Moving Beyond Obsolete Ecological Risk Assessments

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Moving Beyond Obsolete Ecological Risk Assessments

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RHONDA SAUNDERS

Conventional ecological risk assessments (ERA) for contaminated terrestrial sites, often providing the substance for the research reported in these pages, have been conducted in the same fashion for nearly three decades. The conventional ERAs begin with the presumption that the chemical exposures that mammals and birds experience at sites that linger on in a nonremediated state portend certain health risks. The potential for those risks to manifest themselves as observable effects is then addressed by invoking what remains to be ERA's lone toolbox item, the hazard quotient (HQ). Here the ratio of an animal's estimated dietary chemical intake to a safe chemical dose is computed. Where the ratio is found to be greater than 1.0, it is suggested that the ecological receptor is consuming more of a site contaminant than is safe. In nearly all terrestrial ERAs, multiple receptors are found to have HQs greater than 1.0 for multiple chemicals, and often the HQs far exceed values of 1.0. Completing an ever-familiar ERA sequence, pursuant to the calculation of the perceived-to-be troubling HQs, the process moves on to determining a site's soil cleanup level, this achieved through back-calculation to a soil contaminant concentration that equates with a HQ of 1.0.

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A closer examination of the ERA scheme described above, as it is applied at Superfund-type sites, is revealing. Whereas the "failing" HQs would have us believe that all is not well for site ecological receptors, it seems that for the hundreds and thousands of contaminated terrestrial sites that have submitted to a formal ERA process, not a one provides any observable indication that the site ecology has in some way been compromised. No one, for example, can point to a site where the red fox population is experiencing health effects, or where the fox population has been obliterated altogether. No one can point to a site where the songbird population is any less robust than it was at an earlier time.

A closer examination of the HQ is even more revealing. The U.S. Environmental Protection Agency, among many others, tells us that the HQ is not a risk measure (*1*). We find then, that there exists no metric for assessing "risk", the probability that an ecological receptor will develop a toxicological effect of concern. Technically speaking, we find also that the term "ERA" is a misnomer, and that over the last three decades we have yet to produce a true ecological "risk" assessment. Despite these realities, HQ-based ERAs continue to be generated and with no apparent end in sight. Aside from HQs not expressing risk, they are plagued by a lengthy list of other limitations (*2*). They are not linearly scaled, they assume unrealistically high and toxicologically impossible values, and the lowest concentrations of inorganic compounds found in the earth's crust will produce ecological HQs in excess of 1.0—and even when only that portion of the diet that is incidental soil ingestion is considered (*2*). With this last limitation, seemingly all of what we refer to as "site background" needs to be cleaned up, for the HQs are indicating that ecological receptors located there as well, are consuming unhealthful quantities of naturally occurring elements in soil. Importantly, HQs are also not bound to any time scheme; a HQ of 5 means the same thing at a five-year old contaminated site as it does at a 500-year old contaminated site. Finally, with the HQ-based ERA scheme, chemicals can only be assessed individually. Invariably though at Superfund-type sites, there are a dozen or more chemicals of concern in soil, and the site ecological receptors consume them not in single fashion but via an integrated diet. Concluding statements found in our present day ERAs then, of how individual chemicals either "pass" (i.e., do not pose a hazard, because a HQ is less than 1.0) or "fail" (i.e., do pose a hazard, because a HQ exceeds 1.0) are not truly what are needed.

Let us return to the presumption with which all conventional ERAs begin, namely that there is a potential for health effects to arise in the site receptors. If the ERA weaknesses mentioned to this point do not depict an ineffective assessment scheme, surely a closer consideration of this presumption can help to crystallize that point and show also that the present ERA scheme is obsolete. By the time a conventional ERA gets underway, the prototypical Superfund-type site has been contaminated for a minimum of 30 years, and in that time ecological receptors have lived as many as 100 generations through the affected site condition, this assisted by their life spans being vastly shorter than man's. If toxicological

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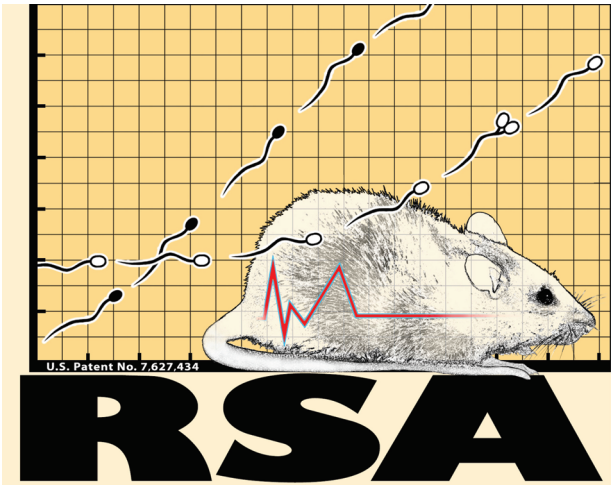
effects were ever to be elicited by a contaminated site, we would know of them by the present day (*3*). And so, to set out to learn of the "'potential" for toxicological effects to arise at historically contaminated sites is an obsolete undertaking.



This past December, a bright spot appeared on the ERA horizon. The Army's Public Health Command (PROVISIONAL) took the proverbial bull by the horns to not only craft a radically different assessment scheme, but to patent it as well. Make welcome Rodent Sperm Analysis (RSA), the only direct health status assessment method for the actual ecological receptor in the wild, and reputedly the only patented method for the greater health risk assessment field (*3, 4*). Leaving behind the conventional ERA process's desktop modeling with its never-ending woes (of unreasonable outcomes and excessive uncertainty), RSA adopts a fundamentally different approach to the central matter of ecological receptors interacting with their contaminated environments. Simply put, it is time to shift tenses, replacing assessments that seek to forecast effects, with those that can determine once and for all, if effects that can seemingly cause receptor populations to succumb have in fact materialized. RSA's so-called fundamental underlying premise, namely that it is too late to be forecasting effects, has been duly vetted, having garnered peer-review acceptance in the literature on multiple occasions. RSA has also been applied at several National Priorities List sites, figured prominently into No Action remedial decisions in several instances (through having supplied the strongest of lines-of-evidence), met with acceptance from the Smithsonian Institution's Department of Zoology, Division of Mammals, and now, in having demonstrated distinct scientific novelty with the recent patent issuance.

RSA may not be the silver bullet (for it addresses only one of the two terrestrial ecological receptor groups, i.e., mammals but not birds), but it holds enormous promise for rendering vastly improved assessments by honing in on the maximally exposed site receptor (the small rodent) and the toxicological end point of greatest concern in ERA studies (reproduction). Now for the first time, the very animals that scurry about at contaminated terrestrial sites are evaluated for their *own* health instead of having them used to feed an ailing, HQ-generating food ingestion model (through quantifying their chemical body burdens). With RSA, if the maximally exposed site receptor is deemed healthy, we can be rather certain that the larger, wider-ranging, and trophically higher receptor is healthy as well. It is critical in this discussion to recall that part and parcel of the present ERA process, is the extrapolation from effects-based chemical doses in laboratory mice and rats to wild species such as fox, mink, and coyote. If extrapolations from dosed laboratory mice in HQ-based ERA can be relied upon in remedial decision-making, surely we can extrapolate from the directly assessed health condition of the field-trapped mouse. With RSA there is for the first time ever, consideration of all three routes of chemical uptake (i.e., inhalation and dermal contact, in addition to the standard-fare ingestion), and even more eye-opening, is the reality that chemical mixtures, to this point termed an unanswerable riddle (*5*), can be squarely addressed. RSA can handily demonstrate that advancing to the field to collect animals need not be a time-consuming and costly affair. Further, an RSA application that provides as definitive a determination about mammalian health as is possible, costs less than does a conventional ERA that is capable of no more than reviewing chemicals singly, and providing unitless expressions of hazard (and not risk).

Seemingly, RSA's greatest contribution to the ecological assessment field comes as an outgrowth of its turning the focus away from predicting ecological effects to that of establishing whether or not effects have taken hold. RSA will likely demonstrate that for every terrestrial Superfund-type site, the actual site mammals will not be found to be harmed in any way. Needless to say, the ramifications of such findings would be profound and far-reaching. Perhaps cleanups are not needed as we always believed.

What remains to be seen is whether the regulatory community can acknowledge that the conventional ERA process is wanting, and that a seemingly superior product has emerged on the ecological assessment landscape. Long-time regulatory agency-implemented practices are not easily shed, and new paradigms are never easily adopted. The outcome of upcoming negotiations with key U.S. EPA ERA representatives, centered about RSA, will tell us if we may be moving beyond obsolete ERAs.

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