[newsletter] Number 39
February 2002

Message from the editor

A note to wish all of our International Union of Radioecology (IUR) members a healthy and happy new year for 2002. Last year was marked by increasing interest and participation of IUR members on the topic of protection of the environment from the effects of ionizing radiation. Last year's activities culminated in a Consensus Conference on Protection of the Environment (October 2001) organized in collaboration with the IUR, which resulted in a "Consensus Statement" containing guiding principles and summary viewpoints for protection of the environment agreed upon by participating individuals. A Specialists' Meeting on Protection of the Environment (November 2001) held by the International Atomic Energy Agency (IAEA) provided opportunities for information exchange, progress reports, and expression of views in three key areas: implications of general protection principles to be considered as a basis for the development of a system for protection of the environment from the effects of radiation; application and specification of protection and assessment endpoints; and examples of reference organisms and tiered approaches that could be applied in a system for evaluating radiation impacts to biota.

Given the scope and variety of international meetings and initiatives scheduled for the coming year, perspectives and recommendations on the development of a framework for protection of the environment from potential effects of radiation will likely become even more focused in 2002. Some of the activities for 2002 are highlighted here. The International Commission on Radiological Protection (ICRP) Task Group on Protection of the Environment is continuing to develop concepts and preliminary recommendations for a system of environmental radiation protection, and continued coordination of the Task Group with its corresponding members is expected in 2002. The Third International Symposium on the Protection of the Environment from Ionizing Radiation, which has as its theme "the Development and Application of a System of Radiation Protection for the Environment", will be held in Darwin, Australia, July 22-26th, 2002. The IAEA is continuing its series of Specialists' Meetings and related activities on protection of the environment. The Nuclear Energy Agency (NEA),

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through its Committee on Radiation Protection and Public Health (CRPPH), is holding a "Forum on Radiological Protection of the Environment" in Sicily, Italy, February 12-14th, 2002. The "International Conference on Radioactivity in the Environment", of which IUR is a co-organizer, will be held in Monaco, France, September 1-5, 2002. And the development of recommendations and approaches for evaluating radiation as a stressor to the environment by individual countries and organizations, and through collaborations, is continuing to move forward (e.g., in Canada, through elements of the Canadian Nuclear Safety Commission, to include an Advisory Committee on Radiological Protection; in the U.S. by the Department of Energy's Biota Dose Assessment Committee, BDAC; and in Europe through the European Commission-sponsored Framework for the Assessment of the Environment, FASSET and EPIC).

IUR members are important stakeholders to the development of a framework for protection of the environment from the effects of ionizing radiation. As such, IUR members are encouraged to remain aware of, become involved in, and express viewpoints on the approaches and recommendations that will result from these international initiatives and conferences. Your viewpoints, perspectives, and progress reports on activities concerning this topic will serve as important contributions to the IUR Newsletter in 2002.

IUR General Assembly was held in Aix-en-Provence, France 4th September 2001

during the ECORAD Conference and 63 IUR members were attending the General Assembly.

The Assembly was opened by the President, Gilbert Desmet.and gave the moral report (see next page).

Status from the IUR activity

The Secretariat introduced and gave a brief overview about the recent IUR activities. In addition different task leaders and members of IUR gave input on work in progress. The issue on the protection of the environment has gained considerable momentum and IUR is one of the central players in this issue as the first organisation endorsing a framework and approach dealing with the protection of the environment. Nick Mitchell presented the flux database and Franca Carini presented the results from the Fruit group. Brenda Howard reported on the Arctic and Antarctic task group. It became clear that in some of the task groups there had been no activity and the ambition of the Board has been too high considering resources available. The General Assembly asked the Board to look into the possibility to reduce the number of task groups. In those groups, where the activity was high, the work had been beneficial and productive.

During the last year 42 new members have joined the IUR and a new Editor has been appointed, Stephen Domotor from USA

Outline of the programme for 2002

The general secretary went through the programme for next year. The programme includes several meetings involving the IUR. The first one is in Antwerp followed by the 5th International Conference on Environmental Radioactivity in the Arctic and Antarctic. The main event next year will be the International Conference on Environmental Radioactivity organised by IUR in cooperation with JER and in association with IAEA. The IUR will also be active in selected groups during 2002.

Financial report and budget

The treasurer described and explained the financial statement for 2000 and the anticipated budget for 2001. She emphasized that there were 2 task groups which were financed for their activities, but for the other IUR activities there was very little spare cash available, with current costs exceeding the membership fee income and other income, such as bank interest. The assembly formally agreed to the accounts and also concurred with the treasurer's view that it is imperative for the IUR to reduce its costs, particularly with regard to management and the newsletters. It was agreed to provide the newsletter over the web and only send it to those members without access. Management costs are also being carefully accessed and reduced where possible. The treasurer proposed membership fee rates for 2002 which were the same as those in 2001, with the only change being an adjustment in the fees paid by members from the USA and Canada to allow for the alteration in exchange rates, to ensure that these members were not paying more than European members. Some Central European members expressed concern at

the level of their fee payment. Nevertheless, the fees for 2001 were accepted by the Assembly.

2002 Fees (See page 8)

The treasurer explained that most task force funds were currently available for the Arctic and Antarctic task force which had three main activities: liason to, and contribution with, AMAP, studies of global fallout contamination in Iceland and Alaska and support for the conference in St Petersburg in 2002 (to which money had been allocated by the Board in agreement with the contractor). Currently, most funds had been spent on the first activity, but the remaining funds would be used in 2002, mainly connected to the conference. The second funded task force on doses to biota had used much of its available funding already."

The election process for the next Board
In 2002 the election of a new Board of Council will take place.
(See page 8)

Moral Report by the President of the IUR, General Assembly 4 September 2001, Aix-en-Provence, FR

Dear Members of the IUR,

It seems to me that 2001 has been an important year for radioecology as many scientific directions have been given new or renewed emphasis. This is on the one hand rather surprising as the major European actor, to say the European Commission, has taken a very low profile recently with respect to programme directions at least; it is on the other hand comforting to see that many other actors such as International Organisations or Governmental Authorities have reinforced their positions. The IUR is involved directly or indirectly in many of the current initiatives.
The list of activities in which the IUR is involved is given in the Report by the General Secretary.
I would like to reiterate the list by giving some views on these initiatives. I would also like to spend some time on the management practices in this scientific society in general. I would like to submit this consideration to the General Assembly for further reflection not only with regard to the future of this society, but also to the future of radioecology as a whole!

In the list of scientific concepts you will note that an old concern has found a new breadth, namely the "Effect of Radiation on Biota". Task group meetings, Workshops and Conferences have been initiated around this theme; the well-known specialists have been called on board to respond to Principle 4 of the RIO Declaration.
From these activities a statement has been issued after an IAEA meeting in 1999, saying that: I quote: *" Nevertheless, a certain number of recent publications have stressed that the existing knowledge is sufficient to provide a basis to begin formalising knowledge into an operational system of radioprotection of ecosystems. The effects studied belong to the determinist category with damage at chromosomic and cellular scale as well as a range of physiological alterations, and their impact on fertility, fecundity, growth, life-span, morbidity and mortality"*. End of quotation.
I endeavour to draw the attention of this audience that the RIO declaration also gives another accent based on these 27 Principles, and which is worked out in Agenda 21, a.o. chapter 15, called the "Conservation of Biological Diversity". In this chapter 15, Protection of the Environment will also find a good basis for its operations. The accent though is not only on "individuals" in an ecosystem, but on the ecosystem as a whole, and on the protection of the genetic pool to be conserved in the ecosystem. Therefore the accent in researches on Biological Diversity is per definition more towards all the actors in the ecosystem, and their "turn-over" in the ecosystem. The effects of environmental factors on Ecosystem stability is complex and the effect of individual environmental factors are to be compared with the totality of the effects on the ecosystem and mirrored against the natural noise of the Biological Diversity. It is indeed to find out which species are the "corner stones" for the stability of the Ecosystem and to find out the "natural noise" of the Biological Diversity! Many other environmental effects could be drowned completely in this "natural noise" and would then be of no ecological significance whatsoever!
These concepts are equally based on the careful reading of the RIO Declaration, and the individual Chapters of the connected Agenda 21.
An assessment of this complex concept should also be done by comparing the effect of individual actors with the effects of the totality of human, industrial activities on the ecosystem, and to assess the impact on the quality of the ecosystem in its

own rights and on the use for Man of the affected ecosystems!
Although the above mentioned IAEA statement on the needs for further research in the domain of protection of the environment does not explicitly exclude more and further research, it could give such an impression to responsible scientists and authorities! The methodological approaches adhered so far are very comparable to the radiation protection methodologies for the protection of Man, where for understandable and humane reasons a great deal of attention goes to the individual. It does not consider very much the possible harm done to an average human population, although since Chernobyl some changes in mentality may have been noticed.

In the Conferences to come related to this challenging topic, it would be a demonstration of intellectual courage to tackle the subject from a as large a scientific perspective as possible, endeavouring to explore methodologies familiar to scientists of related disciplines and not only to satisfy the scientific-political requests that at are fashionable at the moment.

A priority thence to be given in the future is to compare the effect other industrial pollutants would have on the environment with the effect of radiation.
Never will an area or ecosystem contaminated with radionuclides be free of other pollutants or be not affected by agricultural or industrial use.
A "total risk assessment" cannot be carried out in disregard of this ecological complexity.
Radioecology has fully either ignored or at least neglected this paradigm. It is about time radioecology endeavoured to confront its concepts with this reality, and sought to exchange information with the adjacent environmental sciences, dealing with conventional pollution or with the impact of agricultural and industrial activities on dose and risk to man and his Environment!
In most ecosystems, mixed residual pollution exists coming from excess fertilisation, use of pesticides, from heavy metals, mine tailing, oil spill and others. It has been very salient whilst enterprising to mitigate the consequences of the Chernobyl and to set up an environmental restoration management structure for affected zones, that hardly any thought was given to the effect of the presence of other soil amendments and pollutants of miscellaneous nature on the behaviour of radionuclides and the restoration management features of these zones. Many measures though were conceived in a mind as if only radionuclides had contaminated the environment, irrespective of any other amendment. The presence of any soil amendment for example, however, must have an impact on the dynamics of the affected ecosystems, going from ameliorating to deleterious effects on their ecological quality and capacity to transfer radionuclides. The effect of the presence of such complex, mixed pollution on the radionuclide transfer capacity of a contaminated environment has only scarcely been investigated. Their impact on the transfer capacity of the ecosystems has to be assessed.
For radioecologists time seems to have come for uniting the concepts of radioecology with other areas of sciences connected to environmental research (chemoecology). It is obviously essential to continue to complete the general conceptual models of the effects of long-term (chronic) exposures to ionising radiation upon organisms and ecosystems. It is very important to address the complex problem of uniting radioecology and chemoecology.
Last but not least I have to come to a number of IUR matters of organisational nature.

You all know that the forthcoming time is the election time for a new Board of the IUR. You have all received a "call for candidates" form.

It is important for all potential candidates to think carefully about his or her IUR. Where should the future take us, is the question at stake!

I have the personal feeling that a certain development is to noticed, leading the International Union of Radioecology into closer contact with its user group, this means Radiation Protection. In its own rights this is excellent development, as the producer and the buyer are to work in good harmony.

The International Union of Radioecology should NOT become the International Union of Radiation Protection; there are already so many of them, e.g. IRPA! The IUR should not become a duplicate of it! This Union should therefore stay or even return in the hands of Radioecologists if it wishes to safeguard its specific character, laid down in the objectives of radioecology (which I have demonstrated on many occasions in my former workplace) and also come in the hands of ecologists if its wants to broaden its scope towards a more realistic world, where not only radionuclides

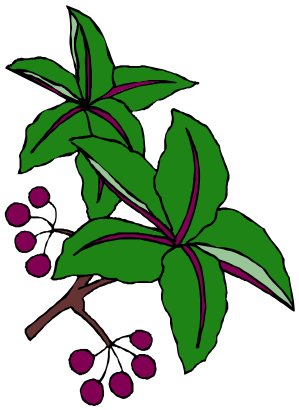
and doses exist but where complex environmental questions exist. The world of nuclear energy production and its consequences should not stay forever in the grip of a self-isolating and self-protecting caste! Narrowing its views to radiation protection only is absolutely no guarantee for its survival; there is more at stake than radiation only in the environment, however important radiation may be!

To end up with my moral report, the next team or Board will also have to take up the adaptation and modernisation of the Statutes of this Union, as they have been conceived "in tempore non suspecto" when it was obvious to create such a radioecological union. Times have changed as well as the challenges. Also the bylaws of the Union have to screened carefully; there is a lot redundant there! It gives very little mainstay for the daily operation of the society! This has absolutely to be professionalised, with much more Members' influence and control on activities and accounting, as it is good practice in any society of this kind that takes itself serious. The Members of this Union will also have their responsibilities at hart towards their Union. It is their right but certainly also their duty, as intellectuals!

I leave this to the potential candidates and future Board Members for their reflection; it would be wise and advisable to listen to professional consultants, or to compare the statutes and rules of internal order with the ones of other very professional societies to find good examples for its professional running. There is a lot to talk about and to change!

Thank you for your attention!

Gilbert Desmet



Radiation in the 21st Century: Ethical, Philosophical and Environmental Issues

Consensus Conference on Protection of the Environment [1]

22 – 25 October 2001, Oslo, Norway

As announced in the previous IUR newsletter, this international seminar and consensus conference, arranged with the involvement of IUR, was designed to promote discussion of the ethical, philosophical and environmental issues of radiation protection in the 21st century. Participants included people with a wide range of interests and backgrounds, including the nuclear industry, radiation protection practitioners, ethicists, communication specialists, regulators, researchers and others with an interest in the subject under discussion. The seminar was chaired by Deborah Oughton and Per Strand.

The meeting itself had two parts.

The first, the seminar component, consisted of invited presentations on the subjects of:

- Risk Assessment and Management,
- Practical Application,
- Public Perception, Communication and Participation,
- Waste/Risk Management Case Studies,
- Protection of the Environment – current status and on-going work,
- Philosophical and Regulatory Issues, and
- Uncertainties and the Application of the Precautionary Principle.

The range of presentations and presenters induced a very international flavour to the meeting as well as a very multi-disciplinary one. Plenty of time was allowed for discussion between presentations in an informal atmosphere, promoting a frank and constructive exchange of views among people with very different perspectives.

The presentations and discussions provided useful information to those involved in current developments in radiation protection, and also provided

[1]A seminar arranged, on behalf of Nordic Nuclear Safety Research (NKS), by the Norwegian Radiation Protection Authority and the Agricultural University of Norway, in cooperation with the International Union of Radioecology (IUR)

an excellent basis for the second part of the meeting, the Consensus Conference. This was designed to explore the scope for identifying common ground in taking forward radiation protection and the environment. As such, participants broke into discussion groups to consider a series of propositions, so as to agree, disagree or modify them. Plenary explanation and discussion of each discussion group output then took place. This output was then used to develop a draft Consensus Statement, made up of guiding principles and a series of recommendations. After further discussion and revision *(including significant simplification of the language!)* a final version was found to be acceptable to many of the the participants. The Consensus Statement is reproduced below. The Statement is commended to all IUR members and to others involved in further developments.

Final Consensus Statement

[Per Strand and Deborah Oughton. Proceedings from the Consensus conference on Protection of the Environment which was part of the seminar Radiation Protection in the 21st Century: Ethical, Philosophical and Environmental Issues, NRPA 2002]

Introduction

The next decade is likely to bring significant improvement in radiation protection. A number of international bodies are currently considering the development of systems for protection of the environment from ionising radiation. The nuclear industry,authorities and regulators are faced with increasing challenges on the practical application of policy, notably theneed to address more widely such values as transparency and stakeholder involvement.

The conference aims were to provide a forum for discussion of current issues in radiation protection and the environment, an input into international developments related to the protection of the environment, and to encourage wider participation in the debate.

In order to discuss these issues, 45 international experts representing various disciplines including Environmental Science, Health Physics, Radioecology, Ethics and Philosophy convened at the Norwegian Academy of Science and Letters, Oslo, 22 -25 October 2001. The participants represented a wide spectrum of perspectives bearing on the question of radiation protection of the environment. Participants met in working groups and in plenum to develop the main areas of agreement, which are as follows.

Guiding Principles

Humans are an integral part of the environment, and whilst it can be argued that it is ethically justified to regard human dignity and needs as privileged, it is also necessary to provide adequate protection of the environment.In addition to science, policy making for environmental protection must include social, philosophical, ethical (including the fair distribution of harms/benefits), political and economic considerations. The development of such policy should be conducted in an open, transparent and participatory manner. The same general principles for protection of the environment should apply to all contaminants.

Statements

√ As part of the effort to revise and simplify the current system of radiological protection for humans, there is a need to address specifically radiological protection of the environment.

√ There are several reasons to protect the environment including ethical values, sustainable development, conservation (species and habitat) and biodiversity.

√ Our present level of knowledge should allow the development of a system that can be used to logically and transparently assess protection of the environment using appropriate end points. The development of the system ought to identify knowledge gaps and uncertainties that can be used to direct research to improve the system.

√ The best available technology including consideration of economic costs and environmental benefits should be applied to control any release of radionuclides into the environment in a balanced manner with respect to other insults to the environment.

√ When a product or activity may cause serious harm to the human population or to the environment, and significant uncertainties exist about the probability of harm, precautionary measures to reduce the potential risk within reasonable cost constraints, should be applied. In making such assessments and decisions, an improved

mechanism for incorporating developing scientific knowledge needs to be established.

√ To assess the impact on the environment there is a need to take into account inter alia radiation type, type of organism,and biological endpoints (impact-related).In order to improve the transparency of assessing environmental impacts, the authoritative bodies should consequently give consideration to the development of quantities and units for biota,with the intent to avoid unnecessary complexity.

Environmental radioactivity – a science in crisis

Scientists ask how long can we maintain the capacity to respond to nuclear problems?

The recent tragedy in the USA has emphasised the vulnerability of the industrial world to extreme and random events. In the nuclear field, the Chernobyl accident showed that it is impossible to foresee every potential threat and therefore governments need to be able to rapidly respond to natural and technological disasters. European scientists could only respond to the Chernobyl threat because at the time of the accident Europe had a strong scientific base in environmental radioactivity. But now, fifteen years after the accident, scientists are warning that this knowledge-base is in danger of being lost.

Scientists all over the world report dramatically declining numbers of young researchers in the field. The best young scientists see no future in environmental radioactivity because national and international agencies no longer view this as a priority research field. Many national or international programmes are now being severely cut back. For example, the European Commission, previously a major supporter of this field, now only funds a tenth of the number of projects it did several years ago.

Scientists have now solved many of the problems experienced after nuclear accidents. Decision support systems have been developed for protection of the public from the immediate consequences of a nuclear accident. But the management of the long term consequences of nuclear activities still needs scientific support. Hundreds of reactors are still operating throughout Europe. In the coming decades these reactors will need to be decommissioned and their nuclear waste reprocessed and stored in an environmentally safe manner. Unless we act now to maintain current expertise and provide young scientists with a future in environmental radioactivity there will be no one qualified to solve these problems. Action is required now to maintain our long-term scientific capacity by providing national and international support for undergraduate and post-graduate programmes in radiation protection and environmental radioactivity.
The radiation protection sciences face many new challenges in the 21st Century. If scientists are to meet these challenges, long-term support for applied research is needed to:

- Maintain and improve our capacity for emergency response in the event of a nuclear incident;
- Assess the environmental costs and benefits of nuclear power generation;
- Assess the risks of nuclear waste disposal options;
- Develop integrated approaches to risk assessment from radioactive and chemical toxins;
- Enhance public understanding of radiation risk issues.

We the undersigned support this call for action by national and international bodies to recognise the ongoing importance of environmental radiation protection science.

Dr. M. Belli (ANPA, Italy)
Mr. B. Khrystyuk (UHMI, Ukraine)
Prof. A. Kudelsky (IGS, Belarus)
Dr. J. Smith (CEH, UK)
Prof. G. Zibold (FH-Wein, Germany)
Dr. A. Bulgakov (TYPHOON, Russia)
Prof. A. Konoplev (TYPHOON, Russia)
Dr. U. Sansone (ANPA, Italy)
Dr. O. Voitsekhovitch (UHMI, Ukraine)

Bellagio, Italy, 21 September 2001

Fees 2001

Most members have been contacted about payment of the fees for 2001. If you have not paid, please could you do so, preferably by providing the treasurer with credit card details. If you want to arrange other methods of payment please contact the treasurer Brenda Howard,
e-mail: bjho@ceh.ac.uk Fax: +44 1 5395 35941.

2002

Membership grade	CIS, China Cuba, Colombia	Central Europe	Other	Other	Other
	$	$	EUR	$	£
Student	7	10	20	18	13
Regular	14	20	50	46	31
Senior	21	30	70	64	44
Fellow	21	30	70	64	44
Emeritus	7	10	20	18	13
Honorary	0	0	0	0	0
Supporting	>140	>200	>400	>420	>260

New members

From October 2001, the Executive Committee has accepted 11 new members to IUR:

Szabolcs Mózca, Hungary
Lindis Skipperud, Norway
Pascale Henner, France
Arnauld Martin-Garin, France
Laurent Garcia-Sanchez, France
Sebastian Denys, France
Shun'ichi Hisamatsu, Japan
Yutaka Tateda, Japan
Yoshihito Ohtsuka, Japan
Ansie Venter, UK
Graham Smith, UK

iur elections for the Board of Council

A Call for Candidates form was distributed with the Newsletter in July 2001.
The candidates nominated for the Board of Council are as follows:

Rudolf Alexakhin, Russia
Francois Brechignac, France
John Hilton, UK
George Hunter, UK
Konstantin Koupri, Russia
Deborah Oughton, UK
Gennady Polikarpov, Ukraine
Per Strand, Norway
Youngguan Zhu, China

A Ballot paper is enclosed with this Newsletter. We ask you kindly to vote for your canidate and return this paper to the IUR Secretariat in a plain envelope to ensure anonymity by **30 April 2002.**

The Chairman of the Election Committee is Rene Kirchmann.

The Conference will be held at The Scientific Palace (Palace of the Great Prince Vladimir) in St. Petersburg from 16 - 20 June 2002.

So far about 180 people want to participate and we have received 130 abstract for oral/poster presentation.

The Final Announcement and Registration Form is enclosed with this Newsletter.

International Conference on Radioactivity in the Environment Monaco 1-5 September 2002

There has been a great interest in this Conference and so far more than 500 people are interested in participating .

420 abstracts have been received at the Secretariat and are now sent out for review for oral/poster presentation to the members of the Scientific Committee.

The Conference will be widely extensive addressing many topics in Radioecology e.g. Protection of the Environment to the challenge of NORM and the sessions will be:

1. *Protection of the environment*
2. *Human and societal effects of exposure to radiation*
3. *Technologically enhanced concentrations of naturally occurring radionuclides in non-nuclear industries*
4. *Radioactive waste storage – status and future needs*
5. *Vulnerable ecosystems and extreme climate conditions (e.g. subtropical, tropical, arctic)*
6. *Remediation and restoration of contaminated ecosystems*
7. *Radioecology*

The final Announcement and registration forms will be sent out during March 2002.

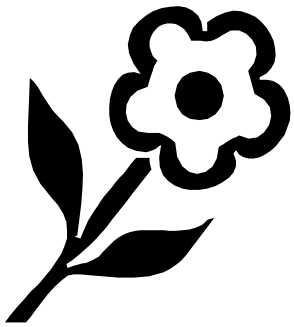
Organisation
The conference is organised by:

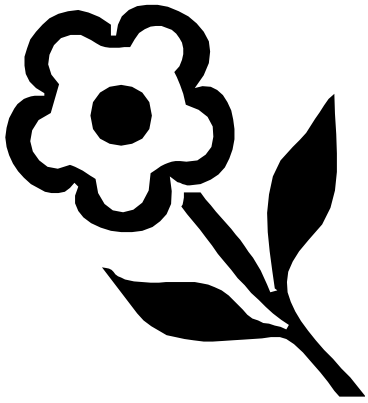
The International Union of Radioecology (IUR), in association with the Journal of Environmental Radioactivity (JER), and in co-operation with the International Atomic Energy Agency (IAEA)

Time and Venue
This International Conference on Radioactivity in the Environment will take place in

- ***Monaco***
- ***2-5 September 2002***

at the International Conference Centre (C.R.I.) (www.iur-uir.org)





Obituary

Vincent Schultz, professor emeritus of Zoology and Wildlife at Washington State University and a widely recognized scientist and author in the field of radioecology, died of cancer on September 12, 2001, at his home in Pullman, Washington.

He was 79.

Dr. Schultz was proclaimed as a Member of Honor of the International Union of Radioecology in 1991 for his outstanding work in the development of radioecology, the study of the effects of ionizing radiation on the environment. His comprehensive 1982 volume "Radioecological Techniques' co-authored by Ward Whicker, is considered the seminal work in this field of scientific study. This volume is only one of more than one hundred of his scientific publications.

Dr. Schultz was intrigued by questions concerning long-range impacts of nuclear "fall-out" on the environment. Under his leadership in the late 1960s, Washington State University became one of the first academic institutions in the United States to offer coursework in radiation ecology.

Dr. Schultz served as a consultant to the U.S. Atomic Energy Commission's Interoceanic Canal Studies, Advisory Committee on Reactor Safeguards, Project Chariot (in Alaska), and the Nevada Operations Office Effects Evaluation Panel. He worked for the "Atoms for Peace Program" of the International Atomic Energy Agency.

His dedication to international understanding was reflected in his friendships with foreign students and scientists. He corresponded with colleagues and students from Thailand, Malaysia, Madagascar, the Ukraine and elsewhere.

While an undergraduate in Wildlife Conservation at Ohio State University, he was enrolled in ROTC, as a first sergeant, bearing the flag and riding in the nation's last horse-drawn artillery. He was drafted into the U.S. Army in 1942. He participated in the Army Specialized Training Program at the University of Connecticut (engineers' training) and at Yale University and the University of Pennsylvania in premedicine. After discharge, he returned to Ohio State University where he earned Master of Science and Ph.D. degrees in zoology, followed by a Master of Science degree in statistics at Virginia Polytechnic Institute and completion of coursework towards a Ph.D. in biostatistics at Johns Hopkins University.

One of his many awards was the Distinguished Alumni Award of the College of Agriculture, Home Economics and Natural Resources Alumni Association (Ohio State University). He was a member of Sigma Xi, a scientific honorary, and accepted an invitation to be a consulting staff member of the Ecology Institute in West Germany. His most cherished recognition, however, was his Eagle Scout award.

Dr. Schultz's childhood interest in Indian arrowheads developed over the years into an appreciation for Native American prehistory, history and culture and an admiration for Native American arts. He shared his knowledge and interest in these areas with his wife, daughters and granddaughters. He donated regularly to Native American causes and charities.

The community will remember "Vince," or "Bill," Schultz as an inspirational teacher, a generous friend, a good storyteller, and an expert craftsman. His family members will remember his love of all creatures of the forest, his ability to identify wild birds by their calls, his admonition to "think," his tolerance of nonconformity, and the support and comfort he provided them until the last moment of his life.

Following his wishes, there will be no funeral. A living memorial will be established for educational and scientific purposes at the University of Idaho Arboretum, represented by the trees and other vegetation found in Northern Ohio. Contributions may be made to the Vincent Schultz Memorial Fund, Advancement Services, P.O. Box 3147, University of Idaho, Moscow, ID 83844-3147.

^{6}Rb MIGRATION THROUGH A FRESHWATER ECOSYSTEM

William L. Duffy
Chris Hedrick
Kenneth Landry
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Introduction

As an exercise in a senior and graduate level Radioecology course at Oregon State University, a ten-gallon fish tank, used to simulate a freshwater ecosystem, was spiked with approximately 0.14 GBq (4 mCi)of ^{86}Rb (Whicker and Schultz, 1982). The purpose of the exercise was to analyze the migration and accumulation of radionuclides in the environment. In addition to experimental determination, the students were required to predict the behavior of ^{86}Rb in the simulated ecosystem by creating a model using the Stella© software package. The results of the two analyses were compared to demonstrate the ability to predict radionuclide migration and accumulation based on available literature.

Method

The system, a ten-gallon fish tank, contained four separate compartments of interest: the water, freshwater fish (guppies, *Poecilia reticulata)*, plants *(Anacharis canadensis*), and bottom gravel. After a "spike" introduction of ^{86}Rb, samples were collected from each compartment at varying time intervals, and the activity within each sample was determined utilizing a Thallium-doped Sodium Iodide (NaI(Tl)) detector equipped with Multi-Channel Analyzer software.

The computer modeling of the freshwater ecosystem was based upon collected literature and experimentally determined values of concentration ratios between the four components. The model was set up such that the specific activity of each compartment was calculated as a function of time after initial introduction of the ^{86}Rb.

The radiotracer was produced through neutron activation using the Oregon State University TRIGA Reactor. Sample activity of 0.14 GBq (3.8 mCi) of was dissolved and introduced into the tank system as a single "spike".

Samples of fish, plants, water and soil were periodically removed from the tank and counted. The frequency of sampling varied over the course of the experiment. After the initial "spike," samples were collected at short intervals in attempts to capture the mixing of the tracer within the tank. The experiment totaled 14 days, with 25 samples taken from each compartment.

Two mathematical models were created using the software Stella (Figs. 1 and 2). In the first, simplified model, it was assumed that ^{86}Rb activity in the water, plant and gravel compartments decreased exclusively by radioactive decay. The accumulation of activity in fish was a time dependent function of water activity, decay and bioelimination. The activity in fish varied as:

$$\frac{dC_F}{dt} = aC_W - k_{eff}C_F$$

Where C_F is ^{86}Rb in fish (Bq g^{-1}); a is the transfer rate from water to fish (d^{-1}); k_{eff} is $\lambda + k_b$ (the effective elimination rate (d^{-1}); k_b is the bioelimination rate (d^{-1}) (calculated as $k_b=\ln 2/T_b$). The value of $\mathbf{T_b}$ was calculated as (Coughtrey, Jackson, and Thorne, 1985):

$T_b=1.54\ M^{0.3}$ (d); M-body mass

The transfer rate *a* was determined as:

$$CF = \frac{C_F}{C_W} = \frac{a}{k_{eff} - l} \rightarrow \frac{a}{k_{eff}}$$

The last relation is true because $k_{eff} >> \lambda$. Based on this relation and on experimental data (CF=5) the transfer rate was found a=2.96 d^{-1}.

A more complex model was developed that included transfer of radioactive material from the water compartment to gravel, plants and fish.

Experimental Results

The expected variation of ^{86}Rb activity in all compartments is shown in Fig 3. The observed water concentration is shown in Fig. 4. The experimental data for fish are shown in Fig. 5 along with the modeled results. In the case of plants and gravel [Figs. 6 and 7] the statistical uncertainties were

high and no statistical analysis were performed.

Results and Discussion

The water data indicate Rb concentrations decrease more rapidly than from radioactive decay alone. The complex model predicts Rb will be transferred in large part due to gravel. In general very good correlation was obtained between the experimental data and the results predicted by the complex model. Using the complex theoretical model, it can be concluded that the peak activity within the fish compartment will be reached after seven days, after 20 days for plants, and after 30 days in the rock compartment. While experimental results due not exactly match predicted, the experiment was considered a success in illustrating the complexity of radioecological processes.

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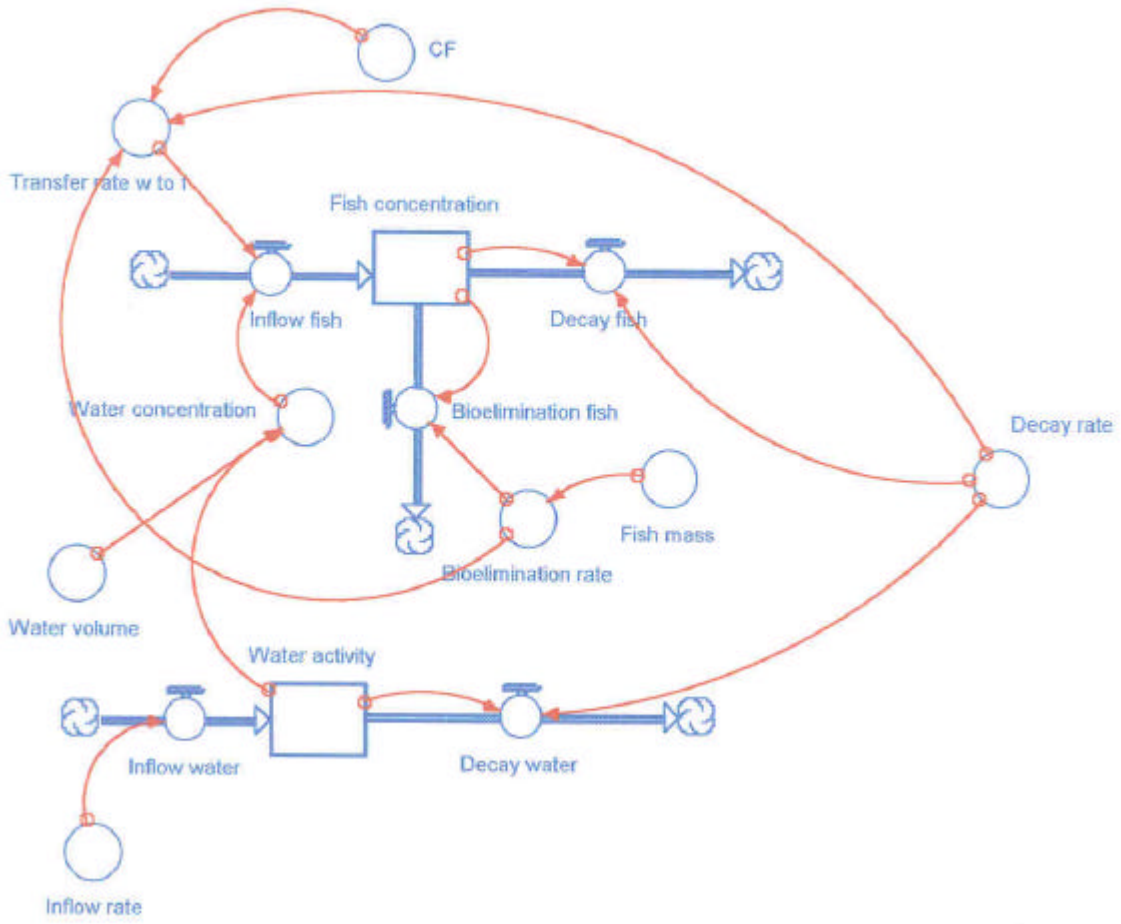

Fig. 1. Simplified Stella Model of Aquarium System

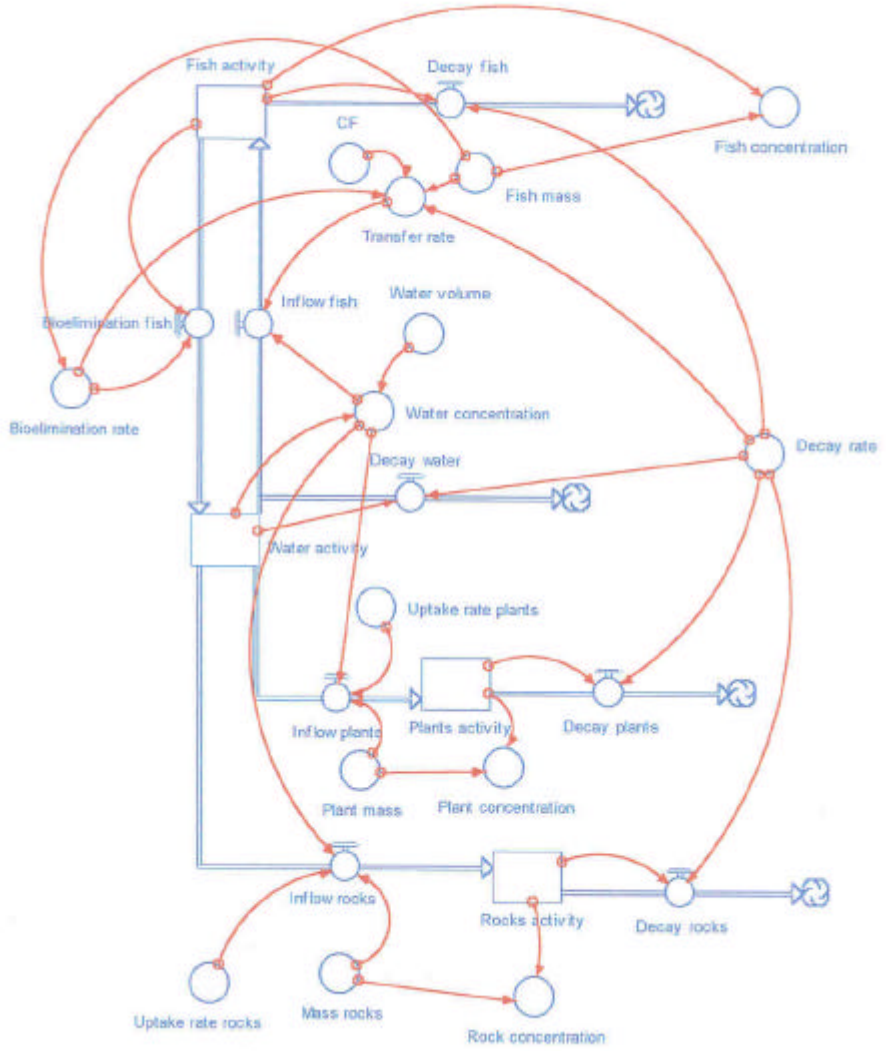

Fig. 2 Complex Stella Model of Aquarium System

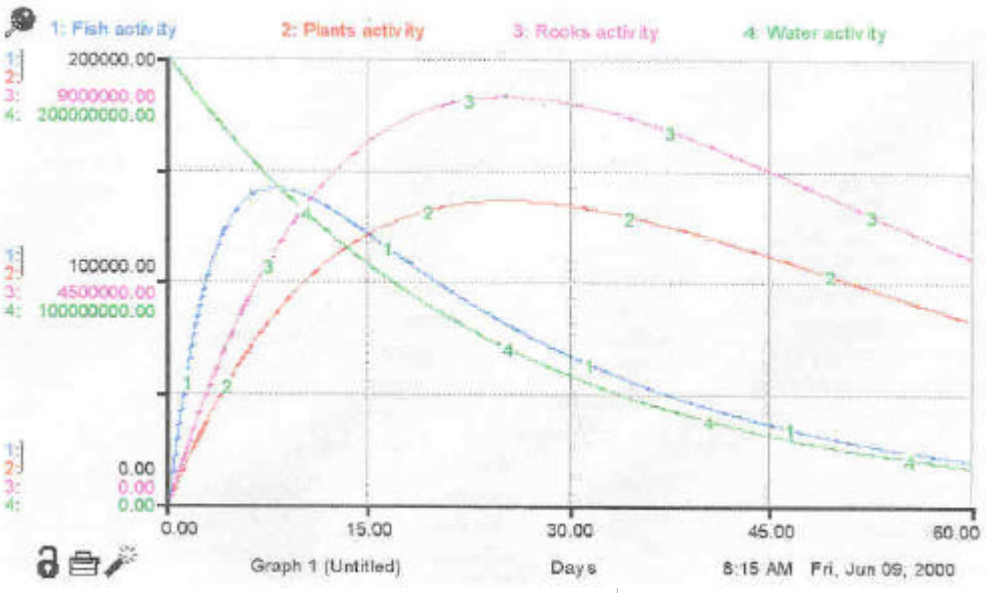

Fig. 3 Predicted Radionuclide Behavior from Stella Model

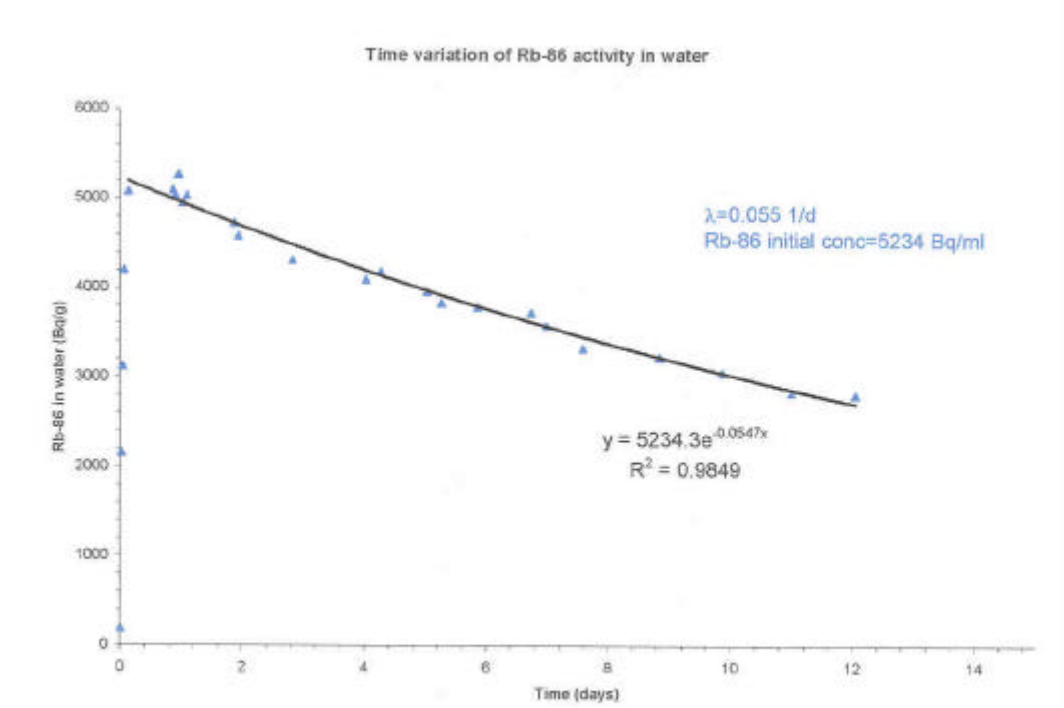

Fig. 4. Observed Water Activity Concentration

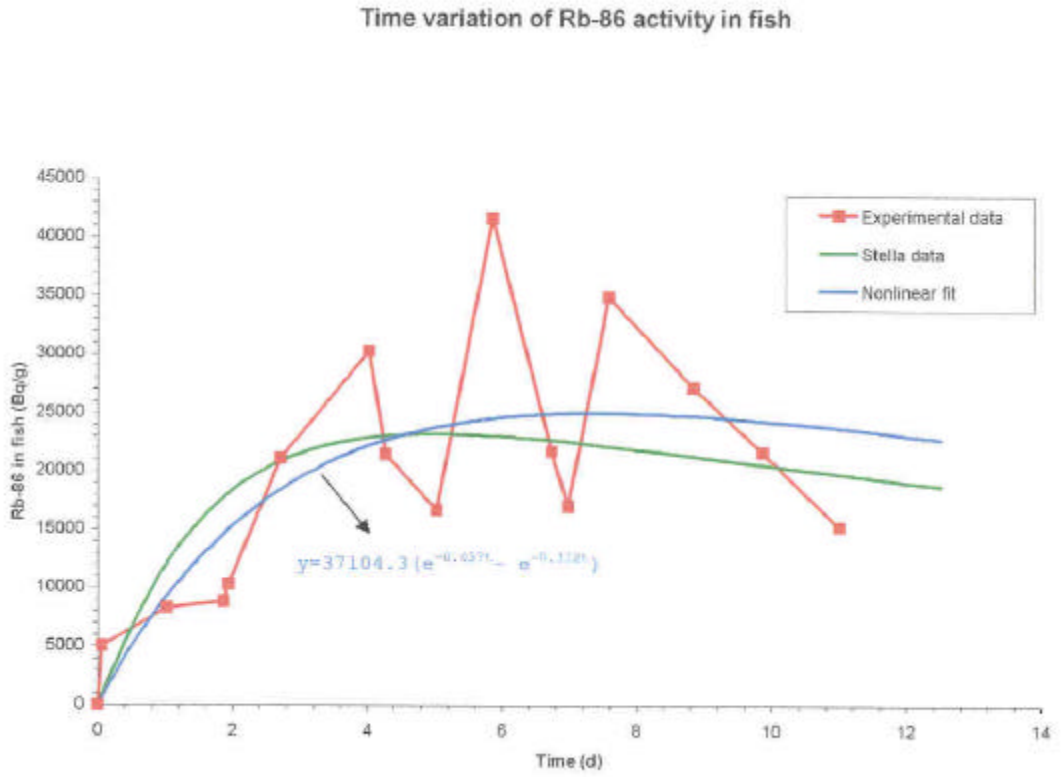

Fig. 5. Observed and Modeled Activity Concentration in Fish

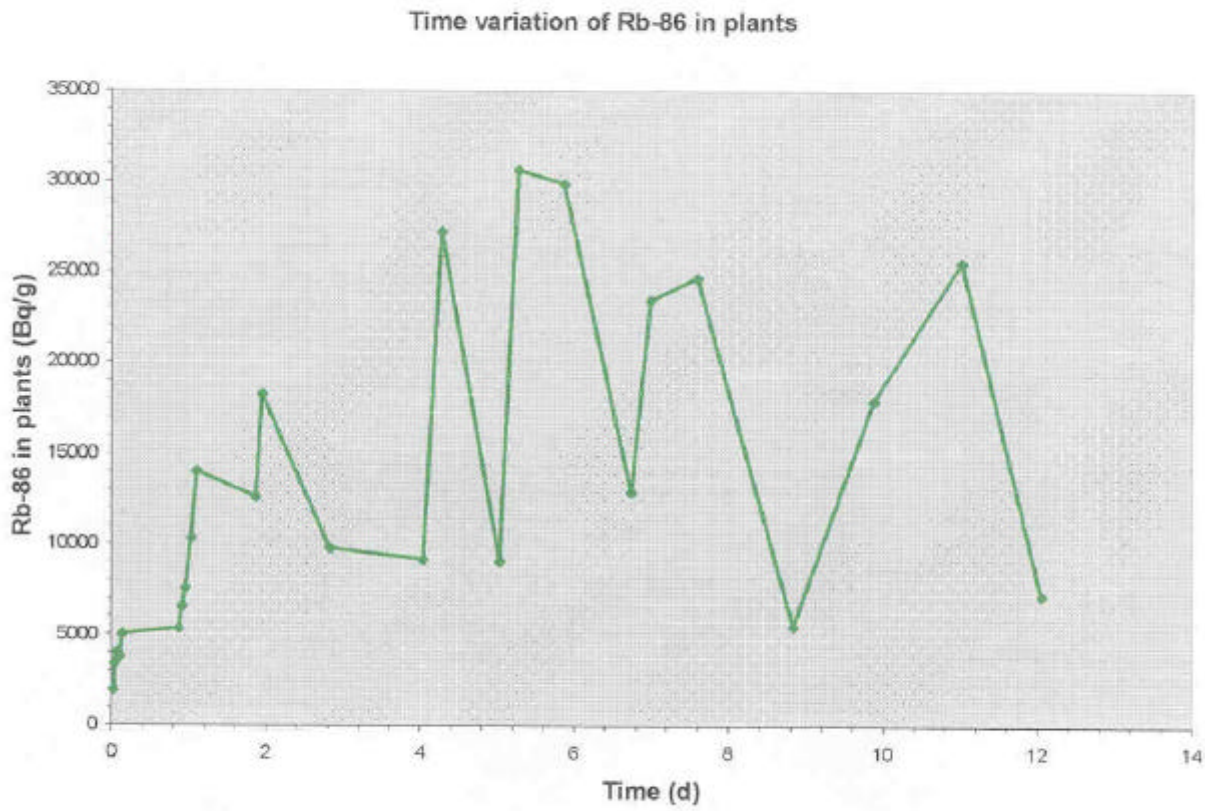

Fig. 6. Observed Activity Concentration in Plants

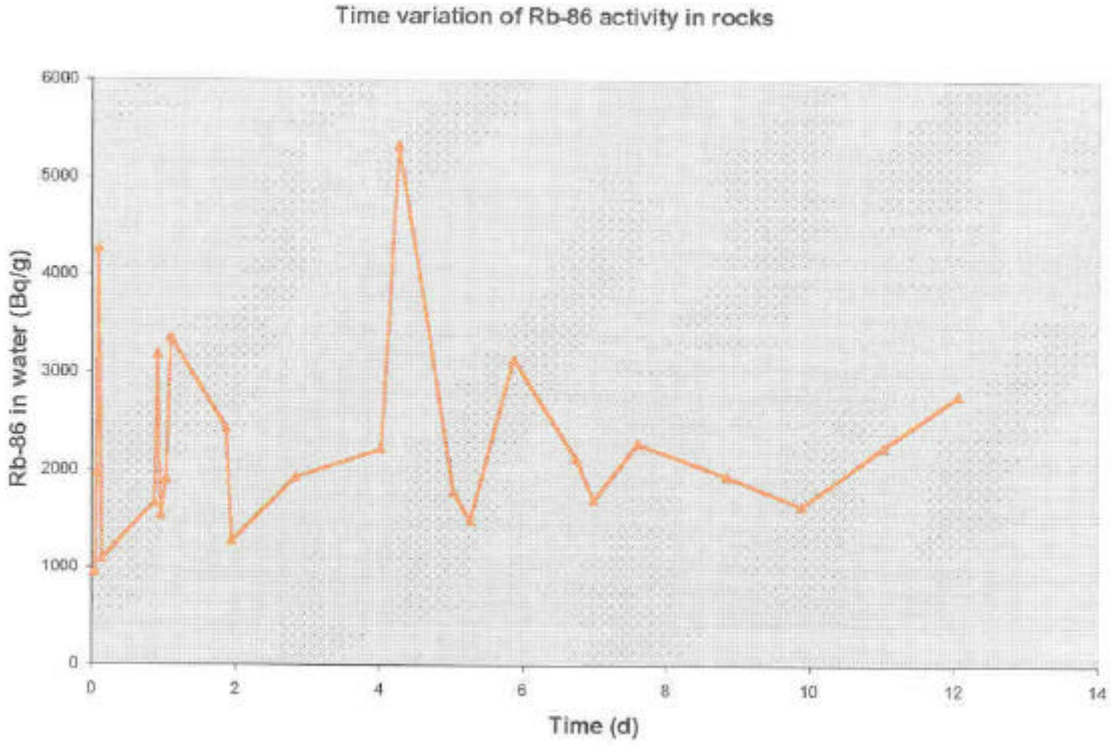

Fig. 7. Observed Activity Concentration in Gravel

PROTECTION OF HUMAN AND NON-HUMAN BIOTA FOR SITUATIONS OF CHRONIC EXPOSURE TO RADIONUCLIDES :

Towards the improvement of risk assessment linked to internal contamination.

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In the framework of environmental chronic exposure to radionuclides, characterized by very low levels of contamination, there still exists a lack of knowledge concerning the resulted consequences for both the biological components of ecosystems and the members of the public. Indeed, in ecotoxicology as well as in radioecology, the available knowledge mainly corresponds to short-term exposure and high "doses" of isolated pollutant. However, these situations of chronic exposure at low levels are likely to cause toxic responses distinct from those observed after acute exposure at high doses, because of the bioaccumulation phenomena. In tissues and cells, these highly localised accumulations of radionuclides, coupling radiological and chemical toxicities, may give rise to particular biological responses of a cell group, capable of causing functional or structural abnormalities. The assessment of these bioaccumulation phenomena is primordial with regard to internal exposure to radionuclides since they increase locally both the radionuclide concentration and the biological effect of the delivered dose. More especially with regard to man, it becomes therefore necessary to precise the validity field of the conceptual system of dosimetry used in radioprotection, which is based on a homogeneous radionuclide distribution pattern. For the environment, taking into account these processes and the resulting biological effects will improve and complete the impact assessment, and should be integrated in models for which the ionising radiation effects on biota are still ignored.

Within this framework, the IPSN launched a research programme in 2001, namely ENVIRHOM. The conceived strategy is based on the assumption that the physical compartments, soil and sediment, play the role of secondary source-terms for biota in situations of chronic exposure. Radionuclide transfers from these compartments are characterized by a high degree of diversity, linked to the biogeochemical behaviour of radionuclides in the environment, and to the feeding strategies employed by organisms of flora and fauna. The chosen approach is mainly focused on experiments under controlled conditions. Carried out on a small number of biological models representative of the plant and animal kingdom and man, they are limited to a restricted number of radionuclides selected for their long half-life and their radiotoxicity with regard to internal contamination. For each studied transfer (direct and trophic), four aims are pursued:

(1) to characterize chronic accumulation phenomena in terms of biokinetics; to compare them with available data for acute exposure conditions; to evidence and quantify bioaccumulation processes (radionuclide microlocalisation at the subcellular level);
(2) to analyse biological effects induced by bioaccumulation on behaviour, growth and reproductive capability of individuals, focusing systematically the research on deterministic effects on immune system, central nervous system and reproductive system;
(3) to analyse the consequences of bioaccumulation with regard to dosimetry and environmental models *i.e.* to reassess radiation doses delivered to organs and organism taking into account bioaccumulation and/or biokinetic alterations; to link the observed effects at individual scale with the population dynamics;
(4) to study the mechanisms of bioaccumulation phenomena.

The full sets of data expected from the present programme should contribute to the development of a complete operational system of radioprotection for whole ecosystems, including man, for situations of chronic exposure. The first experimental studies are devoted to uranium.

Further information is available on request :

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The multipollution context in freshwater radioecology : two Ph.D. theses were achieved at the laboratory for Experimental Radioecology from the Institute for Nuclear Protection and Safety. The lessons learned from this wide experimental programme carried out both in laboratory and in field conditions give positive answer to the following question : Should realism of radioecological evaluations be enhanced while taking into account the deleterious influence of stable pollutants on aquatic organisms which can be physiologically stressed, and therefore can modify their response to radionuclide bio accumulation?

Validity of field bivalves as radioindicators in freshwater ecosystems within a multipollution context (Cd, Zn) by Benoit FRAYSSE, Ph.D. from the University of Bordeaux 1, July 2001.

Abstract - This study concerns freshwater bioindicators of radiocontamination, in a metallic multipollution context. Metals, such as cadmium (Cd) and zinc (Zn), are widely represented in aquatic ecosystems, and their concentrations can induce physiological effects. This chronic exposure generates both metabolic and behaviour stress of individuals, and can also yield to detoxification mechanisms. The main goal of this work was to estimate the influence of metals on the radionuclides (^{57}Co, ^{110m}Ag, ^{134}Cs) bioaccumulation by two different bivalve species (*Corbicula fluminea* and *Dreissena polymorpha*), by studying the contamination level, the kinetics of the radionuclide transfer and the soft-body repartition.
As the exploratory feature of this study, two parts have been developed: (i) testing the problematic suitability in a real biomonitoring situation, and (ii) analysing the metal/radionuclide interaction mechanisms under controlled and standardised conditions (laboratory).
For the different experimental conditions explored (laboratory and field), radionuclide bioaccumulation by freshwater bivalves has been influenced by metal exposure. This result was obtained after assessing a decrease of the organisms contamination level by radionuclide and their accumulation rate, an increase of their depuration rate, and tissue and cellular repartition changes.

Effects of metallic and organic waterborne exposure of fish (rainbow trout and carp). Implications for radionuclide monitoring. by Olivier AUSSEIL, Ph.D. from the University of Aix-Marseille, July 2001.

Abstract – The influence of some metallic (cadmium, zinc) and organic (17 â-œstradiol, atrazine, polychlorinated biphenyls, polycyclic aromatic hydrocarbons) pollutants on artificial radionuclide (^{110m}Ag, ^{134}Cs ^{57}Co) bioaccumulation characteristics by rainbow trout (*Oncorhynchus mykiss*) has been tested. The basic hypothesis of this work assumes that the organisms' exposure to pollutants induces mechanisms of response which could modify radionuclide bioaccumulation characteristics. During the experiments, some biological and biochemical (biomarkers) analyses were performed in order to characterize the nature and the intensity of induced stress in the organisms.
These experiments were performed in the field and in the laboratory. The results show that a cadmium and zinc exposure leads to the induction of systems against oxidative stress or systems implied in metal sequestration. It also leads to a strong reduction of ^{110m}Ag (- 60 %) and ^{134}Cs (- 33 %) bioaccumulation. No effect has been observed on ^{57}Co bioaccumulation.
For all tested organic compounds except for fluoranthene, exposure leads to an increase of radioactive caesium (+ 10 to 45 %) and cobalt (+ 30 to 60 %) quantities bioaccumulated by rainbow trout. Only 17 â-œstradiol exposure leads to an increase of 110mAg uptake by rainbow trout.
Some hypothesis concerning the involved mechanisms are proposed, and the main implications of

this work in operational radioecology are discussed.

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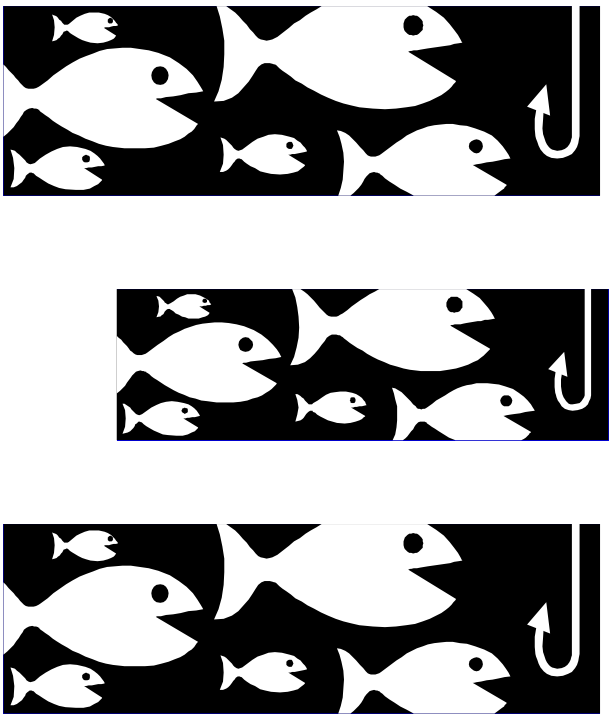

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