

Meeting the Standards with Vanishing Frogs

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Abstract:

The purpose of this article is to explain how to introduce high school students to the issue of declining amphibian populations by reading the book, *Tracking the Vanishing Frogs: An Ecological Mystery* (Phillips 1994) and playing a game based on concepts introduced in this book. In this article we present a teaching/learning activity in which high school biology and environmental science students practice both reading comprehension and graphing skills, important skills stressed by recent educational reform efforts (NRC 1996). *The National Science Education Standards* suggest actively engaging students in inquiries that interest them and relate to current science topics (NRC 1996). The issue of global decline of frog populations has proven both interesting and important to our students. Engaging in the activities suggested in this article presents an opportunity to enhance students' understanding of possible outcomes of human disturbances in the natural environment, the interdependence of organisms, and the nature of scientific inquiry.

Article:

Background

Since the late 1980s, catastrophic frog, toad and salamander declines have been of great concern to scientists. In *Tracking the Vanishing Frogs*, Phillips (1994) recounts the decline of various frog species from around the world. The Golden Toad has disappeared completely from the mountains of Monteverde, Costa Rica, its only known habitat. The gastric brooding frog in Australia has not been seen since 1981. Yellow-legged frogs and red-legged frogs are in trouble in California. Numbers of Yosemite toads, Cascade frogs, leopard frogs and western toads, once abundant in the Cascade Mountains, dropped precipitously in the 1980s and have not recovered. *Tracking the Vanishing Frogs* is an excellent text to use to introduce high school students to the issue of declining amphibians.

In *Nature* (2000) scientists report that we do indeed have reason to ask why frogs are in trouble. As humans, do we need to know what is causing the decline of amphibians? Can the problems responsible for declining amphibians affect humans? Are frogs ecological canaries or biological indicators for our environment? If so, what do we need to learn from the decline and what do we need to do to arrest it?

According to the Houlahan et al. (2000) analysis of 936 amphibian populations from around the world, at a global scale amphibians have declined over the past several decades and continue to do so. Moreover, they suggest that the most dramatic declines for amphibians occurred from 1960 to 1966, decades before herpetologists sounded the ecological alarm.

Ideas abound to account for the frog declines, including changes in local climate, acid precipitation, disease, parasites, environmental contamination, habitat loss and degradation due to direct human impacts, and increased UV irradiation (Houlahan et al. 2000; Pounds et al. 1997). Fungal infections are another possible cause of some declining frog populations.

A fungus that suffocates the animals by coating their undersides and legs has destroyed communities of frogs in Australia and Central America. It is possible that the fungus is spread by herpetologists (Kabbany 1999).

Agricultural chemicals may also be causing some of the declines. When scientists at Trent University in Ontario, Canada, exposed frog eggs and tadpoles to a common pesticide, they found that the frogs experienced high death rates and unusual growth and development patterns (Kabbany 1999).

Ultraviolet radiation causes DNA damage in frog eggs. The increase in UV radiation may be attributed to the depletion of stratospheric ozone (Blaustein et al. 1998).

Undoubtedly, there are other possible causes of local frog declines. As an example of habitat degradation due to direct human impact, the introduction of exotic species into wetland habitats has become prevalent. The introduction of exotic species reduces resources available to native amphibians. Nonnative trout have been released into mountain lakes in California where the yellow-legged frog population has declined. The nonnative trout have made a meal of the slowly developing yellow-legged frogs (Adams 1999).

Clearly, recent studies (Houlahan et al. 2000) provide evidence to support global amphibian population declines. Of the 936 populations of amphibians studied, 61 populations became extinct. Pounds and his colleagues (1997) who have studied amphibian populations in Costa Rica reported that they gathered data for five years expecting amphibian populations to rebound quickly. Unfortunately, amphibian populations have not rebounded; the amphibian fauna remains impoverished. The next section of this article discusses instructional strategies that teachers can use to make students aware of the issue of declining amphibians and the search for causes and implications of amphibian decline.

Instructional Strategies

One instructional strategy that we used in our classrooms was a Paideialike seminar based on *Tracking the Vanishing Frogs*. This approach requires approximately one week of class discussion time (after students have read the book) if you are on a block schedule. First, we divided the class into groups of three, with each group responsible for one of the nine chapters in the book. Depending on class size, long chapters (5, 7 and 8) can be divided or short chapters (1 and 2) may be combined. After reading their chapters, students generated questions to guide the discussion of their assignments. We encouraged students to draft interesting questions that they thought their classmates would want to discuss. Students wrote questions on an overhead transparency before the actual discussion day so that the rest of the class had a chance to read the chapter and answer the questions. Students led the discussions of their chapters. We acted as facilitators and timekeepers, and occasionally interjected with supplemental materials or activities. We gave all students a loose-leaf binder where they kept all questions, answers, notes, and supplemental handouts for each chapter. At the end of our study, we used these notebooks to assess student achievement of learning objectives, for example:

- Students will show awareness of the issue of declining amphibians.
- Students will demonstrate understanding of the interdependence of frogs and other organisms in their environments.
- Students will demonstrate an understanding of the relationships between biotic and abiotic factors in ecosystems.
- Students will show awareness of the impacts of human activities (such as logging, riding 4-wheelers, and grazing cattle near rivers) on the environment.

Following the seminars, we played the game. In some semesters we were unable to read and discuss the entire book and thus opted to use just the Frogs' Futures Game with our students. This game is based on reading selections from chapter 9 of *Tracking the Vanishing Frogs* (Figure 1) and can be completed in one 90-minute class period. This game uses dice to represent the frogs. The game shows students how humans might contribute to an accelerated decline of various frog populations, how extinction may occur, and what might happen to frogs if appropriate conservation measures, such as the Endangered Species Act, are implemented. After we divide students into groups of three, they play four games as described below (Figure 2, Figure 3). Next, they collect

and graph the data for each game (Table 1, Figure 4). Students then compare data from the four different game situations to assess the effects of human activity on frog populations.

Teacher Information

Frogs' Futures Game: Survival or Extinction?

You will need the following materials for your class:

Materials (For Each Group)

- 1 sheet of graph paper
- 20 dice for each group (keep extra dice on hand as the populations of frogs sometime increase)
- 2 paper cup dice containers for each group (one labeled "living frogs" and one labeled "dead frogs")
- At least one copy of *Tracking the Vanishing Frogs* (All page numbers in the following games are referred to the 1994 paperback edition of the book.)

You may want to begin by summarizing or reading the following italicized passage to your class:

Frogs. We do not think of them as cute and cuddly like the panda, dolphin, or wolf pup. However, some scientists believe that they may be nature's calling card, preempting an ecological catastrophe. The purpose of this activity is to identify how altered environmental conditions may lead to the accelerated decline of some frog species and how protecting a species may or may not help the species stabilize over time. In this activity, you will play the Frogs' Futures Game in small groups. This game uses dice to represent frogs and represents how frogs may become extinct if something is not done to prevent their demise.

During this activity, students use dice to simulate the number of frogs that survive during a 10-year cycle. This game has been adapted to *Tracking the Vanishing Frogs*, but could be adapted with little effort to any book, which deals with endangered species. Reading assignments are incorporated into the game. Before each game the students read selections from the book (Figure I), which give them a basis for that game. Alternatively, the teacher may read each of the selections asking students to focus on mental images that the descriptions convey.

After students have read the selection from *Tracking the Vanishing Frogs*

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FIGURE 2 IS OMITTED FROM THIS FORMATTED DOCUMENT

FIGURE 3 IS OMITTED FROM THIS FORMATTED DOCUMENT

Table 1. Game data table template and sample data table.

Year	Game 1 perfect frogland	Game 2 humans vs. science	Game 3 humans vs. nature	Game 4 government vs. nature
0	20	20	20	20
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				

Year	Game 1 perfect frogland	Game 2 humans vs. science	Game 3 humans vs. nature	Game 4 government vs. nature
0	20	20	20	20
1	22	16	4	12
2	25	14	0	7
3	24	9		8
4	32	6		4
5	30	6		3
6	25	9		3
7	22	6		3
8	20	6		0
9	21	5		
10	21	4		
11				

(Figure 1), they play the specified game (Figure 2, Figure 3). The data for each 10-year period game is recorded in the data table (Table 1). Then, the results for each of the four games can be graphed (Figure 4). Groups may graph their results on one sheet of graph paper, but should use different colors to represent each trial so that the trials are easy to distinguish. Finally, students answer the questions below.

Questions

1. Explain the results from your games. What happened to the frog population in each game? Explain why the number of frogs changed with each game.
2. If the frog population did not decline after habitat destruction, what might be the reason?
3. Based on research you find in the library about frog decline, what do you think is causing this mass declination around the world?
4. What do scientists think UV radiation has to do with frog declination?
5. Compare and contrast the scenarios you read and the dice game that followed. Rank them from best to worst with respect to frog survival and explain your rankings.
6. Why should we care about frogs?

7. What are the global implications of frog declines?
8. What are your solutions to the problem of declining frog populations?
9. Find at least one species of frog that has benefited from some ecological disturbance quickly replacing native/endemic species (e.g. *Bufo marinus*, the cane toad). [There is an excellent video called The Cane Toad that is suitable for classroom use and makes a nice addition to a unit on amphibians.] Explain what happened to benefit the frog. How did it affect the environment?

Web Connections

The following web sites will provide you and your students with additional information about declining amphibian populations. Remember, however, that all Internet information should be verified from the source.

1. <http://www.frogs.org.au/> The Victorian frog group's web

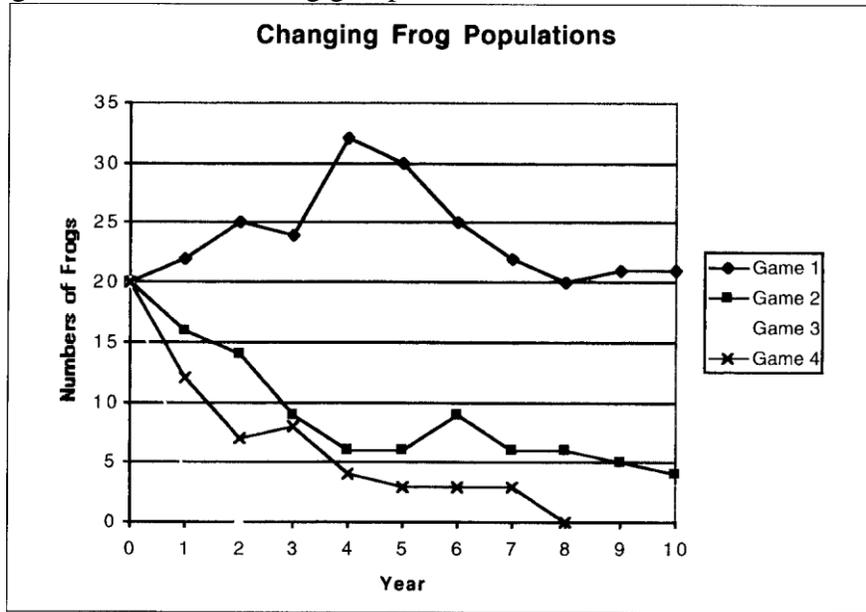


Figure 4. Sample graph.

site includes a classification key for frogs of Victoria.

2. <http://www.mncs.k12.mn.us/html/projects/frog/frog.html> The Minnesota New Country School Frog Project's web site deals with the problem of deformed frogs in local ponds.
3. <http://www.cgee.hamline.edu/frog/index.html> The web site for the Center for Global Environmental Education at Hamlin University is a comprehensive site that includes lots of frog facts and information on frog declines. A PowerPoint® presentation on frogs has good pictures of frog malformations. This site also includes information on how students can become involved in the efforts to save frogs.
4. <http://www.im.nbs.gov/amphibs.htm> The web site of the North American Monitoring Program contains technical information on frog surveys. This site also offers information on how to incorporate amphibian conservation in the classroom.
http://www.aquarium.org/education/spotlight/disappearing_frogs.
5. This web site offers a short, lighthearted fictional account of a frog that seeks the help of a detective in order to find its missing children. This site contains lots of factual information on frogs and the environmental conditions that negatively affect frogs. A short quiz is at the end of the program.
6. <http://www.open.ac.uk/daptf> The home page of the Declining Amphibian Populations Task Force gives a brief synopsis of the causes, importance and findings related to the decline of amphibian populations worldwide.
7. <http://www.npsc.nbs.gov/narcam> The web site for the North American Reporting Center for Amphibian Malformations (NARCAM).

Conclusion

Scientists do not know the specific causes of the declines of certain amphibian populations, but most scientists do agree that declining amphibian populations is indeed a problem. It is an enigma based on an interplay of factors symptomatic of the general decline of environmental quality (Pelley 1998). We as teachers should do our part to make students aware of the environmental problems surrounding frog populations and what these difficulties may tell us about our future. The awareness we pass on to our students today may result in gains in awareness, knowledge and more informed stewardship.

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