Fearing Frog Deformities: Media and Environmentalists Croaking in the Wind

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Hideously deformed frogs, multiple legs sprouting from their various body parts, are the poster amphibians of the environmental movement. Their fragile eggs are supposedly poisoned by agricultural pesticides and other insidious chemical slough, exposed to global warming, and to radiation streaming through the ozone hole. Frogs are utterly defenseless against man's corruption of the environment.

So, what's your reaction when you hear about these deformed creatures? A lot of folks would respond the way researcher Stanley Sessions of Hartwick College did when he heard about deformed frogs in Minnesota. "Actually, when I first heard about the Minnesota situation, I immediately suspected a chemical substance," Sessions admitted. "That's the first thing everybody thinks of. You see a screwed-up animal in the field and that's the conclusion you jump to."[1] Not even Sessions, who ultimately debunked the chemical substance issue with frogs, could ultimately resist the temptation.

Following this line of thought, let me take you on an excursion into the world of frogs to show how public consciousness has been shaped by the media and environmentalists.

Yellow-legged frogs of the High Sierra

Banner Cohen reports, "The mountain yellow-legged frog, *Rana muscosa*, began disappearing from the Sierra Nevada Mountains in the first half of the twentieth century, and the amphibian's decline has become even more pronounced in recent decades. Today, the frog is absent from almost all the Sierra Nevada's high-altitude lakes where it once thrived. The frog's seemingly inexplicable demise has provoked much speculation in the media and among scientists, with parasites, ultra-violet radiation, fungal disease and, especially pesticides blamed for the frog's troubles."[2]

Pesticides and herbicides drifting into the mountains from California central valley farmlands became the favored culprit, and the media and environmentalists played it to the hilt. A minimal amount of data, generated by the U.S. Geological Survey (USGS) was all it took to spawn the inevitable lawsuits by environmental activists. They sued the California Department of Pesticide Regulation and the EPA for failing to review the impact of pesticides on California frogs and other amphibians. Alex Avery reports, "Collectively, these lawsuits have already cost hundreds of thousands of dollars and are far from over."[3]

However, as Paul Harvey would say, here's the rest of the story. It turns out that the disappearance of the yellow-legged frogs has an entirely different explanation. Folks had been stocking the lakes, rivers and streams in the West with all types of fish, starting as early as the 1880s. As part of this action, trout were introduced into the glacial lakes of the Sierra Nevada and by 1924, wildlife biologists noted that mountain yellow-bellied tadpoles and trout were rarely seen in the same lakes. This continued, with thousands of fingerlings being dropped by aircraft in high altitude lakes where there had been lots of frogs but not fish at all.[4] Guess what happened. The frog populations decreased.

Vance Vredenburg of the University of California at Berkeley began removing trout from five separate High Sierra lakes in the late 1990s. He saw frog population explosions and reported: "There are at least 10,000 lakes in the High Sierra. Ninety to 95 percent of them hold introduced species of trout but no more frogs at all. And there may be plenty of lakes that have plenty of frogs, but few or no fish. So the answer is pretty straightforward, and it doesn't get much simpler: with no trout you get an immediate and dramatic response."[5]

Minnesota frogs

In 1995, a group of middle school pupils in Minnesota found some deformed northern leopard frogs, and posted pictures of the poor creatures on the Internet. Mark Rosen observes, "The frog story had all the elements that make a newspaper reporter's ears perk up: children - to provide excellent visuals and add just the right amount of 'cute' factor, a defenseless victim - the frogs, an ultimate evil - pollution, and a possible danger to everyone - the frogs could ostensibly be 'canaries in a mineshaft'".[6] By 1997, an alarming number of newspaper articles had been written on the topic, enough that Stanley Sessions, mentioned earlier in this article, was prompted to comment, "I have never seen a scientific or biological phenomenon grow so fast with so few publications." Later in a 1998 letter to *Science* magazine, Sessions noted that "Approximately half of the recent reports of deformed amphibians in the United States and Canada are from a single study (my own) of one site in California published in 1990."[7]

In September 1997, the Minnesota Pollution Control Agency (MPCA) announced the results of tests at a press conference attended by the national media, including PBS and ABC's "Nightline." The MPCA officials announced that they had found water from sites where malformed frogs had been reported and it was very potent in deforming frogs in their laboratory experiment. However, they weren't able to identify what it was in the water that had caused the problem. They then offered bottled water to families concerned about the wells in their areas.[4]

Bonnor Cohen notes, "Bottled water may have eased the fears of local residents, but MPCA's tests soon came under withering criticism from scientists with the US EPA. According to EPA, it was simply a natural lack of calcium and other salts in Minnesota water that was deforming the laboratory raised African clawed frog embryos, not a chemical contaminant."[8]

As lead EPA researcher Joe Tietge put it, "You could probably take tap water from any county in Minnesota and get results like this. In science, spurious correlations happen all the time," and they are "one of the weakest forms of evidence to support an hypothesis."[9]

Added another EPA researcher: "Results don't mean anything if they are interpreted improperly. Anybody with a tropical fish aquarium knows that if you fill it with tap water it will kill the fish. That doesn't mean your tap water isn't safe to drink."[10]

Looking for the real culprit? It appears to be a parasitic flatworm called trematodes. Two papers that appeared in *Science* in 1999 proposed a parasite theory.[11,12] As Alex Avery notes, "Northern leopard frogs in the wild are afflicted at an early age by a tiny parasitic flatworm called trematodes (ftzbeiroia). The parasites are shed by snails in ponds where they are picked up by frog tadpoles. Once in the tadpoles, they cause cellular dislocations that lead to deformities in adult frogs."[3] The parasite theory was first proposed by Stanley Sessions, the same Sessions quoted early in this article, who initially blamed chemicals. Sessions says of the trematodes, "It's about as close to using an egg beater on the limb bud cells as you can get."[13]

After publishing his theory, Sessions met with high skepticism. He concluded that the entire frog investigation was being manipulated and important evidence ignored in efforts to promote further research funding. He concluded that other researchers were tilting their hypothesis toward at chemical contaminant in a effort to garner more funding.[14]

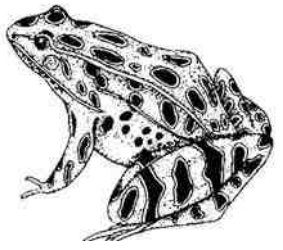
More recent reports support Sessions' findings. Pieter Johnson and colleagues note that the extent and frequency of the frog deformities is not all that unusual. They surveyed museum frog specimens collected 100 years ago and found similar rates and kinds of deformities.[15]

Time magazine's report on global warming's effect on frogs in Costa Rica

Jumping on the global warming scare, *Time* magazine published a special report in their April 3, 2006 issue. Here's what they say about frogs: "With habitats crashing, animals that live there are succumbing too. . . . Last year, researchers in Costa Rica announced that two-thirds of 110 species of harlequin frogs have vanished in the past 30 years, with the severity of each season's die off following in lockstep with the severity of that year's warming."[16]

Courtesy of Mario Lewis, here are some facts *Time* didn't report: "The frogs are not perishing from heat. Annual Costa Rican temperatures have remained remarkably flat during 1979 to 2005. Rather, the frogs are dying from a fungal infection carried by a class of organisms known as chytrids. *Time* argues global warming is increasing cloud cover, which limits the frogs exposure to sunlight - a natural disinfectant that 'can rid the frogs of this fungus.' However, there has been no observed change in Central American cloud cover between 1984 and 2004. So what is causing the frogs to perish in Costa Rica? According to the journal *Diversity and Distribution*, the chytrid fungus was most likely introduced by humans, possibly ecotourists and/or field researchers," wrote University of Virginia climatologist Patrick Michaels in a January 11 story in *World Climate Report*. "

Lastly, on the topic of global warming, recent research indicates that global warming probably isn't triggering a fungal disease killing off Arizona frogs. The culprit in this case also appears to be the chytrid fungus. [18]



Leopard frogs and atrazine

Alex Avery describes Dr. Tyrone Hayes, a California researcher, as "the newest media darling in the supposed 'global frog crisis.' Over the past four years, Hayes has been profiled by *National Geographic* magazine, *Discover* magazine, National Public Radio, and virtually every major newspaper in the country."[3]

Hayes claims that traces of atrazine, one of the most widely used farm weed killers in North America, are affecting frogs from California to the Carolinas. Avery points out, "The media has run with this theory, placing it at the heart of all supposed frog ills. Hayes doesn't argue that atrazine kills frogs or causes deformities. Instead he says that atrazine feminizes male frogs, chemically castrating them. Therefore, Hayes argues, atrazine 'likely has a significant impact on amphibian populations' and should be banned."[3]

Contrary views: Hayes can't explain why after 30 years of extensive atrazine use, frog populations are still thriving in the areas where it is heavily used. Nor can he provide any field evidence that atrazine has harmed a single frog anywhere. Further, scientists from four universities have been unable to reproduce Hayes' laboratory results.[3]

Summary

This short trip into the world of frogs shows how public consciousness has been shaped by the media and environmentalists. Whether frogs were disappearing in California, Costa Rica or Arizona, or deformed in Minnesota, the popular assumption is that a chemical or global warming is the cause.[19] When you dig deeper into this issue, other explanations backed by sound scientific evidence provide a different view.

David Murray and his colleagues sum it up well. The information on frogs would have been perfectly appropriate had it not been transformed (at least by innuendo) into a caution about a looming public health problem. The stories could and should simply have said the following: scientists aren't really sure what's going on and are particularly unsure of whether human beings are at any risk whatsoever. But that story wouldn't have made it onto Page One. The case for all of this is far from open and shut. Perhaps pollutants do play a role. However, it's important to realize that frogs live their entire lives in the lakes that may (or may not) be polluted with chemicals that cause the deformities; human contact with the same conceivable pollutants is less frequent by far, and that makes an enormous difference.[20] ***P&SF***

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Editor's Note:
We would like to mention that Mr. Dini is having so much fun providing these columns that he is churning them out at a rate faster than we can publish them on a monthly basis. Indeed, he has created a blog at http://myblogscience.blogspot.com. If you wish to see more of Mr. Dini's provocative works that might not have appeared in Plating & Surface Finishing*, check it out.*

FINISHERS THINK TANK

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Agitation is also very important to prevent burning and rough deposits. It also permits the use of higher current densities and contributes to fine grained, bright deposits.

Note: The information provided here relates to bright acid copper rack plating of most consumer and automotive goods. The other types of related processes for printing applications - rotogravure and textile, along with electroforming - are not referenced in this review.

The copper anodes required should contain 0.025 to 0.06% phosphorus. Anode baskets are titanium. Napped polypropylene or Dynel anode bags are recommended.

About the bath constituents

Copper sulfate is the secondary source of metal in the plating bath. As in most plating baths, maintaining the copper sulfate above the minimum concentration is required to prevent high current density burning and lower plating rates, as well as poor deposit leveling. Higher concentrations result in harmful precipitation of copper sulfate on the tank equipment, especially coating the anode baskets and deposit roughness.

Sulfuric acid provides the solution conductivity, thereby lowering the voltage required for any current density. Higher concentrations of sulfuric acid promote high current density burning and passive anodes.

Chloride, in conjunction with the organic brightener / leveling additives, prevents deposit burning, dullness, poor leveling and restricted plating current density ranges.

The organic additives consist of proprietary blends that control deposit: grain refinement, brightness, leveling, anti-burn and prevent low current density skip plating.

Analytical control

Wet analysis procedures are commonly used. The copper sulfate is titrated per the iodine - thiosulfate couple method. Sulfuric acid is determined by the acid neutralization titration with sodium hydroxide. Chloride is usually analyzed by a few different methods. In one, the sample is made cloudy by the addition of silver nitrate and the % transmittance of light is measured. Its logarithmic value is then determined, and the concentration is extrapolated on a Beer's Law graph. In another method, the sample is made cloudy by the silver nitrate addition, and then titrated to clarity with mercuric nitrate. Because of the severe restrictions on handling and disposing of mercury containing solutions, this method is not now as widely used.

A Hull cell test normally provides an excellent determination of the deposit characteristics, especially highlighting any defects due to a bath out of balance condition.

Based on specific finishing applications, the possibility of replacing some of the nickel deposit may be an appropriate method for overall cost savings. Back in the 1970s the emergence of nickel-iron alloy baths was somewhat popular during a period of higher nickel prices. Going back a bit farther to the good old days of 1969, the average price of nickel was $1.14/lb. It just goes to show that problems and opportunities do go hand in hand. *P&SF*