

*The Toxics Issue Relative to Invasive Species Eradication:
What are the Concerns for Future Projects?*

— Lisa Arkin, Oregon Toxics Alliance
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Earlier this year, a diverse group of people met to take a look at how Oregon would adopt policies and procedures to address the problem of invasive weeds. What became clear at that meeting was that each person – whether they were representatives of the Department of Agriculture, the Invasive Species Council, Oregon Tilth or Oregon Toxics Alliance – expressed shared goals of environmental protection and environmental viability. That meeting was facilitated by Lisa de Bruckere who expertly led us through a group discussion to identify our values and goals. The points of consensus far outnumbered the points of disagreement.

I came away from that meeting with the hope that both the folks who work in an agency setting and folks who work in the NGO setting are essentially reaching for the same goal. That goal, as I perceived it, is to give utmost attention to protecting the environment. If we aren't doing that, then what is the purpose of our work all about?

Even with the same goals in mind – it's not that simple. No, it's not simple because our different training and perspectives result in substantial differences about what we strive for in methodology and outcome; we also disagree over our understanding of what is at risk and we look at different data sources to inform ourselves.

In fact, in a discussion with ODA staff members I discovered that we often use many of the same words, without being aware that for each of us, the words had different meanings – 180 degrees different! A good case in point is our use of the word “precaution.” In ODA's perspective, precaution is about getting the jump on non-native invasives using early detection and eradication in order to protect Oregon's natural environment. According to my perspective, precaution is about evaluating the full range of consequences of our actions by first identifying the safest options and then striving to eliminate real and potential harm in order to protect Oregon's environmental health.

The catalyst for the theme of this presentation was my realization that we shared many of the same goals, and used many of the same words, yet arrived at divergent conclusions about how best to protect Oregon's environmental health. I'd like to talk about the three concepts that I'll bet everyone here in this room uses, but probably assigns them very different meanings. I believe that these three topics will inform and pivotally shape the future of Oregon's policies on invasive species control.

1. First, the concept of Precautionary Action – what does it mean to err on the side of caution? What is meant by applying caution prior to any action?

2. The second is Risk Assessment versus Alternatives Assessment – in human terms, how do we assess and minimize adverse health impacts from the use of synthetic pesticides? In terms of ecosystem health, what are the full consequences of our actions, or decisions not to act?
3. The last is Human Rights – do people have certain inalienable rights and are these sometimes at odds with invasive species eradication efforts? If so, how do we go about respecting those rights?

Starting with Precautionary Action, what does it mean to make precaution a policy? Over time we have learned more about the potential dangers of pesticides. There are many chemicals society thought were beneficial and safe, but now we understand they are not – so we must first accept that science is not fixed. To the contrary, it is an evolving effort, influenced by technology, economics, politics and culture. The precautionary principle allows us to make decisions using the best information we have at the time, even in the face of scientific uncertainty.

The precautionary perspective is evident in yesterday's announcement from the EPA that they will form a "pollinator protection team" to address the potential risks that pesticides may contribute to what is known as bee colony collapse disorder. The important part of the EPA's press release was their statement that

"Although the role that pesticides play in the phenomenon *has not been scientifically established*, the team will explore possible approaches, tools, and resources for reducing the potential risks of pesticides."

In this statement, our nation's environmental protection agency has essentially acknowledged that scientific uncertainty should not be used to delay efforts to solve an environmental problem – in other words, action can be initiated upon the suspicion of harm, and simultaneously with gathering more scientific evidence.

Another example of how the precautionary principle is becoming an accepted policy guideline is the Oregon legislature's recent vote to ban deca-brominated diphenyl ether (Deca-BDE), which is found in mattresses, furniture and electronics. Water quality advocates were joined by the International Fire Fighters Union to support a ban on the chemical for two reasons: 1. Deca-BDE breaks down into a more toxic form in the environment, which is suspected of harming wildlife and humans; and 2. There are safer alternatives for deterring fires. Public opinion shifted away from believing in the benefit of suppressing fires in electronics and fabrics if that meant using chemicals suspected of poisoning human health and the environment.

Banning Deca-BDE is taking action in the face of scientific uncertainty – which is the crux of the Precautionary Principle. There have been no known deaths or hospitalizations from the chemicals; however Deca-BDE is detectable at high levels in breast milk and in tissue samples taken from salmon, and it is being tested for its possible role in cancer, endocrine disruption and neurological harm. Those warnings served as convincing reasons to institute the ban.

Last week, the California Office of Environmental Health Assessment proposed to list 30 additional chemicals under Proposition 65. Prop 65, which is codified in Health and Safety Code section, requires the State to identify a list of chemicals known to the state to cause cancer or reproductive toxicity and requires warnings on consumer products containing any of these substances. A number of insecticides and herbicides, including some chlorophenoxy herbicides are on the Prop 65 list. Identifying risky chemicals and immediately reducing their use is Precautionary Action.

Aspirin is also on the Prop 65 list. Is that just California going over the top? After all, we've all taken aspirin and we are here today as living proof that it wasn't so very toxic, right? Interestingly enough, the Prop 65 listing contains a precautionary note, one that serves to illustrate the value of the Precautionary Principle:

Aspirin - Note: It is especially important not to use aspirin during the last three months of pregnancy, unless specifically directed to do so by a physician because it may cause problems in the unborn child or complications during delivery.

As noted, listing aspirin as a toxin is a targeted warning for vulnerable populations at special times in their life cycle. Taking action to protect vulnerable populations, the unborn, children and mothers, is a central tenet of acting with precaution.

To sum up – if the safety of a product or technology is questionable, or if safer alternatives are available, the Precautionary Principle establishes that society must be able to choose those better alternatives, and in some cases choose to avoid harm altogether.

Precautionary action goes hand in hand with risk assessment, our second topic. Risk assessment and risk communication are certainly terms that elicit diverse meanings. Conventional risk assessment raises a narrow set of questions on harm. They are often linked with limited cost-benefit assessments, which quantify immediate costs of regulations to producers but usually fail to account for costs and benefits to society over time.

Conventional risk assessment is an approach that attempts to measure an 'acceptable level of harm' with a high degree of certainty. Risk Assessment asks these wrong questions:

- How much harm is tolerable before people take notice?
- How much harm is legally defensible?
- How many vulnerable people will society allow to die (or get cancer, have birth defects, or suffer from asthma?) to balance out the economic benefits

I want to emphasize this point: The assumption of risk assessment is, "How much harm can we tolerate?"

In contrast, the public's growing concern about environmental health is challenging the underlying assumption of risk assessment as it is conventionally applied. The public is calling for a different set of assumptions based on the question "How much harm can we avoid?"

Of course, we all understand that our world cannot be "risk-free," but environmental health advocates and the public are shifting to an Alternatives Assessment model. This model takes into account our knowledge of safer alternatives to the many toxic, carcinogenic, and environmentally destructive practices and products in use today.

Alternatives Assessment is a process that explores all possible risks associated with an action and prioritizes solutions that are least harmful, including the choice of not taking action. Inherent in Alternatives Assessment is a belief that a risk that is *unnecessary, and not freely chosen*, is not acceptable.

Alternatives Assessment raises new sets of questions:

- Is this the best way?
- Is this potentially hazardous activity necessary?
- Who benefits from the various alternatives?
- Who pays or suffers harm?
- In light of alternatives, how can public health be better protected?
- In light of new science, should current practices be reevaluated?

Asking these questions should not be construed as public opposition or as agitation – as has often been the case. To the contrary, I am suggesting that the public’s concerns reflect a change now taking place in the scientific and medical community about risk assessment.

Research on environmental influences impacting health and disease has led to a new paradigm of toxicologic understanding. The old paradigm, developed five centuries ago by Paracelsus (also known as von Hohenheim), was that ‘the dose makes the poison.’ However, for exposures sustained during early development, another critical, but largely ignored issue is that ‘the timing makes the poison.’ Scientific, medical and philosophical paradigms are focusing on new evidence that a number of other factors must be considered - age and health at time of exposure, duration of exposure, genetic differences, synergistic effects and cumulative impacts are factors more determinant of risk than is a simple equation of dose predicting the level of harm.

This extended paradigm – known as toxicity testing – is attracting wide attention as necessary to protect the fetus and child as well as those who are already vulnerable due to existing diseases and conditions.

The goal of toxicity testing is to develop data that can ensure appropriate protection of public health from the adverse effects of exposures to environmental agents. It uses advances in systems biology, epigenetics, and computational toxicology to transform risk assessment from a system based on using high doses of toxicants on laboratory animal testing to one that can evaluate subtle changes in human biologic processes.

Within the field of toxicity testing, a new approach to understanding the low-level health risk from pesticides is the concept of cellular-response networks—interconnected pathways composed of complex biochemical interactions of genes, proteins, and small molecules that maintain normal cellular function, control communication between cells, and allow cells to adapt to changes in their environment.

See the handout that has been passed out titled Toxicity Pathways. This information was published this year in the study “*Toxicity Testing in the 21st Century: A Vision and a Strategy*,” conducted by the National Research Council, and sponsored by the U.S. EPA.

As illustrated, in the cellular-response network, pathways activated by toxicants may be normal adaptive signaling pathways that assist in maintaining homeostasis; however, they are also toxicity pathways in that they lead to adverse effects when the system is sufficiently stressed.

If the cellular response pathways are overly stressed by repeated impacts, normal adaptive processes can become a cascade of dysfunctional responses. Traditional risk assessment does not capture the subtle effects of toxicity exposure on complex cellular response networks. The evidence of an adverse effect outcome that is the result of a series of early, midterm, and late responses may not be measurable in its earliest stages. Furthermore, risk assessment does not account for the cellular responses to combinations of chemicals that interact along the same toxicity pathway.

Toxicity testing is enhancing our knowledge of cellular-response networks and allowing scientists to uncover how environmental agents perturb pathways in ways that lead to toxicity. As a result we will soon grasp the potentially severe consequences of low-level exposures, *in utero* exposures, developmental exposures and exposures to people who can no longer recover because of compromised immune systems or pesticide sensitivity.

The third trend that impacts the way the public perceives the use of synthetic chemicals to control weeds and pests is the issue of human rights.

Human rights to security of person, to health, to security of the home, to a healthy environment, and the right of mothers and children to special consideration have been formally articulated in documents such as the *Universal Declaration of Human Rights* and the *Covenant on Economic, Social and Cultural Rights*, as well as other treaties. These documents have been signed and adopted by governments all over the world.

The beginning of the 21st century may become known as the age of environmental health rights. We can recognize this trend in the growth of the organic food industry and in the passage of consumer safety legislation such as calorie disclosure laws and bans on trans fat content. People expect their government to protect them from assaults to their health and well being.

In fact, the expectation that people have the right to a safe environment has already taken root in Oregon in the form of the Environmental Justice Task Force. This task force, along with the Interagency Group on Toxics Use Reduction, brings all state agencies together to work collaboratively on reducing the need for and the use of toxics in all government programs.

Research and policy organizations such as Environment and Human Rights Advisory acknowledge the power of public support for protection of human rights.

The potential consequences of government agencies ignoring human rights norms are not insignificant. Loss of public confidence in agencies, their Directors and their processes is not a small thing, even from the perspective of the agency, and even when viewed through the lens of basic practicality. When human rights standards are compromised the consequences can be monumental, costly and long lasting.

The take-away point is that the public is demanding the right not to be poisoned by their neighbor, local or global industries or their government. This right is not a [lofty?], virtuous ideal, but is a basic ethical minimum.

In closing, I wish to close with a quote from an article published in the journal *Basic & Clinical Pharmacology & Toxicology* in 2007 (called the Faroos Statement) as an illustration of the way precautionary standards and human rights are being quickly adopted as a cultural norm for government accountability in the chemical use arena.

“Given the ubiquitous exposure to many environmental chemicals, there needs to be renewed efforts to prevent harm. ... Prevention should not await definitive evidence of causality when delays in decision-making would lead to the propagation of toxic exposures and their long-term, harmful consequences. Current procedures, therefore, need to be revised to address the need to protect the most vulnerable life stages through greater use of precautionary approaches to exposure reduction.”

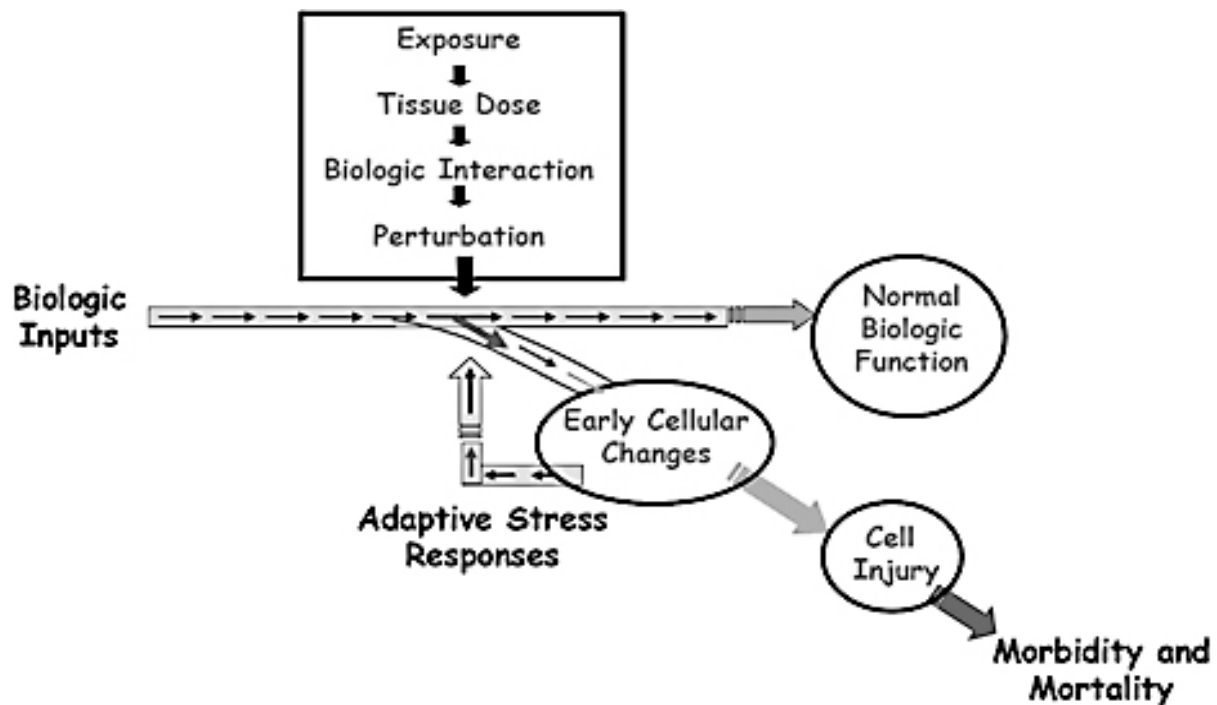
Speaking for my organization, Oregon Toxics Alliance, we recommend two specific suggestions that would enhance the efforts to take on invasive species. I hope that prevention and exclusion would receive the greatest amount of resources in the effort to eradicate invasive species rather than taking extreme measures such as the use of aerial pesticide applications. In that spirit, we would applaud agency efforts to check boats and cars at state borders, and to prevent nurseries from selling or distributing plants that are or may soon be listed as invasive species. In a recent course I took on identifying and preventing the spread of invasives, we learned that many of the species that are currently beyond hope for eradication or control continue to be sold commercially in Oregon – even after they were identified as problematic.

No doubt, different perspectives on invasive species will have to co-exist, and excuse the pun, cross-pollinate. I’ve been told that, if I understood the enormity of the problem, I would change my mind about the need for extreme methods to eradicate invasive weeds. I’ve been handed reams of paper with risk assessments, environmental assessments, and community health assessments ... and told that these would change my mind about accepting the risk of using chemical pesticide and herbicide controls.

The point is not about getting the public to change their minds and proceed in lockstep with eradication plans, but about the fact that over time we have learned more about the potential dangers of chemical control and the data gaps in traditional risk assessment. I would contend that the public will not change their mind about their desire to proceed with as much precaution as possible in the face of poorly understood consequences about human sensitivity to and the environmental fate of synthetic chemical control.

My hope is that the Invasive Species Council and state agencies take precautionary action, alternatives assessment and human rights to be their firm guideposts in future decisions about invasive species work. If these values are incorporated into agencies’ goals they will be opportunities to gain public trust, participation and support.

Toxicity Pathway



Adapted from: Andersen, M.E., J.E. Dennison, R.S. Thomas, and R.B. Conolly. 2005. New directions in incidence-dose modeling. *Trends Biotechnology*. 23(3):122-127.

Definitions related to Precaution and Alternatives Assessment

Systems biology. The study of all elements in a biologic system and their interrelationships in response to exogenous perturbation (“Advances in systems biology: measurement, modeling and representation,” Stephens and Rung, 2006).

Toxicity pathway. Cellular response pathways that, when sufficiently perturbed in an intact animal, are expected to result in adverse health effects (“Toxicity Testing in the 21st Century: A Vision and a Strategy,” a study by the National Research Council, sponsored by the U.S. Environmental Protection Agency.)

Cellular-response networks. Interconnected pathways composed of complex biochemical interactions of genes, proteins, and small molecules that maintain normal cellular function, control communication between cells, and allow cells to adapt to changes in their environment. (“Response-Specific and Ligand Dose-Dependent Modulation of Estrogen Receptor,” Frasor et al. 2003)

An example of how a toxicity pathway works

Responses of cells to oxidative stress caused by exposure to diesel exhaust particles (DEP) constitute an example of toxicity pathways within a cellular-response network (Xiao et al. 2003). In a dose-related fashion, in vitro exposures to DEP lead to activation of a hierarchic set of pathways. First, cell antioxidant signaling is increased. As the dose increases, inflammatory signaling is enhanced; finally, at higher doses, there is activation of cell-death (apoptosis) pathways (Nel et al. 2006).

Thus, in the cellular-response network, pathways activated by toxicants may be normal adaptive signaling pathways that assist in maintaining homeostasis; however, they are also toxicity pathways in that they lead to adverse effects when the system is sufficiently stressed. Can we assess at what point a homeostatic response devolves into a dysfunctional response?

Traditional risk assessment does not capture the subtle effects of toxicity exposure on complex cellular response networks. The evidence of an adverse effect outcome that is the result of a cascade of early, midterm, and late responses may not be measurable in its earliest stages. Risk assessment does not account for the cellular responses to combinations of chemicals that interact along the same toxicity pathway.

In light of the complexity of the biologic response, invasive species management policies should be routinely evaluated by asking the questions of how little harm is possible, how can we protect the public's right to safety and what consequences of all of our actions?