The IAEA's Programme on Environmental Modelling for RAdiation Safety (EMRAS II)

EMRAS II
Reference Approaches for Biota Dose Assessment
Working Group 6
Biota Dose Effects Modelling

M I N U T E S

of the First Meeting held at IAEA Headquarters, Vienna
19–23 January 2009

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*Not present, but will likely participate.

Objectives

Working Group 6 "Biota Dose effects Modelling" (WG 6) is interested in understanding radiological impacts to the environment. To do so requires knowledge of exposure conditions, life history characteristics of the organisms exposed, estimation of absorbed dose, derivation of dose-response relationships, and the scientific establishment of dose (dose rate) screening levels that are believed to adequately protect the environment. Much high quality work has already been accomplished in this area by prior European efforts (ERICA and PROTECT), as well as ongoing international work by the IUR and ICRP. Within the framework of the IAEA's EMRAS II Programme, WG 6 will build on what has already been accomplished, and work closely with the IUR and ICRP as they pursue similar objectives. WG 6's overarching objectives are:

— Dose – Effect Modelling to Assist Environmental Risk Assessments;

— Mathematical Derivation of Screening Level Values and Biota Protection Thresholds; and

— Reach Consensus; Document Methods; Publish Guidance.

General Tasks

The following six tasks were deemed important byWG 6. Work plans were established, and individuals accepted responsibilities relative to these tasks.

(1) Update FREDERICA Dose-Effect database [led by **A. Real**; including 9 other WG 6 members]. This database (developed in the FASSET, ERICA and PROTECT projects) is the foundation upon which we will develop new dose-response relationships and taxonomically-expanded screening level values. It was last updated in 2006 and requires input of recent data, some data thought to have been missed from UNSCEAR, as well as input from Japanese / Russian / Ukrainian literature.

(2) Develop Dose-Response Relationships and Derive Species Sensitivity Distributions [led by **J. Garnier-Laplace**; including 7 other WG 6 members]. This group will be trained to develop dose-response curves using the newly updated FREDERICA database (Task 1). Data from the

dose-response curves will be used to derive homogeneous toxicity endpoints (e.g,. EDR50, EDR10 …) for the implementation of species sensitivity distributions (SSDs) and the corresponding derivation of threshold protection values. Past work in ERICA and PROTECT developed ecosystem-level SSDs based on data derived from laboratory experiments in which the organisms had been chronically exposed to external gamma radiation. Within the EMRAS II Programme, we will derive and compare SSDs for organisms that have been acutely exposed, exposed under field conditions, and for various taxonomic levels.

(3) Incorporate Population Models and Explore Alternative Statistical Approaches [led by **T. Sazykina**; including 11 other WG 6 members]. The impact of a specific dose to a population of organisms is likely dependent on the life history characteristics of that species. Populations that produce an abundant number of offspring at frequent intervals are probably less sensitive to radiation than populations of species that reproduce much less frequently and with lower fecundity. Incorporating such life history characteristics into our effects models will likely improve our predictions of effects. This group will review existing population models, develop life history data sheets for key species, and incorporate population models into our effects analyses. One of their objectives is to derive basic equations that govern population models while incorporating radiation effects, with an emphasis on finding an equation that is simple enough to be generally applicable across different species. Additionally, they will explore alternative statistical methods of deriving protection thresholds. The data used to derive SSDs require specific criteria that result in many dose-response data not being used. Alternative approaches (non-parametric and Bayesian methods) may allow greater use of the FREDERICA data.

(4) Multiple Stressors [led by **H. Vandenhove**; including 11 other WG 6 members]. All organisms are exposed to a complex mixture of stressors; and yet, we manage contaminants as if they occurred in isolation within the environment. The chemistry industry is spending much time and money examining multiple stressors. Our group will review the literature for multiple stressor data in which radiation was among the mix; query ecotoxicologists from the chemical industry to see what their most recent conclusions are relative to the need for multiple stressor analyses; and report to the IAEA on whether this should be a topic requiring further exploration in the future. If individuals have sufficient interest and resources we will also collaborate on a common, multi-stressor, radiological experiment. This work is in conjunction with the IUR.

(5) Canadian Benthic Data Set [led by **S. Mihok**; including 4 other WG 6 members]. We have access to a large and diverse data set of sediment cores taken from uranium mining areas throughout Canada. The data include population abundance and diversity information for benthic invertebrates, and might be useful in testing some of the concepts that we develop in Tasks 2, 3 and 4.

(6) Develop and Publish Guidance Documents; Final Report to IAEA (led by **T. Hinton**; with all WG 6 members participating]. We will document the methods that we used for deriving screening levels; provide guidance on the use of screening levels; provide guidance for conducting effects type research, and produce a final report to the IAEA.

Next Meeting

It is planned to hold a 2 day meeting at IAEA Headquarters in Vienna, 21–22 July 2009, in conjunction with Working Group 4 “Biota Modelling”. **NOTE**: Participants must advise T. Hinton of their intended participation by lastest 20 May 2009 in order to ensure enough time for the administrative arrangements and necessary security clearances.

Tasks	Workers	Task Completion
1. Update Data Base 1a. Literature survey 1b. Add new data to FREDERICA database 1c. QA/QC and score entry as to its applicability for dose-response curve fitting	**Lead: A. Real** 1a: Geraskin, Horemans, Sazykina, Stark, Sundell-Bergman, Vandenhove, Yoshida 1b: Copplestone, Horemans, Sazykina, Stark, Sundell-Bergman, Vandenhove, Willrodt, Yoshida 1c: Copplestone, Sundell-Bergman, Willrodt	1a: 15 March 2009 1b: 15 June 2009 1c: 20 July 2009
2. Dose Response Curves and SSDs 2a. train group members for using database and developing dose-effects relationships 2b. establish new dose-response curves 2c. develop chronic SSDs at taxonomic level 2d: develop and compare SSDs for acute vs chronic 2e: publication	**Lead: J. Garnier-Laplace** 2a–2e: Gilbin, Hinton, Lorentzon, Real, Sundell-Bergman, Willrodt, Yankovich	2a: July 2009 2b: Jan 2010 2c: July 2010 2d: Dec 2010 2e: July 2011
3. Pop. Models and Alternative Methods 3a. review existing population models 3b. develop generic population model for radiological assessment 3c. develop scenario for model application (e.g. estimating exposure levels for 10% decrease in population size, etc) 3d. develop life history data sheets 3e. explore alternative methods 3f. run models, compare results 3g. data analyses, reports; publications	**Lead: T. Sazykina** 3a–3g: Avila, Alonzo, Heling, Hinton, Kawaguchi, Kryshev, Lorentzon, Stark, Vives i Batle, Willrodt, Yankovich	3a: July 2009 3b: Jan. 2010 3c: March 2010 3d: Oct. 2010 3e: Dec. 2010 3f: July 2011 3g: Sept. 2011
4. Multiples Stressors 4a. review of literature/report 4b. query the chemical industry 4c. guidance for mixed stressor experiments 4d. conduct mixture experiment 4e. report to IAEA; publications	**Lead: H. Vandenhove** 4a–4d: Copplestone, Gilbin, Hinton, Horemans, Mihok, Oughton, Stark, Saxykina, Sundell-Bergman, Yankovich, Yoshida	4a: July 2009/Dec.09 4b: July 2010 4c: Dec 2010 4d: Jun 2011 4e. Oct 2011
5. Canadian Benthic Data 5a. Determine availability of data 5b. QC for data entry 5c. estimate dose to benthic organisms 5d. conduct multivariate stat analyses 5e. write report/publication	**Lead: S. Mihok** 5a-5e Bonzom, Garnier-Laplace, Hinton, Yankovich	5a July 2009 5b: Dec 2009 5c: July 2010 5d: Dec 2010 5e: July 2011
6. Reports and Guidance Documents 6a: guidance document on conducting effects type research 6b: guidance document on deriving screening levels 6c: Final report to IAEA; submit publications	**Lead: T. Hinton** with help from entire working group	6a: Oct. 2010 6b: Feb 2011 6c: Nov. 2011