Environmental Modelling for Radiation Safety (EMRAS II)

2nd WG Meeting, IAEA, Vienna,

26-27 January 2010

EFFECTS GROUP

sub-group

on Population models and Alternative Methods (led. by Tatiana Sazykina, Russia)

Participants of the sub-group Population Models and Alternative Methods.

We have an excellent team, participating in our group..

Name	Organisation, country
Jordi Vives i BATLLE	Westlakes (UK)
Tom HINTON	IRSN (France)
Isao KAWAGUCHI	NIRS (Japan)
Alexander KRYSHEV	SPA Typhoon (Russia)
Angelica LORENTZON	SKB (Sweden)
Tatiana SAZYKINA	SPA Typhoon (Russia)
Karolina STARK	Stockholm Univ. (Sweden)
Satoshi YOSHIDA	NIRS (Japan)
Tamara YANKOVICH	Ecometrix (Canada)
Luigi Monte	Italy
Rodolfo AVILA *	Sweden
Jim SMITH*	UK
Frédéric ALONZO	IRSN (France)
Rodolphe GILBIN	IRSN (France)
Rudie HELING	NRG (NL)

At the First EMRAS II meeting an activity timetable was developed for the years 2009-2011.

TASKS	Task Completion
3. Pop. Models and Alternative Methods	
3a. review existing population models	3a: July 2009
3b. develop generic population model for radiological assessment	3b: Jan. 2010
3c. develop scenario for model application (e.g. estimating exposure levels for 10% decrease in population size, etc)	3c: March 2010
3d. develop life history data sheets	3d: Oct. 2010
3e. explore alternative methods	3e: Dec. 2010
. run models, compare results	3f: July 2011
3g. data analyses, reports; publications	3g: Sept. 2011

Our first task was: Review of existing population models appropriate for adaptation in radiation effect assessment (non-human biota).

We had a good progress having at least 8 population models, most of which were specially designed to describe radiation effects in populations, and some can be adapted to simulate radiation effects.

The list of models is given in the Table 1.

Table 1. Existing models, simulating the radiation effects in populations of non-human organisms and relevant models; main features of models

Authors	Type of the model	Generic or specific	Environmental stresses considered	Validation or parametrization of parameters
Jordi Vives I Batlle et al.(in press)	Logistic growth model, age classes	Specific for European lobster	Radiation, fishing	Parametrization
Doi, M., and Isao Kawaguchi (Radioprotection, 2005)	Aquatic microcosm model, 3 species	Specific for experimental microcosm	Radiation, ecological interactions	Validation on experimental data
Kryshev, Alexander et al. (REBS, 2008)	Dynamic population model, self-recovery	Generic fish	Radiation, parasites	Parametrization comparison with data

Alonzo, F. and al. (JER, 2008)	Model of age-structured population (single or multiple generation)	Generic, applied to earthworm and Daphnia	Radiation	Parametrization
Monte, Luigi (JER, 2009)	Model based on Lotka-Volterra equations (resources and consumers)	Generic terrestrial	Radiation, migration	Parametrization
Woodhead, Dennis (JER, 2003)	Population model, age-classes, Leslie matrix	Generic, applied to population of plaice.	Radiation, fishing	Parametrization
Hakoyama Hiroshi et al. (J.Theor.Biol, 2000)	Canonical model, logistic growth with environmental fluctuations	Generic, applied to carp, birds	Toxicant	Parametrization
Sazykina T. et al. (Ecol.Model., 2000)	Ecosystem model with limited resource, simplified Mono equations	Generic aquatic	Can be applied to radiation, toxicants	

These models form good basis for developing a generic population approach, which will be able to simulate main features of radiation effects in a population, and show the key parameters, responsible for the resistance of population to radiation damage.

Main Task to be discussed at this meeting is:

3b. develop generic population model for radiological assessment

HOW TO DEVELOP GENERIC MODELS?
Suggestions:

•Transform each participant's model to a simple generic form, which can be applied to a generic population (for example transform the lobster model to a generic form); or select some simple population model from literature. Obtain a set of generic models;
•Incorporate "dose rate-effect" curves/(formulas) for individual model parameters (mortality, birth rate, etc., taken from Jacqueline's results) into the generic models;

- Run the generic models for a range of different dose rates; obtain an output as a population response to exposure ("population dose rate-effect" curves/(formulas));
- Compare the results for different generic models;
- Compare the "dose rate-effect" curves for individual organisms and "population dose rate-effect" curves;
- Select generic population models most appropriate for various ecological situations;
- Make conclusions about the population radiosensitivity vs. organism's radiosensitivity.