design: User Privacy</b>			
<i>Provision of filtering and moderation for data collected to address privacy concerns</i>	N/A	N/A	<i>Data are all collected anonymously</i>
<i>Any data stored does not support the identification of individuals</i>	3	4	<i>People should register first to make contribution, otherwise there is no 'upload' &amp; 'Your Observations' sections</i>
<i>provides the option to collect data without sharing it</i>	0	0	
<i>Attribution supported</i>	3	3	<i>No attribution provided</i>

## B. Map & Trust Heuristics

It is amazing how many of the user interface guidelines are still valid and relevant. I would like to get your opinion to assess the applicability of the mapping component guidelines. If there is anything else that stands out for its trust-building potential can you please make a note?

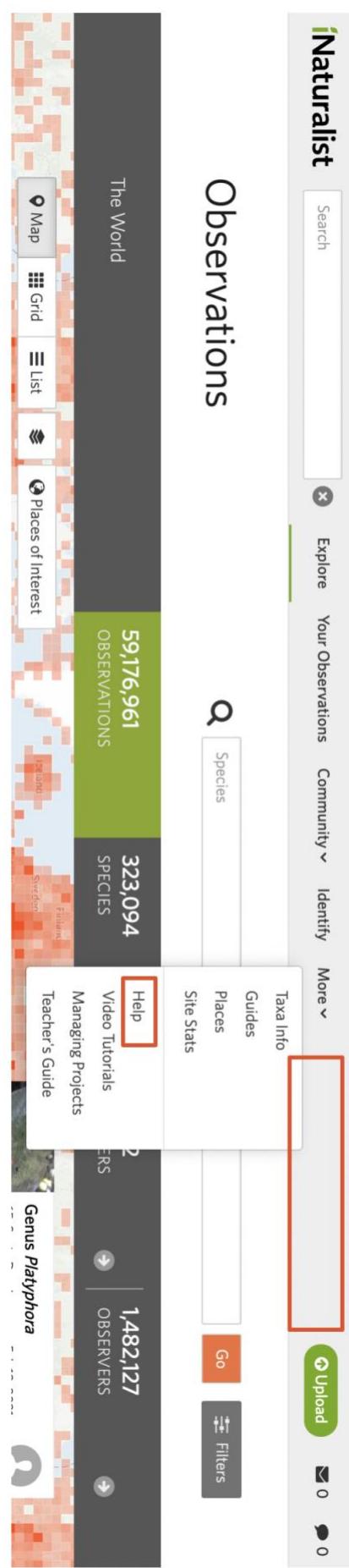
Guidelines	Severity 0-4 (N/A if N/A)	Difficulty	Describe problems/merits found	Screenshot	Comment on problems
<b>User Interface - Graphic design</b>					
The graphical user interface elements should offer affordance and should comply with internet standards	0	0			
The visualisation of interface design features should be consistent throughout the application	3	4	Different format of titles and buttons in sections; too much styling of copy	Figure 1.5, 1.6	
Use high-quality graphics to impart professionalism	0	0			
<b>User Interface - Structure design</b>					
Group the menu and content in a logical manner (information should be easy to find; the menu should effectively communicate Website's contents)	2	2	Some regularly used tags are hidden		
Textual information on different pages should be grouped effectively and should be relevant to the context	0	0			
Titles, headings and subheadings should be meaningful and should help with skipping paragraphs (especially if textual information is too long)	2	3	Table of content (index) at top which is difficult to refer to when scrolling down	Better to have index on the side	
Provide links to navigate between different webpages	3	2	Navigation for observations and tutorials is confusing; allow navigate to the same webpage with different tags	Figure 1.7	
Provide a menu item for MAPS	0	0	All maps under 'Explore' tag		

<b>User Interface - Content design</b>			
Vocabulary should be easy to understand or should be explained	0	0	
Explain scientific terms and provide interactivity options (e.g., hyperlinks, pop-up messages) so that people can refer to them easily	0	0	
Run frequent updates	0	0	
Error messages should be communicated in non-technical terms	0	0	Good to give reason, condition & solution of the error
Provide guidance and documentation for system's novice and expert users	0	0	Have purposeful guidance for data collection, data verification & project management
<b>User Interface - Functionality design</b>			
Fix broken links or 'Not Found' pages	0	0	
<b>Mapping Interface - Graphic design</b>			
Colour combinations should be effective; use distinct colours (e.g., red/blue/green or alternatively shades of blue; consider colour deficiency)	0	0	
Communicate map results effectively (avoid overlapping symbols; instead use different colours or shapes and transparency/levels)	0	0	Change the representation of observations when zoom-in & zoom out
Map size should be larger than 400 × 600 pixels	N/A	N/A	Interactive maps

<b>Selected objects should be easy to identify</b>	0	0		
<i>Base maps should be of high quality and relevant to the context of the application</i>	0	0		
<i>The map results should stand out from the base maps (do not use the colours of base maps to visualise additional information)</i>	0	0		
<i>Scales should be chosen so that each provides high quality and useful maps</i>	N/A	N/A	<i>Interactive map</i>	
<i>Legend should be of high quality and help interpret the map and all of its features. It should be simple and provide information of both map results and base map features</i>	3	4	<i>some features do not have legend; the legend is not pertinent for the specific projects; not consistent</i>	<i>Figure 1.10</i>
<b>Mapping Interface - Structure design</b>				
<i>Legends should not block the map Search box should be immediately visible from map page (ideally located next to the map)</i>	4	3	<i>The whole map has search box; maps for different projects do not have search box; filter box can block part of the map</i>	
<b>Mapping Interface - Content design</b>				
<i>Generalisation should not lead users to doubt map accuracy or make maps difficult to read</i>	3	3	<i>Grid representative without legend and explanation</i>	<i>Figure 1.4</i>
<i>More than four scales should be provided and should be chosen to support and provide meaning to the tasks</i>	N/A	N/A	<i>Interactive maps</i>	
<i>The information on base maps should be considered separately for each map scale so that maps are not cluttered</i>	N/A	N/A	<i>Interactive maps</i>	

<i>Provision of information about spatial features should support both experts' and novices' needs and expectations</i>	N/A	N/A	Spatial features information only refers to location
<i>Information as to how the maps were constructed should be always provided</i>	N/A	N/A	
<i>Provide help and documentation/instructions/or tutorials about GIS tasks</i>	0	0	
<i>Provide information about data accuracy issues (ideally located below the map)</i>	3	4	No related information is provided
<b>Mapping Interface - Functionality design</b>			
<i>Map functionality should be consistent (at all scales)</i>	0	0	
<i>Map functionality should be unique (do not provide more than one function for the same task)</i>	0	0	
<i>An undo or cancel feature should be provided, if the application supports complex tasks</i>	3	2	Cannot change the photo submitted  Better to provide option for changing the photo only without deleting the whole record
<i>Ensure that map tools can be easily recognised (or else provide a tutorial, FAQ section visible from the map page)</i>	N/A	N/A	Application purpose is observation
<i>Functionality tools should be predictable</i>	N/A	N/A	No tools provided for editing the maps
<i>Provided functionality should support users' needs and expectations</i>	N/A	N/A	

**Figure 1.1**



**Figure 1.2**

**iNaturalist**

naturalist51991 ▾

**Editing 1 observation:**

Details

Add ▾  Remove  Combine  Duplicate  Select All

Fields

**b**

Use "b" as a placeholder



**Species name**

**Date**

**Location**

**Notes**

**View**

**Time**

**Animals (Biby)**  
Kingdom Animalia

**Flowering Plants (Bedecktsamer')**  
Subphylum Angiospermae

**Basidiomycete Fungi (Basidiomycota)**  
Phylum Basidiomycota

**Brachyceran Flies**  
Suborder Brachycera

**Borage Family (Boraginaceae)**  
Family Boraginaceae

**Plants (Bitkiler)**

**View**

**View**

**Submit 2 observations**

Figure 1.3

# Observations

Species:  Go Filters 1

Show

- Wild
- Captive
- Verifiable
- Research Grade
- Needs ID
- Threatened
- Introduced
- Popular
- Has Sounds
- Has Photos
- Your Observations

Categories


Date Observed

- Any
- Exact Date
- Range
- Months

Rank

	High
	Low

Sort By

	Date Added
	Desc

Description / Tags

+ -

More Filters

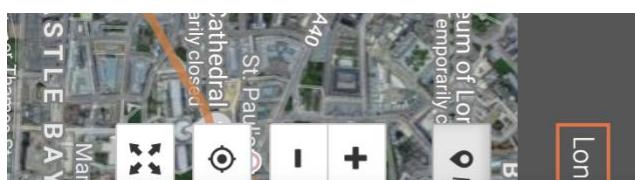
Update Search

Reset Search Filters

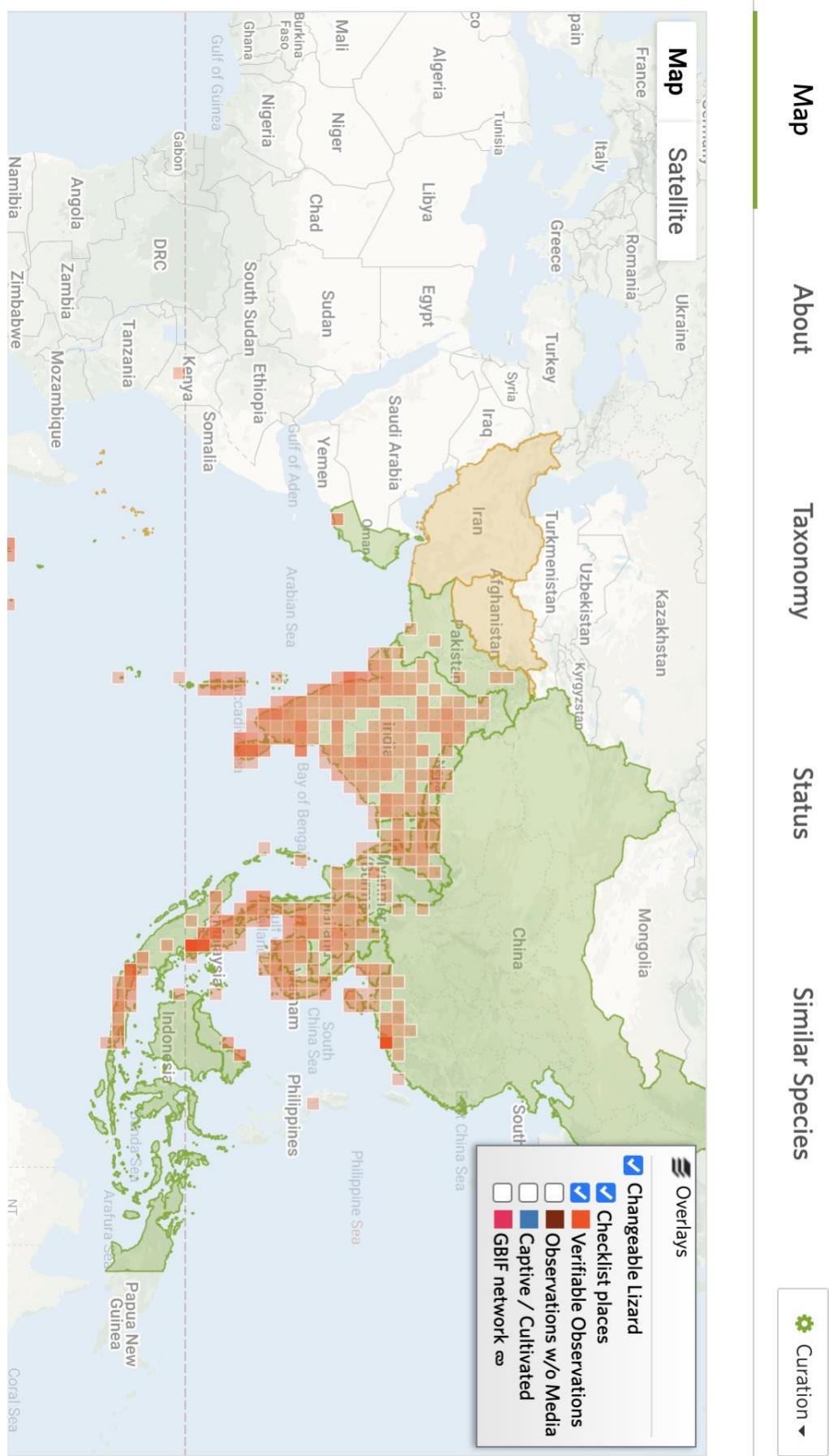
Identify Atom Download

Sugar... • 8/11/2019

2y 2y




**Figure 1.4**



**Figure 1.5**

Get outside, and observe an individual organism. Pick something wild and take a clear, full frame photo. If you already have a photo of something wild, [add it now](#).

You can also use the iNaturalist mobile apps to record observations.

Once you've shared your observations, this page will show you updates from the community in the form of comments and identifications. Who knows what you'll discover!

[Browse Observations](#) ▾ [Getting Started Guide](#)

**Follow Some Nearby Naturalists**

If you visit these profiles and click the follow button, you'll be updated when they post observations

 <b>budak</b> 21642	 <b>big-simonct</b> 10486	 <b>Sohkam</b> 10751	 <b>patricia1</b> 3176
---	---	--	--

[Browse People](#) ▾

## Subscriptions

[Subscribe to a Taxon](#) [Subscribe to a Place](#) [⚙️](#)

**More**

[Getting Started Guide](#) [X](#)

Let us walk you through the main features of this site.

[Get Started](#)

**Blog widget**

Show off your recent observations on your own blog or website!

[Learn More](#)

**Figure 1.6**

While projects can be useful and beneficial, it is not necessary to create or contribute to a project to enjoy using iNaturalist. Making observations and identifying observations are *by far* the most important part of iNaturalist. If you are new to iNaturalist, making a project should be a secondary or tertiary goal.

Before you decide to create a project, we recommend you spend several **oblique** hours using iNaturalist and becoming an active member of the community by regularly adding [tags](#), [comments](#), and observations – those are the core aspects of iNaturalist. **You should be familiar with iNaturalist before creating a project.** Here's what you need to know if you're considering creating an ongoing project, or if you have one already.

**bold**

- Should I Start a Project?

- Project Types
- Collection
- Traditional
- Umbrella
- Best Practices for Managing Projects
- Ideas for Project Outreach
- Limitations of iNaturalist (What You Can't Do)
- Collection Project Settings Explained
- Traditional Project Settings Explained



**color**

## Should I Start a Project?

If your reason for wanting to start a project is to simply keep track of all observations recorded in a particular geographic area, you may find that using the filters on the [Observations page](#) is sufficient for your needs. For example, if you just want to keep track of all of the plants in Florida, you can just use the Observations page [filtered by taxon: Plantae](#) and place: [Florida](#). There are many existing [places](#) with defined boundaries in iNaturalist. **If you need to add a new place (e.g. a local park), you must first have at least 50 verifiable observations.**

**Figure 1.7**

Get outside, and observe an individual organism. Pick something wild and take a clear, full frame photo. If you already have a photo of something wild, add it now.

You can also use the iNaturalist mobile apps to record observations.

Once you've shared your observations, this page will show you updates from the community in the form of comments and identifications. Who knows what you'll discover!

Browse Observations Getting Started Guide

**Naturalist** Explore Your Observations Community Identify More

**Navigate to the same webpage for interactive map**

**Observations** Species  Location

The World 59,190,473 OBSERVATIONS 323,145 SPECIES

**Places of interest**

**Help**

Getting Started Guide

Let us walk you through the main features of this site.

**Community** **Identity** **More**

- Taxon Info
- Guides
- Blog widget
- Places
- Site Stats
- Edit Observations
- Video Tutorials
- Managing Projects
- Help
- Teacher's Guide
- Managing Projects
- Teacher's Guide

**Frequently Asked Questions**

General

Howdy. If you're just getting started with iNat, check out the Getting Started Guide to tour some of the site's features. If you have a question about the site, please peruse the FAQ below. If you're still looking for answers, please email Support at [help@inaturalist.org](mailto:help@inaturalist.org) or post your question to our Community Forum.

1. What is iNaturalist?
2. Why is behind iNaturalist?
3. What technologies and data sources does the project use?
4. What can I do to help iNaturalist?
5. How do I contact iNaturalist?
6. What are staff curators and site admins?

Learn More

**Figure 1.8**

Add: Single observation · Batch · From list · From photos

## Import Observations

*Got your data somewhere else? We can help.*

Import from other photo sites   Import from CSV   Import from sounds

In 2018 Soundcloud changed their API and made it impossible for us to make new connections to your Soundcloud account. If they reinstate this functionality, we can resume linking accounts to Soundcloud. In the meantime, you can upload sound files directly using the [Uploader](#).

**Import Photos**

In February 2019, Google changed their API, making it impossible for us to access GPS coordinates, license information, and almost any information we could use to add an identification (like tags). They also removed text search and numerical pagination. On top of that, they required all connected accounts to have an additional permission, and before a third party can request that permission from users, the third party has to be verified. We are awaiting verification, but until that happens, you will not be able to import photos from Google. If we get approved, you will be able to import photos, but they won't include any location information or license information that you might be able to see on Google Photos. You can read more about this at <https://developers.google.com/picasa-web>. Downloading the original files and adding them using the [Uploader](#) is the best workaround.

**Figure 1.9**

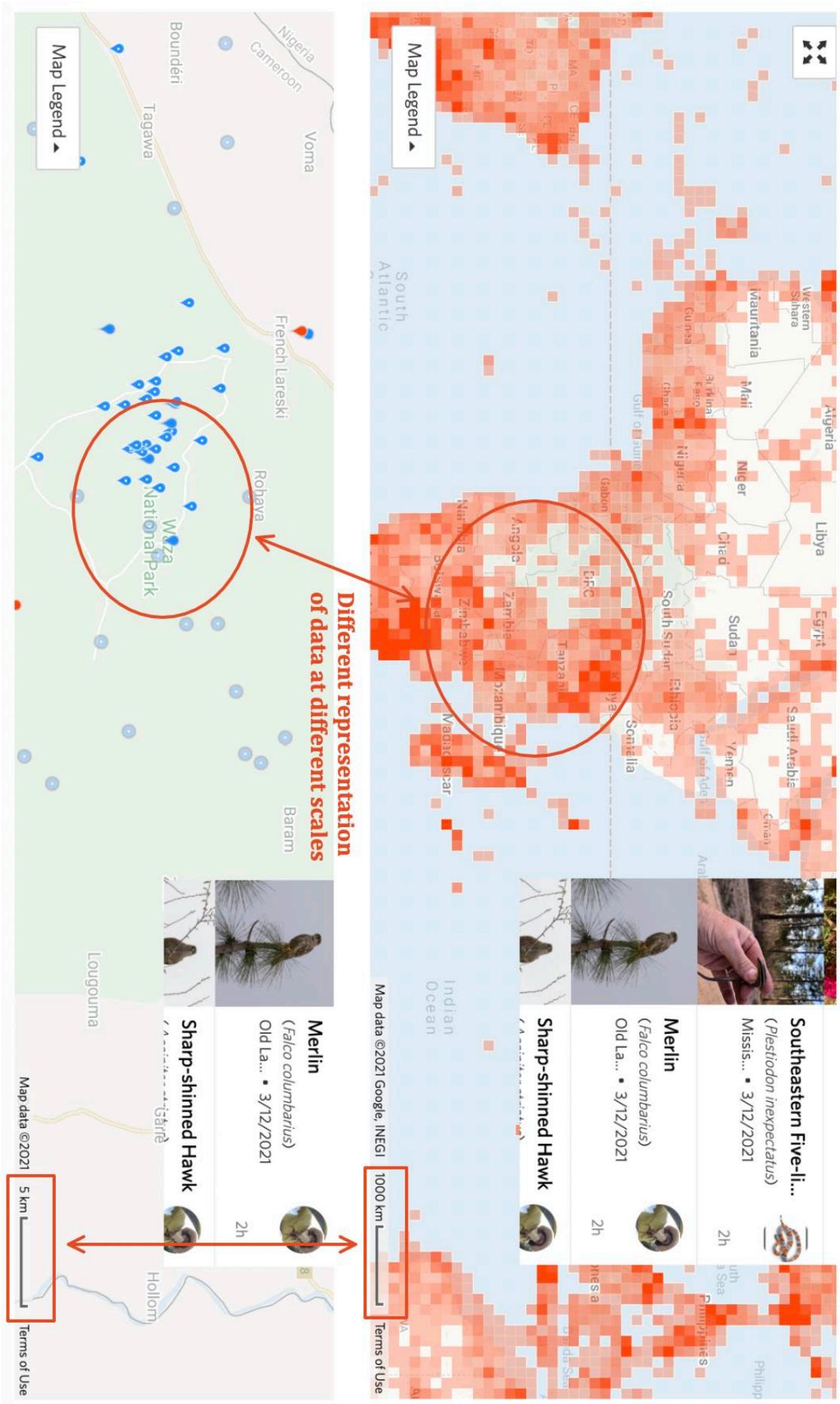
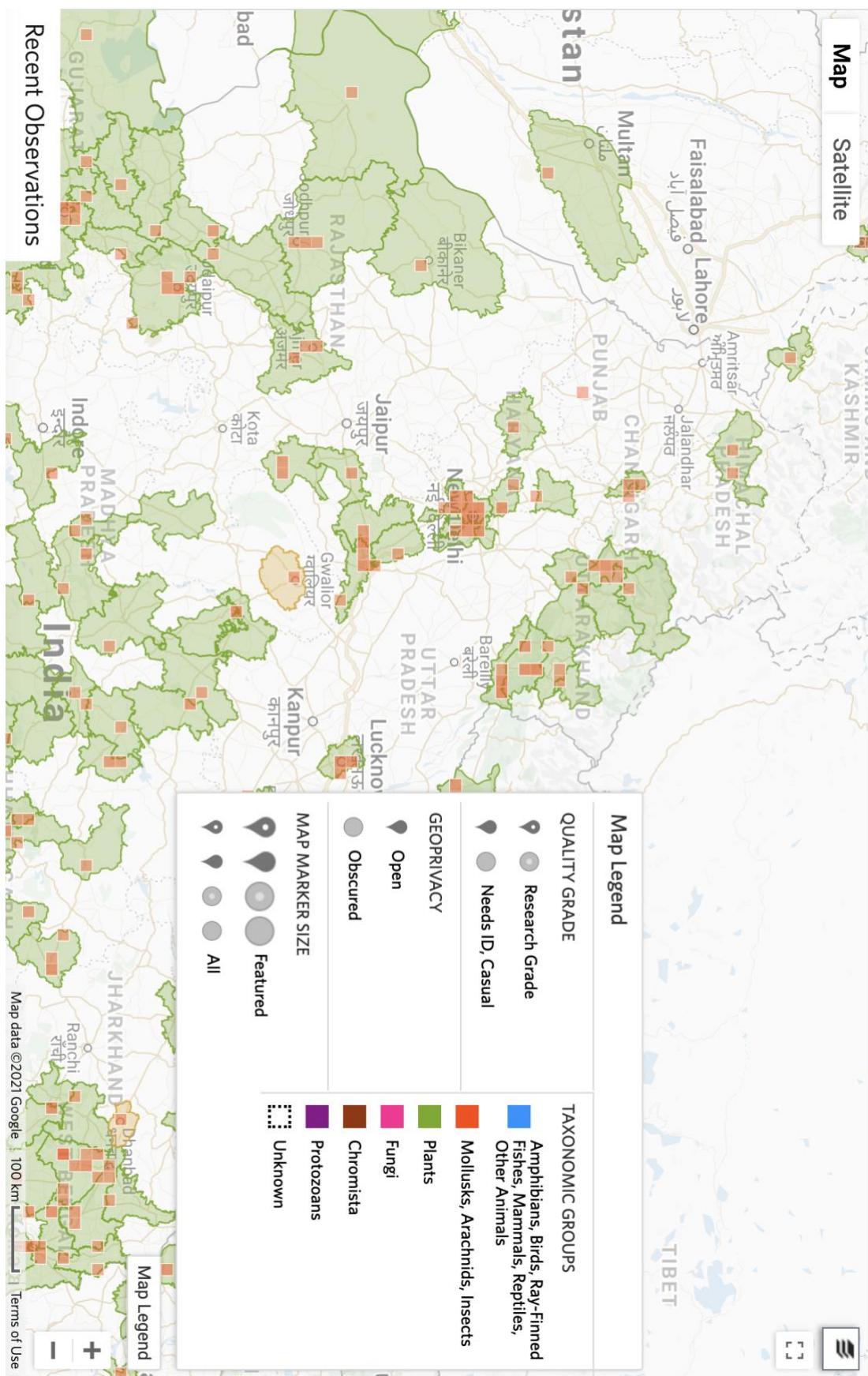


Figure 1.10



## Appendix C: Heuristics Table – iMapInvasives

Guidelines	Severity 0-4 (N/A if N/A)	Difficulty in fixing the problem (0-4 or N/A)	Describe problems/merits found	Screenshot	Comment on problems
<b>Category: Basic features and design recommendations</b>					
<i>Interface design follows popular name and navigation conventions (e.g., 'forum' instead of 'talk')</i>	3	2	Abbreviation of participating jurisdictions is difficult to understand, e.g., 'AZ', 'WE'...		When hovering to the button, whole name of the abbreviations should appear
<i>Project's main page contains information about project description; data collected; project outcomes; and links to news and external links for additional information</i>	4	4	Project page & species record webpage only mention the basic information without species picture; limited external links also provide little information	Figure 2.1	Information should involve text, pictures and more external links to help people identify species correctly
<i>Forum is a separate menu item</i>	4	3	No forum		
<i>Help is a separate menu item</i>	0	0			
<i>Sign up using social media is provided but it is not the only option</i>	3	2	No option for signing up using social media	Figure 2.2	
<i>A registration page is provided</i>	0	0			
<i>Provide a tutorial using pop-up windows</i>	3	3	No pop-up windows, but hyperlinks for tutorials and guides are in one page; each guide is a separate pdf; also have YouTube video links		
<i>An option to skip the tutorial is provided</i>	N/A	N/A	No pop-up window, so do not need to skip		

<b>Category: Communication Functionality</b>			
Provide (real-time) communication functionality - a forum is provided ***pls comment on how heavily it is used***	N/A	N/A	
Map tagging/adding comments on map is provided	3	3	Comment function can be used for verification people's observation
<b>Category: Data Collection</b>			
Real-time data collection is possible	0	0	Figure 2.3
Data contributions are de-anonymised / anonymous *pls comment on applicability and problems in the context of the application *	0	0	
Application collect user's GPS location	0	0	Can choose whether to use GPS location or not
The collection of various data types is supported such as numbers, videos, photographs, text, coordinates *pls note what types*	2	3	Cannot provide video or sound; good to have varies approaches to collect coordinate information
Combining various data types derived from various sources is possible	0	0	
Adding qualitative data to observations is supported	0	0	
Adding photographs for data collection is supported	0	0	
Form design is simple - e.g. use of images and drop-down lists with options are provided	2	3	Only text prompt in the drop-down lists Figure 2.3 Better to have corresponding species' pictures

<i>instead of text fields</i>			
<i>Fields not required to fill in are clearly marked</i>	1	1	<i>Not marked; free to edit</i>
<i>Showing the location of the user to enable easier data collection *with symbology that stands out from the rest of the map*</i>	0	0	<i>The selected location will be marked by red circle</i>
<i>Provision of additional reference points shown on the map</i>	0	0	<i>10 kinds of base maps are provided as reference</i>
<i>Supports data tailoring and personalisation</i>	0	0	
<i>Data validation functionality is provided</i>	0	0	
<b>Category: Data Processing and Visualisation</b>			
<i>Providing a data sharing and viewing option to view the data collected instantly</i>	0	0	
<i>A search function with autocomplete capabilities is provided</i>	0	0	
<i>If a map is provided - then search by location is an option</i>	4	3	<i>No option for search by location</i>
<i>filter data on the map using different variables</i>	4	3	<i>filter option also does not have location option</i>
<i>map zooming and panning tools</i>	0	0	
<i>ability to switch between different map backgrounds</i>	0	0	
<i>read details of data collected while browsing the map interface</i>	3	3	<i>When click a region and click detail, species names and numbers would be listed</i>
<b>Category: Gamification</b>			

**Comment on gamification elements**	N/A	N/A		
The option to skip 'gamification' features is provided	N/A	N/A		
<b>Design: User Privacy</b>				
Provision of filtering and moderation for data collected to address privacy concerns	N/A	N/A	Data are all collected anonymously	
Any data stored does not support the identification of individuals	3	4	People should register first to make contribution	Contribute without registration/signature should be allowed to improve participation; but verification process is needed
provides the option to collect data without sharing it	3	3		
Attribution supported	0	0	When registering, home jurisdiction should be selected you will search or enter data for most frequently, and is tied to some user permissions and species lists	

### B. Map & Trust Heuristics

It is amazing how many of the user interface guidelines are still valid and relevant. I would like to get your opinion to assess the applicability of the mapping component guidelines. If there is anything else that stands out for its trust-building potential can you, please make a note?

Guidelines	Severity 0-4 (N/A if N/A)	Difficulty	Describe problems/merits found	Screenshot	Comment on problems
<i>User Interface - Graphic design</i>					

<i>The graphical user interface elements should offer affordance and should comply with Internet standards</i>	0	0		
<i>The visualisation of interface design features should be consistent throughout the application</i>	0	0	<i>Structure of every page is similar</i>	
<i>Use high-quality graphics to impart professionalism</i>	0	0		
<b>User Interface - Structure design</b>				
<i>Group the menu and content in a logical manner (information should be easy to find; the menu should effectively communicate Website's contents)</i>	3	4	<i>Tags have been grouped properly, but in some pages the information cannot be easily found</i>	<i>Figure 2.5</i>
<i>Textual information on different pages should be grouped effectively and should be relevant to the context</i>	0	0		<i>Better if the ones which have records can be highlighted in the drop-down list, or make the ones without record grey and cannot be clicked</i>
<i>Titles, headings and subheadings should be meaningful and should help with skipping paragraphs (especially if textual information is too long)</i>	0	0		
<i>Provide links to navigate between different webpages</i>	2	1	<i>Button do not give feedback on hovering; button does not respond to click</i>	<i>Figure 2.6</i>
<i>Provide a menu item for MAPS</i>	0	0		
<b>User Interface - Content design</b>				
<i>Vocabulary should be easy to understand or should be explained</i>	4	4	<i>Species and projects are all not explained properly without pictures</i>	

<i>Explain scientific terms and provide interactivity options (e.g., hyperlinks, pop-up messages) so that people can refer to them easily</i>	4	4	<i>Limited information provided</i>	
<i>Run frequent updates</i>	0	0		
<i>Error messages should be communicated in non-technical terms</i>	0	0	<i>e.g., "Warning: Drawing was outside of the Searched Area", "No relevant records treated! Redraw or add the treated presence first."</i>	
<i>Provide guidance and documentation for system's novice and expert users</i>	2	3	<i>More information in pdf format</i>	<i>Better to include videos or interactive tutorial or other formats</i>
<b>User Interface - Functionality design</b>				
<i>Fix broken links or 'Not Found' pages</i>	4	4	<i>Figure 2.7</i>	
<b>Mapping Interface - Graphic design</b>				
<i>Colour combinations should be effective; use distinct colours (e.g., red/blue/green or alternatively shades of blue; consider colour deficiency)</i>	0	0		
<i>Communicate map results effectively (avoid overlapping symbols; instead use different colours or shapes and transparency levels)</i>	0	0	<i>Change the representation of observations when zoom-in &amp; zoom out</i>	
<i>Map size should be larger than 400 × 600 pixels</i>	N/A	N/A	<i>Interactive maps</i>	
<i>Selected objects should be easy to identify</i>	0	0	<i>Selected observation will be highlighted</i>	
<i>Base maps should be of high quality and</i>	0	0		

<i>relevant to the context of the application</i>				
<i>The map results should stand out from the base maps (do not use the colours of base maps to visualise additional information)</i>	0	0		
<i>Scales should be chosen so that each provides high quality and useful maps</i>	N/A	N/A	<i>Interactive map</i>	
<i>Legend should be of high quality and help interpret the map and all of its features. It should be simple and provide information of both map results and base map features</i>	0	0	<i>Map for different scales will have different corresponding legend</i>	
<b>Mapping Interface - Content design</b>				
<i>Legends should not block the map Search box should be immediately visible from map page (ideally located next to the map)</i>	3	3	<i>Filter box will block the whole map and cannot be moved</i>	<i>Figure 2.9</i>
				<i>Better to have a filter box which can be moved, so that user can preview the filter result</i>
<b>Mapping Interface - Content design</b>				
<i>Generalisation should not lead users to doubt map accuracy or make maps difficult to read</i>	2	2		<i>Better to provide explanation for the principle and application of hexagon</i>
<i>More than four scales should be provided and should be chosen to support and provide meaning to the tasks</i>	N/A	N/A		
<i>The information on base maps should be considered separately for each map scale so that maps are not cluttered</i>	N/A	N/A		
<i>Provision of information about spatial features should support both experts' and novices' needs and expectations</i>	N/A	N/A	<i>Spatial features information only refers to location</i>	

<i>Information as to how the maps were constructed should be always provided</i>	N/A	N/A		
<i>Provide help and documentation/instructions/or tutorials about GIS tasks</i>	0	0		
<i>Provide information about data accuracy issues (ideally located below the map)</i>	3	4	No related information is provided	
<b><i>Mapping Interface - Functionality design</i></b>				
<i>Map functionality should be consistent (at all scales)</i>	0	0		
<i>Map functionality should be unique (do not provide more than one function for the same task)</i>	0	0		
<i>An undo or cancel feature should be provided, if the application supports complex tasks</i>	0	0	<i>Have both 'back' and 'next' button; can edit the submission</i>	<i>Figure 2.3</i>
<i>Ensure that map tools can be easily recognised (or else provide a tutorial, FAQ section visible from the map page)</i>	0	0		<i>Figure 2.10</i>
<i>Functionality tools should be predictable</i>	0	0	<i>Bunch of tools are provided</i>	<i>Figure 2.10</i>
<i>Provided functionality should support users' needs and expectations</i>	0	0		

**Figure 2.1**

### Network Species Record

A Caddisfly

General Identification	Status and Specifications
Common Name:	A Caddisfly
Scientific Name:	<i>Crodocentron yavapai</i>
Kingdom:	Animalia
Phylum:	Mandibulata
Class:	Insecta
Order:	Trichoptera
Genus:	Xiphocentronidae
Taxonomic Name Comments:	<i>Crodocentron</i>
Not Listed	

Jurisdictions Tracked	Status and Specifications
in:	None
Jurisdictions	None
Regulated in:	None
Growth Habit:	Not Listed
Species Type:	Animal Insect
Habitat Type:	Semiaquatic
Minimum Separation Distance:	Not Listed
Additional Species Information	
Species ID:	2757851
ITIS TSN:	Not Listed
NS Explorer Page	

[Adopt a Species](#)

[Help](#)

[English](#)

**NatureServe EXPLORER**

---

**Crodocentron yavapai**

---

**Classification**

Scientific Name: *Crodocentron yavapai* Moulton and Stewart, 1997

Kingdom: Animalia

Phylum: Mandibulata

Class: Insecta

Order: Trichoptera

Family: Xiphocentronidae

Genus: *Crodocentron*

---

**Scientific Name Reference:** Moulton J.L.R. and K.W. Stewart. 1997. A new species and first record of the caddisfly genus *Crodocentron* Schmid (Trichoptera: Xiphocentronidae) north of Mexico. Pages 343-347 in R.W. Holzenthal and O.S. Flint Jr., editors. Proceedings of the 8th International Symposium on Trichoptera. Ohio Biological Survey.

**Concept Reference:** Moulton J.L.R. and K.W. Stewart. 1997. A new species and first record of the caddisfly genus *Crodocentron* Schmid (Trichoptera: Xiphocentronidae) north of Mexico. Pages 343-347 in R.W. Holzenthal and O.S. Flint Jr., editors. Proceedings of the 8th International Symposium on Trichoptera. Ohio Biological Survey.

**Name Used in Concept Reference:** *Crodocentron yavapai*

**NatureServe Unique Identifier:** ELEMENT.T.GLOBAL.757851

**NatureServe Element Code:** ITTR163410

**Taxonomic Comments:**

Species recorded from Arizona, as this is a tropical genus (Moulton et al. 1994, Moulton and Stewart 1997).

only subtitle without information



**Figure 2.2**

The screenshot shows the iMapInvasives website interface. At the top right, there is a logo of a magnifying glass over a leaf. Below the logo, the text "Log in to iMapInvasives" is displayed, followed by input fields for "Email" and "Password", and a "Log In" button. To the right of these buttons is a link "Forgot Password?".

In the center of the page, there is a large white rectangular box containing a "Sign Up" button. Above the "Sign Up" button, the text "Help us track Invasives - it's free." is displayed, followed by a note "(Users must be at least 13 years old)".

The sign-up form consists of several input fields:

- First Name:**
- Last Name:**
- Email:**
- Retype Email:**
- Password:**  (Must be at least 8 characters long, with a number and an uppercase letter)
- Retype Password:**
- Jurisdiction:**  Select... ▾

At the bottom left of the sign-up box is a "Join" button.

To the right of the sign-up box, the text "Or if you don't have an account, sign up with the form below:" is displayed.

**Figure 2.3**

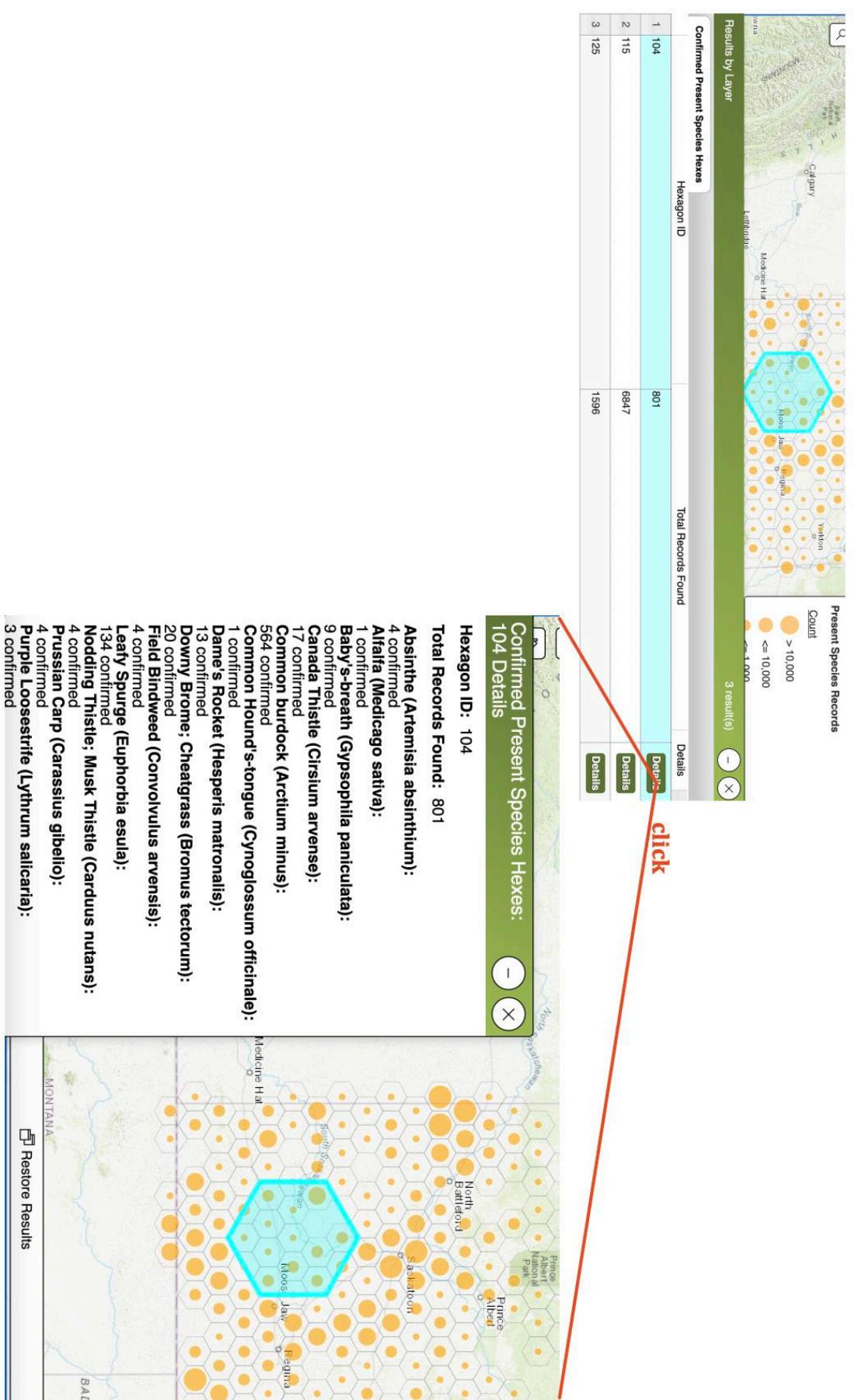
The figure illustrates a workflow for collecting presence records using a mobile application. It consists of three main screens connected by arrows:

- Map Screen:** Shows a map of a location with a red dot indicating the collection point. At the top, there are zoom controls (+, -, X). Below the map, there is a search bar and a section for "Enter Coordinates". A red box highlights the "Latitude: 48.35" and "Longitude: -99.95" input fields, along with a "Submit" button.
- Species Selection Screen:** Shows a list of species found at the location. The species are listed in a dropdown menu. A red box highlights the dropdown menu itself. A red arrow points from the "Longitude" field in the previous screen to this dropdown menu.
- Summary Screen:** Displays a success message: "Your record has been saved!" It also lists the "Searched Area Record" (ID #975468), "Treatment Record" (ID #15352), and "Not-Detected Record" (ID #36408). A red arrow points from the "Present Species" dropdown in the middle screen to this summary screen.

**Annotations:**

- Map Screen:** "varies approaches to collect coordinate information"
- Species Selection Screen:** "only text prompt in the drop-down lists"
- Summary Screen:** "real-time data"

**Figure 2.4**



**Figure 2.5**

The figure displays three screenshots of a web application interface:

- Organizations:** A search interface for organizations. It includes a dropdown menu for "Select Jurisdiction" set to "Nunavut", a button for "Showing All Organizations", and a message "No Organizations Listed". A red box highlights the jurisdiction dropdown.
- Projects:** A search interface for projects. It includes a dropdown menu for "Select Jurisdiction" set to "Ohio", a button for "Showing Active Projects", and a message "No Projects Listed". A red box highlights the jurisdiction dropdown.
- Allegheny County Parks Assessments:** A detailed view of a specific project. It shows the project name "Allegheny County Parks Assessments", a temporary description, and jurisdiction information ("Pennsylvania", "Western Pennsylvania Conservancy (WPC) (PA)"). It lists six members with their roles (e.g., Admin, Member), a section for partner organizations (empty), and a "View on Map" button. A red box highlights the jurisdiction information.

A large red arrow points from the top right towards the bottom right, pointing to the Allegheny County Parks Assessments screenshot. Below the arrow, the text "only when people select the ones that have records, the website can provide results" is displayed.

**Figure 2.6**



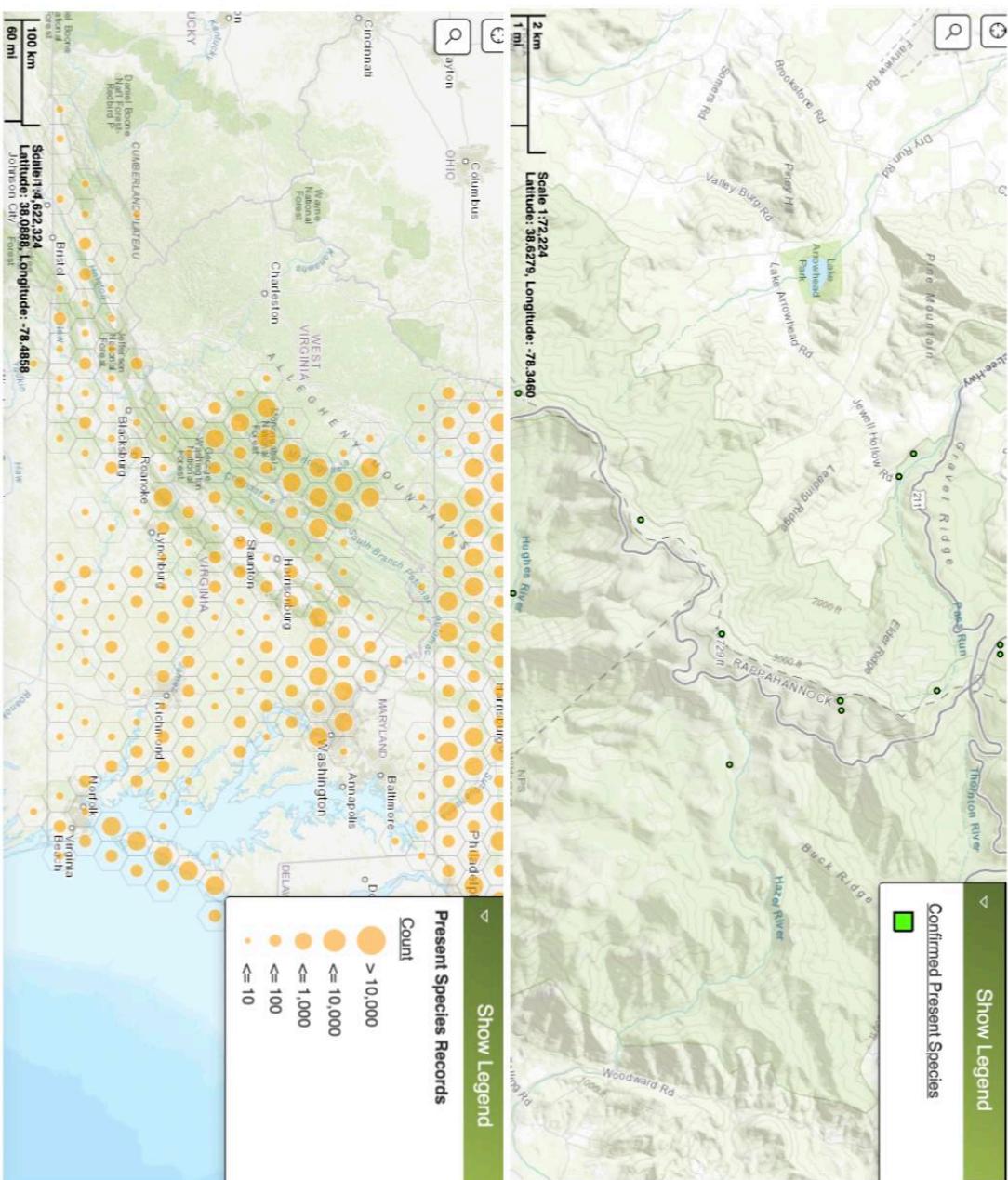
**Figure 2.7**

In addition to the IPMDAT, The Nature Conservancy also has an [Invasive Plant Management Plan Template](#) available online. This template can be modified to suit the scale and goals of any plant management project. It is useful as a reference point for making decisions on where to focus resources and serves as a communication tool to various decision makers including town managers, board members, potential contractors, and future funders.

The screenshot shows a green header with the text "TNC Management Template". Below the header is a navigation bar with links: "INTRO TO INVASIVES", "GET INVOLVED", "NEWS & EVENTS", "ABOUT US", and social media icons for Twitter, Facebook, and YouTube. A red arrow points from the text "Page not found" in the main content area to the "Page not found" link in the navigation bar. The main content area displays the text "Page not found".

The requested page could not be found.

**Figure 2.8**



**Figure 2.9**

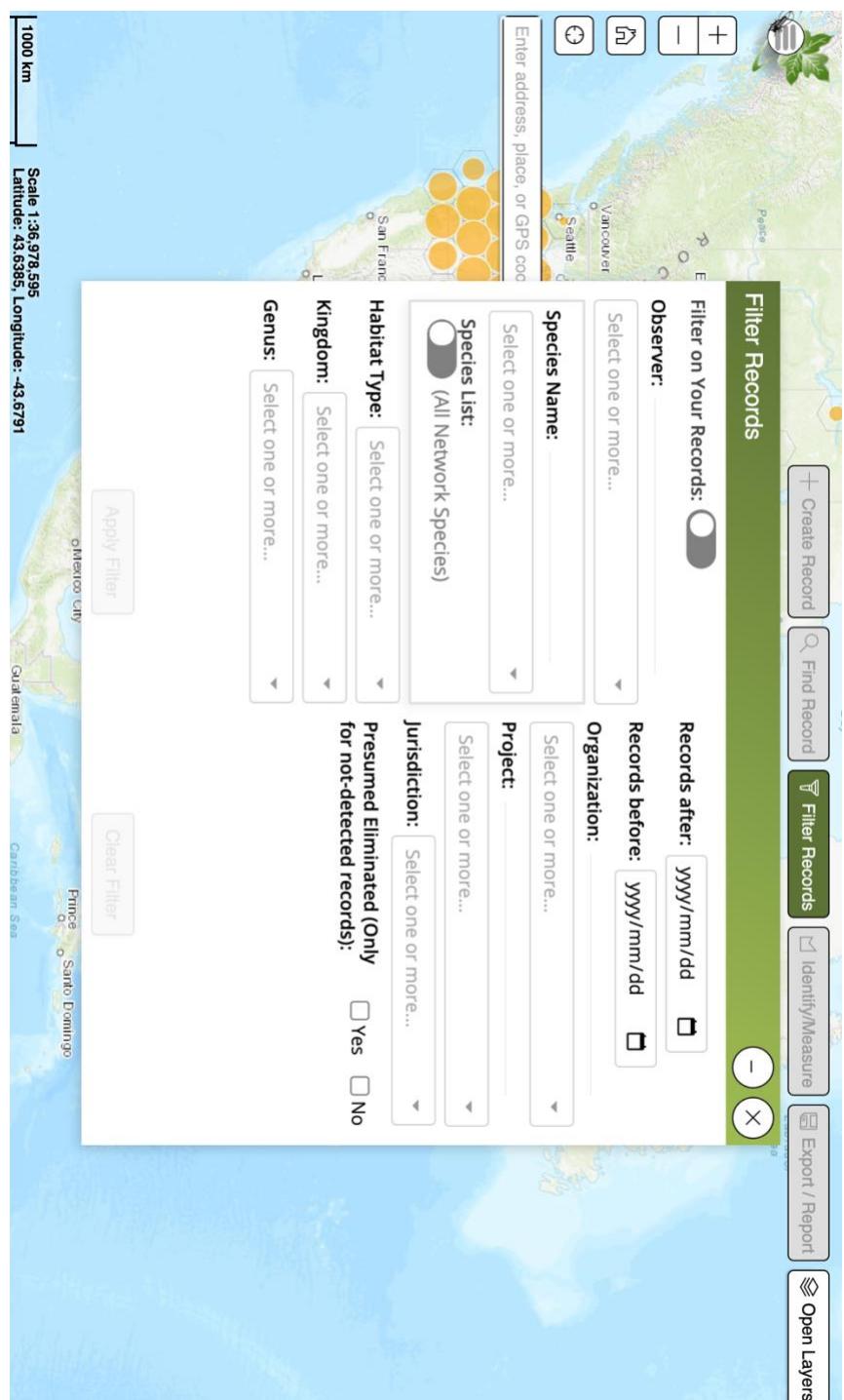


Figure 2.10

San Francisco  
Los Angeles  
Dallas  
Atlanta

Distance: 803.1342 Miles

Select the type of measurement to perform  
 Area  
 Distance

Scale 1:36,978,595  
Latitude: 34.3098, Longitude: -85.0716

**Find Record**

Type: Presence

Record ID:

**Add Distribution Layer**

Create a view of the current filter by selected geography

View Distribution By:

- County/District
- Include Approximate Presences?
- Include Unconfirmed Presences?

Layer Color:

- Show the Distribution Layer
- Remove the Current Distribution Layer
- Unique Title For Layer From Distribution:
- Save Distribution to Layer On/Off

**Layers On/Off**

- Confirmed and Unconfirmed Present Species Hexes
- Unconfirmed Present Species
- Not-Detected Species
- Approximate Present Species
- Treatments
- States/Provinces
- County/District
- Waterbodies
- Conservation Lands
- Transparency:
- USGS Topographic Quad
- Regional Management Partnerships

## Appendix D: Cognitive walkthrough questions

<b>In the process</b>	<b>Considering the results</b>
<ul style="list-style-type: none"> <li>- <i>Will the user understand what to do and how to complete this task?</i></li>   <li>- <i>Are there any features (in the process) that their usability needs to be improved?</i></li>   <li>- <i>Are there any features (in the process) that influence trust? If so how can we (re)design them to improve trust?</i></li> </ul>	<ul style="list-style-type: none"> <li>- <i>Will the user be satisfied from the result?</i></li>   <li>- <i>Does the outcome (and the way it is presented) fulfills user needs?</i></li>   <li>- <i>Is there any missing functionality or information that should be added to support the fulfillment of user needs?</i></li>   <li>- <i>Are there any features that in your opinion provide the user with a unique user experience?</i></li> </ul>

## Appendix E: Justification for cognitive walkthrough plan

<b>Evaluation task</b>	<b>Evaluation aim</b>	<b>Justification and link to specific aims (subgoals) and users' contributions</b>
<i>Create an account and log in</i>	1	<i>Creating an account should be the first process completed by a novice. Besides, log in process should be done every time when using the application, so that it is essential for evaluating adaptability. The easier to adapt to the system for novices, the more likely for users to be interested in the projects and contribute more.</i>
<i>View an observation following users' interest</i>	1, 2	<i>Viewing an observation would be one of the frequent used function on the website. Performing this task quickly, checking others' work and acquiring needed information can make users feel confident to do similar data collection by themselves with passion. Motivation can be improved after knowing the potential results of contributions.</i>
<i>Find information regarding an observation following users' interest</i>	1, 2	<i>Similar to viewing observations, finding further information related can make novice better understand the projects and the meaning behind, further stimulating interest and contribution.</i>
<i>Upload an observation</i>	2, 3	<i>Process of submitting an observation must be done quickly, easily, efficiently and error tolerant. Besides, the display of the results is related to the potential to increase interest and sense of achievement, encouraging them to contribute more data.</i>

## Appendix F: Persona used for cognitive walkthrough

### Hannah



#### Goals

- Support environmental initiatives
- Identify threatened species
- Advance scientific research
- Develop new solutions for environmental problems

#### Frustrations

- Limited time for involvement in environmental matters
- Technological glitches and complicated interfaces
- People not recycling or composting
- High costs and expensive products

#### Bio

Age: 26  
 Work: Zoologist  
 Family: Single  
 Location: London, England  
 Character: Smart, environmentally aware, tech savvy

**Personality**

Introvert	Extrovert
Thinking	Feeling
Sensing	Intuition
Judging	Perceiving

**Motivation**

Motivation Category	Level of Interest (Blue)	Level of Interest (Grey)
Incentive	Very High	Medium
Interest in science	High	Medium
Growth	Medium	Medium
Contribution to change	Very Low	Medium
Social	Medium	Very Low

**Citizen Science Websites and Projects**

Currently does not use citizen science websites and projects

**Preferred Channels**

Workshops and expeditions	Online campaigns & Social Media
Gamified web applications	Mobile applications

**Geographic Information Systems**

Hannah is a zoologist because she has always loved animals ever since she was a little child. Her work is quite demanding so she normally does not have much time to support environmental initiatives. Although Hannah is not currently involved in any citizen science projects, she is eager to learn how she could make a positive impact on the environment. She believes that conservation projects do not necessarily have to be large-scale in order to be effective, they can also be implemented in daily life. Hannah is highly experienced with using a variety of technological interfaces and has a strong social media presence. She frequently uses Google Maps for finding nearby locations but does not have advanced knowledge or expertise in geographic information systems.

## **Appendix G:** Executive summary

**Finding 1:** **iNaturalist** and **iMapInvasives** adopt inappropriate languages in interface.

**Recommendation:** Use more familiar languages (e.g., change ‘Explore’ to ‘Map’ or try to make the website show the whole name of the abbreviations when hovering to the button).

**Finding 2:** **iNaturalist** and **iMapInvasives** lack a customization tutorial for first-time users to reduce confusion and task complexity.

**Recommendation:** Make pop-up tutorial for first-time users a mandatory process, where they can skip the unnecessary steps.

**Finding 3:** **iNaturalist** has the help documentation navigation bar hidden in the menu.

**Recommendation:** Categorize the tags or make the regularly used tag not stacked; improve the visibility of help tag (make full use of the space).

**Finding 4:** **iMapInvasives** does not have proper descriptions for the projects and species records as well as forum, which is likely to make potential contributors feel ‘out-of-their-depth’ and not in a right position.

**Recommendation:** Add necessary information, involving text, pictures and more external links to help people identify species correctly.

**Finding 5:** **iNaturalist** and **iMapInvasives** are lack of search and filter options.

**Recommendation:** Fulfill users’ demands by increasing detailed search options and filter options (such as location option) to assist data processing and collection processes.

**Finding 6:** **iNaturalist** and **iMapInvasives** can only acquire limited information from map interface.

**Recommendation:** While browsing the map, location, species category, date and recorded pictures should be shown to allow audiences to glance all needed information conveniently.

**Finding 7:** **iNaturalist** and **iMapInvasives** do not have consistent styling of tags, titles and buttons.

**Recommendation:** Format the webpages to ensure consistent styling of tags, titles and buttons.

**Finding 8:** **iNaturalist** and **iMapInvasives** waste viewers’ time during filter process, because of the inflexible filter box.

**Recommendation:** Better to have a filter box which can be moved, so that user can preview the filter result.

**Finding 9:** **iNaturalist** and **iMapInvasives** neglect the explanations of the representation of spatial properties, particularly, the **iNaturalist** website even does not have the corresponding legend for different scales.

**Recommendation:** Better to provide explanation for the principle and application of grid and hexagon; check the legend practicability for different scales.

**Finding 10:** **iMapInvasives** do not have social media options for sign in, wasting time.

**Recommendation:** Provide multiple channels, including Facebook, Google, Apple ID, etc.