

Unified Butterfly Recorder Project Plan



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Senior Design Team Dec13-08

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Problem Statement

Background

Butterflies serve as a great indicator species, meaning that their presence, absence, and abundance can be correlated to interesting environmental phenomena. Researchers and conservation workers use butterfly migration patterns and dispersal data to monitor components of the environment from local habitat restoration progress to large scale climate change.

Surveys

Myriad organizations around the world collect or organize the collection of butterfly data, most commonly through surveys. A survey is a collection of butterfly sightings gathered in one general location over a time span that is generally less than a few hours. As with most research, different data is collected with different purposes in mind, so the data required by surveyors for one organization can vary significantly from that of another. This creates problems when trying to look at national or global populations or other larger generalizations.

Protocols

A survey may collect as little information as the presence of a particular species within a county, or data as detailed as the condition of each specimen with light intensity readings at the specific sighting location. The type and method of data collection during a survey is dictated by protocols. Each protocol is designed to answer a specific type of research question. There are many protocols used today.

Pollard Walk: A surveyor repeats an identical transect (route) different times over the course of years, recording sightings visible within a specific range of the path, aiming for consistency of recording. This can allow more rigorous statistical analysis.

Distance Sampling: Record the distance of sightings from a specific line or point transect in order to estimate local distribution and abundance

Presence-Absence: Simply record whether a particular species has been sighted at all in an area.

Meandering Survey: Similar to field trips, this protocol involves individuals or groups walking an indeterminate path looking for as many individuals as they can find.

The data collection forms for several survey protocols can be found in Appendix A.



Problems

There is no national or global standard for the type of data collected, how it is recorded, or the methods of collection. Data collected using one protocol can be similar to that of another protocol, but different enough to not be useful. Current methods for collecting this data are often done on paper and not catalogued uniformly. There is no central warehouse for butterfly survey data, making large-scale research and conservation efforts challenging.

Objective

Our objective is to create a mobile app that will streamline the process of data collection, standardize the data that is collected, and facilitate central storage and access of all data collected with this app.

"This app will help standardize the collection of data and has the potential of impacting conservation efforts both nationally and globally."

- Anita Westphal, Reiman Gardens



Market and Literature Survey

Questionnaire

Our client has proven to be invaluable during this phase of the project. Nathan generated a list of thirty surveyors around the world for us to contact for preliminary feedback. We designed a questionnaire with the objectives of determining which protocols are used the most, ascertaining which data points are perceived as most essential, gathering user interface preferences, and eliciting any helpful ideas. To view the response summary, see Appendix B.

% cloud cover	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
habitat conditions	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
level of ID certainty	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
start/stop times	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
monitor information	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please describe any other data that would be useful during a survey.

What is the length in time of a typical survey for you? *

Enter a range (i.e., 1-3 hours) if appropriate.

In general, what is the maximum time you would spend surveying in a single day? *

What is the distance of a typical survey for you?

Enter a range (i.e., 0-10 miles) if appropriate.

We sent a questionnaire to surveyors to gather user requirements.

The results from this questionnaire validated most of our hypotheses. A few individuals were interested in further discussion. We conducted several Skype and conference calls with surveyors



from as far as Germany. One of them was a leader of an organization from Chicago that had developed his own iOS app that assisted him in survey taking. While it wasn't near the extent that we are planning to develop, it was a good source of potential UI ideas.

One responder of particular importance was Thomas Naberhaus of Butterflies and Moths of North America (BAMONA). "The BAMONA project aims to serve as a one-stop database of butterfly and moth data that scientists can use to form or to address research questions." BAMONA's information page provides more detailed information about the goals and background, which are very similar to the objectives of this project: <http://www.butterfliesandmoths.org/about>. BAMONA currently has a web interface and database for hosting all records. Thomas proposed that we collaborate with him on the specification for the new system and develop the mobile apps to interface with BAMONA's database. We discussed this within our team and with our client to analyze the potential for success and vet potential risks of the collaboration. We determined that this would result in positive outcomes for all involved, and set to work with Thomas to lay out our goals and design specifics.

Protocols

Primarily through discussions with our clients, we reviewed the standards for existing survey protocols and determined the set of data fields we wanted to collect. We included this list of potential data points in the questionnaire in order to gauge market response and capture any fields we had overlooked. The list of fields we collect is available in the functional requirements section of the design document.

Existing Apps

By searching through the Apple App Store and Google Play Store and talking with our client, we collected a list of mobile apps that perform related tasks. The full list is in Appendix C. Most of these suffered from the same problems as manual survey protocols: They collected a small set of information. This search verified that we would not be replicating existing technology with the development and release of our app.



Deliverables

1. One Android app usable on both tablets and phones.
2. One iOS app usable on both tablets and phones
3. Database of all records
4. Web interface for record access

Requirements-to-deliverables Map

Requirement: Collection of GPS, waypoint of routes, date and time, start/stop times, light levels, and walking pace.

Deliverable satisfying the requirement: Android and iOS mobile apps, through automatic collection

Requirement: Tally of sightings for each species, habitat category, habitat conditions, data entry for mark recapture details, categorized behavior notes: Mating, nectaring, basking, puddling, perching, patrolling, site name, level of correct identification certainty, surveyor information (level of expertise, contact info, number of survey takers - recorders, observers), taxonomic tree-based classification, miscellaneous comment section (animal life, plants present), differentiation of sections along route, distance/habitat category

Deliverable satisfying the requirement: Android and iOS mobile apps, through automatic collection

Requirement: collection of temperature, wind speed, wind direction, percent cloud cover

Deliverable satisfying the requirement: Web server access of third party weather service

Requirement: Allow access to all submitted data

Deliverable satisfying the requirement: Drupal web interface to MySQL database and app-local file export



Project Management

Work Breakdown Structure

We have assigned the management of each of four main project tasks to different team members.

Manager	Component
Ryan	Android development
Curtis	Documents and website
Cameron	Database
Julie	Communication and presentation

The component leader delegates tasks as necessary to meet our objectives by our target deadlines. In addition, Ryan serves as the primary liaison with Dr. Rover, and Julie serves as the primary liaison with Reiman Gardens.

We worked as a team to develop our user requirements, working with our client and advisor.



Timeline

Target Date	Milestone
Mar 1	Survey responses aggregated & requirements set
Mar 15	Determine location of database for this summer
Apr 1	Divide tasks among team members; begin prototype
May 10	Finish Android prototype with ability to store data in the server; beta release
Aug 15	Aggregate feedback from field testing
Sept 15	All feedback from summer addressed; have iOS prototype finished
Oct 15	All known bugs fixed; version 1.0 release
Dec 10	Poster and presentation finalized

Resources

Hardware

iPhone and iPod Touch: We will check these out from the department's Computer Support Group. We are exploring possibilities for testing on iPads.

Android phone and tablet: We will use our personal devices for testing.

Server: BAMONA will provide the physical server, and we have a backup running in a VM acquired through campus IT.



System Software

Android 2.3 and above. Primary target is Android 4.

iOS 5.0

Drupal 7

MySQL

PHP

Redhat 5

All system software is freely available. Redhat 5 is provided on our backup server by ISU.

Development Software

Eclipse Juno - Android development environment

Java 6

XCode 4 - iOS development environment (includes testing tools)

JUnit - Java testing framework

EclEmma - Java code coverage tool

All tools are freely available.

Risks and Mitigation Strategies

BAMONA

Because we are collaborating with BAMONA on the database, web server, and web application portions of the system, we must address the possibility of their withdrawal, however small it may be. We have set up a local server to use both for testing and as a backup in the case that we lose their partnership. Drupal is an open source framework, so we can mirror any progress made locally. We will design the mobile apps to have database-agnostic interfaces in order to make switching with a new web server implementation easy from the device side.

Additionally, working with BAMONA just became a possibility at the beginning of April. This was a late addition into our design that will require more work during the summer to ensure system health and development readiness for the fall.



Drupal

Drupal is a large system that was introduced to use with the entrance of BAMONA into our project plans. We will leverage the existing BAMONA Drupal platform and prototype the interface this summer. We are working closely with a BAMONA developer to integrate the database schemas and external interfaces of our systems.

iOS Application

Because we are developing this application solely during the fall semester, we run the risk of not having enough time to complete the app. Our system will be functional with just an Android implementation, in the worst case. Our design will facilitate a generic mobile app interface, so that the lead time on developing the iOS version is minimal.

Software license

We need to explore what our rights are concerning this software as it is being developed as part of a university class and for a government-funded client (Reiman Gardens), and as part of a collaborative system with BAMONA. We will explore the possibility of releasing the app as an open source project to maximize maintainability of the project.

Data license

We need to explore the legal implications of ownership of the data submitted through our application into the database. We need to determine what the rights of users will be with respect to their own data and data submitted by others. BAMONA currently has defined standards for this, which are viewable here: <http://www.butterfliesandmoths.org/faq/what-are-terms-use>. We will further explore this with our client in the interest of providing an open community.

Loss of a team member

There is always the possibility that a team member will be unable to continue his or her progress on the project. To mitigate this risk, we plan to document each component of the project and all interfaces so that they can be developed in effective isolation if necessary. This modularity will ensure that any progress made by a teammate will not be lost.

Possible future loss of 3rd party service data

Our design of interfaces for external services will allow easy swapping of new services to conform to our existing usage of this data in the app.



Identification of bottlenecks

We will perform both field and software testing, including user feedback built into the alpha/beta release of the application.

Scalability

It is likely that our users will input widely varying amounts of data into our app and database. We need to make sure that a large amount of cached data on the app will not slow it down. We will investigate current data sizes for existing warehouses and test our infrastructure beyond those limits.

Testing and Evaluation

Automated Testing

Unit testing

We will write unit test suites for the Android and iOS apps using the Android testing framework and Xcode Unit Test target, respectively.

Code Coverage

We will employ tools to measure the code coverage of our test suites. For Android, we will use EcEmma, and for iOS we will use Xcode's coverage features.



Prototype and Beta Release

Throughout the summer, users at Reiman Gardens and those we have contacted through our client will use the application to perform real surveys. This will allow us to get user feedback on the app's interface and functionality. We will perform surveys in the field ourselves to get an idea of what our users will experience.

Beta Release/Evaluation Plan

We will release the app publically through the Google Play Store on May 10th, noting fully in the store and on the app the status of the project as a prototype. We will send notice of release to the same people who responded to our questionnaire, as well as further contact suggested by our client. We will use the summer term to collect data using the feedback feature of the app. We will examine the expected vs. realized use cases for the system and reevaluate our system design in August. We plan to perform field testing ourselves, doing several surveys to gain a better understanding of the challenges associated with collecting quality data.

Prototype Plan

By May 10th we plan to complete a prototype suitable for a beta release, managed by Ryan. This will implement the meandering walk protocol and have the ability to submit data to a server and export locally. It will have a built-in feedback feature through which users can send bug reports, suggestions, and requests. This will feature a full user interface, leaving only further protocol implementations to be completed.

Maintenance

Our short-term maintenance plan is to respond quickly to user feedback and personal test results by developing and release new features prior to our October 15th target release date for version 1.0. Of particular importance during this process is the results from our summer of field testing, both by professionals, and our team. The app's built-in feedback mechanism will be key to the success of this plan, as users will be able to very easily provide us with feature requests and bug reports.



We are creating the app with modularity in mind, in that we will be able to implement an arbitrary number of survey protocols with extensive data field support. This allows us to quickly respond to feedback regarding features.

We are releasing the prototype through the Google Play Store, which provides a fast, standard avenue for distribution of the app and, importantly, pushing updates to our users throughout the prototyping cycle.

We are exploring the most appropriate long-term maintenance plans to ensure the success of the system after our graduation. Partnering with BAMONA is a huge part of this objective.

Current Project Status

Prototype

This semester, we have developed a basic Android app as a proof-of-concept that has the ability to collect user input and submit it successfully to our server. We are currently finishing up the prototype to meet our target release date of May 10th. We have basic user interface features completed and some rudimentary communication between the server and the application setup. We will finish the implementation of one protocol and include a form for bug reports and feedback.

Server

We are running a web server on campus through which we are able to submit data from a generic web client, including our mobile app.

Appendix A - Protocols

MARK-RECAPTURE FIELD DATA SHEET

[illegible]

Butterfly Sampling: Pollard Walk

Butterfly species composition and relative abundances are sampled using transect counts, modified from Pollard (1977). Transect routes are established as appropriate for each site, typically including distinct segments near the base of a sloped habitat, mid-slope, and along ridgetops. Observers record butterflies observed within a 5 meter band on both sides of a transect, while walking at a slow and steady pace. Species identifications are made visually, using binoculars when needed. Occasionally, identification may require capture with nets, after which the insects are released unharmed. Transects are walked during midday hours (1000–1500) on at least one day during each 10-day sampling period. Sampling is restricted to relatively calm conditions and times when air temperature exceeds 13°C in sunny weather or 17°C in cloudy weather.

Recording

Record all butterflies seen w/in bounds of route (5 meter width rec'd) and w/in 5 m ahead.

Helpful to imagine recorder w/in moving 5 meter box

– record all butterflies seen w/in box.

Walk at steady pace.

No special effort to record butterflies settled out of sight in dense vegetation.

Record each individual once only.

Record at least once per week.

Restrict recording to middle of day (e.g. 1000 to 1500 PST, or 1100 to 1600 PDT)

Temperature: shade temp ≥ 17.0 °C

(or lower, e.g., 11.0 °C at northern sites where butterflies adapted to cooler temps)

Wind speed estimated using Beauford scale

References

New, TR 1997. *Butterfly Conservation, 2nd Edition*. Oxford Univ. Press, Melbourne, Australia.

Pollard, E, and TJ Yates. 1993. *Monitoring Butterflies for Ecology and Conservation*. Chapman & Hall, London, UK.

*Pyle, RM 2002. *The Butterflies of Cascadia : A Field Guide to All the Species of Washington, Oregon, and Surrounding Territories*. Seattle Audubon Society, Seattle, WA.

BUTTERFLY TRANSECT DATA FORM

Site Name _____ Site ID No. _____

Date _____ Observer _____

Transect Location _____

Transect UTM's: Start: N _____ E _____

End: N _____ E _____

Elevation _____ Aspect _____ Slope (%) _____

Start Time _____ End Time _____

Weather:

Start Temp °C _____ End Temp °C _____ % Sun _____ Wind _____

BUTTERFLIES OBSERVED

[illegible]

Number of Butterfly at the Site (collected specimen strongly recommended):

Species (if known)	Larva /pupa	Adult	Density*	Collected Specimen ID	Comments (behavior)
			___m ²	S___-20___-___	
			___m ²	S___-20___-___	
			___m ²	S___-20___-___	
			___m ²	S___-20___-___	
			___m ²	S___-20___-___	
			___m ²	S___-20___-___	
			___m ²	S___-20___-___	
			___m ²	S___-20___-___	
			___m ²	S___-20___-___	
			___m ²	S___-20___-___	
			___m ²	S___-20___-___	
			___m ²	S___-20___-___	
			___m ²	S___-20___-___	

* estimated size of area(m²) needed to see one adult at this site (1 adult/___m²)

Other relevant information:

Please send packaged and protected specimens to:

Newfoundland and Labrador Butterfly Survey

Wildlife Division,
Department of Environment and Conservation
Box 2007
Corner Brook, Newfoundland A2H 7S1
Attn: **Bruce Rodrigues**

(Label as) **Fragile**

Please send the completed forms to:

Via mail: same address as above.

--or--

Fax: 709 637 2080 / Attn: **Bruce Rodrigues**

--or--

Email: BruceRodrigues@gov.nl.ca

Appendix B - Questionnaire

17 responses

Summary [See complete responses](#) [Publish analytics](#)

Name

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Email

[illegible]

Organization

[illegible]

How often do you perform a Pollard survey?

6-8 times per year couple times a year 8 times per year about 6 times/year 2 12 plus times per year never Never never Coordinating
one Daily to several times per week 1/week never every week At least 6 times per year 6-8 times per year 8 to 14 per year

How often do you perform a Mark Recapture survey?

Never never Never occasionally 0 Have used mark-recapture once never Never never Performed 2 Daily to several times per week in
particular years never never never 1 time per year (unrelated to the Butterfly Monitoring Networks) never rarely

How often do you perform a Distance Sampling survey?

Not sure what Distance Sampling is never Never rarely 2 never never Never never never Frequently during April/May and Sept. (observing seasonal migrants) never never never never never never

How often do you perform a Presence Absence survey?

Not sure what Presence Absence survey is couple times a year 4 times per year 10+ times per year 3 1-2 times per year 3-4 days a week Never never 1-2 times a year Continuously (online citizen science reports) 2/year never every year Rarely never rarely

How often do you perform a Meandering survey?

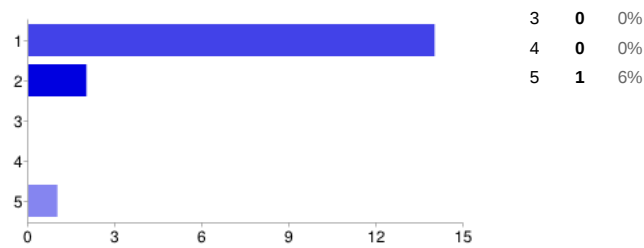
Not sure what Meandering survey is couple times a year Never about 6 times per year 3 6 plus times per year never 40-50 times per year multiple times a week in season never never weekly never never Rarely never ~3 times a year

If you conduct any other types of surveys, please briefly describe the method and list how often you perform them.

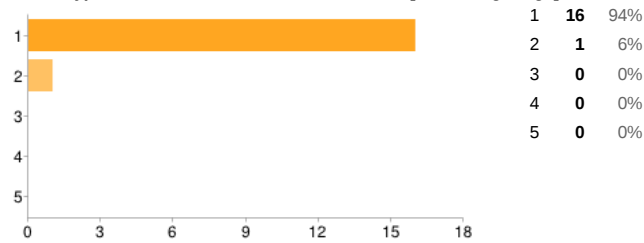
I survey miscellaneous sites around Iowa for butterflies using a random walking survey designed to record species presence and abundance at that single point in time. I record species as I encounter them during the walk using a pen in my field notebook, then estimate the quantity of each species seen during the walk when the walk is complete. This may be the same as a Meandering survey, I had just never heard that term before. I visit most sites once a season, and some two or three times a season. Visiting multiple times during a season and in multiple seasons gives a sense of butterfly population trends over time, but that is not the main objective my surveys. I collect moths about twice a week at a blacklight. Will probably do more butterflies with the right apps. An app would make it easier to track pictures and specimens. Rarely conduct a transect survey, but do not believe they are efficient.

Which types of data would be useful to collect? [GPS coordinates of sighting points]

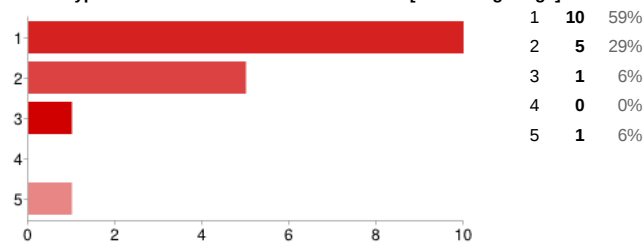
1	14	82%
2	2	12%



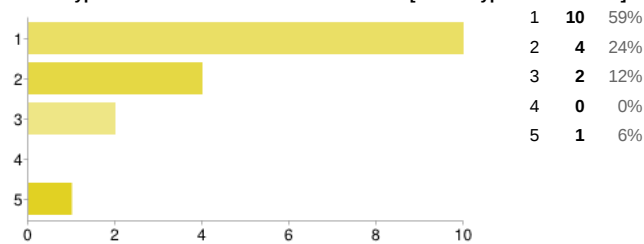
Which types of data would be useful to collect? [date of sightings]



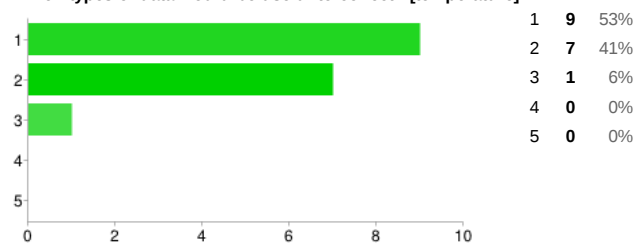
Which types of data would be useful to collect? [time of sightings]



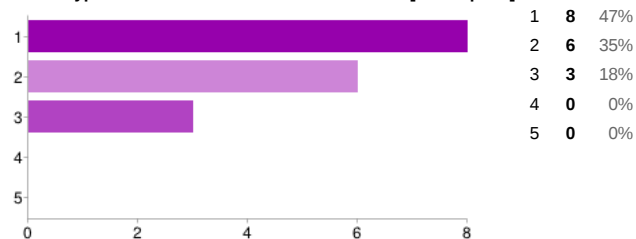
Which types of data would be useful to collect? [GPS waypoints of routes]



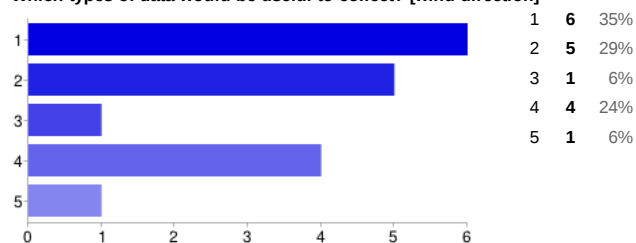
Which types of data would be useful to collect? [temperature]



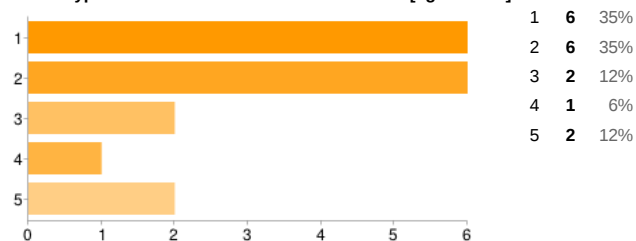
Which types of data would be useful to collect? [wind speed]



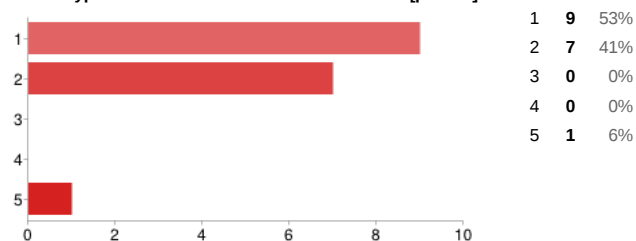
Which types of data would be useful to collect? [wind direction]



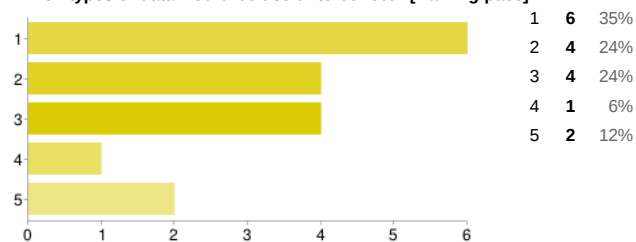
Which types of data would be useful to collect? [light levels]



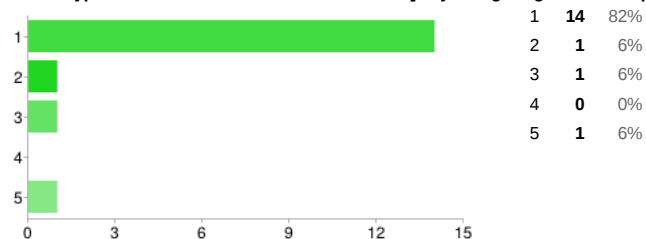
Which types of data would be useful to collect? [photos]



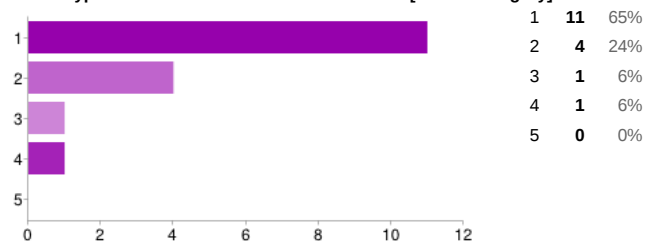
Which types of data would be useful to collect? [walking pace]



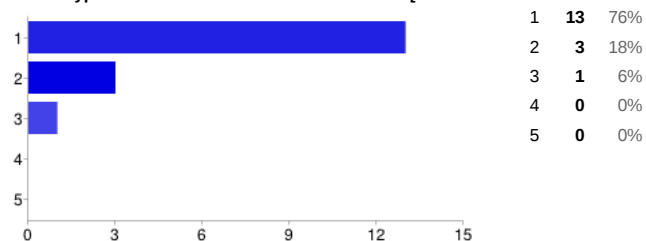
Which types of data would be useful to collect? [tally of sightings for each species]



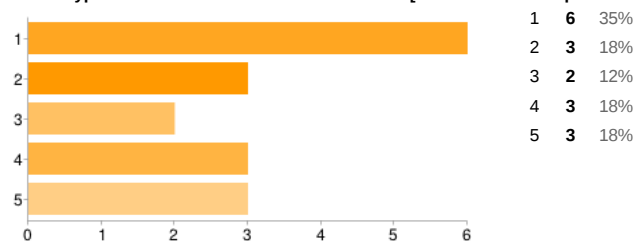
Which types of data would be useful to collect? [habitat category]



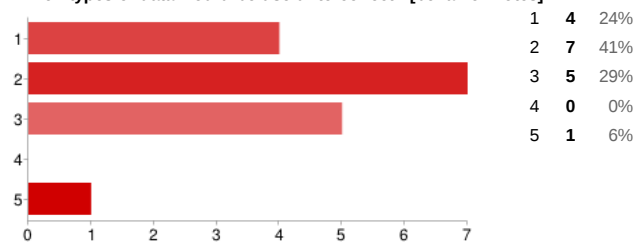
Which types of data would be useful to collect? [differentiation of sections along route]



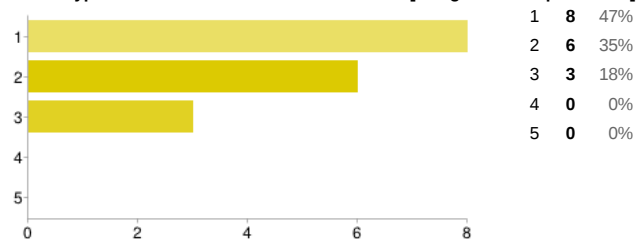
Which types of data would be useful to collect? [need for marked specimen data]



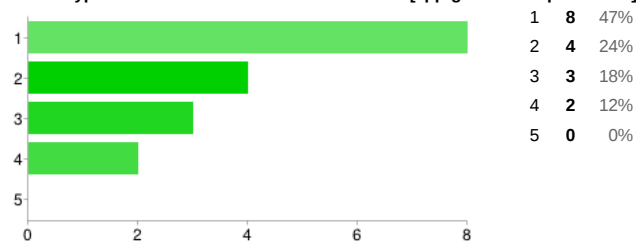
Which types of data would be useful to collect? [behavior notes]



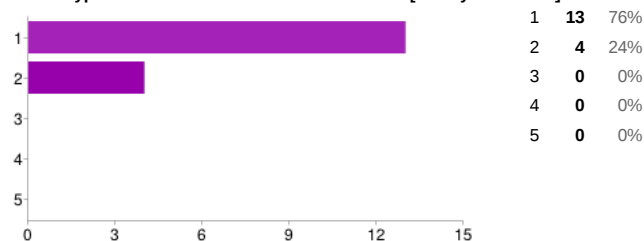
Which types of data would be useful to collect? [self generated species list]



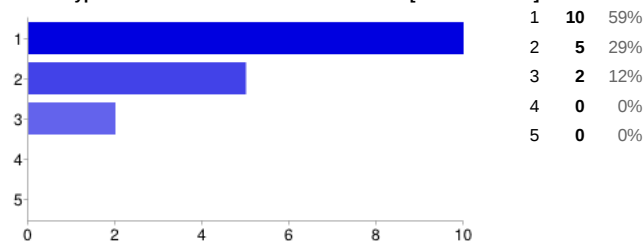
Which types of data would be useful to collect? [app generated species list]



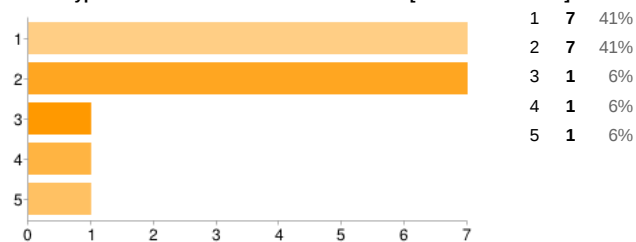
Which types of data would be useful to collect? [survey site name]



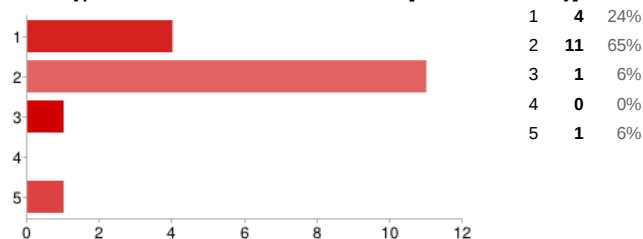
Which types of data would be useful to collect? [% cloud cover]



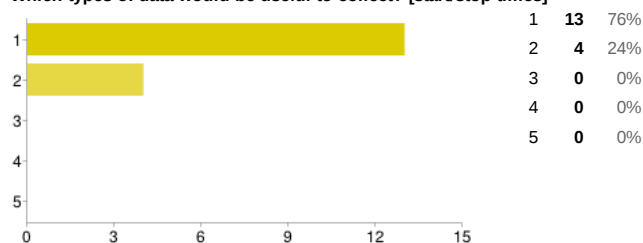
Which types of data would be useful to collect? [habitat conditions]



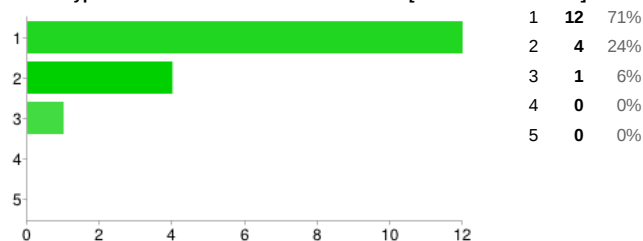
Which types of data would be useful to collect? [level of ID certainty]



Which types of data would be useful to collect? [start/stop times]



Which types of data would be useful to collect? [monitor information]



Please describe any other data that would be useful during a survey.

Description of survey site county, state, and ownership, i.e. "Folsom Point Preserve (TNC-owned), Mills County, Iowa. Also a place to record miscellaneous remarks such as "one of the Tiger Swallowtails was a black-form female" or "Butterfly netted and released for identification purposes." Assistant name Length of pauses Not necessarily needed for TN (but still might use it), but based on protocol comparisons, might be useful for OH since they do record: Larvae sighted Plants in bloom Energy sources (including nectar sources, sap, feces, etc.) possibly plant phenology - bloom nectar plants plants used as oviposition substrate degree days? min-max on temperature wing wear? Condition of the specimen -- whether just hatched or was it a worn individual -- might be helpful, but not critical. The ability to collect specific latitude and longitude of individuals of rare species is important but in general only the ability to collect a single location latitude and longitude of a particular site is needed. Also important is the ability to collect notes of other life forms such as plants, birds, mammals, other insects, etc. Free format mode for this latter information would be fine. unrecognized specimen "complex" of two or more species, or family-level recognition Names of discrete points within a survey route (e.g., Territory 1) Number of individuals observed at a particular point at a survey Status of each individual observed at each point (for territories: occupant, intruder, vagrant), and Occurrence and number of territorial interactions at a particular point. (e.g., Territory 1: 1 occupant, 1 intruder, 3 interactions; Territory 2: 2 occupants, 4 interactions) For migration observations: compass direction, estimated height above ground, estimated linear distance of butterfly from observer (for a distance sampling survey). We also use a field called note taker. It's left blank for people doing their routes solo. A comments field would be essential. We also should figure out how partial identifications will be dealt with.

What is the length in time of a typical survey for you?

0.5-3 hours 2hrs 1-2 hours 1-1.5 hrs at a site 1-2 hrs 2-3 hours 2-3 hours 30 minutes - 4 hours 1-3 hours 30-40 min 1-3 hours 1-4 hours 0 45 min 1-2 hours 0.75-2 hours 2 hours

In general, what is the maximum time you would spend surveying in a single day?

All day 4hrs 3 hours 5 hours 6 6 hours 8-10 hours 8 hours 8 hours over multiple sites volunteers in Israel do it once in 2 weeks 3 hours for Pollard; 5 hr. for distance sampling of migrants 32 years 0 2h 3 hours 1 survey per day, no more than 2.5 hours 2 - 4 hours

What is the distance of a typical survey for you?

A few hundred feet up to 1.5 miles 2miles 1-2 miles 2-5 miles 1-3 miles 1-2 miles 2-3 miles 1 mile 1 mile for each site 300-600 m 4 miles 0 1 km 1 - 3 miles about a mile 2 miles

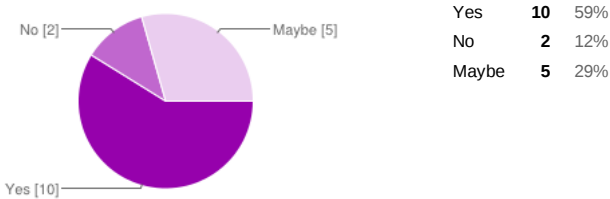
In what format(s) do you currently store your data?

Data from field notebook is supplemented with a written narrative when the survey is complete, then both are entered into an Excel spreadsheet for a complete record. excel spreadsheet and AVISYS Excel spreadsheet Word, Excel, GPS in garmin .gdb, Google Earth maps, jpg for images database database - online SQL Server, and local Access DB online database AviSys database spreadsheet and database online database Notebook; Excel spreadsheet xml mysql database SQL database database Filemaker Pro Database. We also have online entry available. Data from this system are stored in an HTML log and uploaded into the Filemaker Database at the end of each season. excel

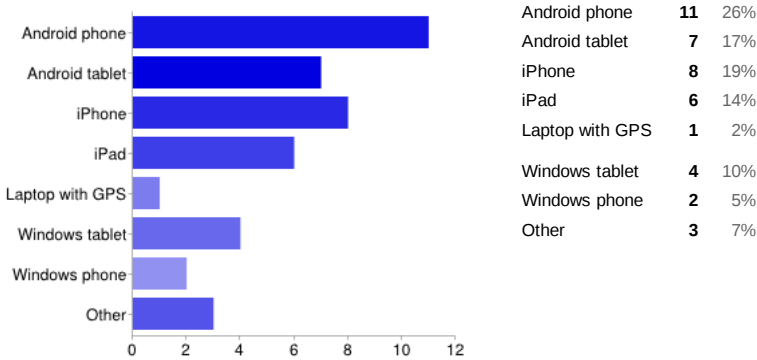
How would you like to be able to review and use your data?

Spreadsheet and some sort of visual mapping excel spreadsheet and data on maps Custom web interface, mapping spreadsheet, web, mobile spreadsheet Spreadsheet, text files, custom web interface on the mobile device, mapping, custom web interface Spreadsheet spreadsheet, SQL database SQL database Spreadsheet, mapping, graphic and statistical analysis, custom web interface, SQL database, API access spreadsheet imported to bamona and reviewed on butterfliesandmoths.org website SQL database I'd be OK with spreadsheet or a delimited text file I would like to be able to generate reports, work with maps and do spatial analysis

Would you or your organization be interested in utilizing a central database solution if available?

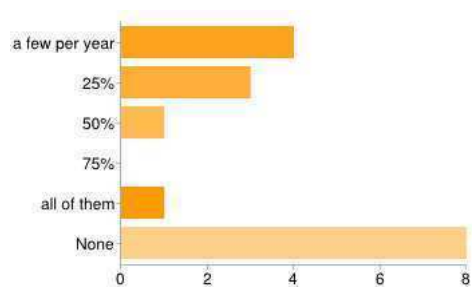


Which devices would you prefer to use for surveys?

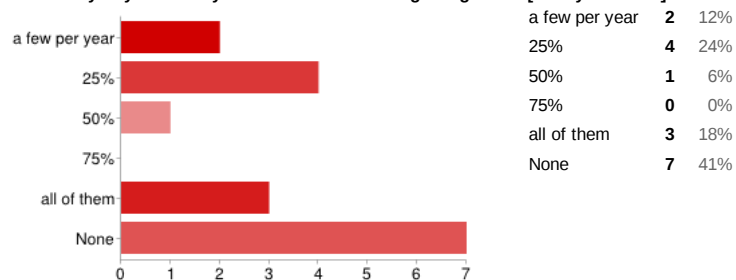


How many of your surveyors fit into the following categories? [One-time users]

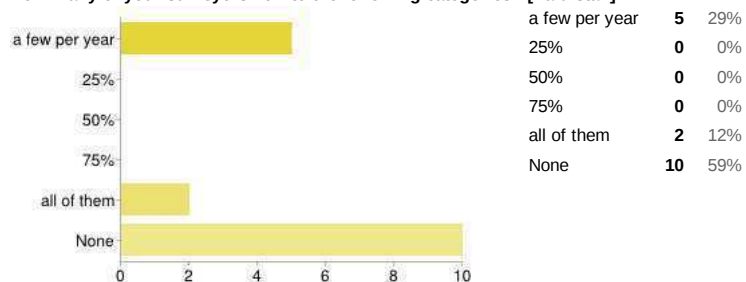
a few per year	4	24%
25%	3	18%
50%	1	6%
75%	0	0%
all of them	1	6%
None	8	47%



How many of your surveyors fit into the following categories? [First-year users]



How many of your surveyors fit into the following categories? [Paid staff]

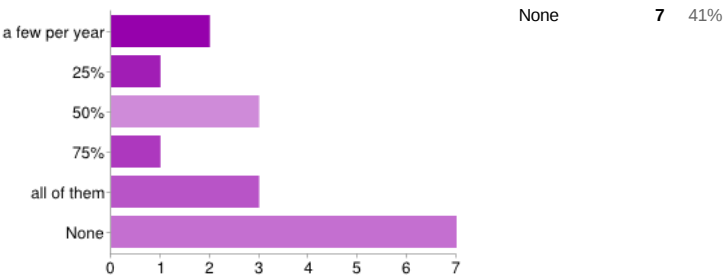


How many of your surveyors fit into the following categories? [Trained volunteers]

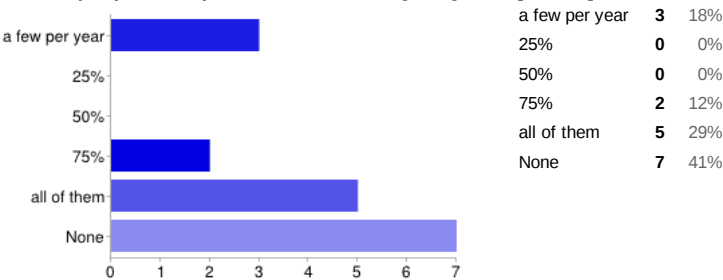


How many of your surveyors fit into the following categories? [Self-taught volunteers]

a few per year	2	12%
25%	1	6%
50%	3	18%
75%	1	6%
all of them	3	18%



How many of your surveyors fit into the following categories? [Just me]



Please give any other comments or ideas you may have.

I would give priority to being able to record the exact location of sightings during a survey and of the survey route itself because most devices now have GPS tracking capability, and to me it would be the most important item needing to be known if the survey is to be replicated in the future. Within a site there may be multiple habitat types and if habitat-specific butterflies are present, knowing which habitats they are found in is a big help in trying to relocate them in the future. If the app had photos to help with ID that would be great. An app that shows tracks and wpts would be good. I think the app could be adapted to do bird surveys. I do some of those and the same data is used but would just need to be birds instead of butterflies. Most apps have you mark a point and note whether you are moving or not but don't track route. Should be able to enter unknowns at various taxonomic levels. Would be best if it can be used across a wide variety of platforms since volunteers are not likely to all have the same hardware/software and may change frequently. Of top priority for me is to have a central database that we can access on the Internet to enter all of our Iowa butterfly/skipper observations. Then have the ability to search for ALL records (from other individuals as well as mine) at a given site, or by a given species, or by a given observer. You might consider adding a data field that indicates under what conditions the observer documented the species -- e.g., collected, caught and released, photograph, good sighting, fair sighting, etc. The main challenge to me is the ability to use a fragile electronic device in the field while also carrying camera and binoculars. Important that the app will enable adding individuals of a given species to an existing list, and minimum re-uploading events. It is critical to enable people to a-priori decide, or know, where the data are to be sent to and how will sensitive data (e.g. rare species) be handled. The Pollard-like surveys I do are somewhat different than the usual design. My daily surveys are bicycle routes through a series of butterfly territories on campus. Territories are fixed locations at which there is a relatively high probability of finding a butterfly; butterflies are much less likely to be found away from territories. Thus there is much more focus on examining particular points along the route than there is on monitoring a continuous strip as is typically done in a Pollard survey. Hi, I am the developer of the butterfliesandmoths.org web application and will be working with Leslie Ries and Doug Taron to create a repository for all of the data on a new version of the bamona applicaiton. I would be happy to meet with you and discuss how to move forward with a greater degree of cooperation. From my point of view it is important not to mix pollard walks with detection/non detection surveys (a better description than presence absence). An app specially for one purpose is probably the best.

Describe an ideal user interface for performing a butterfly survey.

Here's what jumps to my mind. The first page is a series of text boxes where users enter the name of the site they're surveying and its location, the weather, their start time (this could probably be obtained automatically from the device), description of habitats at site... possibly some other info. The user hits a "Start" button which activates the GPS tracking and starts a time recorder and the device displays a series of collapsed drop-down boxes with the name of the butterfly families (Swallowtails, Whites/Sulphurs, Blues/Hairstreaks/Coppers, Brush-footed Butterflies, and Skippers). Upon seeing a butterfly, the user taps the dropdown and an expanded list of species appears, and the user taps the entry of the butterfly species that was seen, at which point the device makes a GPS and time recording. Upon completion of the survey the user hits a "Stop" button to stop the GPS tracking and record the survey ending time. Start the survey (app would know location and time), keep track of route, allow marking species seen and location, and would allow the download of data and also make a map showing the route and wpts. If the data were in a master location (check out birdlog app and see some of the features. It allows you to email the list to yourself but you have to go to ebird to see other data.), then the data is available to others to use. I like the idea of data being open for others to see and use. Easy to read in bright sunlight (high contrast and large type) One screen for general data (weather, site, etc.). Click submit and it goes to Start screen Click Start and it records start time and takes you to sightings screen. Pause/Play button on sightings screen to

automatically record long pauses for ID Once finished click "Finish" and it automatically records stop time and takes you to a review screen so you can proofread data. Click "Save" and it saves and takes you to tally screen. Thanks for working on this! Data categories used need to be quickly accessible; user should be able to modify and save a form with just categories needed for survey; then other info can be added at beginning and/or end - temp, rH, wind, plants blooming, etc. Other than what I described in the last section, no other comments. I sometimes use a Garmin GPS device with mapping capabilities, but nothing more. Ideally it would be great to have an auditory interface or some other hands-free way to enter and confirm data in the field as often as needed. Next best way would be to enter data through touch screen back at the car. Prefer to do it by phone or skype when you have the time and interest! Kind regards, Guy

Something that would allow me to quickly collect data along with environmental variables and geographic coordinates, and then to readily download data to various analytical, graphing, mapping, and database programs. Let's discuss! This description is for a Pollard transect. The user interface should not require any changes to the survey protocol beyond simply recording data electronically rather than with pen and paper. The screen on the interface should resemble as much as possible the paper form that a program already uses. There might be a setup step that the user performs once before taking the interface out into the field. This setup might involve setting default values like the monitor and site names. All species name entry should be menu driven. During the setup, the user might pre-load the interface with those species that they most typically observe. For each field visit, the user would open the ap and indicate that they wish to begin a new route. Data recording should not involve typing anything on a keypad once one is out in the field. Buttons are preferable to menus for most tasks. The device that I have been collecting data with allows the user to toggle up and down in selected cells in the data table in units of 1. I like that system a lot. Being able to decrease as well as increase value in the cells is essential, because there is always a risk of mis-entry that you would want to be able to correct on the spot. It should be easy, while in the field, to enter species not pre-loaded onto the data sheet interface. This should be menu-driven. When the route is complete, the user should be able to submit the data directly from the field. The developers should bear in mind that this device will typically be used in bright sunshine. The interface color scheme and font choices should allow the text on the screen to be easily read under these conditions.



Appendix C - Similar Apps

Wildlife or Animal Tracking Apps

Bugs count

<https://play.google.com/store/apps/details?id=uk.ac.nhm.bugscount>

Record Wildlife

<https://play.google.com/store/apps/details?id=com.record.wild.life>

Wildlife Log

https://play.google.com/store/apps/details?id=appinventor.ai_Ockmeyer.WildlifeLog

Africa: Live

<https://play.google.com/store/apps/details?id=com.kruger.live.working>

Sightings Tracker

<https://play.google.com/store/apps/details?id=za.co.hrdit.stracker>

Bird Atlas Recording Software

<https://play.google.com/store/apps/details?id=com.smartphone2b.birdatlas>

Kruger Park Sightings

<https://play.google.com/store/apps/details?id=com.wKrugerSightings>

General Mapping and Geo-location Apps

GPS Grid Reference

<https://play.google.com/store/apps/details?id=com.luck.GgridReference>

GPS Waypoints Navigator

<https://play.google.com/store/apps/details?id=com.luck.GgridReference>

Gmemo for Field Survey

<https://play.google.com/store/apps/details?id=jp.android.Gmemo>

Survey

<https://play.google.com/store/apps/details?id=com.survey>

GIS4Mobile

<https://play.google.com/store/apps/details?id=com.gis.gis4mobile>

2GIS

<https://play.google.com/store/apps/details?id=ru.dublgis.dgismobile>

Maverick

<https://play.google.com/store/apps/details?id=com.codesector.maverick.lite>

Path Tracking

<https://play.google.com/store/apps/details?id=com.pathtracker>