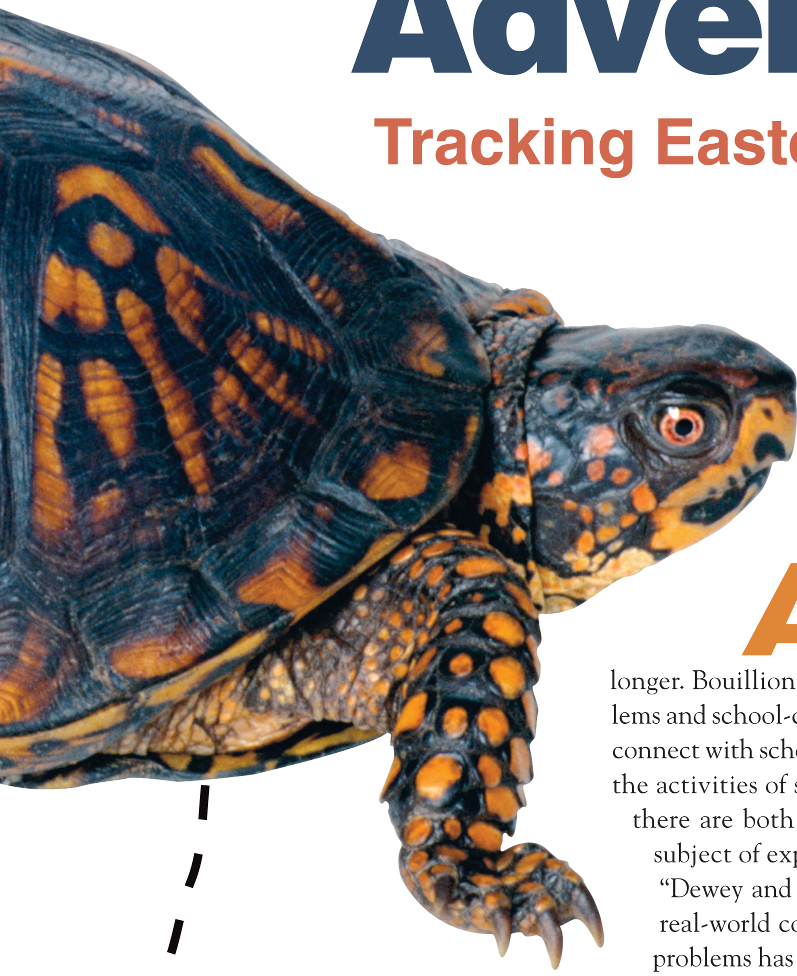
# Outdoor Adventures

## Tracking Eastern Box Turtles



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A thematic and hands-on approach to learning ensures that students develop a deeper understanding and retain information longer. Bouillion and Gomez (2001) argue that real-world problems and school-community partnerships help engage students to connect with school science. When there is a disconnect between the activities of school science and children's own experiences, there are both cognitive and affective consequences. On the subject of experiential learning:

"Dewey and others have long advocated situating learning in real-world contexts and the use of 'authentic' tasks or realistic problems has become a common practice in project based science activities.... The task before us is to help children...feel that the practice and knowledge of schools can have an impact on the world they live in and care about.... At least part of that task will be accomplished when science curricula are connected directly to expertise and lived experience...building bridges to communities beyond school." (Bouillion and Gomez 2001)

This project was designed to engage middle-grade students in an authentic task involving the study of an endangered species, the eastern box turtle (*Terrapene carolina carolina*). It emphasizes learning by doing and promotes character growth, teamwork, reflection, and literacy. This article describes the process of coming together under these theories to study a population of eastern box turtles. The project's goals are to:

- bring together the middle school, university, and community to educate students about the environment and the importance of stewardship;
- integrate math, science, reading, computer literacy, and scientific field techniques in a science classroom and interdisciplinary project; and
- produce documents that will provide a model for other schools interested in establishing hands-on science with conservation implications.

## *The concept*

Eastern box turtles are long-living reptiles that are late to mature and have few offspring. Habitat loss, road kill, and international pet trade demands are a few of the reasons that concerned scientists are raising questions about viable population numbers and the long-term survival of this species. In 1994, the United States submitted a proposal to regulate box turtle trade to other member nations of the Convention on International Trade in Endangered Species (CITES) (Dodd 2001). Due to a lack of national biological data for this species, conclusive evidence of its decline could not be determined. However, many respected scientists believe that continued pressures on box turtles will be detrimental to their survival given their particular biological characteristics (Howe 1996).

We performed several turtle-tracking trials prior to seeking and receiving two $5,000 grants from the local university and one $5,000 Environmental Protection Agency (EPA) grant. These funds allowed us to purchase the equipment and supplies needed for this project, although it is possible to conduct a low-tech version with very little funding.

Locating, marking, and tracking the box turtles on the school grounds and adjacent property serves as the foundation from which all of the other activities evolve. Students weigh, measure, and identify the gender of the turtles. They record information about landscape features and identify plants that live in the habitat where the turtles are found. Students also complete handwritten data sheets, enter data in a computer-based spreadsheet, and use the same electronic equipment that professional researchers use to learn about wild animals. This technology is integrated in the field through the radio telemetry and GPS study, and in the classroom when classes input tracking data into spreadsheets. Teachers and students practice field techniques, study turtle morphology, discover the flaws and frustrations of determining the age of live turtles, and learn how to determine home ranges and the importance of population monitoring.

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**FIGURE 1** **Safety concerns with box turtle capture**

CAUTION

1. When you pick up a box turtle, hold it firmly by the upper shell. Don't let your fingers get caught in a hinge should the turtle decide to close its shell.
2. Wash your hands after handling turtles and before you eat or rub your face. Turtles and all other reptiles can carry Salmonella, but if you follow careful hand-washing procedures then the risk of contracting it is minimal.
3. Avoid dangling your fingers in front of their heads …yes, box turtles might bite, although this is unusual.
4. The biggest safety concerns are incidental and to be expected in fieldwork. Box turtles enjoy briar patches and poison ivy (at least that's where we often find them) and, of course, other pests such ticks and stinging insects are likely to be in the out-of-doors. When working near roads, exercise particular caution with respect to cars.
5. And, most importantly, for the safety of the turtles: Do not move them around casually or allow others in your project to do so. Do not allow your field study site to become a dumping site for turtles that are displaced by well meaning but misinformed participants. Almost without exception, turtles should be returned safely to the place they were captured.

## *Finding turtles*

Most people are familiar with box turtles because they see them on roads and in their yards. These terrestrial turtles move in search of food, mates, or (if female) a place to lay eggs; they are likely to be seen on roadsides because roads have transected many of their home ranges. However, finding a box turtle when you *want* to find one is a different matter altogether.

Initially, we tried to locate turtles by simply walking the school property on favorable weather days, but quickly realized that visual searches for box turtles conducted dur-

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*Students weigh, measure, and identify the gender of the turtles.*

ing class periods would not be productive enough in our area to carry the project forward. To solve this problem, we contacted the owner of two hunting dogs (two Boykin spaniels) that were trained to catch box turtles unharmed. Their owner had been marking and releasing box turtles near his home in Tennessee when we approached him about helping with our project. He enthusiastically joined us and the dogs proved quite successful at finding the turtles. The dogs discovered more than 90 percent of the turtles we tracked. No turtle in this study has ever suffered an injury from either a dog or a human working on this project (see Figure 1 on page 33 for safety concerns with box turtle capture). (Note: Turtle people tend to find one another if they talk about their projects. A good way to learn about others working with box turtles in your area is to contact your local or state natural science museum.)

If you don't happen to know someone with box turtle-catching dogs, but know someone with either Boykin spaniels or Labrador retrievers, consider that both breeds of dogs have been trained successfully to capture box turtles for research. If you don't have access to dogs and decide to conduct this study using only visual searches, you may spend a lot of time looking and not much time locating box turtles; however, box turtle densities vary enormously from region to region. Our experience has been that counties that include protected areas, such as national or state parks or forests, or those less impacted by agriculture and heavy traffic, can have much denser populations of box turtles. This suggests that school groups in rural but non-agricultural areas may have better success finding box turtles by searching visually. There are several other methods of finding box turtles that we have not tried yet in this project, including coverboards (plywood sheets or pieces of old tin roofing that are placed strategically in the environment to attract reptiles) and feeding stations.

If you don't have dogs and don't want to spend time looking for box turtles, then you may want to consider studying other, more easily located reptile and amphibian species. It is important that you decide on a species that will yield successful data for students to analyze. If you are in an urban area and feel like you are unable to conduct fieldwork, or if you are looking for other case studies, the *Looking at our Environment* project offers an excellent case study of the gopher tortoise in Florida. You can access materials to teach this case study in your classroom at *www.late.worldwatcher.org*.

**FIGURE 2 Suggested equipment**

The following items are kept in a couple of backpacks so the instruments for fieldwork are handy. The list includes the items as well as approximate costs.

- hydrometer and thermometer (relative humidity, air, and soil temperature)—$40
- flagging tape (to mark location)—$3
- spring scales (or digital)—$10–$60
- triangular file (to mark turtles)—$6
- pencil or indelible ink pen (no standard ink pens)—$3
- receiver and antenna (if radio tracking)—$900–$1,200
- data sheets (morphometric and locality)
- global positioning system unit (if available)—$180
- list of codes that will be used on next turtles
- map of property to mark location
- wristwatch (to record times of location and release)

## *Radio tracking*

We tracked six box turtles using radio telemetry. This activity requires the purchase of telemetry equipment (receiver and antenna) and battery transmitters (see a list of suggested supplies in Figure 2). Small thumb-sized transmitters are anchored to the back of each turtle's upper shell with epoxy (Schubauer 1981; Eckler et a1. 1990). We use a Telonics TR4 receiver and a Wildlife Materials TRX-1000S. With one receiver we use a flexible antenna called a "rubber ducky" and with the other a rigid antenna. Cost of both receiver and antenna is roughly $900–$1,200. We prefer RI-2B transmitters from Holohil Systems, Ltd., which cost about $180 each and must be ordered weeks or months

**The very engaging, hands-on, outdoor nature of these activities kept students eagerly involved.**

**FIGURE 3** **Locality data survey sheet**

Turned name and/or ID: ________________ Date: _____________________ Day of week: _________________
Scribe: ____________________________ Group leader: ______________ Time turtle was located: ________
Total number in group: ________________ Names: ___________________________________________
_____________________________________________________________________________

How was the turtle located? (circle one) 1 = radio tracking 2 = visual 3 = dog 4 = other

GPS information: Elevation: _________________ Latitude: _____________________ Longitude: ___________

Turtle's activity (circle one):
1 = inactive, in view 2 = inactive and covered 3 = walking 4 = winter hibernating

Unable to determine because: 5 = turtle deep in brush 6 = dog capture 7 = other

Was the turtle touched? (circle one) yes no

Head (circle one): 1 = in 2 = out 3 = not known

Habitat (circle one): 1 = road 2 = edge (of habitat boundary) 3 = field 4 = forest
5 = stream or stream bank 6 = open wetland 7 = forested wetland 8 = other, describe below:

in advance, especially if the order is placed in late spring.

Student trackers, guided by their science teacher, meet regularly after school to track the turtles' movements. Training in the use of this tracking device takes several hours, including practice sessions to get the hang of listening to "chirps," locating the correct frequency (each turtle's transmitter is set to a different frequency), and then locating the turtle. However, once a turtle's relative location is known, it takes just a few minutes of training for students to find them.

## *Student involvement*

Initially, student involvement was limited to volunteer students who worked after school, on weekends, or occasionally during an elective class. These students joined either a tracking team or a public speaking team. Together, about 15 students played significant roles in the box turtle project over its first two years. Later in the project we incorporated several "turtle days" that involved whole-class turtle tracking. This typically involved breaking students into three groups (five to eight students per group) that rotated among three activities: observing the dogs capturing turtles, hands-on tracking of turtles with receivers, and classroom-based environmental activities. Several strategies were used to curtail potential management issues during these large-group turtle tracking days. First, in the days leading up to the field experience, teachers reviewed fieldwork protocols and acceptable behaviors in the field. Using small predetermined groups allowed teachers to distribute students in such a way as to thwart potential pairs of unruly students. Finally, the very engaging, hands-on, outside nature of these activities kept students eagerly involved. As the project became more successful, the headmaster of the school decided to make the turtle project an elective class.

## *Recording the data*

Turtle behavior and measurements were recorded on two data sheets. The locality data sheet focused on habitat choice and characteristics (see Figure 3) and the morphometric data sheet focused on collection of physical data from the turtle itself (see Figure 4). The morphometric data is a good way to teach science concepts and processes, such as how to use scales and calipers and record data accurately. The site data is important for learning about habitat needs and preferences. Studying activity ranges for each turtle demonstrates that individual turtles prefer a particular area and allows students to hypothesize about how a turtle might meet its basic needs for food, water, mates, nesting, and hibernation within that limited range. This data is important in stressing the conservation theme of the project. Roads, habitat destruction, and people taking turtles away from their home ranges threaten turtle populations all over the world. Once turtles were captured, the following student activities formed the basis for recording data:

*Sexing and aging*—Students learned to identify the sex of a box turtle by looking at its eyes: males generally have

**FIGURE 4** **Morphometric data sheet**

Fill out a separate sheet for each turtle. Use only pencil or indelible ink pen.

Site: ______________________ Turtle species: ________________________ Turtle #: __________________

Date: ____________ Day of week: _____________ Time of capture: A.M. or P.M. Recapture? y or n

Collector/Observer(s): ____________________________________________________________________

Gender (circle one): M F Age:________ (circle one) Adult, but not sure Juvenile

Weight (g): ________ Straight carapace length: __________ Left abdominal scute at midline: _______________

Plastron length (PL), anterior to hinge: _______________ PL, posterior to hinge: _______________

Overall width at hinge (mm): _______________________ Maximum width (mm): _______________

Shell height at hinge (mm): _________________ Shell height at center (mm): ____________________________

Turtle's activity/behavior: ________________________________________________________________________

Scute counts: _________ vertebrals Injuries/defects/parasites: ___________________________

________ Left costals ________ Right costals

________ Left marginals ______ Right marginals

Location of capture (county, nearest town, road and distance to nearest intersection, name of landowner, etc.)

__________________________________________________________________________________________

Habitat (circle one): 1 = road 2 = edge (of habitat boundary) 3 = field 4 = forest
5 = stream or stream bank 6 = open wetland 7 = forested wetland 8 = other, describe:

Capture method (circle one): 1 = road capture 2 = observed while mowing 3 = visual search

4 = radio signal 5 = dog 6 = other, please describe: __________________________________________

Released at point of capture? yes or no Date and time released: _________________________

If not released at point of capture, why not? __________________________________________________

If not released at point of capture, where and how far from the point of capture was the turtle released? _______

Comments: ____________________________________________________________________________________

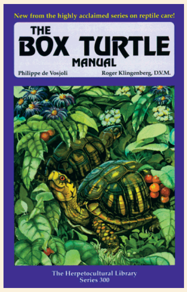
bright red eyes, while females have brown, yellow, or dull red eyes. Students also learned to determine gender by the shape of the shell. Male box turtles have a concave depression on their bottom shell (plastron) that allows them to stabilize when mounting a female to mate. Students also learned to age box turtles by counting the rings on the scutes, which are called *annuli*. This method provides only a rough estimate, but currently is the only way to estimate the age of a living turtle. Rings are difficult to count if there are more than 20, so the older the turtle, the more difficult it is to age.

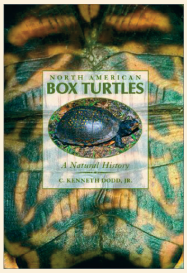
*Weighing, marking, and measuring turtles*—All turtles are weighed using a digital scale. Numerous length and width measurements are made with calipers and the data recorded in millimeters on the morphometric data sheet (Figure 4). All turtles are marked by filing a number pattern on their marginal scutes (those parts of the shell that are arranged around the edge of the carapace) and then released at the point of capture (Gibbons 1988). Recaptured turtles are remeasured only if one year has elapsed since the last measurements were taken.

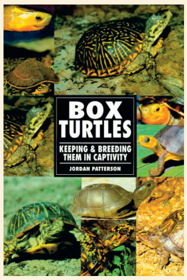
*Abiotic factors: The box turtle's habitat*—Site, temperature, and weather data are collected for every capture. Other important information includes time spent searching (a.k.a. search effort), method of collection (human or dog), substrate (soil) temperature, weather data (air temperature 2 cm above the ground and relative humidity), and habitat characteristics (dominant vegetation type and height, and distance the turtle is located from the edge of habitat). Thus, we have a fairly complete record of habitat preferences for each turtle. Our turtles thus far indicate a definite preference for edge habitat, spending most of their time at the junction or edge of the forest and an old field. Students can search for any reptile or amphibian on their school grounds using these techniques and data collection methods.

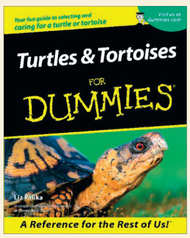
**FIGURE 5** **Box turtle books**

- DeSpain, P. 1994. *Eleven Turtle Tales*. Little Rock, Ak.: August House.
- De Vosjoli, P. and R. Klingenberg. 1995. *The Box Turtle Manual*. Mission Viejo, Ca.: Advanced Vivarium Systems.
- Dodd, C. 2001. *North American Box Turtles, A Natural History*. Norman, Ok.: University of Oklahoma Press.
- George, W. 1989. *Box Turtle at Long Pond*. New York City, N.Y.: Greenwillow Books.
- Korman, S. 2000. *Box Turtle at Silver Pond Lane*. Norwalk, Ct.: Soundprints and the Smithsonian Institution.
- Palika, L. 2001. *Turtles and Tortoises for Dummies*. New York City, N.Y.: Hungry Minds, Inc.
- Patterson, J. 1994. *The Guide To Owning a Box Turtle*. Neptune City, N.J.: T. F. H. Publications.
- Schneider, R., M. Krasny and S. Morreale. 2001. *Hands on Herpetology*. Arlington, Va.: NSTA Press.
- Wilke, H. 2000. *Tortoises and Box Turtles: A Complete Owner's Manual*. Hauppauge, N.Y.: Barron's Educational Series.




*Using GPS units, maps, and mapping to record turtle positions*—Students learn to use handheld Global Positioning System (GPS) units to read elevation, latitude, and longitude when box turtles are located. Data are recorded on the locality data sheet (Figure 3). If your school does not have access to a GPS unit, you can get a topographic map of your school site and read elevation, latitude, and longitude measurements from the map.

## Sharing the results

In addition to students who volunteered to be on a turtle tracking team, a number of students volunteered to be on a public speaking team to share results of our study with middle level students at other schools in nearby counties, the state middle school science teachers association, and members of organizations related to the research. Additionally, students went to local elementary school classes to share their knowledge of box turtles with younger children.

## Conclusions

Tracking turtles has been a high profile project because of the gentle and charismatic nature of the turtles and the university/school/community partnership. We have generated interest in box turtles in students, teachers, and members of the community. Students have become aware of the interdisciplinary nature of curriculum and have learned specific information from the sciences, mathematics, and language arts, as applied to real-world conservation issues. (See Figure 5 for a list of recommended books on box turtles for classroom use.) Students have had opportunities to give public presentations to elementary school students, other middle school students, professional herpetologists, and science teachers.

## Resources

We have produced a number of documents that will help other schools implement similar studies. Documents include a poster, several PowerPoint presentations, and a science curriculum integration notebook. We are currently working on a box turtle research techniques handbook and a chapter for a forthcoming book on integrating the middle school curriculum. For additional information please contact Elizabeth M. Walton at *chippery@juno.com*. ■

## References

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