

The All-Taxa Biodiversity Inventory

Perspectives on the ATBI

By the Editor

THE ALL-TAXA BIODIVERSITY INVENTORY (ATBI) IS A potent, ambitious, and intensive model for the discovery and study of park biodiversity. While it may not be sustainable for all parks, several have embarked on this long-term endeavor that seeks to document all life-forms in a park. Here we present interviews with **Marc Albert**, Stewardship Program director, Boston Harbor Islands National Recreation Area, Massachusetts, and

Todd Witcher, executive director, Discover Life in America, the nonprofit partner for the ATBI at Great Smoky Mountains National Park, Tennessee and North Carolina, to gain insight into this robust inventory tool. We also share a feature article on pages 58–61 about the ongoing inventory work at George Washington Memorial Parkway to round out our coverage of ATBIs.

AYA ROTHWELL



Marc Albert in transit to the Boston Harbor Islands.

Interview with Marc Albert

Editor: What is an All-Taxa Biodiversity Inventory?

Marc Albert: It's a long-term inventory process, the overall effort given to cataloging biodiversity in a park. It is an ongoing and ultimately never-ending effort that flows directly from the National Park Service mission to understand the resources in a park.

How did the ATBI at Boston Harbor Islands come about and why was it focused on arthropods?

Marc: E. O. Wilson got the idea going around 2000, based on his concept of the "microwilderness." He has been a great champion of popularizing science, and one of his big ideas is that we are all a lot closer to biodiversity than we realize. You don't need to go to Yellowstone to see biodiversity. As an entomologist he had a particular insight into all the diversity that is unno-

ticed underfoot. He's based at Harvard University, so when the Boston Harbor Islands was in the process of doing our first inventories—geology, soils, vertebrates, vascular plants—he attended an inventory event and challenged the park to expand those inventories to focus on invertebrates. Through his connections with a nonprofit foundation, he facilitated the first donation to support this idea. I think he saw this as an opportunity to stimulate locally what he had been thinking about as one of his broad principles.

How did you organize and run the events over the six-year period?

Marc: Brian Farrell is at the Harvard Museum of Comparative Zoology and was the principal investigator for the insect and terrestrial invertebrate portion of our ATBI. Jessica Rykken was a postdoctoral researcher who served as

the project leader. She directly oversaw the collection and identifications, and also facilitated some of the educational and interpretive materials that came out of the program.

What did it accomplish?

Marc: Last year Jessica and Brian published a comprehensive technical report of the “microwilderness” ATBI from 2005 to 2010, and it provides full details.¹ But the highlights are many. Paraphrasing from this report, 40 scientists and 50 students, interns, and volunteers participated, and the latter group contributed 12,000 hours to process nearly 77,000 specimens in the lab. Altogether they identified approximately 2,000 species, including at least 239 nonnatives.² Beetles were the most diverse group and millipedes the least. However, a little more than half of the approximately 160,000 specimens collected remain unidentified, and flies and wasps could ultimately exceed the number of beetle species. Fifteen species are thought to be new records for Massachusetts, New England, or North America, including an agricultural pest from Europe, a click beetle. Also, we have discovered European fire ants on the islands and, though they haven’t been a problem here, they are a public nuisance elsewhere, so it’s good to

know. The ATBI also fostered unparalleled opportunities for outreach, including chances for public participation in field and laboratory settings and school programs for thousands of students.

Was there a broader context to the science?

Marc: The investigators wanted to understand if island area and distance from the mainland, as predicted by the theory of island biogeography, would correlate with species richness for these islands, which are so heavily influenced by human disturbance. For six focal taxa they did find that as island size increased, so did species richness. Likewise, as island distance from the mainland increased, species richness declined. Also, as the distance between islands increased, the similarity in the focal taxa communities decreased, but more so for species with limited flight ability. For ecological, economic, and management reasons they also were interested in the proportion and distribution of native species to nonnatives. Compared with a control area on the mainland, the islands had fewer nonnative species but the proportion of nonnatives to natives was higher. Though six nonnative focal beetle families occurred on more islands than did natives, variation in species abundance was too great to draw a conclusion about the proportion. Comparing plants with invertebrates, they found that as island distance from

the mainland increases, the proportion of nonnative to native plant species goes up more than it does for invertebrates.

Why did you refer to this as an ATBI when it focused initially on terrestrial arthropods?

Marc: When I got to the park in 2005 this project was called “the ATBI.” But as time has passed and as we’ve had an opportunity to think more broadly, I have stopped thinking about this discrete arthropod project as the ATBI and instead, of course, think of the ATBI as our overall effort to catalog biodiversity in the park. The terrestrial insect and arthropod-targeted effort was a huge piece, but it wasn’t the ATBI.

What other taxa have you investigated?

Marc: Intertidal biota. Concurrent with the beginning of the insect work was a thorough inventory of biotic assemblages of the intertidal habitats throughout the park. We funded a project manager—a graduate student from Northeastern University—and she arranged for several intertidal biologists to use more of a classic bioblitz model to collect specimens at several islands in the intertidal zone over a couple of tide cycles in one day.

Has technology played a role in your bio-discovery work?

Marc: Last year we piloted two “photo bioblitzes,” as we are calling them. They emerged out of our partnership with Harvard and our work with Jessica Rykken, who helped us coordinate the first one. We viewed it as more of a pilot as opposed to a full bioblitz effort, because we wanted to figure out whether using images can work to document biodiversity scientifically or whether it’s only useful—and this is valuable too—as a biodiversity discovery engagement tool. Therefore, we only registered 15 participants who were willing to be a part of this pilot and who came out to Thompson Island with their cameras. The participants had to set up their own accounts with iNaturalist. The idea was that all of the images they uploaded to iNaturalist would be grouped and shared as the Boston Harbor Islands photo bioblitz.

Some species must have been easier to identify than others.

Marc: That’s the trade-off with iNaturalist. It allows you to request identification suggestions from the user community, and while professional taxonomists might browse the photos and help make identifications, it is more of an amateur enthusiast user group. Of course, amateurs can be right and they can know a lot of things, but there’s definitely a quality-control step when using a crowd-sourced site like iNaturalist. That’s why it was really important for us to have

¹ See <https://irma.nps.gov/App/Reference/Profile/2195282>.

² All of the records are available at http://insects.oeb.harvard.edu/boston_islands/ and <https://irma.nps.gov/NPSpecies>.

Jessica serve as the curator of the collection.

What did you conclude about the viability of the photo bioblitz to document species?

Marc: It worked well, although there were some technology challenges. As a scientific inventory tool, it's nondestructive and it allows us to crowd-source the collection of information and the suggested identifications. The taking of pictures can be done by a lot of people. And it's excellent as a biodiversity discovery community engagement tool. The challenge is that you still have the same basic bottleneck as you do with any inventory, which is the authority, the taxonomist, who actually curates the collection and makes the final call on species identification. You don't get around that with a photo bioblitz.

Is the ATBI over? Is it ever complete?

Marc: We have stopped broad-scale collection, processing, and identification of insects. But I would by no means say that our ATBI is over. Even if you stop collecting and transition to monitoring of a particular focal group, for example arthropods, you would almost certainly find new species as you were looking the second time and therefore add to biodiversity information in the park. So by my way of thinking the ATBI does not have an end, because we're going to continue to try to catalog the

biodiversity of the park. Until this is no longer a park where understanding the resources is fundamental to our mission, it's not going to end.

So it's more of a strategy?

Marc: Right. It's an approach to understanding park resources and it flows directly from the National Park Service mission. An ATBI should be a core organizing principle around inventories in parks. However, there are funding limits, so we're not operating in the way we were during the active funded part of this work.

Are the specimens kept at Harvard?

Marc: Yes. From my perspective the National Park Service gains by having the Harvard Museum of Comparative Zoology be the curators of the collection. They know what they're doing, they have the time and resources to manage the collection, and they have collections from all over Massachusetts and the world. It is a benefit to the science and to the National Park Service to be able to look at the Boston Harbor Islands collection in the context of all these other collections.

How did you handle data management?

Marc: I was very concerned as the main inventory was winding down that we were going to end up with all of the information being over at Harvard, and that it would just

get farther and farther out of reach. It did take quite a bit of discussion between the NPS Biological Resource Management Division, who maintain the NPSpecies database, the Inventory and Monitoring Program staff, park staff, and our partners at Harvard to figure out how to export the data and transform it in a way that would automatically load into NPSpecies. The main issue was figuring out which of the fields in the Harvard database³ were in common with NPSpecies. But we eventually did do it. The transfer of this massive number of specimen records has gotten us to think about NPSpecies and its value. We're going to bring NPSpecies into more use for things like interpretive programs.

How would you characterize the level of public involvement?

Marc: Public involvement was built into our project in multiple ways and continues to be. We've had public involvement on individual collecting days. We've had several bioblitz events that were part of the overall insect inventory and the public was invited to those, plus we had the two photo bioblitzes in 2013. While most of the collecting has been done by the lead investigators and undergraduate research assistants, a little bit has been done by other members of the public as part of the engagement process. Several commu-

nity volunteers were involved in the lab, because there's a role for the public in the initial sorting of insects and other groups, throwing out random parts that can't be identified, drying the specimens, and pinning them so that an expert can take a look. We also developed posters and a card game to involve the public.

Tell me more about that.

Marc: One feature that enhanced both the science and educational value of the project was high-resolution photography. Harvard has this fantastic system to take three-dimensional photographs that can then be used for measurements to help with identification, but also have been used for posters and even a custom card game. Not everyone is going to have access to a high-end system like this, but even just taking photographs with a digital camera can enhance the biodiversity discovery value of the specimens for the public. Instead of just reporting the number and names of species collected, you can share the individual images that are sometimes creepy and amazing, especially at poster size. The Great Smoky Mountains project has produced some incredible posters. We also produced clear resin-covered specimens of various invertebrates. They're used as part of a curriculum-based program in which students do math and other exercises related to food webs for understanding the ecology of terrestrial ecosystems.

³See <http://insects.oeb.harvard.edu/mcz/>.

What is the legacy of the ATBI?

Marc: I think the curated collection at Harvard is an important legacy. The inventory and the potential for further biodiversity discovery live on in that collection. For example, a mycologist from Harvard has begun to study fungi that grow on the bodies of insects. Some of the fungi biodiversity that he is discovering will be from those specimens collected eight years ago as part of the insect study.

What are the next steps for biodiversity discovery at your park?

Marc: This partnership between the Boston Harbor Islands and the Museum of Comparative Zoology at Harvard continues to lead to new investigations. Our current focus is on cataloging the fungi of the park, working with Danny Haelewaters from Donald Pfister's Harvard lab and an NPS intern from UMass Boston. For this work we're targeting two islands and one peninsula in order to try to capture a range of conditions such as varying distance from the mainland, wooded versus shrubby habitats, etc. The team is using both morphological and molecular techniques to do the taxonomy. Another spin-off that is emerging is research into the distribution of mosquito species on the Boston Harbor Islands. We might pick up a couple of species from that, and we might learn something about

the public health aspects of different species acting as vectors for disease.

What management issues relate to the information you gained from the ATBI?

Marc: While the ATBI is valuable and ongoing, we do have other stakeholders, and in our case other landowning partners, in the park. I do think that at times talking about insects for six years became tiresome and even viewed as an opportunity to pigeonhole the Park Service as focusing on impractical things. Where partnerships are really critical and where funding is tight, it is important for parks to consider what their key stakeholders are interested in as well. Biodiversity can be approached from plenty of angles and there are plenty of focal groups. Not every park might focus on terrestrial arthropods and intertidal biota like we did, but certainly the opinions and interests of key partners should be considered. Part of the thinking through of taking on ambitious inventories should be to identify clear links to park management issues of concern. We have to be sensitive to the practical value of biodiversity discovery, for public health, agriculture, and visitor services, for example, at the same time as we're interested in the scientific value.

Some parks focus on different taxa as part of annual bioblitzes and can more easily manage this approach

than they could an all-out ATBI. Is this a good model?

Marc: It's a terrific model for a couple of reasons. Number one is that the main leverage that we have with taxonomists is their own professional enthusiasm for the subject. The cool thing about the focused bioblitzes is that you might get a lot of taxonomists together who like being in a room talking about the thing that they love. That's a benefit compared to the "try to get everything" approach where Jessica had to be sending boxes of sorted specimens all over the country and world. It's great if you can establish those professional relationships, but then it may take a while for those taxonomists to get to our box of materials. It's not the same as "come out here and geek out in your subject-matter area with us and with other like-minded taxonomists." I think that is what makes the discrete taxa bioblitz model so fun for the participants and so efficient for the National Park Service.

Another model is to change the location of a bioblitz from year to year.

Marc: Right. That model can be excellent for parks that have a local university or institution that wants to play a big role and can themselves be the facilitators of getting taxonomists for the various groups. I was at a workshop at Valley Forge National Historical Park outside of Philadelphia last year and they were talking about doing a biodiversity

event and working with the Philadelphia Academy of Natural Sciences [at Drexel University]. Of course the academy has an entomologist, a mammalian zoologist, plant and fungi people, and so they can serve as the key liaisons to the taxonomic expertise for the various groups. I think that sort of model, a local park doing a community event collecting a lot of stuff, can work when there's a dedicated institution that also sees it in their best interest to be involved.

Are there other considerations in designing a biodiversity discovery activity to meet a park's needs?

Marc: It is important to think through the scientific and community engagement objectives as distinct topics. It's great if you can have one event like the NPS–National Geographic BioBlitzes that are designed to answer scientific questions and engage the community. Their high profile may help draw taxonomic expertise, but it takes a lot of staff time and infusion of external money. It is incredibly time-consuming to take the vast amount of specimens from these events and make them into a scientifically valid set of collections. The day of collecting is a tiny piece of the effort, and then the sorting and processing and identifications can be overwhelming. I think it is all too easy for parks to be overly ambitious regarding the scientific goals. The best way to think this through is to distinguish between scientific and community engagement

goals. Let's make sure we don't set up something so that we're going to be frustrated or disappointed with one or the other. It's fine to have a biodiversity discovery event in which you engage the community and they help make species lists, but it would not be smart to plan on this being *the* scientifically valid inventory for the park.

What risks need to be planned for?

Marc: Just like with any other park activity, there are potential environmental impacts and safety concerns of this type of activity. You don't want people climbing down a sheer bluff to pick a certain plant. You also have to think through the pos-

sible impact on species of special concern and on seasonal nesting species. We had to schedule our intertidal bioblitz in the fall to avoid coastal breeding bird species that nest in a lot of the low-lying areas on many of the islands.

How would you compare your inventory work with the ATBI at Great Smoky Mountains National Park?

Marc: If I understand the Great Smoky Mountains model, the organizing principle seems to be targeted research on individual groups with individual researchers and taxonomic working groups, as facilitated through their partnership with Discover Life in America. That's how they've

been able to make their model work. It's this ongoing deep relationship with a nonprofit dedicated to this task. That's a good model. I think our deep ongoing relationship with a local institution is another good model. Great Smoky Mountains National Park has been able to do more projects, and so that's certainly something to aspire to.

Where is biodiversity discovery headed in the National Park Service?

Marc: I think we're in a phase of piloting all sorts of different methods for doing this and figuring out what works and what doesn't. Some of this is figuring out where to distinguish scientific goals from public

engagement goals. Some of it is figuring out who the right partners are to engage with to make these things work well scientifically. And part of it is to be more strategic. I would like to see the National Park Service take a more strategic approach through which we can engage taxonomist partners in a more structured way, maybe through the idea of a taxonomist-in-parks program, or maybe dedicated funding to biodiversity inventory that is able to engage a breadth of taxonomist expertise. The key problem is that we're all going to end up asking for the same people's time. That lends itself to a strategic solution.

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DUIA/CHUCK COOPER

Todd Witcher, executive director of Discover Life in America, addresses participants in the annual Great Smokies ATBI scientific conference.

Interview with Todd Witcher

Editor: Where did the idea for an ATBI originate?

Todd Witcher: It was the brainchild of retired ecologist Dan Janzen. He coined the term, came up with the concept, and in 1993 attempted to do an ATBI in Costa Rica that focused on lepidopterans. After enduring difficulties there, he came back to the United States with the desire to do one here. He picked Great Smoky Mountains National Park as a biologically diverse area that he felt would work well for what turned out to be a pilot ATBI. Given

the park's varied physical and geographic characteristics, it seemed probable that a large portion of species had yet to be discovered, particularly among the invertebrates. These less studied species form the foundation for ecosystem functions that support more familiar animals and plants. So he rallied scientists, park staff like [ecologist] Keith Langdon and [entomologist] Becky Nichols, and community leaders around the idea. This group recognized that the National Park Service would not be able to take on something of this magnitude



DLIA/CHUCK COOPER

Todd Witcher (second from left) discusses the ATBI with a group of citizen scientists near the grounds of the Appalachian Highlands Science Learning Center at Purchase Knob.

without a lot of help. As a result our nonprofit, Discover Life in America [DLIA], was formed in 1997 to coordinate and manage the ATBI.

Can you give us an idea of the scope of this ambitious undertaking?

Todd: The goal of the ATBI is to bring researchers to the park to document every living species in every taxonomic group in the park. It's one of the largest natural resource inventories in the world. Over 15 years of fieldwork we have involved about 1,000 scientists from 20 countries and more than 25 states. Dozens of universities and museums and hundreds of educators have taken part too. We have trained more than 800 amateur specialists, volunteer scientists, students, and teachers in our citizen science program and have logged more than 50,000 volunteer hours. Additionally, hundreds of visitors have worked alongside scientists sifting through

soil for millipedes, wading upriver to collect tardigrades, and crouching in sun-dappled forest to investigate ferns. The results have been remarkable: 931 species new to science, an additional 7,799 species previously unknown to the park, and nearly half a million data records. The new species to science have included 36 moths, 41 spiders, 78 algae, 56 beetles, 26 crustaceans, 57 fungi, 23 bees and their relatives, 21 tardigrades, and 270 bacteria, and more than 200 scientific publications have been disseminated. We have just begun to scratch the surface with regard to potential discoveries of bacteria.

How quickly did this ramp up and what level of activity are you experiencing now?

Todd: The decision to do the project was made in 1997. The following year the nonprofit was formed and we began to raise money. The year after that we began giving the first grants and fieldwork began.

In a matter of just two years this huge project got off the ground. The activity level has been pretty consistent until the last three of four years. There is less to study now, but the biggest deterrent to our continued work is funding. Still, we host three to four major studies each year. We also hold several citizen science events, including Biodiversity Days in the Smokies, host up to four interns annually, and organize several fund-raising events.

How do you decide what taxa to study?

Todd: When we started, we threw a wide net and invited whomever to go out and do research on something we hadn't looked at before. Of course, the mini-grant program had a lot to do with directing this work. That's how things went until the last four or five years. Now we narrow it down by meeting with park Inventory and Monitoring staff and scientists to identify important groups still left in the park that we would like to know more about, for instance, pollinators, species occupying high-elevation habitats, or "keystone" species. This includes taxa for which little or no work has been accomplished, groups that need to be completed, and at-risk communities. In the introductory category we need to look at parasitic wasps, mites, nematodes, protozoa, microbes, and particular fungi, crustaceans, true bugs, and flies. We need to finish work

on centipedes, earthworms, flatworms, scorpionflies, ticks, aquatic snails, dragonflies and damselflies, and bryozoans [aquatic invertebrates]. At-risk groups that need attention include Fraser fir remnant areas, hemlock stands, dry cliffs, and certain wetlands.

Your ATBI is such a massive undertaking that I'd like to ask you a number of practical questions about how you manage the effort. For example, what are TWiGs and how do they work?

Todd: They are taxonomic working groups and are a way to organize the fieldwork of the ATBI. They revolve around the expertise of taxonomists to make collections in the park and follow up with identifications in the lab. This approach was part of our initial science plan and it has worked really well for certain taxa, but not all. It can take a charismatic scientist to lead a TWiG, to gather all the specialists that are studying a particular group, and to get them involved and excited for the project. Our lepidoptera group, led by Dave Wagner at the University of Connecticut, is a great example of one that has worked really well. Dave has written a book on caterpillars of the eastern United States, developed from his work on this project. In some cases, however, you don't need a whole TWiG, because a particular animal group may not have many species or you may want to learn a lot about one species.

Has it been difficult to find taxonomists for certain animal groups?

Todd: Taxonomy has been a dying field in science for a long time. In some cases there's just nobody to identify the specimens that you need to have looked at. And that's a challenge for every park. We have tried to get younger people involved, and we've had some success through our internship and citizen science programs. We send out RFPs [requests for proposals] and do all kinds of things to try to get people interested. Our hope one day is to have an alliance-based ATBI so that the research opportunities can be shared among scientists more easily. There are Web sites used by taxonomists where we might publish this kind of information. Generally, though, it's through word of mouth that we find taxonomists. You know, a springtail expert knows a fly expert and so on.

Do scientists get a stipend to help defray their costs?

Todd: We have had a mini-grant program to entice specialists to come to the park. It helped draw scientists from a limited pool. For about 10 years we gave away around \$60,000 a year in \$1,000 to \$5,000 increments. This money came from park fund-raising partners, Friends of the Smokies, and the Great Smoky Mountains Association, as well as from our own fund-raising efforts. We've

had to try to raise more of our own funding in the last few years as partner funding has been directed at other projects. An additional focus now is getting our own fund-raising efforts off the ground. The hope had always been that recipients would be able to leverage their mini-grants with National Science Foundation or other funding. In one case several coleopterists used a mini-grant to leverage a much bigger NSF grant that resulted in a beetle and arthropod museum being established at Louisiana State University based on the work they did in the Smokies.

Where do you house visiting researchers?

Todd: The Appalachian Highlands Science Learning Center at Purchase Knob [see photo, previous page] has space, and they allow scientists who are studying on the North Carolina side of the park to stay there. We don't have a site on the Tennessee side where they can stay. Early on, park neighbors would give up a room in their house for researchers, but we've gone away from that. It was too complicated. Now we ask local accommodations to give scientists a price break. It's hard because our room needs coincide with the busiest tourist time of the year.

How are research permits handled?

Todd: Discover Life in America has a general or over-

lying permit from the National Park Service that we can use to train volunteers and get them involved in the ATBI, as needed. The scientists also need to get permits for the specific work that they're going to be doing.

Where are the specimens curated?

Todd: It's different with every group of scientists. Of course, every collected specimen belongs to the National Park Service. Some of our scientists return their specimens to the Park Service once they've finished with them and they go into the park collections, and some want to keep them for long periods or on permanent loan.

How are data managed and shared?

Todd: That was a challenge initially because of the number of scientists and kinds of organisms we were working with. What we did was to create our own ATBI database. We have a data manager who checks the validity, usability, and format of the data and enters them into the ATBI database, which the National Park Service maintains locally. Another value we add is that the public can access the ATBI database through a Web site, with filters, of course, for protecting location information about threatened and endangered and economically valuable species. The data are being migrated to the NPSpecies database now.

What educational activities are part of the Smokies ATBI?

Todd: We hold an annual scientific conference and it's open to the public. The conference is where scientists present their findings for the past year or multiple years, including protocols and educational products. We give scholarships to about 25–30 local and regional teachers, and we have about as big a percentage of regular citizens who attend. Attendance was about 175 per year, but we've had a drop in that number over the past several years because of travel restrictions and limits placed on conference attendance on the National Park Service and other government agencies. We hold events each year to involve citizen scientists and have helped park staff develop educational programs, such as Parks as Classrooms, focused on ATBI events and information.

Does the National Park Service have a reporting requirement for the ATBI?

Todd: There is no reporting requirement other than what we report as part of the superintendent's annual report for the park. Of course, we have always thought that the annual conference serves this purpose, and the conference proceedings are published on the DLIA Web site [www.dlia.org].

What is the legacy of the Great Smokies ATBI?

Todd: A simple thing is the baseline information. Lots of environmental changes are already taking place here, and I think they will become more severe. The information provides a baseline that will help us understand how species are responding to those changes and what qualities make species resistant or vulnerable to change. We also feel our ATBI can serve as a model for this type of work at other parks. That's part of it. We're also developing some products. We are working with the University of Tennessee on a biodiversity mapping program. It uses approximately 40 environmental layers for the park, soils, vegetation, and those kinds of things, coupled with our biodiversity data to predict where a species, whatever it might be—a fly, a bird—might be found. It's still in the development stages. Our interns are verifying some of those predictions now.

Have you come up with any new methods for inventorying?

Todd: We have. One of our goals is to develop a “best practices” set of documents for doing an ATBI. We don't have that yet, but a group of scientists we worked with from Europe called EDIT (European Distributed Institute Taxonomy) has published a manual of protocols [see

<http://www.atbi.eu/wp7/>]. It's worth sharing as it may make a good reference.

What new techniques for biodiversity discovery are emerging?

Todd: The iNaturalist idea and the way technology is moving is an area that I think can be valuable.

Are you nearing the end of the ATBI?

Todd: This is a question we are asked a lot, and I don't think we have an exact answer. I believe we are moving more toward the end, and with NPS help we are moving toward a monitoring situation. However, if we keep finding new species at a high rate, then I think that question is hard to answer. The scope does change and adjust as we go on and unfortunately this is based more on funding than on science. We do hope to continue to be a highly valued NPS partner for years to come.

What has been a personal highlight from your involvement with the ATBI?

Todd: I love science and discovery and I can't think of many jobs that combine the two so well. But I do think that our society has a low level of knowledge of science, and this project is a great way of reversing that by involving citizens in real-world science.

For parks that are not able to mount a long-term ATBI, can information from individual bioblitzes be accrued and integrated into something like an ATBI?

Todd: It depends how well the data are collected and managed by the park. At Great Smokies, we want to know where and when species were found—more circumstances than just a running list—so that the information can be better integrated into management. For example, the mapping program I mentioned uses ATBI data and essentially will be able to map the biodiversity of the park. This tool could be used to show decision makers, who are contemplating the location for building a structure or road, where rare, endemic, or critical species exist so that they can then make a more informed decision. For a bioblitz to provide this context it comes down to how it is planned and managed, what information comes out of it, and the assurance that identifications are validated by experts.

How do you view the state of knowledge of biota in the national parks?

Todd: I would say it's pretty low. I think parks know a lot about relatively few species (the charismatic fauna), and not much about everything else. I hope the National Park Service is moving in the right direction, but so many things

tend to sidetrack federal agencies, including lack of funding. I hope that we can keep the focus on understanding and saving biodiversity.

How does biodiversity discovery contribute to park protection?

Todd: Park management needs to know what species exist in the parks. Maybe not every single thing, but much more about all groups than any park currently does. It is impossible to do a good job protecting parks without this knowledge. I also believe that by collecting these data and involving citizens we build a broader love for parks and wild places. In the long run this will better protect parks because people will better realize their value.

—Jeff Selleck, Editor
(jeff_selleck@nps.gov)