Environmental Studies
FACT SHEET
www.curriculum-press.co.uk
Number 149

Conservation Case Studies: Frogs

This Factsheet:
- Describes the importance of frog conservation
- Uses Case Studies of frog conservation studies to illustrate How Science Works

There are about 5,200 known species of frog in the world and they inhabit every continent except Antarctica. However, their populations are under threat from pollution, climate change, infectious disease, invasive species and habitat loss. But why should we care about frogs?

Frogs have several features that make them very useful **bioindicators**:
- Most species require both aquatic and terrestrial habitats so their populations are a good indicator that suitable habitats are being maintained
- Their permeable skin easily absorbs toxic chemicals so a decline in a population may indicate pollution
- They act as both predator and prey so they are an integral part of the food web

Frog conservation also benefits medical research (Table 1).

Table 1 Medicinal value of frogs

Species	Use
Waxy monkey frog 	Secretes dermaseptin which is used to treat antibiotic resistant Staphylococcus bacteria
Phantasmal poison frog  *(credit Paulinwiki commons)*	Produces epibatidin an extremely powerful painkiller
Whites tree frog 	Produces caerin which blocks HIV transfer
African clawed frog 	Produces magainin used to treat foot ulcers

Many frog populations are in serious decline but before a conservation strategy can be implemented scientists need to identify the causes of the decline – this is not always easy.

How Science Works: Deformed frogs legs across the US

In the mid 1990s there were many reports of frogs having deformed legs. Scientists initially suspected four possible causes: heavy metal pollution, pesticide pollution, infection by parasitic worms or UV-induced genetic damage.

Scientists collected a large sample of frogs.

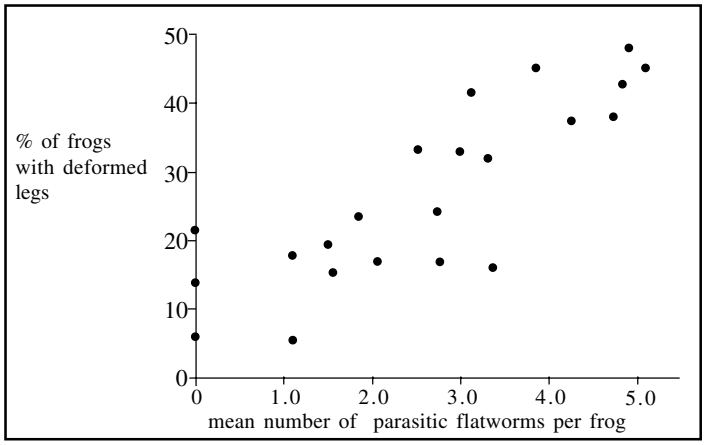
Q.1 Apart from getting a large sample, what would the scientists have need to do to ensure that their data were **reliable?**

Key term
Reliability relates to the consistency in (or your confidence with) a set of measurements. **Reliability is improved by repetition** - if repeated results lie close together then the results have high reliability. Taking repeat measurement also helps you identify and omit anomalous results – those that are clearly out of line with the other data.

Hopefully you realised that the data would need to be randomly collected, involve a single species collected at roughly the same time from a large number of different ponds.

It quickly became apparent that many of the deformed frogs had infections of parasitic flatwoms. Fig.1 shows the relationship between the mean number of parasitic flatworms found in the frogs and the percentage of frogs with deformed legs.

Fig.1 Relationship between the mean number of parasitic flatworms found in the frogs and the percentage of frogs with deformed legs



Q.2 Which of the following conclusions were the scientists able to reach?
- As the mean number of parasitic flatwoms increases, so too does the percentage of frogs with deformities
- The number of parasitic flatwoms appears to be positively correlated with the percentage of frogs with deformities
- The parasitic flatwoms are causing the deformities

The scientists were concerned that they could find very few ponds that had not been influenced by human activity and the only ones that were pristine were in remote mountainous areas. Thus, they concluded that their sample size was too small to establish a clear pattern and that by pooling data from a large number of ponds that had obvious human influence with a much smaller number of pristine mountain ponds, they were not comparing like with like. They concluded that they did not regard their data as sufficiently reliable to draw firm conclusions.

A second team of scientists took a different approach. They investigated six ponds; all six contained the parasitic flatworms. Three of the ponds were polluted by run-off from agricultural fields. The other three ponds did not receive agricultural run-off.

Two cages of uninfected frogs were put into each pond. One cage had a mesh that allowed parasitic worms to enter whilst the second cage had a very fine mesh that the worms could not enter through. Table 2 shows their results.

Table 2

	Percentage of frogs with deformed legs					
	Ponds polluted by run-off			Ponds not polluted by run-off		
Pond no.	1	2	3	4	5	6
Cage that allowed entry of flatworms	25	24	27	6	6	4
Cage that prevented entry of flatworms	0	0	0	0	0	0

Q.3 What could the scientists conclude from their data?

How Science Works: Deformed frogs legs across the US Answers

2. The first two conclusions are valid but the third one isn't. Correlation is not the same as causation. Other factors may be involved and, as you can see on the y axis, some ponds had no flatworms but did contain deformed frogs.

3. They concluded that it was the parasitic worms that were responsible for the deformities. Not a single frog became infected in the cages where the mesh prevented the worms from entering. However, frogs in all the wide-mesh cages became infected. The wide-mesh cages that were polluted from run-off had the highest rates of deformity suggesting that the pollution was making the effect of the flatworms worse.

Since then, attempts have been made to reduce fertizer run-off into ponds and to reduce the populations of the flatworms. It has become apparent that the problem of deformed frogs is caused by a combination of the fertilixer run-off and the flatworms. The increased nutrients entering the ponds led to an increase in algal growth which, in turn led to an increase in the population of water snails – which the flatworms use as a host. Thus, more snails led to more flatworms and an increase in deformities.

Saving the Spotted Tree Frog

The Spotted Tree Frog is a critically endangered species in the Central Highlands in Victoria in Australia. The Tree Frogs live in the vegetation growing along the banks of fast flowing rocky mountain streams in moist woodlands. They are mainly threatened by introduced trout that prey upon their eggs and tadpoles.

Scientists implemented a strategy using barriers to try to prevent the trout from moving to upstream regions and thus reduce predation. To evaluate the effectiveness of this strategy, the scientists measured the abundance of Spotted Tree Frogs at eight 0.25ha sites.

The survey results are shown in Table 3.

Table 3.

Abundance of Spotted Tree Frog before barriers erected	Abundance of Spotted Tree Frog after barriers erected
8	4
2	8
3	2
6	6
4	5
5	4
4	7
6	2

Typical Exam Question

Identify possible harmful ecological effects of this strategy and assess whether it worked.

Markscheme

disruption to the breeding or feeding patterns of other species;
disruption to the food chain;
strategy unsuccessful because abundance unchanged / no obvious increase in the population;mean abundance remained at 4;

How Science Works

You have been asked to investigate whether the declining populations of frogs was due to acid rain. Preliminary research reveals that acidification may harm frog populations by reducing the number of fertilised eggs which hatch into tadpoles.

Plan an investigation, which you could personally carry out, to test this hypothesis. Use the following headings:

(a) Plan of the investigation to be carried out (7)

(b) Recording of raw data measurements, presentation of results and methods of data analysis (5 marks)

(c) Limitations of your method and an indication of further work which could be undertaken (4)

(Markscheme at end of Factsheet)

Identifying conservation priorities

Australian scientists surveyed frog populations in three 20km^2 regions, X.Y and Z. Each survey lasted 2 days and nights and was conducted in spring. The weather was sunny during the surveys in regions X and Y but the weather was very wet during the survey in region Z. The scientists wanted to evaluate the species richness, abundance and diversity of each region. Table 4 shows some of their results.

(a) Define each of the following terms:
  (i) Species richness;.
  (ii) Species abundance;
  (iii) Species diversity (3)

(b) Identify the region with greatest species richness (1)

(c) The scientists calculated Simpson's Diversity Index as a measure of the species diversity of the frogs in each region. The table shows the results.

Region	Species Diversity Index
X	0.84
Y	0.78
Z	0.67

The results of the survey are to be used to decide which region should be prioritised for conservation funding. Use the information in the tables to list the three regions in order of priority for protection and funding. Explain your reasons (4).

Table 4. Number of recorded frogs in each region

Species	Conservation status	Region		
		X	Y	Z
Common froglet	Not threatened	14	12	74
Green and golden Bell frog	vulnerable	0	3	0
Southern brown tree frog	Not threatened	8	10	34
Leaf green tree frog	Not threatened	7	3	0
Giant burrowing frog	Vulnerable	3	0	0
Eastern banjo frog	Not threatened	4	8	18
Lesuer's tree frog	Not threatened	5	0	0
Spotted marsh frog	Not threatened	8	0	9
Striped marsh frog	Not threatened	4	0	10
Southern barred frog	Critically endangered	0	4	0

Markscheme

(a) (i) the number of different (frog) species;
(ii) the total number of individuals of each (frog) species;
(iii) a measure that incorporates the species richness (number of species) and the relative abundance of each (frog) species;

(b) region X;

(c) Region Y, then X, then Z;
Region X has the greatest species richness, the second highest abundance (34 individuals) and the highest species diversity;
It has one vulnerable species;

Region Y has the next greatest species richness, with six species, and the second highest abundance and species diversity;
However, it contains two threatened species;
including the only population of the critically endangered Southern Barred Frog;

Region Z has the greatest abundance, the lowest species richness (5 species), and no threatened species;
Completely different weather during sampling may reduce the reliability of the data but with the high numbers recorded counted this is probably not important unless a small species was totally missed;
With no threatened species and low species diversity, region Z is the lowest priority;

Practice Question

The table shows some strategies that have been used to try to conserve the natterjack toad.

Strategy	Reason
Mow or allow grazing of grass around ponds	Natterjack toads feed on beetles that prefer short grass as a habitat
Create shallow ponds	Deep ponds harbour predators that eat natterjack tadpoles
Maintain pond pH between 5 and 7	Optimum pH for natterjack tadpoles

Some conservationists argue that these strategies may harm the populations of other important species.
Explain how this harm may occur (2)

How Science Works: Investigation plan answers

(a) Null hypothesis;
stated number of fertilised eggs used (at least 10);
from same species/ from same batch of eggs;
placed in measured volume of water;
in suitable container eg glass tank;
control of pond water;
pH adjusted by addition of dilute sulphuric/ nitric acid
method of measuring pH - e.g. indicator;
suitable pH 7 e.g. 4-7;
controlled conditions e.g. temperature / light /I oxygen
method for determining effects e.g. time taken for 50% to hatch;
repeat at each pH;
repeats at each pH to obtain mean;

(b) Table format;

pH	Mean time for 50% of eggs to hatch/days
7.0	
6.5	
6.0	
5.5	
5.0	
4.5	
4.0	

Suitable graph;
Title;
Axes labeled correctly;
Suitable stats test if sufficient data;

(c) difficult to judge hatching point;
difficult to maintain pH;
addition of lab acids not the same as the components/ application rate of acid rain;
exact time of fertilisation difficult to verify / some eggs not fertilised;
investigate effect on other amphibia;
investigate effect on adults egg laying;

Practice Question Markscheme
Reduction of species that prefer long grass around ponds;
Reduction of deep pond predators;
Uncontrolled prey may than become a pest/problem;
Reduction of species that do not prefer pH 5-7;

Acknowledgments: This Factsheet was researched and written by Kevin Byrne.
Curriculum Press, Bank House, 105 King Street, Wellington, Shropshire, TF1 1NU
 ISSN 1351-5136