Amphibian Decline - Parasites and Increased UV Radiation

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Earthfiles, news category.

May 27, 1999 Corvallis, Oregon - A headline in the Environment section of the October 28, 1996 *Time* magazine said, "Trouble in the Lily Pads - Something ominous is happening to Minnesota's frogs - and it's spreading." Amphibians are particularly sensitive to environmental changes and pollution because they live in water and on land and breathe through their skin. So, like a canary in a miner's cage that will die before the miner does if the air is bad, frogs, toads and salamanders are signaling that something is wrong in our world.

The problem was first noticed in 1995 when school children in Minnesota found deformed frogs. Some were missing a leg, some had withered arms, others had shrunken eyes or none at all. One had nine legs and another had three eyes, one in the back of its throat.

By the fall of 1996, the problem had spread to Wisconsin, South Dakota, Vermont, Missouri, Colorado, California, Oregon, Canada and Japan and by 1997, deformed amphibians found all over the United States were reported in national newscasts.

Theories about what might be happening included chemical pollutants - which no one had found - and trematode parasites which might be taking advantage of weakened immune systems among amphibians, perhaps related to the stress of increased UV light due to the thinning ozone layer.

Finally, hard data did link increased UV exposure to amphibian deformities. Dr. Andrew Blaustein, Professor of Zoology at Oregon State University in Corvallis had his ultraviolet research published in the *Proceedings of the National Academy of Sciences* on December 9, 1997. (*Proceedings of the National Academy of Sciences*, Vol. 94, Pages 13735-13737, December 1997, "Ambient UV-B Radiation Causes Deformities In Amphibian Embryos," by Andrew R. Blaustein, Ph.D. (c) 1997 National Academy of Sciences.)

In a radio interview, Dr. Blaustein explained to me that he placed long-toed salamander eggs in test and control enclosures on lakes and ponds in the Oregon Cascade Mountain Range, which is their natural habitat. He told me: "Both enclosures are exactly the same. They both have shields and they both are

subjected to the same temperatures, same water, same everything, except one of the shields lets UV in and one does not."

What happened stunned Dr. Blaustein. 85% of the embryos in the eggs exposed to the sun's UV rays died. In the remaining fifteen percent that hatched, all but four had skeletal deformities and eye problems. In the eggs shielded from ultraviolet sun rays, 98% hatched and all were normal.

Dr. Blaustein said: "We haven't seen mortality like we're seeing now and we have data that goes back to the 1950's. So, what I'm led to believe is that an environmental change has occurred and is probably ozone depletion. Some of our best data already show that UV is killing plankton under the ozone holes. And there is even a study that shows fish are impacted at certain stages by ultraviolet rays in the Antarctic. I think we have a significant problem here!"

Then in the April 30, 1999 journal *Science*, two studies were published concluding that defects found in frogs throughout the Western United States might be caused by a trematode - a simple parasitic flatworm. The flatworm has a complex life cycle that includes infecting developing legs of tadpoles.

Stanley K. Sessions of Hartwick College in New York, who co-authored one of the *Science* studies said, "Every single frog I have looked at with extra legs - and I have looked at hundreds - all have these cysts around the deformity."

Media, including the *Wall Street Journal*, reported that parasites were the answer to the amphibian deformity and decline problems, but the issue is far more complex. The following are excerpts from an interview on May 26, 1999 with Prof. Andrew Blaustein, Dept. of Zoology, Oregon State University, Corvallis, Oregon. He was a scientific reviewer of both papers in Science in which his research perspectives were also quoted.

Interview:

Andrew Blaustein, Ph.D., Professor of Zoology, Oregon State University, Corvallis, Oregon: "There's confusion now about two totally different phenomena which may or may not be related. The one phenomenon is the whole amphibian decline situation where amphibians around the world are disappearing at rates that are very alarming to many scientists. The other phenomenon which is probably NOT closely related is the amphibian deformity issue where animals are being seen with multiple legs, multiple eyes, deformed bodies, things like that. Those are probably not closely related to one another and the press and part of the media and even some of the scientists have put these two phenomena together erroneously.

So, the amphibian decline problem. As many of you know out there, amphibians are declining around the world at increasing rates. It's part of an overall problem in biodiversity. We're losing our biodiversity such as many of the living species of microorganisms, plants and animals. And amphibians are part of this biodiversity crisis. And the fact is that there are many things that are causing amphibian population decline. There are many agents out there. Amphibians are being insulted by a number of things.

One is ultraviolet radiation. One is pollution. One is introduced exotic species. And there are pathogens involved also. It's obviously clear that there are some global climate changes and associated atmospheric changes that are contributing to some of the mortality we are seeing in amphibians in the field. Some of these global climate changes and some of the atmospheric changes actually cause the immune systems of amphibians to diminish and allows them to get diseases more easily.

WHICH COULD EVEN INCLUDE THE ASSAULT OF PARASITES?
Well, that's a question that everyone is looking at, including myself. And it's possible that these global climate changes are causing immune systems to allow parasites and other pathogenic entities to enter their bodies.

Now, let's talk about the amphibian deformity issue. In my opinion, some of the best work on what is causing amphibian deformity has to do with two studies that came out in the April 30th issue of Science which is the most prestigious scientific journal in the world. And it had to do with parasites as a cause for causing multiple legged frogs. We found them even where I live in Oregon all over the place. And it looks like these parasites CAN cause these multiple legged frogs. But it's not the only cause and it certainly has no bearing on what's making the parasites more prevalent. The parasites have been here at least as long as amphibians, yet all of a sudden, they are getting into the amphibians more easily? Well, we have to figure out why. We think there are some environmental changes that are occurred that are allowing these parasites to enter the amphibians more easily.

As a matter of fact, I reviewed both those papers for Science as a reviewer and I thought they were good papers. But it was just one part of the story and it's been distorted. (The media's) thrust is, 'OK, we found a natural cause of parasites that causes these multiple legged frogs. Let's stop worrying about chemicals and ultraviolet rays and ozone depletion.' If we stop worrying about that, we're in trouble!

BECAUSE FROM YOUR POINT OF VIEW, THEY ARE AT THE ROOT OF WHAT WOULD BE MAKING THE AMPHIBIANS SUSCEPTIBLE TO THE PARASITES IN THE FIRST PLACE.
I think the potential is there that there is some environmental damage or environmental change that occurred and it's possibly fertilizer runoff which is not natural. It's possibly a pollutant from another source. Or, UV radiation. And I think *that* is probably making these animals more susceptible to parasites at this point. They are not going to explain some other incredibly damaging things that have occurred and I didn't talk to you about this, I don't think. But in the Cascade Mountains in Oregon, we published a paper in late 1998, December, showing that frogs that are basking in the sunlight have retinas that are totally destroyed by ultraviolet rays. They are just sitting out there. The UV rays hit their eyes and it destroys their retinas. Now, the implications to humans there are great. If the frogs that are basking out there are having their eyes damaged, humans that sun bathe and don't use sunglasses and are out there all the time can have the same damage.

IS OREGON THE FIRST PLACE IN THE UNITED STATES WHERE YOU'VE CONFIRMED RETINAL DAMAGE FROM UV RADIATION?
At this point, it's the only place I know of. The only paper that's published that shows there is retinal damage in the frog or maybe even in any vertebrate - I think we are the only ones who have shown it right now. It's pretty confirmed.

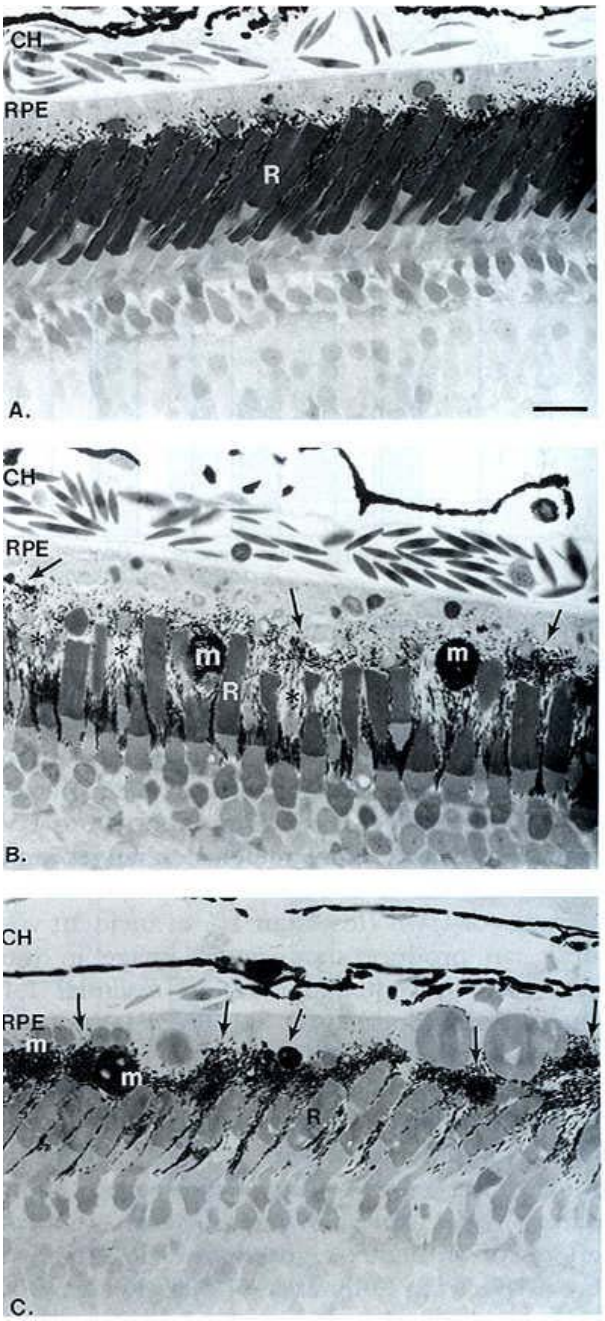
I think it is one of the most alarming things that can be totally related to what can happen in humans. We know that UV rays can cause immune system dysfunction and causes cataracts in humans. And obviously, if you have retinal damage in a frog, the implication is there for many other vertebrates, including humans."

More Information:

Below are three photographs of retinal damage in frogs labeled A, B and C.
A = is a transverse section from the retina of a spotted frog that was not subjected to UV radiation.

B = Retinal section of a spotted frog that has light damage. This shows regions of abnormal distributions of retinal pigment epithelia (RPE) melanin pigmentation (arrows).

C = Retinal section of a Cascades frog taken from the wild from the mountains of Oregon showing major abnormalities of RPE pigment distribution consistent with UV light damage.



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