

# Phytoplankton Monitoring Network: Using Mobile Technologies for Research & Education

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The Phytoplankton Monitoring Network (PMN) is committed to researching Harmful Alga Blooms (HABs) and educating others about them. One way the group has done this is through a mobile application called *Phyto*. This summer the second version of the app will be released with many more features for both PMN volunteers and anyone else interested in learning more about phytoplankton and their identification. This article includes background information about the PMN, a summary of key features and benefits of the mobile app, and an app development process outline for individuals or organizations interested in utilizing this technology.

## The Phytoplankton Monitoring Network

The Phytoplankton Monitoring Network (PMN) is a collaborative “citizen science” program. It allows volunteers across the country to work with NOAA scientists in the study and identification of potentially harmful phytoplankton. The network area includes coastal Atlantic, Gulf, and Pacific waters as well as freshwater environments in the Great Lakes regions. Volunteers participate in hands-on research by collecting water samples, identifying species of interest, and entering data on a weekly or bi-weekly basis. The data are then confirmed and further analyzed by NOAA scientists and have been used to alert state managers to potential toxic bloom events (Trainer et al. 2014). For example, data generated by volunteers have been used to determine the extent of the toxic diatom *Pseudo-nitzschia* in the southeast United State (Shuler et al. 2012), which was linked to Pygmy Sperm Whale mortality events (Fire et al. 2011). All data collected by PMN volunteers are publically available

and can be viewed using an on-line map tool located at <http://www.ncddc.noaa.gov/website/PMN/viewer.htm>.

The PMN currently has over 150 sampling sites covering marine, estuarine, and freshwater environments. Volunteers monitoring these sites represent public and private schools, colleges, and universities, Native American tribes, state and national parks, aquariums, 4-H centers, civic groups, and other non-governmental organizations.

The specific goals of the PMN program include:

- to create a comprehensive list of marine and freshwater phytoplankton and potentially harmful algal species;
- to monitor and maintain an extended survey area year-round;
- to isolate areas prone to harmful algal blooms (HABs) for further study by researchers;
- to identify general trends, such as time and area, where HABs are more likely to occur;
- to increase public awareness of phytoplankton and HABs through education and outreach;
- to increase public awareness of research conducted by federal, state, and private researchers;
- to support communication and interaction between researchers and the public via volunteers.

Volunteers are instructed on algae identification and sample on a weekly or biweekly basis, reporting their data to researchers at the Marine Biotoxins Program. Students and volunteers receive specific training in sampling methods, plankton taxonomy and ecology, microscopy, and phytoplankton

identification of 26 different species. Each volunteer group is supplied with a plankton net, thermometer, salt refractometer, and other project support supplies. After microscopic analysis, volunteers submit basic data about the sampling site (e.g., water temp and salinity) and if any of a predefined list of phytoplankton are present in the sample or if there is an elevated number of that species. The list of species is unique to each area based on historical information, species dispersion, and research interest. However, if a species is observed in high abundance that is not on this list, the volunteers are trained to preserve and send the sample to the Marine Biotoxins Program for positive identification.

## The Phyto Mobile Application

The PMN was able to grow into a national monitoring program by use of various web-based tools such as an interactive website and a geographic information system (GIS) tool for data visualization. Volunteer training sessions and workshops are given by NOAA scientists using internet teleconference capabilities. A smart phone application, *Phyto*, was developed to assist in helping volunteers learn to identify phytoplankton and as a reference guide to use when analyzing a sample. *Phyto* was initially developed on the iOS platform, then subsequently developed for the Android platform, and is available for free. The iOS version of the app has been downloaded approximately 6,700 times and the Android version about 3,200 times. Both applications (app) have been downloaded globally. Figure 1 shows the breakdown of the number of downloads from each app per country. The Android app has a wider distribution outside of the United States.

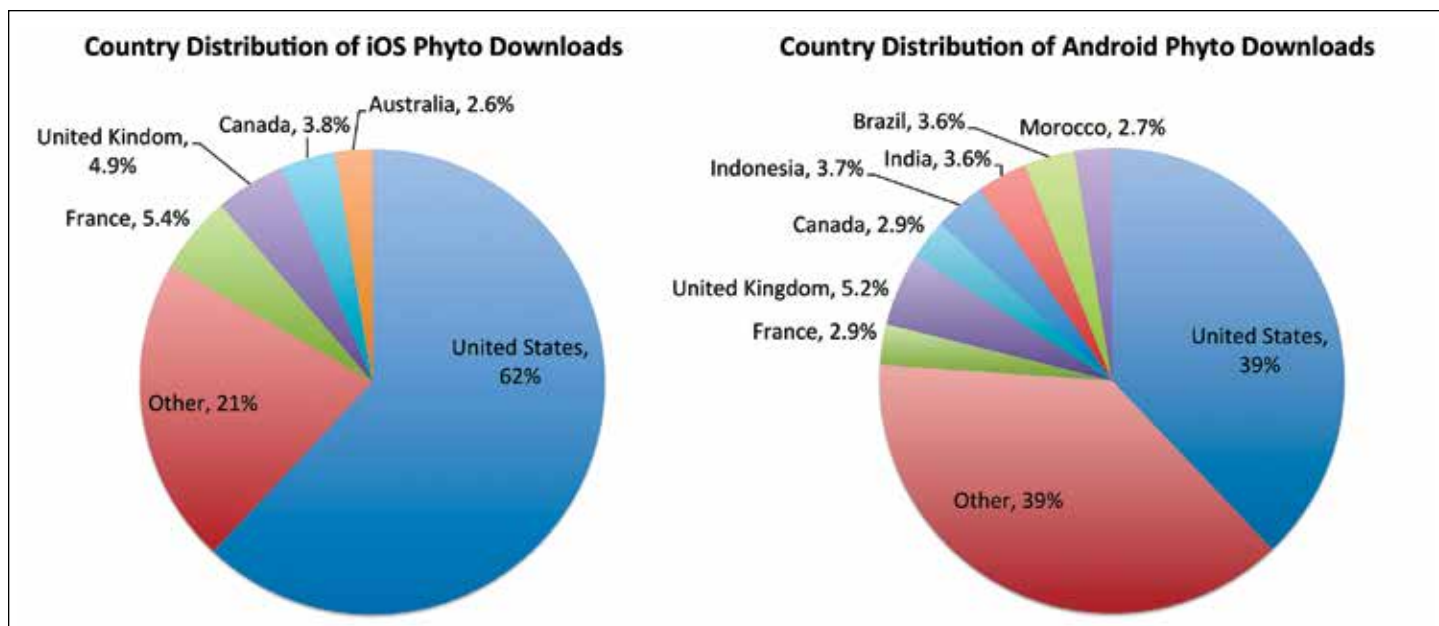


Figure 1: Phyto app download global distribution.

The second version of *Phyto* will be released in Summer 2015 for both iOS and Android and with many new features. The app has updated the index of common species to 46, up from the original 28 species, including those typically associated with coastal HABs as well as freshwater species. The index includes a detailed listing of each species with multiple photos and a pronunciation sound clip; see Figure 2 for two screenshots of the index. To help make learning to identify the species more fun, the app includes a flashcard game; the updated iOS version also includes a second variation of the flashcard game that allows you to compete with friends and other players from around the world. The app also includes a guide, as shown in the left side of Figure 3. The guide was designed to help aid in identification of difference species by shape and other visually observable characteristics. The new samples feature will mainly benefit PMN volunteers, allowing them to directly load sample data and submit it through the app to the NOAA experts for further analysis. The last new major feature is a news tab that displays current topics of interest to the community.

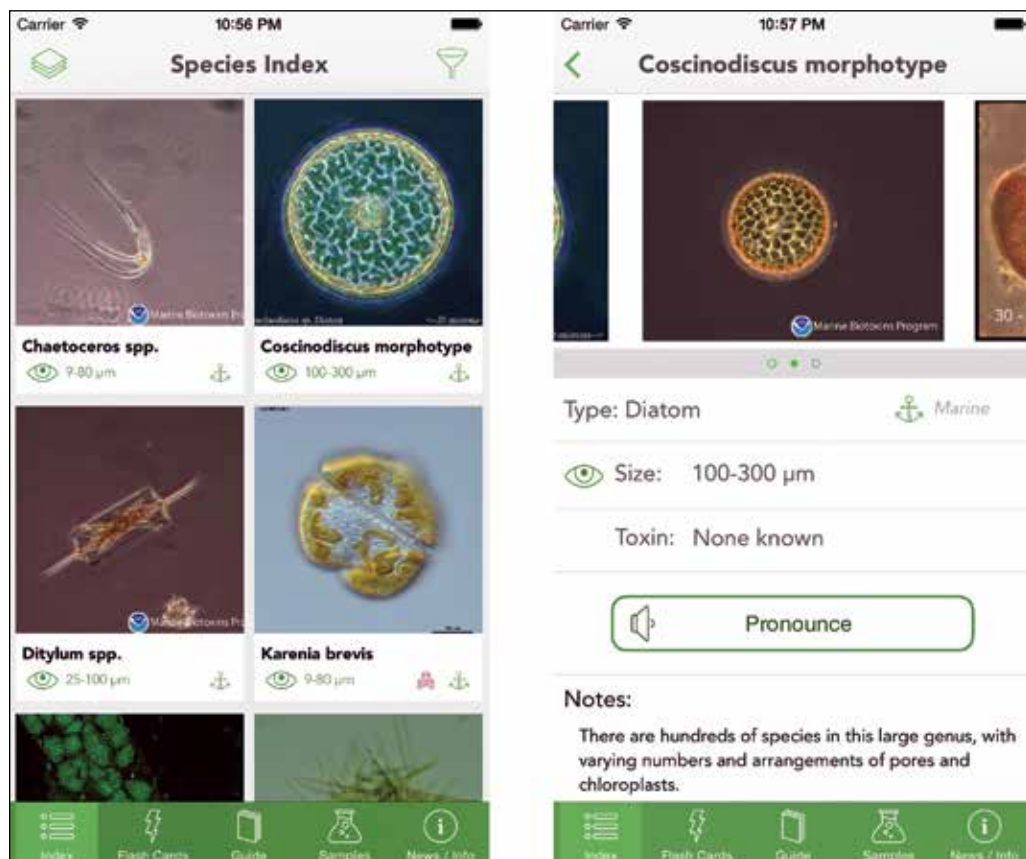


Figure 2. Screenshots of the species index (iOS version of the app).

### An Overview of the Mobile App Development Process

Creating your own app can be a great tool in educating others about your area of study or your organization. Deploying a good app requires a defined plan as

well as a team that has the right mix of graphical design and technical skills. While there are many details that go into creating and designing an app here are a few things we learned and thought might be useful if you are considering creating your own!

## Planning Phase

1. *Focus on one thing and doing it well.* Figure out what the most important thing you want your app to do or accomplish and don't try to add a lot of features initially. You can always update the app in the future with more features. If you keep adding a lot of ideas during development, called scope creep, you run the potential of never finishing the app or creating an app that is hard to use.
2. *iOS or Android or both?* Determining which mobile platform you are targeting up front can be very useful as you build up your team. This is mainly due to the large differences in development skills needed for each operating system. If you have experience programming in multiple languages and/or have a large budget, you could set out to build an app for multiple platforms from the start. Otherwise it might be wise to start with the one you know the best and, if successful, then expand to others.
3. *Building the team.* At least two skills are needed when developing an app besides creating the idea and the content of the app: graphics and programming. Determine how much of the app development you (or your organization) can do internally and how much of the effort will need to be outsourced.
4. *Cost.* Estimating the cost is not straightforward and depends how much you plan to do yourself. If you can do most of the work yourself the main cost will be time. If you are contracting the work they should give you a reasonable estimate. App development costs vary greatly depending on the complexity. If you plan to hire someone to create the graphics and do the programming, even a simple app will cost around \$10,000 for a single platform. If you have a database, server side data, or social media hooks the cost can rise quickly.

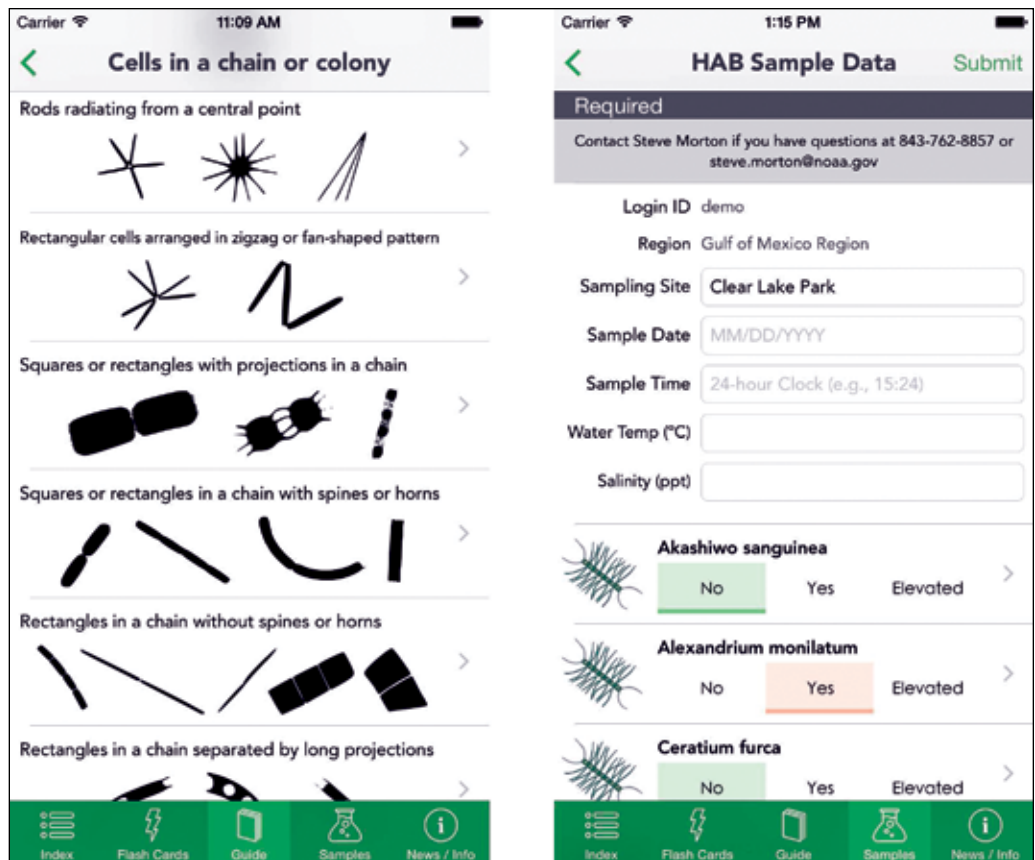


Figure 3. Screenshots of the species guide and sample submission form.

5. *Future updates.* If you are outsourcing the development of your app, thinking about future updates is particularly important. Mobile operating systems and devices change a lot each year; so keeping your app compatible with the latest software versions and screen sizes will take some effort.

### Specifics for iOS Development

1. You have to have a Macintosh computing platform
2. Apple registration and yearly fee are required
2. Apple's App Store Review Guidelines are specific and they are strict
3. Developer Tools: Xcode (free)
4. Language – now there are two: Objective-C and the new Swift language
5. Testing – the Apple-provided simulator is good but you will want to test on as many different devices as possible. If you are planning on a universal app – test on both iPhones and iPads.

### Specifics for Android Development

1. Any computer will do
2. Registration and app submission is free
3. Developer tools (free)
4. Language – Java
5. Testing – use the Android simulator and devices. Extra testing will be needed because of the larger number of potential device screen dimensions as well as android operating system versions.

### Outline of the App Development Process

1. Sketch out basic functionality and overall design
2. Code Development – Making the App Work
3. Overall Design and Graphics Development
4. Testing
5. Releasing the App

### References

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**Selective References**

Phytoplankton Monitoring Website: <http://products.coastalscience.noaa.gov/pmn/>  
 Phyto version 1: <http://www.gano.name/shawn/phyto/>

General information of Harmful Algal Blooms: <http://oceanservice.noaa.gov/hazards/hab/>

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**Shawn Gano** is an aerospace engineer by day and an app developer by night. He is also a Phytoplankton Monitoring network volunteer from the Texas gulf coast region. He created the first version of the *Phyto* app because he was struggling to learn how to pronounce all the different species names!



**Next Issue –  
 Fall 2015 *LakeLine***

In the fall issue of *LakeLine*, we will focus on “Climate Change” – how it affects lake processes and cyanobacteria; considerations for managing watersheds and wetlands in a changing climate; and how to better communicate climate change.



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