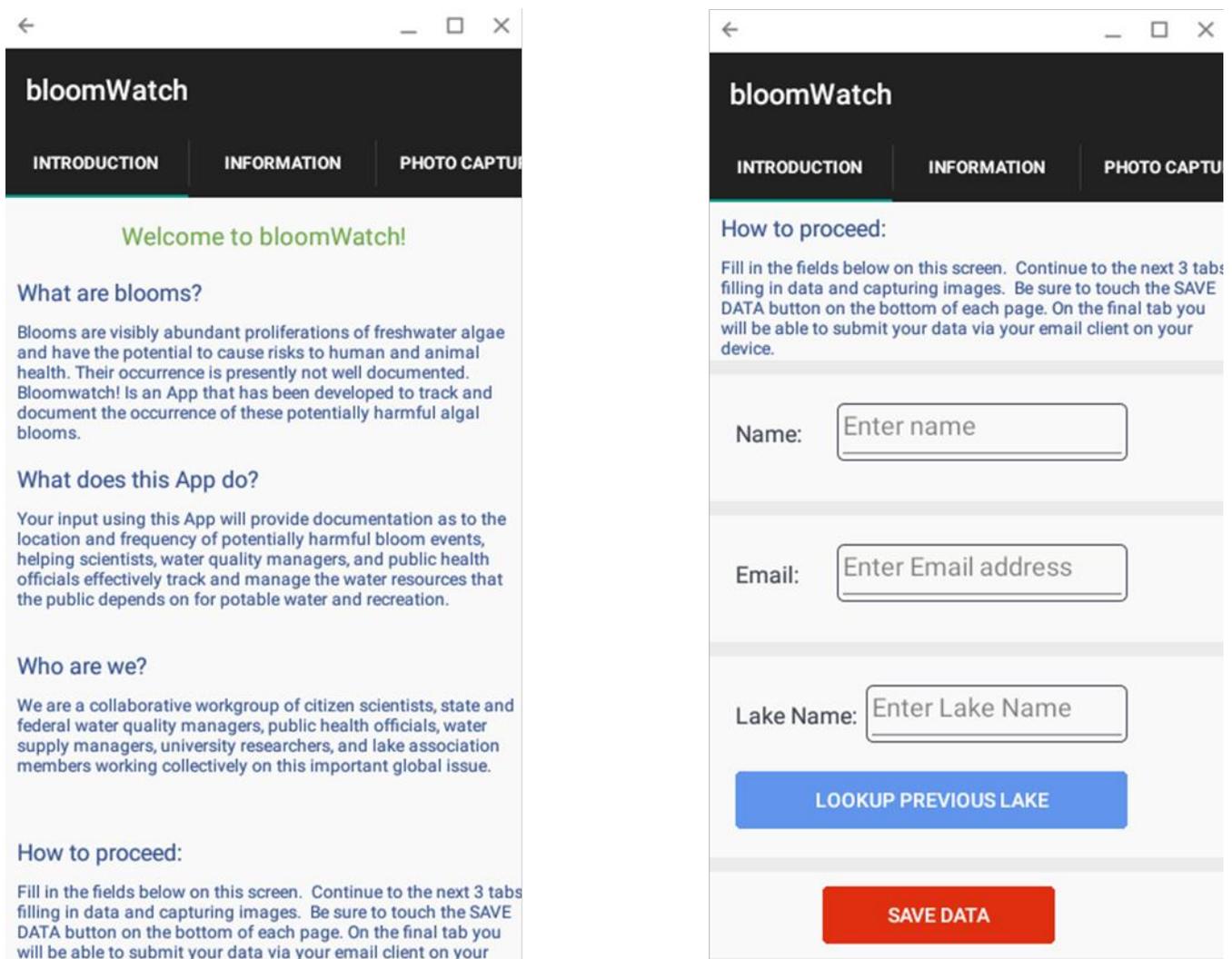


**5.1.a BloomWatch Tools:** The only tools required for this program component is a smartphone and its accompanying bloomWatch App (<http://cyanos.org/bloomwatch#Project-Overview>). IOS phones must have version 7.1 or newer, and Androids must have version 4.0 or newer. By utilization of this App, it will be much easier to engage the public's help with a common tool that they already have. The App consists of four input screens; **Page/screen 1**) an introductory/welcome screen which explains the purpose of BloomWatch from which your name or affiliation name is entered, the relevant email address where images that were taken will be sent in addition to being captured in the crowdsourced database, and the name of the waterbody where the images were taken. Input screens have been designed so that previously entered information will pop up again on initial entry, providing consistent data input formatting. Input information is then saved prior to proceeding on to the next screen/page (*Figure 1*).

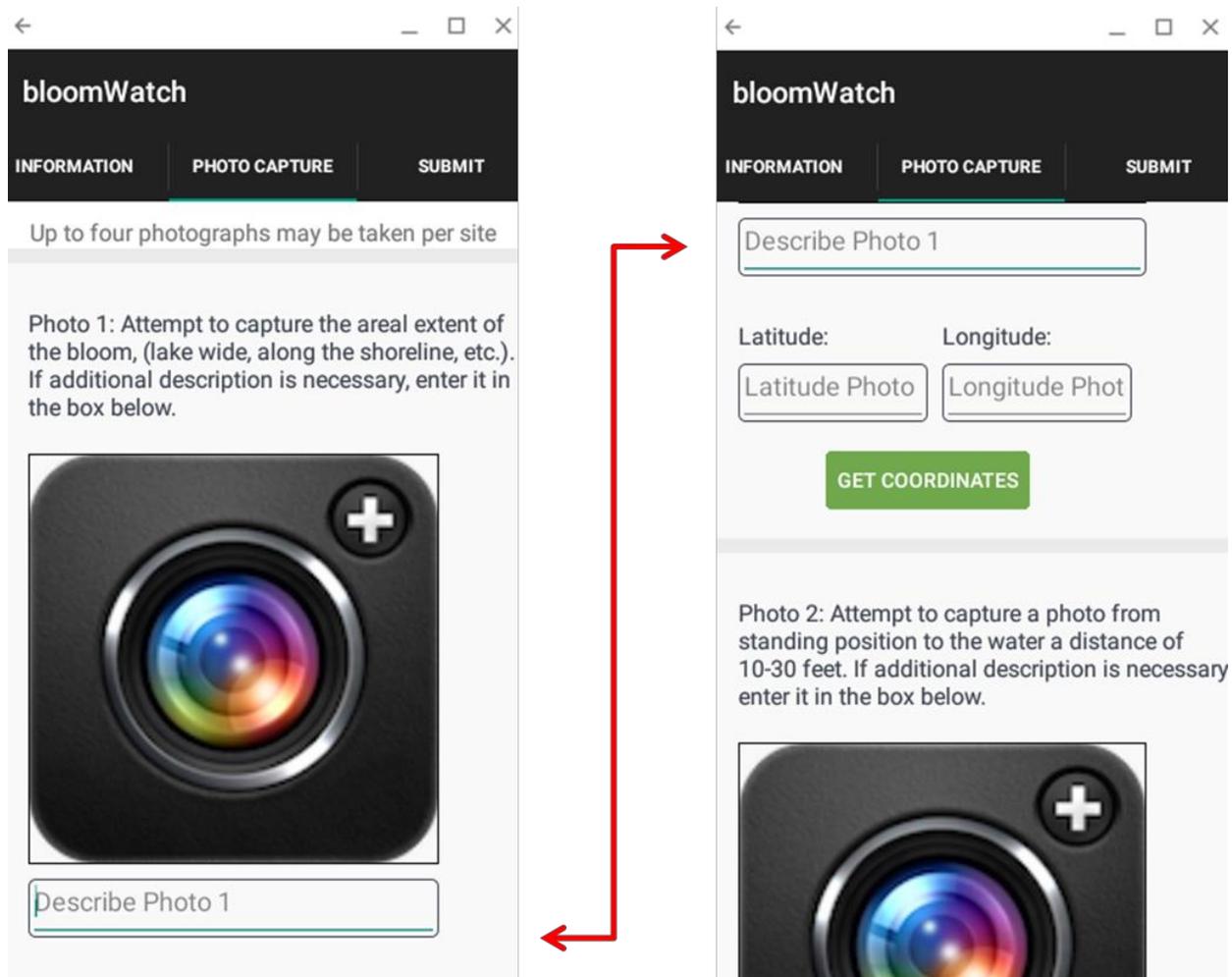


**Figure 1:** Introductory and general information page for bloomWatch. Page/screen 1 of 4.

**Page/Screen 2)** Screen 2, (Figure 2), captures general but important information on current weather and lake surface conditions that help provide a “weight of evidence” that a harmful cyanobacteria bloom has occurred. This information can be important indicators, as warm and calm overcast days are ideal conditions for bloom formation. The occurrence of breezy conditions may also be informative information as to a highly localized bloom in a certain location of the lake, positioned there by the prevailing wind. Bloom size is also important to help determine if the current bloom encompasses the entire lake, is concentrated on the surface or distributed throughout the water column, or is localized due to current lake and weather patterns. The app utilizes common items/places (i.e. tennis court) as a spatial frame of reference rather than measurable units (i.e. square meters), as it is easier and usually more accurate for people to visually quantify area in this manner.

The figure displays two screenshots of the bloomWatch mobile application interface. Both screenshots show the 'bloomWatch' title and three tabs: 'INTRODUCTION', 'INFORMATION', and 'PHOTO CAPTURE'.  
The left screenshot shows the 'INFORMATION' tab. It includes a 'Date' field with the value '10/26/2015' and a 'TODAY' button. Below this is a 'SELECT DATE' button. A question asks 'Does lake have public access for boating, fishing, or bathing?' with a 'Yes' input and a 'SELECT' button. The 'Weather conditions' field is set to 'Overcast' with a 'SELECT' button. The 'Surface conditions' field is set to 'Ripples' with a 'SELECT' button.  
The right screenshot shows the 'PHOTO CAPTURE' tab. It includes a 'Surface conditions' field set to 'Ripples' with a 'SELECT' button. Below this is a 'Bloom size or extent' field set to 'Between a tennis court' with a 'SELECT' button. The 'General Comments' field contains the text 'Not sure if cyanobacteria or duckweed'. At the bottom is a large red 'SAVE DATA' button.  
A red arrow points from the 'Ripples' field in the right screenshot to the 'Ripples' field in the left screenshot.

**Figure 2:** Lake conditions and bloom size screen. Page/screen 2 of 4.



**Figure 3:** Image capture screen. Page/screen 3 of 4

**Page/Screen 3)** The photo screen page, (Figure 3), is designed for the capture and submittal of three separate and distinct images of a perceived bloom. The photos should all be taken from the same location, which is geo-located by turning your “location on” function in your smartphone or by selecting “get coordinates” directly from the app. The images need to be captured as follows: Image 1 is a large area photo that should show the extent of the bloom and should capture part of the shoreline in the picture and a large area of the lake and some skyline. This image helps verify the areal extent of the bloom while presenting an indication of current lake and weather conditions, ongoing lake activity at that point and time, and an indication of whether the bloom is waterbody wide or isolated to a discrete area. Figure 4 depicts two good examples of first images. This first image is also used as the geo-referencing point that uses your smartphone internal GPS. Image 2 should capture an image from a standing position to the water surface at a distance of ten to thirty feet (Figure 5). This helps to document if the bloom is stacking up along the shoreline, has a surface scum or matt, is limited to a very narrow band along the shoreline or a small cluster, or appears to extend from the shoreline into the majority of the lake. The third image should be a close up photo of the bloom from three feet away or less, or



**Figure 4:** Decent first images for the bloomWatch app showing some skyline, the shoreline, and an indication on the extent of the bloom.

if possible, a picture of the bloom material in a clear glass container held out at arm's length. This image helps to verify if the bloom may be filamentous in nature, globular or in clumps, a thin film, accumulates at the surface, etc. all providing clues that help to determine the likelihood that it is a cyanobacteria bloom. The close-up or macro image may definitively determine not only the existence of a cyanobacteria bloom, but potentially what type of cyanobacteria (Figure 6).

The final screen in the BloomWatch App is the data submittal screen (Figure 7). This screen verifies that the waterbody name is correct and the date of when the images were taken. Once the images are submitted, they are sent to the crowdsourcing database CitSci.org where the BloomWatch images



**Figure 6:** Good example of third image for bloomWatch App submittal. Photo courtesy Des Moines Water Works

and accompanying data will be stored for public use. Your personal information, email address and name are protected and hidden from public view. The App is designed so that, if

desired, upon pressing the submit data button, data and images will be automatically sent to key contact people. By pressing send, the data and images will not only be sent to the CitSci.org database, but also directly and immediately to these other pre-



**Figure 5:** Good example of second image for bloomWatch App

**bloomWatch**

INFORMATION | PHOTO CAPTURE | **SUBMIT**

Lake Name: Long Pond

Date: 10/26/2015

On Android devices, select EMAIL as the choice for your submissions.

**SUBMIT DATA**

Once the waterbody information and pictures have been submitted, you can delete the waterbody from your device to save space. Simply select the waterbody you wish to delete from the list below and click the "DELETE LAKE INFO" button.

Lake Name:

**LOOKUP WATERBODY**

**DELETE WATERBODY**

**Figure 7:** BloomWatch data submittal page. Screen 4 of 4.

determined contacts. The App leads you through the data and image collection process step by step.

**Note:** A few users have had some difficulty uploading images to the App, which, when downloaded, should automatically ask you for permission to access your location data for geo-referencing the images and to access the images on your phone. If these prompts do not appear and you receive an error message, go to the "applications manager" on your phone and manually allow permission for access. This should resolve the problem.

### **5.1b A note about CitSci.org & bloomWatch**

BloomWatch is a project that is established within CitSci.org, a crowdsourcing website that is designed to promote collaborative efforts between citizens and scientists to address local, regional, and global issues. The CitSci website was developed through Colorado State University's Natural Resources Ecology Lab, with initial funding from the National Science Foundation. The bloomWatch App gathers data collected by members of the Cyanobacteria Monitoring Collaborative, which is then automatically brought in to the bloomWatch project page at CitSci.org, where data can be analyzed, visualized, and shared among others with the same interests. This approach enhances environmental education at several levels, while advancing scientific understanding on critical environmental issues.

The bloomWatch App has the added flexibility of being able to be applied to discrete projects while simultaneously allowing submitted data to be aggregated up to the default comprehensive scale of the App. For any entity wishing to use bloomWatch as a part of their own project, all submissions will still go through the bloomWatch project page on CitSci.org. However, data on this page, which includes images, location, and water body name, can be constrained by a user or specifically selected for their own use. Submissions are still visible to the public and will be sent to any key state contacts, but "nested" project data can be parsed out. To simplify this process groups have a few options. The first is to have a code word that the group can insert into the "General Comments" section on the Information tab. The second option is to have each contributor for a certain project use the project name as part of their alias. For example, a project relating to alpine blooms could type AlpineBloom as one word in the general comments section, or have their members log-in as Alpine1, Alpine2, etc. This will allow the group to select out their individual project data from the larger dataset.