Citizen Science Toolkit Conference

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vital signs
open source data input tools

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Note that this document did not originate as a formal paper. Rather, it combines an oral presentation with accompanying PowerPoint slides and reflects the more informal, idiosyncratic nature of a delivery prepared specifically for this live event.

Documentation of the conference is meant to serve as a resource for those who attended and for others in the field. It does not necessarily reflect the views of the Cornell Lab of Ornithology or individual symposium participants.

The following is one of three focus point presentations delivered as part of the session titled "Technology and Cyberinfrastructure" on day two of the Citizen Science Toolkit Conference

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For complete documentation of conference proceedings and to learn more about citizen science and the Citizen Science Toolkit, or to join the ongoing citizen science community, go to:

http://www.citizenscience.org

Cover art by C. Michael Lewis

Vital Signs
Open Source Data Input Tools

Sarah Kirn,
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About the Gulf of Maine Research Institute

I am from the Gulf of Maine Research Institute and I'm here to tell you about VitalSigns, our cyberstructure-enabled citizen science program. I wasn't going to talk about GMRI's greater mission, but then I had a conversation with someone from the conference who asked about the Institute and I realized that a lot of what we do could be called citizen science. So I'm going to tell you a bit about it.

Gulf of Maine Research Institute
Science. Education. Community.

www.gma.org

Science. Education. Community.

Our mission is to:

- Provide a neutral inclusive forum to discuss marine issues;
- Increase scientific literacy through place-based, user-driven, inspiring, authentic, aquatic science programs; and
- Execute an ecosystem-based research program to inform management process and decisions.

We have a three-part mission: Science, Education and Community, focussed on the Gulf of Maine marine ecosystem. What we mean by "community" is that we provide a neutral, inclusive forum to which we invite people with different perspectives on marine natural resource issues in the Gulf of Maine. We get them to share their information. We don't advocate for any one of them, but we believe that getting more information to the decision-makers will lead to better decisions.

We increase scientific literacy through place-based, user-driven, inspiring, authentic, aquatic science programs, and those words are all very deliberate.

And third, we execute this ecosystem-based research program. What is special about that ecosystem-based research program is that we very rarely use research vessels for our research programs. Instead we use fishing vessels. This serves two purposes. One, fishing days

have been greatly reduced in an effort to rebuild the fisheries, and that leaves the fishermen, obviously, under great hardship to make a living. We are interested in sustaining all of the communities around the Gulf of Maine, both the wild ones and the human ones. Working with the fishermen and paying them for their time at sea helps them through this tight spot while we're waiting for the fish to rebound.

More importantly, those fishermen have an enormous wealth of knowledge from years and generations of summers and winters spent fishing those species in the Gulf of Maine. I went out with one fisherman and I had done some sailing myself so I said, "So Vincent, where are your charts?"

He looked at me and said, "Charts? I don't have charts," and he pulled out this little black notebook. It had all of the notes that his grandfather had made about the bottom and where the best fishing ground is. His father had the book and had made annotations, and now he had the book and he made annotations. And he was navigating by the bottom, which to me is amazing. We think that in citizen science we are using citizens who don't necessarily know much about science to help us answer these great questions. Often the citizens bring a lot more than volunteer hours to the table, and I just wanted to mention that.

Collaborative Fisheries Research

" We think that in citizen science we are using citizens who don't necessarily know much about science to help us answer these great questions. Often the citizens bring a lot more than volunteer hours to the table… "

Talk Outline

- What we've done
- What we've learned
- Where we're going next

Vital Signs

Overview

What I am really here to talk about is Vital Signs. At Vital Signs we are now kind of between things, but we have had almost ten years of experience using technology for citizen inquiry and citizen science and have thought a lot about how this works. Right now we are moving from proprietary solutions to open source solutions, from very linear replicability to unlimited or nearly unlimited replicability, and that is what I am really going to focus on in this talk. The basic outline I will follow is what we've done, what we've learned, where we're going, and why.

What We've Done

We started out on an Apple Newton, which is interesting because the CyberTracker program started on them as well. But this is the first project that we really rolled out. It was developed for the Palm

operating system. That's a Palm IIIc I think, which is color. We developed software that let students use these devices to collect an image, the temperature (with a temperature probe), GPS position, and written observations.

Art by C. Michael Lewis

- Custom conduits through Palm Desktop (PC-only)
- ESRI ArcSDE database
- ESRI ArcIMS online mapping
- 6 schools, 2 natural science education centers.

This started with the idea that, well, kids like computers, maybe they'd like to use computers to collect observations. That was really the genesis of the idea. There was no question. There was the notion, wouldn't it be interesting if we developed these tools and gave them to students, scientists and fishermen? Would they collect different information because of their different perspectives? That might be interesting.

We gave it to six schools (four middle schools and two high schools) and two natural science centers to test informal versus formal education venues. We just gave them to the teachers and said, "Call us if you have any technology problems and we'll drive up and help you, and you tell us how this works educationally."

We also developed custom conduits, which is computer software that pulls the information off the handheld onto the desktop. We were limited to PCs. We developed our database and online mapping system based on ESRI software. We found a great ESRI developer who could develop a much more user-friendly, customized interface for us.

Then we had a group of visitors from Ireland on an economic development trade mission, who saw this and said, "Hey, this would be perfect for what we need to do in economic redevelopment and revitalization of part of the western border between Northern Ireland and Ireland, where the troubles and military response have divided previously intact communities. What if we gave handheld computers to kids on either side of the border, and got them looking at the water that makes up that border using the same equipment and sharing their data online? Wouldn't that be a great science education and peace and reconciliation, community-building project?"

So they hired us, licensed the software, and we worked with them to develop a new version of the software because of course, all the hardware had changed since we started it in Maine. Now the camera

was integrated into the handheld, and the handheld had Bluetooth capability so it could have wireless connection to GPS. We actually took the probes and disconnected them from the handhelds so that we could upgrade our probes.

- Replicated the whole system in Republic of Ireland and Northern Ireland
- Riparian Habitat Monitoring
  - Camera integrated into Palm device
  - Probes independent
  - Online Administration
- We host Web site

vitalsignsireland.org

I came onto the Maine project after it had already been started, and was looking over the equipment and noticed that the handouts that came with the little probes that we were using had a box at the top that said, "Warning: for educational purposes only. Not to be used for research or commercial purposes."

What a way to shoot the whole thing in the foot! We're trying to make this something real and then we tell the kids, "Well this is just for you and it's really not going to mean anything." So we got rid of that and are using real probes that scientists use.

We are hosting the Ireland project Web site, primarily because our partners in Ireland didn't have the funds to purchase the ESRI software and didn't have the intellectual property rights and expertise of our software developers, who had customized the mapping interface. We couldn't give those intellectual property rights because we didn't own it. So we're hosting the Web site, but otherwise they are independent. You can go to vitalsignsireland.org and see the students' data. I highly suggest looking at the pictures and reading the notes.

So the Ireland project was up and running and it was time to bring the new technology back to Maine. But of course, of the two years all of the technology had changed yet again.

What We've Learned

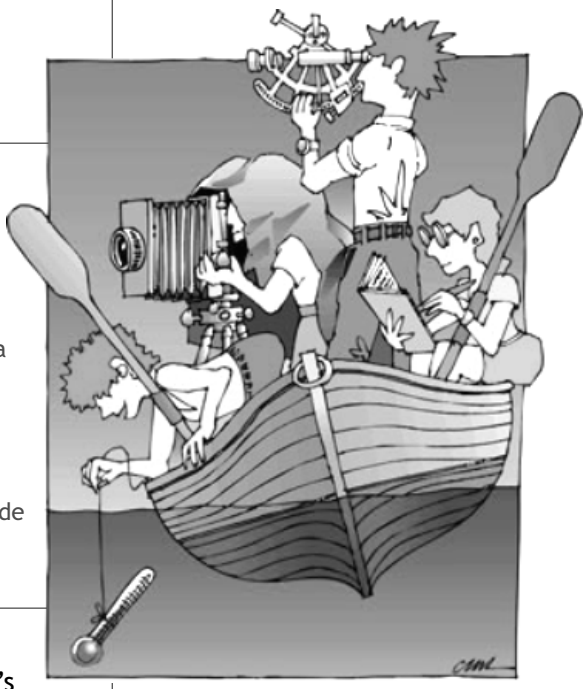
Before I talk about where we're going, what did we learn from all of this? We learned that students really do like that fancy technology. They love those handheld computers. That was true in Maine, and it was true in Ireland. Interestingly, the teachers had a little bit harder

time with the technology, and more than once I would drive multiple hours only to find the problem was that the batteries were dead in the GPS receiver, or somebody had taken the batteries out of the cameras because they weren't using them and then forgot and didn't check. So the teachers had a harder time than the students. The smart teachers got students to be their technology helpers in the classroom, which is really interesting, and very insightful and good, and I could go on and on about that.

The other thing that we discovered is that scientists really like this idea of collecting data in the field with a computer because it gets rid of transcription errors and saves time, and you can also have that at-the-moment-of-data-collection feedback to prevent errors while you are still in the field and can correct them. In the eBird presentation earlier, we saw that data entry error response when you enter 175 kingfishers instead of 1. You can catch things like that in the field before it's in your database, before you have to cull through and try to find things like that and remove them.

What We've Learned

- Students really do like whiz-bang technology
- Scientists really like technology-enhanced data collection
- Desire for data to "mean something"
- Note everyone uses latitude and longitude…



Art by C. Michael Lewis

There is one thing that we have heard over and over again: Teachers really wanted the data that the students collect to mean something outside their classrooms. That is more true maybe in Maine than in Ireland, but I wasn't involved as much with that implementation. But teachers kept asking, "Who is using the data? I want to be able to tell the students that Dr. So-and-so is answering such-and-such question with this information."

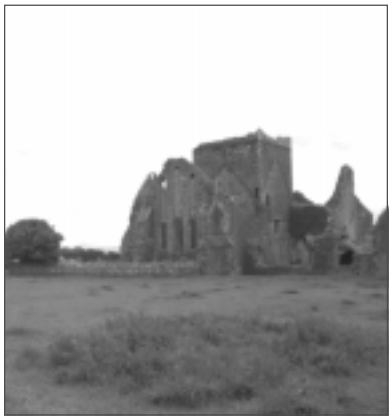
I had to say, "Well, at the end what we have is temperature, picture, location, and observations, and no scientist can really use that," which was hard for me and hard for them.

Another thing that we learned is that not everybody uses longitude and latitude. I've noted that here because it is amazing, the assumptions that we make. I was in Ireland setting up this project and I was going through the software with fisheries people and said, "So here is where your latitude and longitude are recorded," and they said, "We don't use latitude and longitude."

I said, "Excuse me?" They explained that they had an Irish National Grid System. I asked whether there was an Irish grid system and a Republic of Ireland grid system and luckily the answer was no.

What We've Learned

- Proprietary solutions are limited
- Proprietary software is expensive
- Mobile computing industry currently in flux
- Universal access is achievable and important goal



The point is, and it is a point we heard in earlier presentations, you've got to tailor your data collection to the question that you're asking and to the people that you're working with, and it reinforces how important it is to involve those people from the start.

The other thing that we've learned is that closed, proprietary solutions are limited and expensive. We've just heard this during Steve Kelling's presentation also. In the Ireland project, they can't have their whole project over there on a server because they don't know how to handle the software that was developed and they don't want to buy the ESRI software license that would let them do that.

The other thing we discovered when we came back home from Ireland is that the mobile computing industry is currently upside-down and sideways. PDAs as we knew them two years ago are no longer and neither are cell phones. They are kind of merging, but which one is going to win out? And every one has its own operating system. Because we can't forecast who is going to come out on top, it's really hard to predict the winner and develop for the operating system that is going to be around the longest. They're all sort of going their own way, and who knows what's going to come?

The other thing that we discovered as an organization was this idea of providing universal access to our programs. We discovered that it was actually achievable and really important and hugely inspiring and galvanizing. There is another project at the Gulf of Maine Institute in which we bring every fifth- or sixth-grade student in the state to our lab for a half-day marine science experience. We have two busses that really do look like the one below that drive to schools, pick up students, and deliver them to our site for those experiences. We've devised a risky and somewhat bold funding strategy to make that possible at no cost to the schools. It is just amazing what providing universal access has done for that project.

Where We Are Going

So that is what we have learned, and now we are thinking: Okay, what is the next step, how do we do it, and how do we do it really smart? How can we do this to the best of our abilities? What is the best investment of our hard-won, fund-raised dollars? What would be the best experience for students and scientists? What we decided is that

while technology is in flux, something like the Internet is probably going to be around in ten years. We're still all going to be connected and sharing information and talking to each other. Something like that is probably going to be around in twenty years. The functionality of the Internet is something that is going to be around. The technology of it is likely to be entirely new.

We are also collaborating with the Maine Learning Technology Initiative. We had a very bold governor named Angus King who took surplus money in the budget one year and said, "I'm going to make a statement, I'm going to put Maine on the map, and I'm going to set Mainers up for twenty-first century careers, and that means we've got to prepare them better in schools. I'm giving all seventh and eighth graders and their teachers a laptop." And he did it. Now the program is being extended to high school teachers. That has just been announced in the last couple of weeks. Right now we have 32,000 students with laptop computers across the state, and their 6,000 teachers as well.

We've decided that open source is the way to develop so that we can be ready for replications outside of Maine. We realize that if we solve some of these problems for Maine, we solve them for people elsewhere, and we want to make our solutions available.

We're also thinking about these standards-compliant data formats. The developer that we are working with is the Gulf of Maine Ocean Observing Systems, and they do two things. One is develop open source software, but they also serve the data that is collected by eleven oceanographic buoys that are collecting data and reporting it in real-time or near real-time to a Web site.

They have done a lot with the Open Geospatial Consortium, which is working on a set of standards that don't prescribe how your database is constructed, but do describe formatting that enables data to be seamlessly shared. So if I'm juggling apples over here and you're juggling oranges over there, I can throw an apple through my ceiling and it changes format into a tennis ball and the tennis ball is a universally transferable type of fruit, and when it falls through your roof, it turns into an orange because that's the format you work with. That is my analogy, anyway. In any case, our data is going to be housed in a way that you can easily pull it into your database and use it for your own purposes.

Where We Are Going

- Web-based, platform-independent
- Collaboration with Maine Learning Technology Initiative (32,000 7th and 8th graders)
- Open source (replication ready)
- Standards compliant (data sharing-ready)

New Content, New Technology

Vital Signs links students and scientists in the rigorous collection and analysis of essential environmental data.

Deployed on the Maine Learning Technology Initiative's laptop computers, **Vital Signs** will be universally accessible to all 32,000 7th and 8th graders in the state.

- **Georeferenced data**
- **Students collect field data**
- **Share, analyze, display data**

Where We Are Going

- Collect data scientists will use (Advisory Group)
- Set up for success
- Levels of participation—flexibility for teachers
- Built-in evaluation tools, points of collection feedback, etc.

We're also collecting data that scientists can use. With that picture, the location data, and simple observations of the environment, we can perform a great service to scientists and communities by monitoring for invasive species. To set everyone up for success, we're choosing species that scientists have told us they would trust students to be able to identify, and developing protocols that work for teachers and scientists. We designed the protocols together with scientists and teachers. We are incorporating different levels at which teachers can participate so that it is flexible for multiple classrooms, and we are building in evaluation tools and point-of-collection data feedback.

I would like to end with a somewhat abbreviated picture of the Gulf of Maine watershed. Watersheds don't physically honor geopolitical divisions, so it's nice to look at this in a way that is not chopped up into states or Canada-U.S. divisions.