ECO

Tri-Service Ecological Risk Assessment Work Group (TSERAWG)

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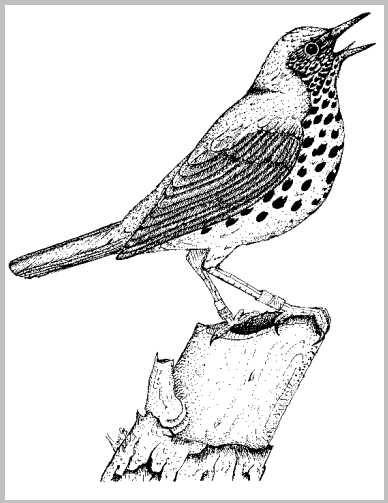

Hylochia mustelina (Wood Thrush)

Welcome to the Tri-Service Ecological Risk Assessment Work Group

Matthew McAtee
U.S. Army Center for Health Promotion and Preventive Medicine

The Tri-Service Ecological Risk Assessment Work Group (TSERAWG) has been meeting since 1996. It was officially chartered in January of 1997 by the Tri-Service Environmental Support Centers Coordinating Committee. The Work Group is organized to share experiences and to coordinate and develop uniform technical guidance for the conduct of ecological risk assessments (ERAs) within the military community. The TSERAWG also provides technical information transfer to member organizations regarding the latest in formation on ERA applications and participates in technical reviews of various techniques and methods in ERA.

The TSERAWG is composed of technical scientists and managers from the Air Force, Army, and Navy. Fields of expertise represented on the Work Group include risk assessment, engineering, toxicology, aquatic and terrestrial biology, soil and plant sciences, chemistry, ecology, and veterinary medicine, and allied sciences.

The Group meets three times per year on average and meeting hosts are rotated among the services.

This is our first Annual Update. It is designed to summarize important activities and actions of the TSERAWG and to provide abstracts of meeting presentations.

For more timely updates on products and for information on meeting dates, our website is the best resource. It is located at the following address:

http://chppm-www.apgea.army.mil/erawg/default.htm

Tri-Service Remedial Project Manager Handbook for ERA

Mary Ellen Maly
U.S. Army Environmental Center

The TSERAWG is preparing a handbook for the person responsible for managing an Ecological Risk Assessment (ERA). Its purpose is to educate the Remedial Project Manager (RPM) about the ERA process so that they can manage the project to meet DoD and regulatory requirements. The objectives of the handbook are to: (1) provide an overview of the ERA process that complies with current regulations and laws; (2) provide a listing of when and where to seek technical assistance; (3) provide a list of key terms cross-referenced for use in an ERA; (4) highlight useful "Rules of

Thumb" for overseeing ERAs; and (5) provide Internet sites with useful information for doing and managing ERAs.

The handbook, written in an easy to read format, is an updated summary of the *Tri-Service Procedural Guidelines for Ecological Risk Assessment* (1996). It also incorporates topics introduced in the U.S. Environmental Protection Agency's *Ecological Risk Assessment Guidance for Superfund*, 1997. This summary attempts to help the RPM understand what the ERA is all about. It is intended to aid the RPM to ensure the ERA stays focused on estimating ecological risk while being timely and cost-effective.

The handbook is final and is available at the TSERAWG website.

Soil Screening Values for Ecological Resources

Activity Summary

Drew Rak
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At the August 1997 meeting, the TSERAWG identified a need for a uniform set of toxicity benchmarks (Toxicity Reference Values, TRVs) for terrestrial wildlife. This need is due to the lack of nationally accepted TRVs for birds and mammals. The current practice is to develop a set of TRVs unique to each site or facility. The current approach is time consuming, repetitive, and leads to inconsistencies in the identification of chemicals of potential concern. A proposal was drafted and an initial subcommittee was formed at the following meeting. The TSERAWG subcommittee met with staff from EPA and the Ecological Soil Screening Level (Eco-SSL) Work Group was initiated. The EcoSSL Work Group is a joint effort by EPA, DOD, DOE, states, and industry to develop a consistent set of nationally uniform soil screening criteria for ecological receptors. While EPA provides the majority of the logistical support, the TSERAWG provided funds and technical input through the ESSL Task Groups 1 and 4 (see related article on Task Group 4). The ESSL Task Group 1 is assigned with developing methods and the subsequent derivation of TRVs for terrestrial wildlife. The wildlife TRV is analogous to the reference dose (RfD) used in the human health risk assessment. The TRV is based on a combination of NOAEL and LOAEL data with a focus on endpoints that would relevant in the maintenance of a population. The initial step in the derivation of the TRV was the identification of the relevant literature. The Army and Air Force funded the identification and compellation of the relevant toxicity studies from the published and gray literature. The initial literature search was performed for 10 chemicals. The EPA has developed a method for extracting the toxicity data and scoring the quality of the studies. Based on the dose information identified in the literature studies, a TRV for birds, small mammals, and large mammals will be selected. The final TRV derivation methods are still being drafted. The current co-chair of ESSL Task Group 1 is Dr. Doris Anders, AFCEE. (Editors note: Mr. Rak was the previous representative.) Several other TSERAWG members are actively participating in the EcoSSL effort.

The Eco-SSL group maintains a web site for members and other interested parties at the following site:

Current Products / Activities

- **Toxicity Reference Value Method Development & Database activities (on-going)**
- **Collaboration with the U.S. EPA and other organizations in the development of Ecological Soil Screening Levels (EcoSSLs)**
- **Guidance: Tri-Service Remedial Project Manager's Guide to Ecological Risk Assessment (2000)**
- **Guidance: Tri-Service Procedural Guidelines for Ecological Risk Assessment (1997)**

We're on the Web!

http://chppm-www.apgea.army.mil/erawg/default.htm

http://38.232.74.161/DYNTRANS/homepage.nsf.

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Using Exposure/Effects Data to Characterize Ecological Risk

Presentation at January 1999 Meeting

Robert K. Johnson
Navy SPAWAR Systems Center

Assessing the ecological risk of toxic chemicals on coastal and estuarine ecosystems requires knowledge of chemical exposure levels, biological effects caused by chemical exposure, and the ecological context for interpreting chemical effects from other sources of stress. Data and information from a study of ecological effects from hazardous waste sites at the Portsmouth Naval Shipyard in Kittery, Maine were used to characterize ecological risk. Ecological risks were characterized by weighing the evidence of chemical exposure in water, sediment, and tissue and the evidence of biological effects to representative pelagic, epibenthic, benthic, eelgrass, salt marsh, and avian species. Individual measures were weighted based on the quality of the data and reliability to infer harm to ecological receptors. The weight-of-evidence approach was used to estimate risk based on the preponderance, magnitude, extent, and strength of causal relationships between the exposure and effects data.

Having defined the levels of risk present, a probabilistic approach was used to identify contaminants that could be responsible for the risk. Using exposure concentrations measured for areas of concern and reference areas (ambient), the probability of an effect or the probability of exceeding a benchmark, criteria, or standard was calculated. Contaminants that had a greater probability ($p > 0.05$) of exceeding effects levels in the areas of concern than for reference conditions were identified as potential risk drivers. The risk characterization identified the level of risk, the confidence in conclusions, and the chemicals most likely to be responsible for risk. The process was acceptable to stakeholders and the conclusions about risk will support risk management decisions.

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Integrated Sediment Management

Presentation at January 1999 Meeting

Stacey Curtis and Sabine Apitz
Navy SPAWAR Systems Center

An integrated approach to understanding contaminated marine sediments can significantly reduce the cost and time involved in managing them. The magnitude of the problem is increasing for the Navy as more sites are identified for possible cleanup and dredging operations are delayed or halted due to the presence of contaminated sediments. A general construct for approaching this problem is to understand which contaminants are present and at what levels, where they are, whether they are mobile, and whether there is toxicity or other biological/ecological problems related to their presence in the sediment. Screening tools can be useful in rapidly mapping the extent of a contaminated site and in limiting the amount of traditional laboratory analysis that is required, thereby reducing overall costs. Additionally, they can be used to monitor remediation efforts at cleanup sites. Various screening tools are being

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developed and used at the SPAWAR Systems Center in San Diego (SSC SD) including Field-portable X-ray Fluorescence (FPXRF) for metals, UV Fluorescence (UVF) for PAHs, video imaging for grain size and contaminant distribution measurements, QwikLite for rapid bioluminescence toxicity testing, and the biochemical toxicity indicator for sublethal DNA effects from a large number of contaminants. Additional tools for benthic flux and mobility assessment include the Benthic Flux Sampling Device (BFSD), the Diver-deployed Pore-water Probe, and the Multi-sample Seepage Meter. Other related tools include sediment contaminant dispersal and fate modeling as well as data management, visualization and interpretation. Historically, sediment management options include no action with associated monitoring; removal; containment including capping and CDFs; treatment; and upland dumping. Cost versus benefit analysis shows that after a certain level, the cost to remove contaminants becomes prohibitive. How contaminants behave in sediments is largely dependent upon the nature of the sediment, therefore, sediment characterization that examines the site-specific contaminant-sediment interactions can help predict what management protocols would be reasonable to use at a given site. Interactions between contaminants and sediment components, the mode of introduction on contaminants into the sediments, postdepositional weathering, and diverse mobility characteristics control behavior of the contaminants in marine sediments, their bioavailability, risk, and the best approach to their management. Sediment characterization may include biogeochemical fingerprinting, contaminant and grain size distribution analysis, visualization, examination of factors that may cause "false positives", and biodegradation potential and microbial health. With such information on hand, a site manager can make a streamlined and informed decision about what remedial options are available, based on site-specific sediment characteristics, allowing for rapid progress toward completion.

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Kriging Analysis & Benthic Bioassay Data in ERA of Harbor Sediments

Presentation at January 1999 Meeting

Christopher J. Leadon
Navy Southwest Division NFEC

The application of kriging analysis (a spatial statistical technique) to the spatial estimation of benthic invertebrate bioassay data, associated with ecological risks from hazardous contamination in harbor sediments. Benthic bioassay data from contaminated sediments in a large harbor at a California Navy base are presented as an examples of the bioassay data used in ecological risk assessments of harbor sediments. The kriging of the benthic bioassay data from the example harbor generally shows that the total number of sampling stations usually planned can be reduced by 10% and the benthic bioassay data can still be adequately characterized. The laboratory analyses of benthic bioassay samples collected for ecological risk assessments in harbors can be very expensive. Kriging can be a very effective statistical method for limiting the number of samples needed to spatially characterize hotspots while still insuring adequate data quality. Maps of the spatial error variance of sample data of a parameter, the error of estimation, can be used to place additional sampling points or minimize the number of additional samples needed at a site.

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Fate and effects of TNT to tiger salamanders (*Ambystoma tigrinum*): A holistic method to address soil toxicity to a terrestrial vertebrate

Presentation at May 1999 Meeting

Mark S. Johnson, Ph.D.
U.S. Army Center for Health Promotion and Preventive Medicine

Predicting risk to wildlife from exposures to anthropogenic substances in a soil matrix has been problematic. Current methods focus on ingestion exposures and neglect other ecologically relevant variables (e.g., alternative feeding regimes, dermal exposures, etc.). Tiger salamanders were chosen as a model to investigate soil exposures to 2,4,6-trinitrotoluene (TNT) in a microcosm design. Tiger salamanders are predominantly terrestrial, fossorial, carnivorous, and relatively long-lived. TNT was investigated since it has been shown to be present in the soil at many Army installations at high concentrations. Initial investigations included an analysis of dermal relative to oral exposures to TNT, using a PCB mixture as a real-time control. Oral exposures contributed most to total body burdens for PCBs where dermal exposures contributed the most for TNT. As TNT concentrations in the soil decreased with time, concentrations of the primary reduction products increased. A subsequent toxicity evaluation investigating immunological stress

effects of both oral and ingestion exposures revealed no TNT-related effects. Histopathological evaluations were inconclusive, yet a histological examination of the liver revealed a high concentration of heavily pigmented, iron-rich phagocytes (melano-macrophages) that may be excellent indicators of stress. Too few treatment representatives were available for an accurate statistical characterization of these cells via image density to be made. This investigation presents a realistic approach and preliminary data for investigating the effects from xenobiotic exposure in a soil matrix for a terrestrial vertebrate.

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Technical Project Planning (TPP) Process

Presentation at May 1999 Meeting

Terry L. Walker
U.S. Army Corps of Engineers, HTRW Center of Expertise

This talk is an introduction to the USACE Engineer Manual, EM 200-1-2, ***Technical Project Planning (TPP) Process.*** As delineated in the guidance, the TPP process is a multi-disciplinary approach, focused on site closeout. Intended to satisfy EPA Order 5360.1 and conforming to ANSI/ASQC E4, this engineer manual promotes the identification of the type of data required for HTRW site investigations and cleanup (both quantity and quality), insuring that the data collected is appropriate for its intended use and that unnecessary data is identified as such and not collected. The process consists of four (4) phases: Phase I - Identify Current Project; Phase II - Determine Data Needs; Phase III - Develop Data Collection Options; and Phase IV - Finalize Data Collection Program. Through development of detailed project objectives, the process results in documentation of detailed data quality objectives (DQOs), Statement/Scope of Work (SOW), detailed cost estimates, the technical basis for sampling and analysis plans (SAPs), quality assurance project plans and work plans. The TPP process is compatible with the EPA's 7-step DQO process (QA/G4), with an appendix providing a "crosswalk" between the two processes. The document is currently being evaluated for publication as a Tri-Service ("Purple") document.

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Army Standard Practice for Ecological Risk Assessment: Development, Use of Toxicity Reference Values (TRVs)

Presentation at May 1999 Meeting

Mark S. Johnson and Matthew McAtee
U.S. Army Center for Health Promotion and Preventive Medicine

An integral component of ecological risk assessment for wildlife is the development of some quantitative measure of the toxicity of a chemical to the animals (or receptors) of concern. There are two common measures. One is a point estimate, commonly referred to as the toxicity reference value (TRV). The other is a mathematical function, the dose-response curve. Toxicity measures that are employed in Army programs have not been consistent or necessarily defensible. This is due in part because regulatory organizations have not yet provided TRVs, dose-response curves, or standardized protocols. This is the first Army Standard Practice for Risk Assessment that describes a procedure for deriving TRVs for wildlife. The Standard Practice is being developed now. Currently, it is consistent with a tiered approach, with an increasing level of effort corresponding with each tier. This level of effort is primarily one of data analysis, not of increasing literature review. The first tier (screening level) includes an analysis of the effects and sets a No Observable Adverse Effects Level (NOAEL) TRV and a Lowest Observed Adverse Effects Level (LOAEL) TRV for all species within a class, without the use of uncertainty factors. This bracketed approach will help to determine the relative concern level for each risk value. The second tier describes a foraging guild specific approach that integrates the use of assessment endpoints. The third tier includes using the benchmark dose or the entire dose/response curve to generate a TRV. These TRVs, including a toxicity profile, references, and the documentation regarding the literature review will be submitted to USACHPPM as Wildlife Toxicity Assessments and be maintained on a web site for use by others. This should result in more consistent risk estimates for wildlife, enhance regulatory approval, and reduce military costs incurred from site-specific repetitive efforts used to date.

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Development of Marine Sediment Toxicity Data: Ordnance Compounds

Presentation at September 1999 Meeting

R. Scott Carr[1], Karen D. Miller[2], and Steven A. Saepoff[3]
(1) USGS, Biological Resources Division, (2) Naval Facilities Engineering Service Center, and (3) Navy Engineering Field Activity, Northwest

Several sites in the vicinity of Naval facilities are suspected of being contaminated with ordnance compounds (i.e., 1,3,5-trinitrobenzene, 1,3-dinitrobenzene, picric acid, tetryl, 2,4,6-trinitrotoluene, 2,4,-dinitrotoluene, and royal demolition explosive (RDX)) from past use, storage, disposal and incineration of these compounds. Little or no toxicity data for marine or estuarine organisms and no Sediment Quality Standards (SQS) currently exist for these substances or their degradation products. Initially, sediment quality assessment surveys were conducted at several of the sites suspected of ordnance contamination. Based on the results of these initial toxicity and chemical surveys, several stations at each site were selected for sediment toxicity identification evaluations (TIEs) to ascertain whether ordnance compounds were responsible for any observed toxicity. In addition a toxicity data base for these compounds was developed using a variety of sensitive marine organisms (e.g., sea urchin, *Arbacia punctulata*, fertilization and embryological development; polycheate, *Dinophilus gyrociliatus*, life-cycle test; fish *Sciaenops ocellatus*, hatching success and larval survival; *Ulva fasciata*, zoospore germination and growth test). The information generated from these studies will be used to support the development of quality criteria and sediment quality guidelines for use in a regulatory framework on a national level.

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Navy Developing Preliminary Remediation Goal Procedures for Sediments

Presentation at September 1999 Meeting

Greg Tracey[1] and Diana Bartlett[2]
(1) Science Applications International Corporation (SAIC) and (2) Naval Facilities NORTHDIV

In response for the need for procedures for the development of site-specific preliminary remediation goals (PRGs) for ecological receptors in aquatic sites, the Navy is developing a document that provides remedial project managers and technical support contractors involved in site remediation with an example approach for calculating site-specific PRGs. This approach, implemented towards the end of the Remedial Investigation (IR) phase, uses the results from the human health and ecological risk assessments to establish sediment-based concentrations that represent thresholds below which adverse effects on ecological and human receptors are not expected to occur. Once developed, the PRGs are used to support the remedial alternatives evaluation in the Feasibility Study (FS) in accordance with the requirements of the National Contingency Plan (NCP) and CERCLA.

The basic assumption of the PRG development approach is that the level of chemicals in the sediment, sediment porewater, surface water, and biota are in equilibrium. Therefore, by monitoring one of the components (i.e. sediment) the Navy can show it is being protective of all the components. The proposed PRG development approach integrates various exposure pathways using a consistent and systematic seven step process separated into two phases. In the derivation phase, information from the risk assessments is used to determine the limiting contaminants of concern (CoCs) and calculate protective concentrations (PRGs). In the implementation phase, a sanity check is done by performing an analysis of site-specificity and practicality of the PRGs for supporting risk reduction and Applicable or Relevant and Appropriate (ARAR) compliance.

This approach was developed by the Northern Division Naval Facilities Engineering Command and has been demonstrated at several sites in EPA Region 1. The document is expected to be available by April 2000.

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Application of Sentinel Species: Environmental Biomonitors

Presentation at September 1999 Meeting

Tom Shedd
U.S. Army Center for Environmental Health Research

The U.S. Army Center for Environmental Health Research (USACEHR) mission is to direct and conduct research, development, testing, and validation in the areas of medical environmental surveillance and environmental health in support of medical force protection. The USACEHR is investigating the use of sentinel biological systems for early

detection of potential toxicity in the environment. The bluegill sunfish and the honey bee sentinel systems under development will be described with an emphasis on the more mature bluegill system described below.

Within the Sentinel Biomonitoring program at USACEHR, an Automated Fish Biomonitoring System was developed to identify developing toxic conditions in water by continuously monitoring the ventilation and movement patterns of the bluegill (*Lepomis macrochirus*). This Monitoring System provides an early warning that reduces the risk of causing environmental damage from a release of toxic effluent. The use of continuous biomonitoring was recognized by State and Federal Regulators and quickly embraced as a monitoring strategy. The Automated Fish Biomonitoring System includes input from researchers, regulators, engineers, programmers, and project site managers for monitoring a complex effluent discharge.

Physiological stress to the bluegills, characterized by changes in fish ventilation and movement patterns, is used as an early warning to identify developing acute toxicity of a treated groundwater (effluent) discharge at Old O-Field, Aberdeen Proving Ground, MD. An IBM-compatible personal computer continuously monitors and records ventilatory rate, ventilation depth, cough rate, and whole body movement of up to 32 fish simultaneously.

Monitoring begins with 16 fish held in control water for a three-day acclimation period followed by four days of baseline data collection. The fish are then divided into two groups (8 fish in control water and 8 fish in effluent). During the subsequent continuous exposure to effluent, the computer provides immediate analysis of statistically significant departures from baseline conditions for fish in the control and effluent-exposed groups. After two weeks exposure to effluent, new fish are placed on-line to continue monitoring the effluent.

The Automated Fish Biomonitoring System, now called The Real-Time Environmental Protection System (REPS), has been integrated with the Groundwater Treatment Facility at Aberdeen Proving Ground, MD. When the monitoring system identifies a potentially toxic effluent (6 fish responding to the effluent), an effluent sample is automatically collected for chemical analysis, a remote monitor in the treatment facility control room identifies the problem to the facility operators, and if necessary, the discharge is diverted to storage tanks until the problem is resolved.

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About ECO

From the Editors

ECO is a yearly report of the proceedings of the Tri-Services Ecological Risk Assessment Work Group. It is published by the collaborative efforts of the editors. There are three types of articles appearing herein. They are either activity summaries or editorials written by TSERAWG members specifically for the publication or they are abstracts of presentations given during a Work Group meeting.

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- US Army Center for Health Promotion and Preventive Medicine
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