# just because you paid them doesn't mean their data are better

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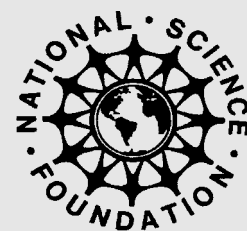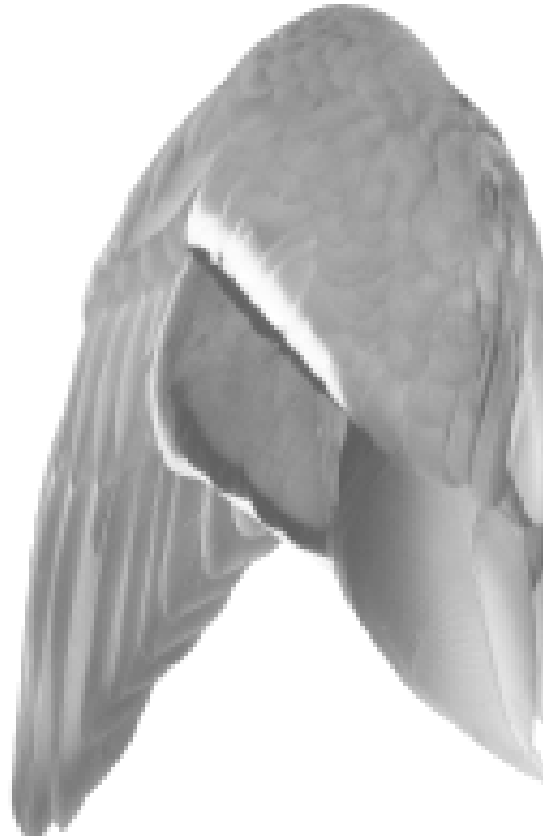
This presentation took place at the Citizen Science Toolkit Conference at the Cornell Lab of Ornithology in Ithaca, New York on June 20-23, 2007.

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 presentation by Sam Droege was delivered as the opening talk for the Citizen Science Toolkit Conference as a whole and at the first conference session, "Citizen Science Challenges and Opportunities."

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**

# Just Because You Paid Them Doesn't Mean Their Data Are Any Better

Sam Droege,
Biologist,
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## Attitudes about the Validity of Citizen Science

When I talk to my ecology colleagues (you know, the *real* scientists) about citizen science and some of the things that we're doing to collect information about population change—which is what we primarily do at Patuxent, and we really have to use volunteers to do that, it's not a choice, we just can't afford to do it otherwise—there is this sense that you get. The sense is, "Well, that's nice, it's good you're working with the public. I'm glad somebody is doing that, but it's not real science. That information you're collecting isn't some-thing that you could really use."

This attitude has shifted, as there are now a lot of publications that use citizen science data as the primary core information, and we'll see some examples of that, but there is still this sense out there that if you're working with volunteers and you're collecting citizen science data, you're not really right up there on the pedestal. I'm here today to tell you that you are, and that your information is often better than the kinds of information coming from other groups that are paying people.

## The Value of Citizen Scientists

### An Example of a Citizen Science Volunteer

I'm going to start with an example. Dave Holmes is a birder from the metropolitan Washington, D.C. area, and he has been very active over the years in lots of different kinds of projects. I knew him as a kid when I was growing up. Here is what he has done. This is an example of how citizen science really can make a big impact, much bigger than almost any other kind of program.

David Holmes has worked with the Breeding Bird Survey (BBS). Basically, this is a survey during the breeding season in which you count birds to collect information about population data, and you repeat this over and over as a set route that you travel.

In thinking about how to kick this conference off, we tried to think of a person who could get up and really give us an overview of citizen science and talk about the challenges, the opportunities, and the history. One person kept coming up over and over again and that was Sam Droege, who has been involved in this for a really long time.

Sam is at the Patuxent Wildlife Research Center, which is part of the USGS. He worked on the Breeding Bird Survey for many years, started the North American Amphibian Monitoring Program, started FrogWatch USA, and is now studying native bees. Sam is going to take us away into the land of what we can accomplish with this great movement. - Rick Bonney, Director of Program Development and Evaluation, Cornell Lab of Ornithology

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**David Holmes**

- Has run 10 BBS routes every year for 35 years
- He gets up WAY before dawn each time
- He uses his own car and pays for his own gas
- Each survey is 50 stops and takes about 4.5 hours to run

- He fills out all the forms
- Enters the data online
- His data have NO parallel among any PAID technician or researcher
- Congratulations — Taxpayers just saved $70,000

David Holmes runs ten BBS routes every year. What does he do on these surveys? He has to get up way before dawn, so already we're talking something like two or three in the morning. He uses his own car, he pays for his own gas, and he gets no reimbursement from the government for any of his expenses. There are fifty stops on these surveys and each stop is three minutes long, and at the end of that four-and-a-half to five hours of doing these surveys, you are really exhausted. You are on that whole time and have to detect and count everything that comes by. You have counted hundreds if not thousands of birds as well as bird flocks and what is going on in those flocks, and you are using all of your skills while you are doing this.

> This is the kind of thing that volunteers can do that you really can't find in circumstances in which people are paid. The value of that, setting the uniqueness of the data set aside and counting just the number of hours, we calculate to be $70,000.

And then we have lots of forms that have to be filled out. He fills out all of the forms, he enters the data online, and what do we have? He has been doing this for thirty-five years. You have a data set of ten routes times thirty-five years with the same observer, a consistent, absolutely perfect data set that cannot be replicated by anyone, including researchers that were paid. This is the kind of thing that volunteers can do that you really can't find in circumstances in which people are paid. The value of that, setting the uniqueness of the data set aside and counting just the number of hours, we calculate to be $70,000. So he has made a contribution to taxpayers of $70,000. That's an example of the kinds of things that can happen with citizen science and of the kinds of contributions that are being made, which are worth a lot of money.

## Volunteer Data Quality

I'm not going to go into a lot of detail about these things, it is mostly about ideas, but we have a lot of studies now that have shown in a range of circumstances—counting frogs, counting birds—that in terms of data quality, volunteers can do just as good a job as professionals. There are nuances to that, and I think we will be hearing a number of examples of how it works and how it doesn't over the course of this conference. However, in a lot of cases there is really no difference in data quality between volunteers and technicians.

When you are doing a citizen science program, one of the things to do is apply the same sort of standards to your volunteers in terms of the kind of quality and types of information you want that you would to a paid technician. At that point, if you're applying the same standards of what you accept and what you don't accept, then the only difference that you have is, hey, you are paying people for the same quality of data that you

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**Volunteer
Data Quality**

- Many studies showing comparability to professionals
- Apply same standards to paid and volunteer
- Data you throw away do not negate the data that remain

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**Volunteers
Can Be Better than
Technicians**

- They stay around for years
- Mature
- Careful
- Dedicated

can get for free, so which way are you going to go?

FrogWatch is an interesting example. It involves people counting frogs. There, we very much liberalized who could participate. We said that anyone can participate: You can take these tests and validate the information you're producing, or you can just go out. The objective there was twofold. In addition to collecting good information for us on a subset of those areas, we wanted families to get out there and actually experience nature at night, to move away from the television and realize that they themselves can actually engage in nature. If the data aren't up to our standard that's fine, we get rid of it. The fact that some of those data need to be expunged because they don't meet our quality standards does not negate the fact that the remaining data are of high quality and usable. You get this sort of notion sometimes that—"Well, I can show you where your data are bad." If you get rid of that bad data, the remaining data aren't besmirched by the fact that you had to get rid of some of the data.

In a lot of ways, as I said before, volunteers are better than technicians. First of all they stay around for years, whereas with data collection for a lot of operations, the paid technicians are often college students who are there for a few years and have to move on. Particularly when you are involved in monitoring information, which is what I am interested in, there is a big impact of changes in observers. Depending on what they're counting, observers often bring in their particular skills and biases in how they estimate things. It's nice in something like the Breeding Bird Survey if you have a consistent person who can model the impact of changes in observers. If you have high turnover in paid technicians then you don't have that consistency.

A lot of times, paid observers tend to be college students while volunteers tend to be older. There is a maturity issue involved. Volunteers often take their job collecting data more seriously, and they bring a lot to the collection of information that you often don't see with students. Volunteers came there because they wanted to, not because it was a job or would look good on a resume.

## Volunteer Recruitment, Training, and Retention

If the information that is being collected for your program is of high interest to the volunteers, that is attractive. If there are low training requirements so they don't have to spend a lot of time just to get up to speed to be able to participate in the program, that is attractive. And it is attractive if they feel there is a mission, if there is passion behind the reasons that they are doing this, and you are showing that passion. When you started a program you had some reason for doing so, and you need to transmit that to your volunteers and not rely on some dry formula posted on a couple of Web sites or that kind of thing. They like to feel that you think it's important and you're passionate about your role in it.

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**What Works**

- Data collection is interesting and of high importance to the volunteer
- Training requirements are low or interest has to be very high
- There is mission, story, and passion behind the project

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**Important Factors in Retention**

- They get to see critters
- Conditions are not physically daunting

## FEEDBACK = RETENTION
### This is your number 1 job

- Volunteers want to see that you are using the data — OR WHY BOTHER

- E-mail listserve for making announcements and reminding to collect or send in data

- Make several announcements throughout the year

- Send out scientific papers — even if they don't read them

- Summarize results — even if it's just a partial tally

- Summarize their results...the best

It's also important that in critter-based projects, they get to see the critters. This translates to other types of projects also. It's important that they get to see things. It's not like: "Okay, you're going to sit here, and at some point the coyote's going to come by and sniff the station and then you take the picture." It helps if there's a lot of action, if there are a lot of things going on, if they're counting things, if they see wildlife. Again, because a lot of times they don't have much direct experience themselves, they may not have the patience. That's an important aspect to a successful program. And because a lot of people aren't the "climbing-the-highest-peaks" kind of folks, physical conditions become important so that they don't feel they're getting eaten alive by mosquitos or that they're going to be bitten by snakes. Physical conditions need to be attended to in terms of designing and developing successful programs.

In terms of your job in setting up a volunteer program, we tend to come from backgrounds and training in academia. We really feel like our job is analyzing results and using our special expertise. In reality, our number one job is feedback and training and interaction with the volunteers. If we are too remote or inaccessible and are not giving the strokes to our volunteers, and again, these are unpaid volunteers, they are going to leave. If they're leaving, that means no more data for you to collect and do the thing that you're interested in, which is analyzing the results.

You can use e-mail listserves or a lot of announcements saying "Hi" and communicating the notion that you are there. It doesn't have to be a whole lot, but you need to let them know that you haven't forgotten about them, and that you are communicating to them in particular. The more you can bring it down to, "I am talking to *you*, not to the global 'you' of all volunteers," the better. Again, a lot of times they came in because of some personal contact with someone, so they like to feel this connection with you.

> In reality, our number one job is feedback and training and interaction with the volunteers.

When papers come out you may say to yourself, "Well, our volunteers don't want to see these because these deal with all kinds of high-level information."

Send it to them. You can do it via PDF files. They don't have to read it, but they can say, "Look, it's being used. Great! I'm not going to read it, but I can see where I'm important because it's generating these kinds of things." That leaves an impression.

Summarize the results. Here is another thing: sometimes we are overwhelmed by the amount of volunteer data. Even if it is cursory (e.g.,

1,500 reports came in and here's a list of the species) and you know from your perspective that's a very shallow summarization of that information, it doesn't matter. They want to see that you have used the data at some level, even if you don't feel it's a good analysis. Some kind of feedback regarding results in a timely way is important. Additionally, if there is a way to give them feedback on their particular results, like "Thank you for bringing in those five Cerulean Warblers," it shows that type of one-to-one connection that retains people.

## Data Management

We will be hearing a lot more about data management during this conference, but we have found that online data management is the way to go. It forces compliance. You don't get, "I tend to modify things a little bit," or "I didn't count these because I didn't feel I needed to." We've heard these kinds of things. If they don't get to submit their data until every single form is filled out, and there are double-checks, that will save a lot of headaches. In submitting paper forms, as I'm sure a lot of you can attest to, there is always a need to check back with the person—they forgot this, they omitted that—and that adds a lot of time to your management of people.

> **Data Management**
>
> • Online data entry = compliance
> • Online data entry = uniformity
> • Online data entry = standardization
> • Online data entry = quality control
> • Online data entry = one and only one data source

Online data entry allows uniformity, standardization, quality control, and one and only one data source. Everything goes into one database and it ends up being very nice because you're not trying to make several different things compatible, and you don't have data entry issues from several different groups providing you with information. If it's all online it really brings a lot of issues together, particularly if you're doing large-scale work. If you're working with several different volunteer groups that collect turtle information, having one data entry port rather than having three and trying to compile them later is the kind of thing that can help you avoid potential problems.

## Contributions and Lessons Learned from Past and Current Citizen Science Projects

### Early Citizen Science Projects

The Christmas Bird Count is often cited as the first citizen science project, but I have to say that is not the case. The projects I'm going to talk about were started in the 1800s, but I have a feeling that the weather people have been collecting volunteer data for a lot longer than that. In terms of birds, the first two surveys both started in the 1800s and have some residues that we can look at to this day.

> **Historical - 1800s**
>
> • Lighthouse surveys
> • Migration Record Schemes
>   - Wells Cook
>   - 6,000,000 records

The lighthouse surveys are interesting. One of the first acts of the American Ornithologists' Union (AOU), which I believe was formed in the 1880s,

*Wells Cook*

was to deal with one of the blazing issues of the day, which was that large numbers of birds whacked into lighthouses and died. Their solution was to start a volunteer effort that involved contacting all of the lighthouse keepers up and down the coast and all over the Caribbean. They said, "Could you count the birds that strike the lighthouse?" They had a form and it went back to the AOU. The interesting thing is that all of the interesting issues that we deal with now show up there. These still exist. You can go to the archives in Philadelphia and read them, they're all on display. There are letters like, "This is the dumbest thing I've ever heard of. Why am I counting birds?"

Then you get the problem of uneven data quality. Some of them are talking about Storm Petrels and others are talking about Mother Carey's chickens. You have terms like "yellow bird," and problems with taxonomic issues. I can't say that I've ever seen a publication come from that information, but apparently it was useful enough that they extended it for quite a number of years. Maybe they decided that birds striking lighthouses weren't that big a deal. I don't know what happened.

That was probably the second volunteer survey. The first one was started by one of my heroes, Wells Cook. He was from the Midwest, traveled around, was a school teacher, and then later became a college professor. He was very interested in bird migration and probably got this idea from Germany and Great Britain, where they were starting to have an interest in bird migration. He organized people and asked them to collect information about when birds first arrive, when they become most abundant, and when they leave in the spring and the fall. The program ran from the 1880s and was picked up by a series of organizations and ultimately the government, and continued through at least World War II and petered out in the '50s. Maybe it continued a bit through the '70s. Over the years of that program there were 6,000,000 records, with thousands of volunteers collecting this kind of information.

We've used it because sometimes we want to talk about whether a species was common or not common. Though this stopped in the 'fifties,



**Maryland Spring Migration Dates**
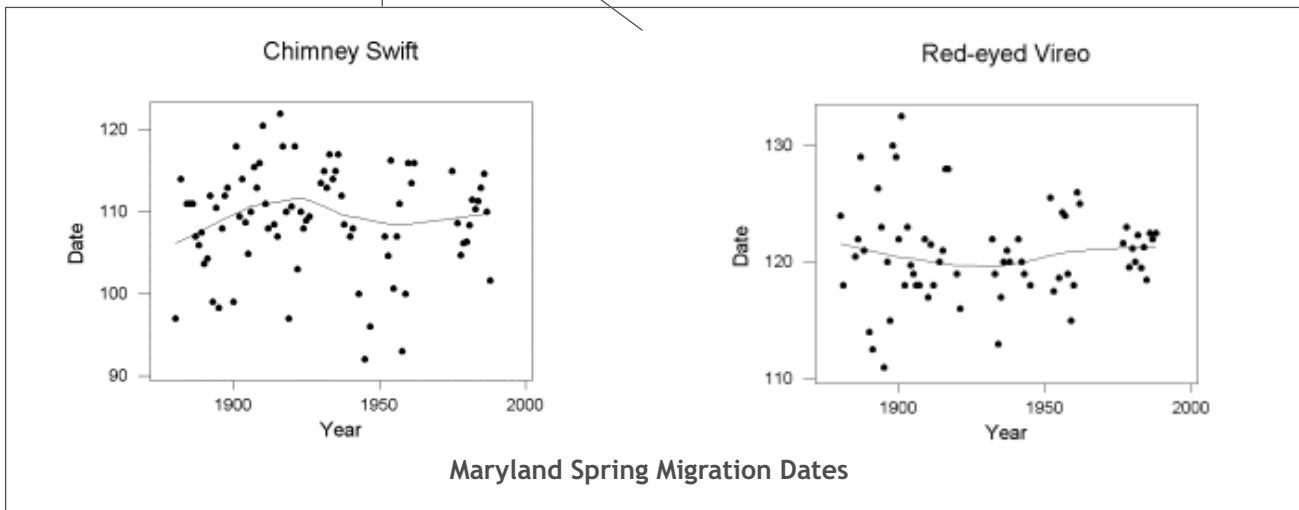
a few places collect first migration dates still. Maryland is one of them and we did a little paper looking at these data in an exploratory way in terms of what they can tell us.

This data set is still appropriate for analysis and retention right now. You can look at the curve in terms of issues like global warming, for example. The data that were collected a long time ago are still valuable, and I'll bring this theme up again a little bit later. That datum point from that person in 1880 who wrote down that first time that Bobolinks arrived in Iowa is still used today, over and over and over again. It's a permanent contribution.

### Hunter Success Surveys

Another interesting example is hunters. If you're a hunter and you want to go out and shoot ducks, you have to get a special permit for that. When you get that permit, you get registered and your address goes into an information bank, and a set of hunters are sent a letter by the federal government. It says, "Please fill out a diary of what ducks you shoot and when."

The interesting thing is that sixty percent of the hunters who get that request do it. We heard earlier that there are something like ninety million gardeners. Do we get sixty percent of ninety million gardeners doing any kind of monitoring? Do we get sixty percent of the bird watchers doing anything? We get sixty percent of hunters. People may make remarks about hunters, but hey, they're ponying up here.

Also, they didn't go onto the Web and say, "Gosh, I like to count ducks, I'm going to sign up for a survey counting ducks." They were simply asked. That is another point. If hunters will respond to a simple request by the federal government to give them some information, that tells you that there is a huge untapped pool of people who have not been asked. I think the important thing is that they were directly contacted and asked to do something rather than: Oh, you know I've built this structure here and now I'm waiting for people to come and find me.

I found this when I was managing the Breeding Bird Survey. If I needed more people in an area, I didn't put an ad somewhere in the bird watching journal of the state. That has a very low response. I would get in contact with people and I would just start making phone calls: "Who do you know?" And then I would call that person up and say, "Will you run this for me?" The success was very high and we were able to build up the program, so keep
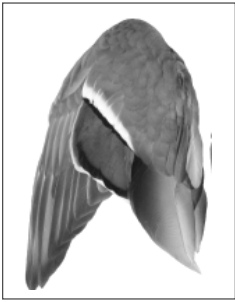
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**Ask and Ye
Shall Receive**

- 60% response rate
- Original plus 3 follow-ups
- 40,000 responses
- Two-thirds kept actual diaries
- Notice this: Hunters did not initiate the contact, FWS did.
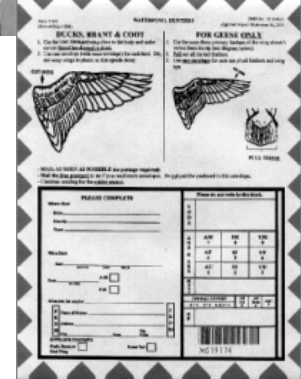- Build it and maybe they will come, ask and ye shall receive

that in mind when you are trying to build up your constituency. That is, if you need to build your constituency. Sometimes there are too many people involved.

## Waterfowl Parts Collection Survey

We asked the same group of people, hunters, to do another task in addition to the diaries, and we again got a sixty-percent response. We don't actually tell them that we don't trust that they can identify a Gadwall correctly. What we ask them to do is send in a wing from the fowl (and in some cases with geese, the tail) and then we can do the identification as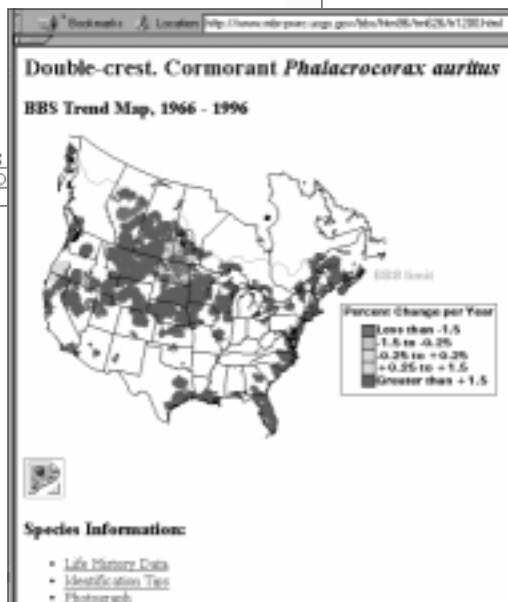 well as gain a variety of other information. We get the same sixty-percent response rate and in general, hunters are the crowd that would be more conservative and mistrust the government. They're an interesting group to work with.
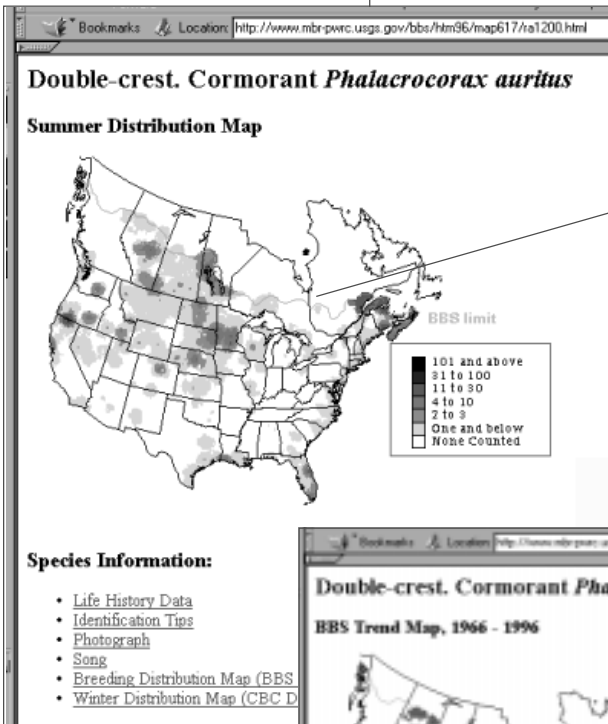


## Breeding Bird Survey

Below this line are the primary places from which data are generated for the Breeding Bird Survey. It's very extensive. Many, many people are now involved and it is comparable to the migration surveys done in the 1880s. There are lots of people involved, all volunteers. Cormorants are not one of the more common species. The BBS can look at abundance, they can look at trends, and they can do lots of analysis. Thousands and thousands of analyses have been done each year on this data set, and many, many hundreds of publications have come out of this.

Let's look at what is going on at the core of this, at who is paying for this. It's a federal government program with no donations. It costs about $900 per species, per year, to generate that data. There are now 4.2 million records in the data system and notice that we haven't actually



**Double-crest. Cormorant** *Phalacrocorax auritus*

**Summer Distribution Map**

BBS limit

101 and above
31 to 100
11 to 30
4 to 10
2 to 3
One and below
None Counted

**Species Information:**

- Life History Data
- Identification Tips
- Photograph
- Song
- Breeding Distribution Map (BBS
- Winter Distribution Map (CBC D



**Double-crest. Cormorant** *Phalacrocorax auritus*

**BBS Trend Map, 1966 - 1996**

BBS limit

Percent Change per Year
Less than -1.5
-1.5 to -0.25
-0.25 to +0.25
+0.25 to +1.5
Greater than +1.5

**Species Information:**

- Life History Data
- Identification Tips
- Photograph

gotten around to the records that were generated in the 1800s. It has been going for forty years and about ten thousand observers have been involved in the project.

In terms of contributions, if you tally up who is doing what, there are about 29,000 hours of volunteer effort. That yields the equivalent of fifteen federal full-time employees. We would be paying fifteen bodies for the entire year as well as taxes and benefits. I would bet that not one of you has a staff of fifteen. We have an effective staff of fifteen that we don't pay. I think people tend to not highlight this, that the people who are doing things for you as volunteers are people who should be paid in a perfect world. When you bring up your program, you should be calculating those contributions because they are very impressive most of the time. We could not afford this, so we would not have a Breeding Bird Survey if we were paying people—there is no way.

The people who run Breeding Bird Surveys stay a long time and we have very good retention of people. And I have to say, referring to what I recommended earlier, that we didn't give them a lot of feedback either. We didn't stroke them as much as we do now. I don't know why they stayed in some of those middle years.

When we look at why people leave the Breeding Bird Survey it turns out that a lot of times they leave because they have to. They move, their hearing is going bad. Sometimes we have a situation in which a volunteer wants to continue doing the survey but their hearing should actually be disqualifying, so we're gently putting off the fact they should go.

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**The Breeding
Bird Survey**

**System**

- $900/species/year
- 4.2 million records
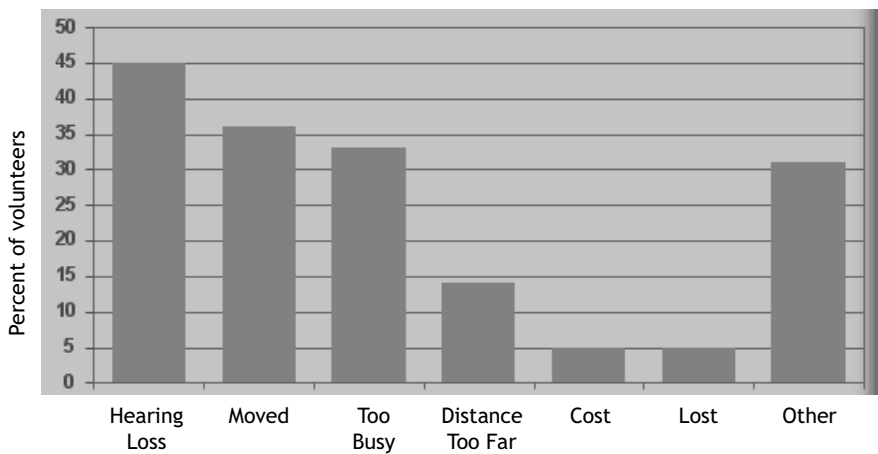- 40 years
- 10,500 observers

**Annual Contributions**

- 29,000 hours - 15 FTEs
- 150,000 miles

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**BBS Observer
Demographics**

- Observer retention averages a tenth of a lifetime
- The average observer volunteers for 8 years
- 10% remain active past 25 years
- 75% remain after their 1st year

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**Why do volunteers leave?**

## North American Amphibian Monitoring Program: Training and Testing Volunteers

There is something that we are now moving into with the North American Amphibian Monitoring Program, which is similar to FrogWatch, and I know the Lab of Ornithology parallels us in this. Instead of passively recruiting people who already know everything about birds or frogs, we now have training programs and testing programs, so we're interacting in a more direct and educational way. You want to volunteer? Hey, we will also train you and we'll test you to meet these skill standards. I think there will be a lot more of that in the future, with volunteer training occurring within the context of programs.

### Two Examples of What Not to Do

Here are two examples of how not to do things. One is the Colonial Waterbird Surveys, one of the first efforts by the federal government, which traditionally just looked at game birds. They had responsibility for non-game birds, but because people weren't shooting them, they didn't really start working on their population status and conservation until they became endangered. One of the first sort of proactive events was to look at colonial waterbirds—terns, herons, egrets, seabirds, those kinds of things—because these were species groups that were in trouble or about which issues were raised. The first part of the refuge system surrounded issues having to do with colonial waterbirds. This was in the 'sixties or 'seventies.

People would count how many terns or herons, so people were doing things, but the whole notion of statistical approaches lagged behind. What they did was get a pile of money and then handed it out to differ-ent groups and said, "Count colonial waterbirds for us and then give us your report." They would do this every ten years, and they did this several times.

It turns out that after tons of money and tons of ways of looking at it, none of it is usable. Basically, all of that earlier information, from a statistical status monitoring point of view (though there are other things you could do with it), was a waste of time. The reason was that each group decided to do it in a little bit different way, and they all kept it in a slightly different database, and when they tried to put it all together, after spending millions of dollars, there were a lot of incompatibilities. They weren't getting a lot of feedback from a coordinator saying, "This is how we want the data, this is our requirement." Instead, people would modify their survey techniques, and it turned out a death of a thousand

cuts occurred in that the accumulation of all the errors and all of these little discrepancies made the whole system fall apart.

Now we still don't, in some sections of the country, have quality data on colonial waterbirds. In other cases, such as the Great Lakes, they had to start from the beginning and reorganize along the lines we talked about previously, so that they have good statistical techniques, everyone is collecting the data in the same way, there is one organizing force, and they work out the system.

The Salamander Monitoring Program was one of my programs. I still like it a lot, but it was one of my several failures. What you would do is put out squares of wood on the ground in the woods, and sometimes streamside, and then you go back later and you look under them, and there are salamanders and you count them. And it's very nice, kids can take part in this, it's something you can do during the day, it's attractive, it's not very difficult. We worked out the statistical details of how you do it, and they're great because you have low annual variation and you can calculate trends easily.

We gave it to a person who was very interested, a total salamander-head who also likes running Web design, and he never followed through with some of the kinds of things we're talking about here. He didn't give people feedback, he wouldn't accumulate their data, his Web site was half there and half not. It fell apart not because it was a poor idea, I think, or because of the volunteers, but because the management of the system didn't work out. I'd be happy to talk to you more about those kinds of things, but I still think that particular program is good enough to be rebuilt.

## Recommendations and Next Steps

### Where Do You Put Your Money?

When you look at collecting information or a monitoring program, one of the general questions is, where do you put your money. I would argue that if it's appropriate for volunteers, and in a lot of cases it is, it's almost always more financially efficient to spend that money on managing and working with volunteers. Even though there's an effort involved, the gain is much greater than working with paid technicians.

### Monitoring versus Research

Monitoring versus research is a little bit of an aside, but I brought this up earlier and I think it's a point that often gets missed by groups. It's a point that can be used to help attract attention and help get funding in particular. Research in the broadest terms is answering a question, a question that can, in most cases, be answered at any point. The issue with monitoring is that if we don't collect monitoring data this year, that can never be recollected again. Once a year's worth of monitoring or a

**Where Do You Put Your Money?**

Money spent managing volunteers has a much higher yield than money spent hiring and managing technicians

**Monitoring vs. Research**

- Research questions usually can be answered at any point

- A year lost monitoring is a year that can never be regained

- Monitoring Data
  - Permanent contribution
  - Used over and over
  - Increase in value with their age

place's worth of monitoring is missed, it's never recollected, so we lose every year we wait or every time we don't involve someone who could do a particular sighting.

This is something to emphasize to people who are participating in monitoring types of questions and programs: If your data do not come in, we will never know what the frog populations for that year were. The other thing is that once those data are in, just like those migration data from hundreds of years ago, these data are always there and will be used over and over again. That you saw bluebirds on your Breeding Bird Survey route in 1978 means that bluebird point for that one route is used over and over again, thousands of times by now, each year in creating information about population change or status or maps or the many other kinds of programs. So once they've made their contribution, it's not like a one-off, like we answered that question now, here's a little paper, then we put it away and it disappears.

This is something that builds, and monitoring information, as many of you know, only gets better with age because you're able to detect more trends the more years you have in. And it's all a mathematical situation— the longer you've been there, the better the information gets. The difficult thing for a lot of people dealing with these kinds of data, and it doesn't matter what species or what kind of thing it is, is the first year or two. People want results. What is the status of worms? What is going on with Cerulean Warblers? Mathematically, it's very difficult to detect those kinds of changes over the first few years, but once you have ten years in, then it starts getting to be gravy. Then you really have the ability to detect changes, to analyze the data and to look at things. So for a lot of these efforts, from just a mathematical point of view, you're in a difficult place in the first few years to offer quick results. This comes up so often I think it needs to be emphasized.

### Where to Next?

In terms of citizen science monitoring projects, we have been doing the kinds of things that make sense to us. We look at birds, we look at bird lists because traditionally those are things that people and metrics have looked at a lot. We haven't looked at it from an ecological information point of view in terms of what information we need. So right now we have a lot of programs working on vertebrates, and that's good. We're getting the kind of information that informs conservation efforts. When we talk about changes in bird populations and why we're looking at this versus that, we are looking at the data first and then saying, "Because we can see that species declining, as we can see in the Christmas Bird Count and the Breeding Bird Survey, we are working on these."

When we look at some of these other groups, we don't have that information. I'm looking at native bee species now and I can tell you that there are no data sets. We have no way to look back on them. We have

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**Where to Next?
Rotating Inventories?
Checklists?
Records Schemes?
Atlas?**

- Crickets and Katydids
- Ladybugs
- Mushrooms
- Worms and Isopods
- Ants
- Poop and Carrion Beetles
- ?

little dead bodies in museums from pre-World War II. I can't tell you what the status of bees is despite the newspaper articles saying they've all disappeared.

It would make some sense in the largest of large pictures to look at what other groups we want information on that would give us an idea of the health of the world. Because I'm a critter-based person I have a few examples here. This goes for "what is your place in the scheme of things and how am I unique or not," in that I'm getting a new measurement of world health. For example, crickets and katydids are processing the environment in a very fundamentally different way than birds. They are, in fact, bird food. They are processing health identification issues that are cricket and katydid issues, so if we have measures of crickets and katydids, we have a new way of talking about the health of the earth.

The same with ladybugs, or mushrooms, or worms. John Losey, who is here, is starting a ladybug program, which is great. The question is, what information would be nice to have from an ecological perspective?

### The Eighty-Percent Rule

The eighty-percent rule is something I've thought about a lot. Maybe this doesn't translate to other people, but eighty percent of everything that I do fails. Sometimes it just doesn't work out. Say eighty percent of the people who come with me to work on a project disappear, but the thing is that twenty percent of them work out really well. The argument is that if you have tried something or tried certain aspects and have just totally failed, it's really not about you. You have to make a lot of attempts at doing citizen science or other new ideas in order to get successes. So if you say these things just don't work, it's never going to work because you haven't tried it all. A good chunk of them don't work out, and again that might be my personal experience, but by doing what you guys are doing, we are gaining an awful lot.

### Web Sites

The Monitoring Manual site is based on the idea that you're developing something where you're attracting change, and that you need to think about how you set that up so that the results ten-plus years down the road, when it really starts getting juicy, are as usable as possible. This is a philosophical Web site. It goes through all of the steps that you need to do when you are considering how and what and how many, what kind of information you're going to get out of it, goal setting, and what area—things that have tripped people up over and over again. I've tried to write it in a way that is understandable. Then you can take that to a statistician and say, "Help me calculate sample size."

There are various forms that you can fill out, and you can also document your program so that when you leave and someone else comes along and says, "What in the world were they doing?" there is documen-

**80-Percent Rule:**

- 80% of everything you do fails
- 20% does not
- Keep trying

www.pwrc.usgs.gov/monmanual

www.discoverlife.org

tation there so that they're ready to go, hitting the ground.

I put the discoverlife.org Web site up because it's a good Web site for geographic information and online identification guides. I haven't talked about those, but we use them a lot and I like their approach. It's free and they work with different people all the time.

**Ask Me About
Native Bee Surveys**

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