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Bats 101: High School Students

MERLIN D. TUTTLE

A creative new way of teaching high school biology could inspire students to seek careers in science; along the way some important bat research is being conducted . . .

BY STUART PERLMETER WITH PAT GREENLEE

IN OUR CHANGING WORLD, skill in the sciences is becoming increasingly important for students leaving high school. Yet they graduate with limited knowledge in science and little confidence or interest in the subject. Educators, politicians, and business leaders alike are concerned that students in the United States consistently rank at the bottom of the standardized testing barrel on math and science scores in developed countries. Although the demand for improved scores has been assigned as a top educational priority, more and more school districts are struggling with shrinking dollars to fund programs that could help.

These facts became increasingly frustrating for me as a biology teacher for the Springfield Public Schools in Springfield, Oregon, and as a parent of school-age children. It occurred to me that one of the failures of high school science education, as it is now taught, is that many students see little connection between classroom content and the real world. In attempting to come up with a solution, I decided that maybe what students needed was the opportunity to pursue science in depth, focusing on a single topic. "Why not bats?" I asked myself. I had long been interested in these misunderstood mammals, and much more study was needed. Could a field program based on bats help enhance student understanding of biology and

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and Field Research

stimulate an interest that would produce a group of life-long learners?

I began to construct an image of how this new education model would look. The success of such a project would be greater, I felt, if a partnership could be forged with either a state or federal wildlife agency, which would also benefit and could assist in the field classroom. Before presenting my bat research field-class plan to the school administration, I called the Willamette National Forest office in Eugene. I arranged a meeting with Pat Greenlee, the Coordinator for Threatened, Endangered, and Sensitive Species for the Willamette National Forest, to discuss my vision of the project and solicit feedback from her.

When I arrived at Pat's office to find a Bat Conservation International poster predominating amongst the file cabinets and stacks of documents, I suspected that a cooperative project would be a "match made in a cave." Although we worked for two unrelated public institutions, we clearly shared a common fascination with bats and interest in the education of young minds. We decided to collaborate on a program that, while based on bats, could also be applied to a variety of field sciences in many locations.

First, the program we envisioned would immerse high school students in a larger, more complex classroom. In the forest ecosystem, they could readily apply skills and technical knowledge learned in the school classroom while developing self-confidence, responsibility, and social skills. Second, the program would create a new model for public school teachers, combining teaching with the research traditionally found only at the university level. A blend of teaching and research also leads to the stimulation of new ideas and reduces "teacher burnout." While the program could be designed to address many subjects, ours—based on bats—would also gather much-needed baseline data on the distribution pattern and night-roosting habits of bats. The information void on the ecology of Townsend's big-eared bat (*Plecotus townsendii*), a species listed as threatened by the Oregon Department of Fish and Wildlife, was of particular interest to us. We hoped to gather whatever information we could on their declining numbers. Finally, the program would demonstrate to students that the scientific process is more than a random collection of facts and figures and that it can be a world of discovery and fun.

We both felt that this model for reshaping the delivery of high school science education had an unlimited number of possibilities. When Pat generously offered the Forest Service's help in funding the cost of the project through a challenge cost-share agreement, I knew we were off to a solid start.

The next step was to convince

STUART PERLMETER

Opposite page: *Gathering baseline data on the ecology of Townsend's big-eared bats in the Willamette National Forest was one of the project's goals. The species is threatened in Oregon and is a candidate for federal endangered species listing.*

Above: *Aimee Hart scans the forest using radio tracking gear to pick up signs of bats. She found day-roosting sites for long-legged myotis in several large snags.*

ROB ROMING, SPRINGFIELD NEWS

Stuart Perlmeter (left) *and Aimee Hart* (right) *work on identifying a bat that they have caught in their mist net. Alex Rybak, a young visitor, looks on in amazement.*

school district officials that the study of bats could easily fit into the regular high school curriculum. Using the latest jargon of theme teaching, we adopted the Order Chiroptera. Counting, measuring, classifying, describing, writing, and public speaking about bats would allow our young researchers to practice all of the skills we expected of students receiving their high school diploma. More important, this project would force them to think creatively, something often missing from textbook-driven curricula. The school district agreed, allowing me to reduce my teaching assignment to participate in field research one day a week, and providing transportation to the field sites.

Selecting students as research assistants became the next challenge. Eligibility was based on a combination of grades, motivation, and a willingness to sacrifice lunch time with friends and to give up weekend jobs and social lives. In return we offered the students the opportunity to retrieve a tangled bat from a mist net while their legs went numb from standing in the frigid mountain streams of Oregon, to engage in heated debates over whether the bat in hand was a *Myotis lucifugus* or a *Myotis volans*, and to be deprived of sleep after counting bats under guano-laden bridges until dawn. What average high school student could possibly turn down such an exciting proposition? Their parents, on the other hand, were happy to see their progeny with an outlet for their youthful energy and exploring minds, and were grateful to have their phone lines free on weekends.

Fifteen students signed up for the project—far more than we had envisioned spending our weekends with. The question was how to pare down the numbers without damaging egos or stifling enthusiasm. Weeding out came naturally via a Saturday field trial, covering over 400 miles, crawling through two lava tubes, and finally scaling the steep sides of the Fort Rock escarpment in eastern Oregon. The outing started at four in the morning and ended as we rolled into the school parking lot after eight that night. In the end, the only sounds resonating from the small yellow school van were synchronized snores.

At our next meeting, natural selection had clearly prevailed and reduced our budding bat researchers to a more reasonable number of seven. In-school bat classes began during lunch hours. These training sessions covered anatomy, flight, echolocation, classification, and behavior. Students learned how to handle live bats, what physical features to look for in telling one species from another, and what to measure on a bat. We assigned each student readings on a variety of topics, which we discussed the following week. Responsibilities were determined, and first-aid procedures and common safety were covered at the field sites.

In late March of 1992, we took our group of prospective bat biologists on their first real expedition. We focused on the art of setting up mist nets and using bat detectors to monitor bat activities. The students quickly learned that field research often goes unrewarded; we captured no bats that first evening. The bat detector and a flashlight beam further demonstrated the frustrations typical of field biology by revealing big brown bats (*Eptesicus fuscus*) foraging just *above* our mist nets.

Over the next eight weeks the bat team from Springfield High School took six additional trips to sample bats at various locations in the Willamette National Forest. At each of these sites, we set mist nets across streams and examined bridges to determine if they were used as night roosts. As the nighttime temperatures increased from May to July, so did the diversity of bats. After weeks of handling the small, less descriptive *Myotis* bats, the students' faces lit up with astonishment and awe when the first hoary bat (*Lasiurus cinereus*) was captured in our mist net. The bat's comparatively large body and teeth caused even our most confident students to hesitate. Despite great excite-

Josh Foshay (right), *Micah Yoder* (center), *and Todd Perlmeter* (left) *set up a mist net over a stream for a night's work. As the project progressed, students found their individual talents and became part of a cohesive team.*

ROB ROMIG, SPRINGFIELD NEWS

ment at the capture, they nominated me to extract the large hoary bat from the net.

AS THE FIRST SEASON of the project progressed, we watched the students transform from an inexperienced and uncertain group of individuals into a cohesive and knowledgeable team. Throughout the course of the first year, we witnessed them fumbling with snagged mist nets and dealing with clouds of dust, swarms of mosquitoes, treacherous footing under bridges and in streams, and long, sleepless nights. Like pieces to a jigsaw puzzle, each student made a contribution to the overall picture of the project. Aimee Hart channeled her love for numbers toward meticulous data collection; Micah Yoder's patient and gentle nature proved invaluable at removing seriously entangled bats from the nets; and Jesse Fittipaldi's inquisitive mind and endless energy produced challenging questions that often led us in a quest for reasonable answers.

The students were quick to learn that life under a bridge is very different from day to night. By day these bridges appeared to be nothing more than barren slabs of concrete devoid of life. By night they served as Chiroptera truck stops, teeming with large numbers of bats briefly resting between forays for insects. A host of other nocturnal creatures shared refuge with the bats. We found cave crickets with enormous legs that seemed to empower them with Olympian jumping abilities, a variety of other insects that defied our attempts at classification, and wood rats in search of yet another item to add to their collection of valuables. One thing was consistent: bats clung to these artificial caves in large numbers, often forming clusters of over 100 individuals, with as many as 500 under a single bridge.

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In the first year we surveyed 35 bridges. We recorded six bat species, including both little (*Myotis lucifugus*) and big brown bats, long-legged myotis (*M. volans*), California myotis (*M. californicus*), long-eared bats (*M. evotis*), and Townsend's big-eared bats using these bridges for some level of night-roosting activity. As the season progressed, we consistently observed a change in species. Little brown bats were replaced by the larger long-legged myotis, and the rare Townsend's seemed to be easily intimidated from the roosts by other species. Also, females were significantly more likely to use these night roosts than males. This practice varied from bridge to bridge and depended on the time of year sampling was done.

Despite our hard work and successes in other areas, at the end of the first year we still didn't have much data on the elusive Townsend's big-eared bat. Except for the occasional male found night roosting under a bridge, we knew little more than when we began. That situation, however, changed in July 1992.

I was then preparing to depart for a year at York University in Ontario, Canada, to start a Master's program with Dr. Brock Fenton. In the midst of packing up my family for the move to

Tips on Establishing Research Partnerships Between Schools and Wildlife Agencies

THE education-field-research model developed by Stuart Perlmeter and Pat Greenlee for high school science classes has the potential to effect change in the way science is taught and to encourage students to pursue careers in biology. They have prepared the following tips to help others interested in establishing such programs in their own schools.

Establishing Cooperative Relationships

1. Identify a teacher and wildlife agency official with the dedication to commit and follow through with such a project.

2. Establish clear objectives for both parties in the partnership. Include provisions for how responsibilities will be delegated and how much financial support will be provided by the school district and other agency.

3. Involve school administrators in planning and developing the project. A supportive administrator can help you clear unforeseen hurdles.

4. Establish a good working relationship with parents of the students involved in your project. They can be powerful allies if school administrators or board members question the value of the project.

Selecting Students as Research Assistants

1. Have a clear set of criteria for selecting students. Keep the number small enough to ensure that each student will be kept busy with work (this number will vary depending on the nature of the research).

2. Student participation in the project should be contingent on approval from all their teachers and an understanding that they must maintain good grades in all their classes.

Being Prepared for Field Research Trips

1. All students who will handle bats must be vaccinated against rabies. Approach the local medical society or a public health clinic to help defray the cost.

2. Conduct pre-trip visits to field sites to locate adequate living arrangements and to identify safety concerns. Make sure students are clear about safety procedures and how to respond if an emergency should arise.

3. Make checklists to ensure that all food items and equipment are brought. Establish a chore schedule for the students.

Educating the Public

1. Contact the local press and television about the project. News stories are a great way to demonstrate to the public that cost-effective and innovative programs are taking place in education.

2. Whenever possible, have the students conduct talks or workshops in schools or for the public at large.

Toronto, I received a call from Jesse Fittipaldi. I dropped what I was doing, called Pat, and headed off to confirm Jesse's discovery: a small cave located in a steep, rocky hillside on private property, with a maternity colony of between 50 and 75 Townsend's big-eared bats. Earlier that year we had received permission from the owner to conduct a preliminary survey for bats and had thus far found only two Townsend's and a handful of little brown bats.

Overjoyed, we recontacted the owner. Our concern and enthusiasm must have been contagious, as he agreed to restrict access to the cave, ensuring protection of the colony. This single experience far exceeded our expectations for the project. Less than a year before, these students showed the fears and apprehensions about bats common to many people. Now they found themselves identifying a rare bat species and playing an instrumental role in protecting its critical habitat.

Another aspect of the project allowed the students themselves to become teachers, giving presentations on the importance of bats in ecosystem management and putting on workshops for schools, public organizations, scientific societies, and wildlife professionals. The integration of many academic skills was obvious and convincing when watching these articulate and self-confident young adults surrounded by an eager group of elementary-age children or officials of the forest management team for the Willamette National Forest.

Even more impressive was their presentation to Forest Service officials in June 1992. In fact, it was instrumental in securing funding for the second year of the project. In Spring 1993 Jesse Fittipaldi and Aimee Hart were invited to present their work at the Northwest Scientific Association Symposium. Warmly received, they demonstrated to members of the scientific community in the Northwest that the work coming out of this

project was more than just another field trip.

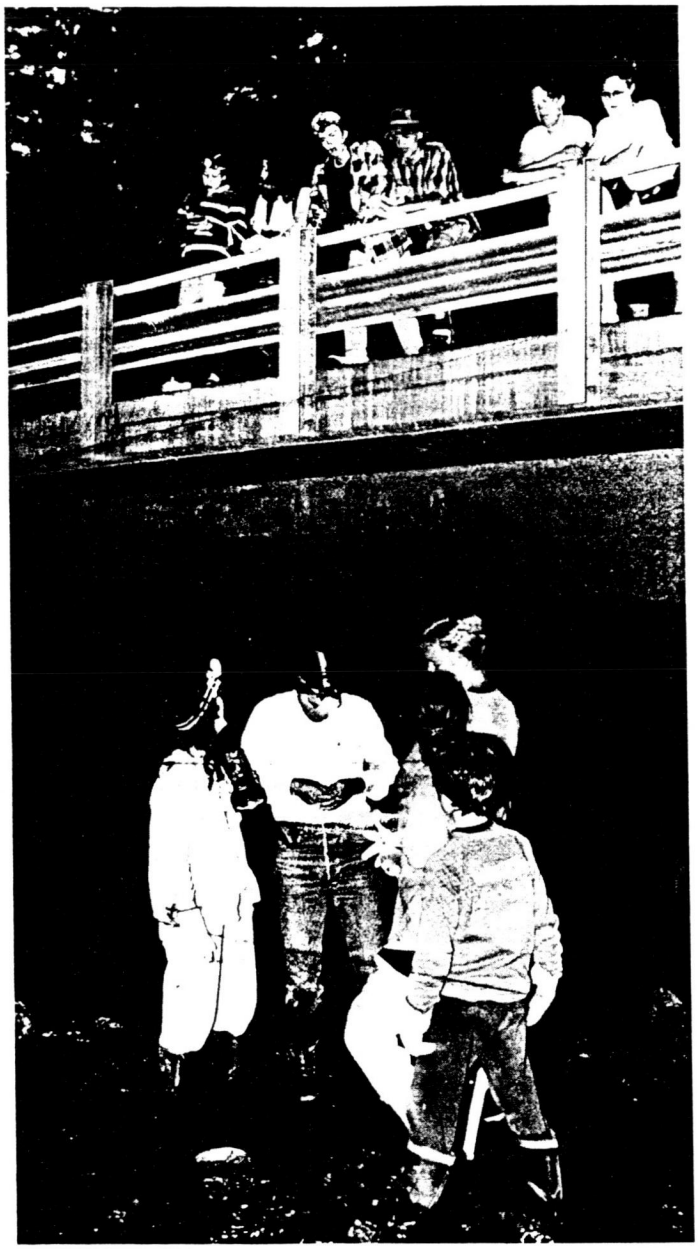
WE CONTINUED THE PROGRAM this summer with four students who were able to devote full time to it. This season we spent considerably less time netting bats because we were concerned that the long hours of tedious and sometimes uneventful work would prove difficult for the students. The students, however, quickly adapted to our long nightly routine and became nocturnal creatures themselves.

Our study area for the next two years will be the Douglas fir, western hemlock forest of the H. J. Andrews Experimental Forest near Blue River, Oregon, a research facility operated by the U.S. Forest Service. The focus of the project has shifted from a broad survey of bridges to developing a more detailed picture of the dynamics of night roosts at four specific bridges. We are now examining the relationship between ambient temperature, night-roost temperature, and occupancy rate.

Unlike barns or other buildings used as night roosts, which are often occupied by one or two species, a peek under the bridges in our study area may reveal as many as five species at one time. Through our work at these night roosts, we hope to determine if patterns of species diversity change with the season. We have also discovered that these same crowded bridges are not totally lifeless in daylight hours. To date, we have documented six male Townsend's big-eared bats using these sites as day roosts.

In addition to our study of night roosts, we began examining how forest age and structure influence the selection of diurnal roost sites for various bat species in the forest ecosystem. Using a temporary adhesive, we secured radio transmitters to several small insectivorous bats for four to five days. Radiotelemetry helped us to locate maternity roosts and define the variables that make them suitable for day roosting. Radio tracking in a forest environment proved to be challenging—a perfect opportunity to repay the students for all their comments about aging. As they huffed and puffed their way up the steep slopes of H. J. Andrews, struggling to maintain their balance while carrying the heavy 5-element antenna and scanner, we had difficulty containing our laughter. We reminded them that forest radio tracking would probably qualify for alternative credit in the physical education department at the high school.

Preliminary results for at least one species, the long-legged myotis, indicate that they choose to day roost in snags that have a very large diameter



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One of the main focuses of the project was to examine bridges for roosting bats. The students discovered that as many as five species at a time may use a single bridge for some level of activity during the course of a night.

We watched these students gain a level of self-confidence, responsibility, and knowledge that will never be measured by any standardized science test.

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Long-eared bats were frequently found night-roosting under bridges. Next year the project will compare the roost dynamics of four different bridges.

The success of this project has the potential to show other federal and state wildlife agencies that valuable wildlife data can be collected through similar joint projects with public schools.

(over 40 inches DBH*) and that have some degree of bark peeling away from the trunk of the tree. During the 1994 field season we hope to attach at least ten additional transmitters to several other bat species and compare day roost sites.

THIS PROJECT HAS offered me the occasion to fulfill my commitment to teaching as well as my desire to conduct research on bats. We strongly believe that allowing public school teachers a professional development system will go a long way toward keeping good people in the system. Conducting research has the added benefit of demanding that a teacher stay abreast of the latest scientific developments so that these ideas can be integrated into the classroom.

For Pat, the success of this project has the potential to show other federal and state wildlife agencies that valuable wildlife data can be collected through similar joint projects with public schools. Projects of this nature offer the Forest Service a cost-effective means of collecting data, while providing public school teachers with a real working laboratory in which to conduct scientific exploration.

This intense interaction with a small group of students has offered us hope that when young people are provided with an opportunity to learn, grow, and work hard, they respond positively to the challenge. Their commitment and dedication to the project far exceeded our expectations. These students not only proved to be outstanding research assistants, they also became ambassadors of bat conservation to their peers, younger students, and the public at large. Even more, they gained a respect for, and knowledge of, the natural environment and its inhabitants, and they welcome their lifelong responsibility to care for it. They proved that a powerful mechanism for producing effective change in the educational system is to allow students to immerse themselves in a project where they truly feel ownership.

Perhaps most important, we watched these students gain a level of self-confidence, responsibility, and knowledge that will never be measured by any standardized science test. Four of the students from the project's first year have now entered college and have chosen some area of the sciences as their major. When we first started working with them, their goals for education leaned more toward careers in business or other academic endeavors.

As night passed into day on our last field trip of the season, the glow of our campfire warmed the tired lines of our faces as a pair of hoary bats foraged above our heads. We had talked our way through yet another night. Cradled by nature and the darkness, solutions to a wide range of social, political, and environmental issues seemed simple and obtainable. Such clarity prevails in nature.

Around these nightly fires, we covered a curriculum far more diverse and detailed than any single high school class could ever hope to cover within the confines of classroom walls. We were drawn together not by a bell signaling the beginning and the ending of class, but by the small, winged mammals unaware that they had contributed to the education of this team of learners who continue to teach, inspire, and challenge one another.

*Diameter-breast-height, the diameter of a tree measured 4' 6' from ground level.