

Radioecological Research Activities (Particularly Marine-Related)
in the Mediterranean Region and Nearby Countries

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Abstract

Present radioecological research activities, particularly those related to the marine environment, are reviewed for the Mediterranean region and some nearby countries. Current research trends are identified and important areas for future marine radioecological research are proposed.

Résumé

Les activités actuelles en recherches radioécologiques, particulièrement celles qui sont reliées à l'environnement marin, sont présentées pour la région Méditerranéenne et quelques pays proches. Les tendances actuelles des recherches sont identifiées et des domaines importants sont proposés pour la recherche future en radioécologie marine.

INTRODUCTION

Throughout the more developed areas of the world, radioecological research as an applied science has tended to grow hand in hand with the development of nuclear technology, in particular, the nuclear power industry. Likewise in the Mediterranean region and certain nearby countries, some of the nations either already have, or are contemplating constructing, nuclear power reactors.

In fact, throughout the 1970's only three countries (France, Italy and Spain) possessed nuclear power reactors or facilities capable of releasing radionuclides to the environment in significant amounts; however, according to recent projections, there will be a significant increase in the number of nuclear plants during the 1980's in these countries as well as in at least five others surrounding the Mediterranean (Helmer, 1977, IAEA, 1981). Table 1 presents data on nuclear power generated electricity in the Mediterranean region through 1980. As is generally the case, most nuclear installations in the Mediterranean are, or will be, located along rivers or in the coastal zone in order to fulfill cooling water needs. The Mediterranean Sea is a semi-enclosed body of water with only very limited water exchange. Furthermore, weak coastal currents and a general lack of tides may not contribute to the dispersion of radionuclides entering coastal waters. This is one reason why radioecology is potentially an important science in this region despite relatively limited present-day radionuclide inputs.

We have assessed present radioecological research activities as well as future trends in Mediterranean and nearby countries and include our findings in this report. Much of the information contained herein was kindly provided by organization staff members in response to a questionnaire distributed in January, 1982. We include all the replies received at the time of preparation of this manuscript, together with relevant findings from a previous survey (Fowler, 1981) and other personal communications.

We have summarized our findings by briefly describing, country by country on-going and future radioecological activities, together with a breakdown of these activities grouped according to discipline. From a synthesis of this material we then have attempted to identify potentially important areas for future research in Mediterranean radioecology with emphasis on marine studies.

ACTIVITIES

Austria

Atominsitute of Austrian Universities,
Vienna.

Three divisions of the institute (radiation protection, radiochemistry, accelerator and gamma spectrometry) collaborate on radioecological field research dealing with reactors situated upstream on the Danube river. The principal aim of the programme

is to assess concentration factors for fission and activation products in edible fish, and from the data construct collective dose models for the water-fish pathway leading to man. At present radioanalytical measurements are done by low level spectrometric techniques. In addition, ^{14}C exposure studies are carried out in collaboration with other institutes (BVFA Arsenal).

Egypt

Egypt Atomic Energy Commission,
Protection Department,
Environmental Unit,
Cairo.

The overall program aims at developing facilities for monitoring radionuclides associated with power reactors which are planned for coastal areas in the future. Present studies include the biokinetics of various fission products in marine invertebrates, using radio-tracer methodology. Emphasis is placed on trophic transfer processes and examination of marine food chains as possible sources of radioactive contaminants for man.

France

Cadarache Center for Nuclear Studies,
CEA, Saint-Paul-lez-Durance.

The laboratory undertakes a wide variety of multifaceted radioecological research programmes with principal emphasis on terrestrial and freshwater ecosystems. Most studies are orientated towards behaviour of radionuclides associated with the production of nuclear energy. Recently, laboratory work has begun on assessing the migration of ^{99}Tc in soils, ground water and plants. In addition, nuclear techniques are used to study the flux of conventional pollutants (heavy metals) through the environment.

Laboratory of Marine Radioecology,
CEA/PSN/Dpr, Cherbourg.

The principal focus of the laboratory's work is on monitoring radionuclide levels in aerosols, sea water, sediments and organisms in the vicinity of the La Hague waste reprocessing facility. Recent effort has been put into studying the behaviour of certain transuranics and long-lived fission products in the coastal zone. This has included both field and laboratory experiments on the transfer of ^{239}Pu , ^{241}Am , ^{244}Cm and ^{99}Tc from water and sediments to benthic fauna. In addition, work on delineating the chemical form of radionuclides released from the site is also under study.

Laboratory of Marine Radioecology,
CEA, Le Seyne.

This small, recently created Mediterranean unit is part of the marine radioecology programme overseen by Cadarache. At present the laboratory is concerned with measuring levels of artificial radioactivity (mainly fission products) in environmental samples (e.g. sediments and water) from the Rhone estuary and delta.

Center for Low Level Radioactivity,
Joint CNRS-CEA Laboratory,
Gif-sur-Yvette.

Studies at the Center continue on establishing theoretical and practical approaches to the following topics: technical and experimental studies of *in situ* detection of gamma radioactivity released from the La Hague reprocessing facility; theoretical calculations (including experimental verification) of the efficiency of *in situ* gamma detection in semi-infinite homogenous media; development of simple diffusion models for calculating eddy diffusivity in single-lobed river plumes and for calculating residence times of a homogeneously dispersed pollutant (e.g. radioactivity) entering the sea from river discharge.

Geology Laboratory,
Ecole Normale Supérieure,
Paris.

The coastal marine biogeochemistry section of this laboratory studies the behaviour of selected natural and artificial radionuclides in various estuarine and coastal environments. To date work has encompassed *in situ* measurements of ^{238}Pu , $^{239,240}\text{Pu}$, ^{241}Am , ^{238}U , ^{137}Cs , ^{144}Ce , ^{106}Ru , ^{125}Sb and ^{131}I in water, sediments and organisms from the Seine, Loire, Gironde and Rhone estuaries. Results are used to develop models on radionuclide behaviour at the river/ocean and sediment/water interfaces.

Greece

Nuclear Research Center "Demokritos",
Athens.

Emphasis is currently being placed on establishing environmental baselines of stable elements in the marine environment prior to the installation of nuclear power plants. Research includes the distribution of stable Mo in plankton and pelagic fish in the Aegean using a radiochemical ion exchange procedure;

the distribution of Co, Zn, Cs, and Se in pelagic organisms determined using neutron activation analysis; the detailed distribution of Co, Sb, Cr, Zn, and Cs in a pelagic tunicate. Additional research, recently started, includes using ^{110}Ag and ^{124}Sb tracers in experiments to investigate metal accumulation in select invertebrates. Additionally, analyses of sea water, fish, and seaweeds are being carried out for ^{137}Cs , ^{90}Sr , ^{238}Pu , and $^{239+240}\text{Pu}$, again with the aim of establishing a pre-nuclear installation baseline for environmental levels of these radio-nuclides.

Israel

Isotope Department,
Weizmann Institute of Sciences,
Rehovot.

Natural radionuclides and fallout radioactivity are being used as tracers for dating events in the hydrological cycle and in sediments. Variations in age and abundance of ^{18}O , ^{13}C , ^2H , and ^{15}N are being assessed for studying sedimentological processes in saline lakes (e.g., Dead Sea), paleolimnological research utilizing pore water composition in sediments, and air/sea interactions over the Mediterranean. Monitoring includes analysis of ^3H , ^{14}C , ^{226}Ra and daughter products, ^{137}Cs , ^7Be , and ^{10}Be in sediments, water, pore waters, and soils.

Ministry of Agriculture, jointly with Technion-Israel
Institute of Technology,
Haifa.

The vertical distribution of ^{137}Cs in the Levant Basin water column, and the presence of ^{137}Cs in sediments and biota are being studied. ^{137}Cs concentration factors are being determined for various benthic invertebrates and fish. ^{137}Cs accumulation in sediments is also being examined. Other radioisotopes studied in some detail are ^{90}Sr , and $^{95}\text{Zr}/^{95}\text{Nb}$ in sea water, sediments, and marine biota. To date, laboratory studies using tracer methodology have focused on the biokinetics of ^{65}Zn in prawns and the influence of temperature on bioaccumulation of Zn. Future research will assess several aspects of the behaviour of transuranics in the aquatic environment.

Italy

CNEN Laboratory for Marine Environmental Studies,
S. Teresa,
Fiascherino (La Spezia).

The laboratory's activities have dealt with the description and classification of local marine ecosystems and the behaviour of select radionuclides in these waters. Emphasis has been placed on studying distribution and behaviour of fission products; analyses have been of sediments, water, particulates, benthic organisms, fish and seaweed by gross beta and gamma spectrometry. Attention has focused on monitoring of radionuclides released from a 160 MW nuclear power station at the mouth of the Garigliano River. Fission products including ^{90}Sr and ^{137}Cs were detected over a coastal area of 1100 km²; the distribution of two nuclides -- ^{60}Co and ^{137}Cs -- are correlated with sediment characteristics (e.g., grain size). Additionally, special attention has been paid towards studying the marine behaviour of Tc, including chemical speciation and biokinetics in invertebrates and seaweeds. The use of tracer methodology ($^{95\text{m}}\text{Tc}$) indicated that brown algae may serve as useful bioindicators of ^{99}Tc . Other studies include interactions of bacteria and sediments with certain radioisotopes and modelling water movement and pollutant behaviour in the environment.

Radioecology Operative Unit,
Institute of Zoology,
University of Parma,
Parma.

Analysis of biogeochemical cycles of alpha emitters (e.g., Pu, U, Th, isotopes, and alpha decay products) have been made to measure distribution of radioactive elements along the Italian coastline, including the Po River delta region and the North Adriatic Sea. Both abiotic and biotic components of the environment are being monitored. Additionally, ^3H , ^{90}Sr , ^{131}I , and ^{137}Cs are being analyzed in Po delta samples. Particular attention has been devoted to studying radioactive effluents from the Caorso nuclear power plant on the Po river as sources of radioactive contamination in the Adriatic Sea. Some measurements are also being made on radioactive fallout of gamma and alpha emitters in the terrestrial environment. Other activities include the use of a Sr label to investigate the physiology and ecology of gastropods in brackish lagoons and the Po delta.

CNEN - Medical Service & Radiotoxicology,
FUNZ-CSN Casaccia,
Roma.

New methods, based on extraction chromatography, are being devised for the determination of ^{241}Am , ^{238}Pu , and $^{239,240}\text{Pu}$ in environmental samples. Analyses are being intercalibrated with findings from other laboratories using IAEA standard samples.

Plutonium is being measured in marine sediments, biota, and sea water from Taranto Gulf in collaboration with the University of Parma. Coastal sediments are also being analyzed for Pu to monitor the discharge from the Latina nuclear power station.

Environmental Geochemistry Laboratory - C.R.E.,
Casaccia (Roma).

Analysis of stable and natural radioactive elements in environmental samples and studies on their movement and transfer through various geochemical spheres.

Information Center of Experimental Studies,
Segrate (Milano).

Activities include studies of the distribution of environmental radioactivity emanating from liquid wastes, evaluation of the thermal impact of nuclear power installations on the environment, and advising on the siting, preoperative phase, and operation of nuclear power plants.

Health Physics Service, CAMEN,
S. Piero a Grado (Pisa).

Monitoring of environmental radioactivity, particularly in Italian ports to monitor possible releases from nuclear powered vessels.

Monaco

IAEA International Laboratory of Marine Radioactivity,
Oceanographic Museum,
Monaco.

Marine radioecological research focuses on the following aspects: Analysis of Natural Samples - Measurements of transuranic elements have been carried out throughout the Mediterranean in order to determine depth profiles in the water column and sediments, as well as their levels in particulate matter and marine biota. The aim of these measurements is to construct an inventory for transuranic elements in a large, semi-enclosed marine system (the Mediterranean) whereby sources (rivers, water exchange with the Atlantic, etc.), transport processes, and sinks (sediments) are well characterized and quantified. In addition, methodology is being developed for the determination of natural radionuclides in seawater, with the aim of studying the disequilibria of elements in the U-Th

series for determining rates of certain geochemical processes (e.g., water residence times, sedimentation, etc.) in which these elements are involved. The laboratory is also responsible for intercalibration exercises wherein transuranic analyses in sediment and sea water samples are intercalibrated with various other laboratories worldwide. ^{210}Po , which constitutes a major fraction of the natural radioactivity dose received by most marine organisms, is examined in midwater crustaceans and fish. Studies assess the influence of various biotic and abiotic factors on Po accumulation. Recent research includes ^{210}Po and ^{210}Pb analyses in the surface microlayer and in marine neuston.

Radiotracer Experimentation in the Laboratory - Biokinetic studies of select transuranics and other long-lived radionuclides (e.g., Tc) in marine phytoplankton, seaweeds, zooplankton and other invertebrates (including various benthic species) are in progress. Studies include the influence of various abiotic and biotic factors on these processes. Emphasis is placed on trophic transfer processes, assessment of bioavailability of sediment-bound radionuclides, and influence of lower trophic level organisms on vertical transport of nuclear wastes. Adsorption studies of transuranics and Tc with marine sediments are also in progress, and include general characterization of the chemical properties of the sediments. This research attempts to evaluate the geochemical partitioning of radionuclides in sediments as it might relate to the deep sea disposal of radioactive wastes.

Portugal

National Laboratory of Energy and Industrial Technology,
Department of Radiological Protection and Safety,
Sacavem.

Research is divided into three main areas of activity. To assess the radiological impact of nuclear power plants, monitoring of radionuclides at one site in Portugal and another near the Spanish border are being carried out. Emphasis is placed on analysis of ^{137}Cs , ^{226}Ra , ^{241}Am , $^{239+240}\text{Pu}$, and ^{210}Pb in sediments and fishes in regions of interest, including international rivers. Additionally, laboratory experiments on determination of site-specific transfer rates are being conducted in sediments with ^{60}Co , ^{134}Cs , and ^{228}Ra , and in soils using ^{228}Ra . To evaluate the environmental impact of uranium mining and milling, radiological surveillance including soil analysis is regularly performed around Portuguese U mines. To address the possible impact of sea dumping of radioactive wastes, research on the interactions of radionuclides and the black scabbard fish (and other fish species) is in progress to see if the local fishery could represent an important pathway of radioactive wastes leading to man.

Romania

Polytechnical Institute,
Bucharest.

Emphasis of recent research has been placed on determination of short and long-lived fission and activation products in water, suspended matter, and sediments of the Danube River. Black Sea samples are also examined. Principal isotopes detected are ^{144}Ce , ^{125}Sb , ^{22}Na , ^{106}Ru - ^{106}Rh , ^{137}Cs , ^{54}Mn , $^{110\text{m}}\text{Ag}$, ^{65}Zn , and ^{60}Co . K_d values in sediments are being determined for some isotopes in laboratory experiments. Mathematical models are being developed to describe the movement of nuclear wastes in the Danube in relation to liquid and solid discharges, current movement, and sediment characteristics.

Romanian Institute of Marine Research,
Riobiology Unit,
Constanta.

Laboratory work has recently begun on establishing concentration factors for the uptake of ^{131}I , ^{134}Cs , ^{89}Sr , ^{59}Fe and ^{65}Zn by several species of Black Sea macrophytic algae. In addition, primary productivity measurements utilizing ^{14}C have been carried out for various stations in the Black Sea.

Spain

Nuclear Energy Commission (JEN),
Department of Nuclear Safety and Radiological Protection,
Madrid.

Principal studies include the site-specific monitoring of total alpha, beta, and gamma radioactivity as well as specific radionuclides in various links of the food chain in fresh water, terrestrial and marine ecosystems. These measurements furnish baseline data for radioactivity levels throughout Spain upon which future inputs from nuclear power programmes can be gauged. Besides furnishing radionuclide distribution patterns, the data are used to identify potential bioindicator organisms as well as calculate concentration factors for certain radionuclides in key species in each ecosystem. Laboratory experiments have also been designed to examine the influence of environmental factors and radiation on phasing DNA synthesis in fish and rats. Two recent studies have been initiated concerning the control of nuclear ships and the marine environmental impact at the Vandellos nuclear reactor site. Future programmes at the national level are being established which will monitor tritium, transuranics and ^{85}Kr in rainwater and aquatic and terrestrial food chains.

Switzerland

NAGRA,
Bienne.

This group will participate in a surveillance programme at the North East Atlantic dumpsite which is used for disposal of low and medium-level radioactive wastes. The NAGRA programme, including participation in oceanographic cruises from 1982 onwards, will specifically address questions relating to the transfer of waste-associated radionuclides at the sediment-water interface. Measurements will be calibrated with other laboratories and include water, sediments, and suspended particulate material. Associated characteristics of the suspended particles and sediments will be determined.

Turkey

Cekmece Nuclear Research Center,
Turkish Atomic Energy Commission,
Istanbul.

Only radiotracer studies have been conducted to date. Studies have been in progress on biokinetics of ^{74}As , ^{65}Zn , and $^{115\text{m}}\text{Cd}$ in select fish and marine invertebrates, together with research on localization of these and other metals in brackish water and marine organisms. Experiments include the influence of various abiotic environmental factors on bioaccumulation. Recently, ^{110}Ag have been included in these studies and it is anticipated that ^{241}Am will also be used in the near future. An attempt is being made to find a possible test system (e.g., chromosome disruption, enzyme interference) to assess the effect of radioactive and stable chemical pollutants released at low levels from projected nuclear power plants. An attempt will be made to develop models describing the environmental behaviour of radionuclides and their pathways to man. In addition, ^{210}Po has been analyzed in anchovies collected in the Black Sea.

Plans are now underway for establishing a programme for the environmental monitoring of transuranics in marine matrices.

Ankara Nuclear Research Center,
Turkish Atomic Energy Commission
Ankara.

The institute is continuing its analyses of natural series radionuclides in different environmental matrices from the proposed Akkuyu reactor site as part of a pre-site environmental impact survey.

Black Sea Technical University,
Department of Biology,
Trabzon.

Radiotracer studies employing ^{75}Se and ^{210}Pb have been carried out to examine the accumulation, retention, and distribution of these elements in a species of carp, an important food fish in the local economy.

Istanbul University,
Department of Radiobiology,
Istanbul.

Experimental studies have focused on measuring the biokinetics of radionuclides in marine species. ^{65}Zn and ^{210}Pb tracers have been used to measure organ distribution and biological half-lives of these radionuclides in fish. Other experiments have been designed to assess $^{115\text{m}}\text{Cd}$ and ^{65}Zn interactions in marine invertebrates.

Istanbul University,
Hydrobiological Research Institute,
Istanbul.

Active participation with the utilities companies has begun on the Akkuyu pre-site survey as regards natural radioactivity in environmental samples. Studies involve gross measurements of natural beta-emitting radionuclides in sediments from the area.

Institute of Hydrobiology,
Faculty of Science,
Ege University,
Izmir.

Gross beta radioactivity is measured seasonally in sediments and marine invertebrates of Izmir Bay.

Yugoslavia

Center for Marine Research, Rovinj, and Institute,
"Rudjer Boskovic",
Zagreb.

Use of ^{75}Se and ^{203}Hg tracers in studies on toxicity and biological half-lives of these elements in marine shrimp and mysids has been explored. Examination of synergistic and antagonistic interactions of metals on marine organisms was also investigated with these isotopes. Stable Hg and Se are measured in these matrices by neutron activation analysis. Additionally, impact

surveys are pending for future nuclear power plant sites located along Croatian rivers flowing into the Adriatic Sea.

Institute "Jozef Stefan",
University of Ljubljana,
Ljubljana.

Present programmes include the use of nuclear techniques for analyses of metals in environmental samples. In the future environmental measurements of transuranium elements in the Northern Adriatic Sea are envisaged.

CONCLUSIONS

At the outset it should be emphasized that we fully realize that the thoroughness of our preliminary survey is questionable. Temporal constraints limited us from undertaking an in-depth study into all institutes, universities, hospitals, etc. that may deal with some aspect of radioecology. Our principal contacts were with national authorities responsible for the nuclear energy development sector and, hence, our presentation may be biased accordingly. Furthermore, institutes were surveyed based on information known by the authors or in available published materials. Some countries were not contacted simply because of lack of sufficient time to identify proper focal points; others were omitted from the survey due to lack of response to our questionnaire at the time of writing. Therefore, in the light of the above, the conclusions drawn from this survey must be considered preliminary.

Given the data in hand, it appears that the emphasis of radioecological research in the Mediterranean region including Portugal, Switzerland and Austria is on coastal marine or fresh water systems. There seems to be an even balance between biokinetics research using radiotracer methodology and analysis of environmental samples for natural and artificial radioactivity. The latter is often tied to the siting of nuclear power plants or waste disposal sites as part of an overall monitoring scheme. The radioecological research activities in the Mediterranean countries are grouped by discipline in Table 2. It would appear that further scientific progress may be expedited by the adoption of a unified approach so that research is not needlessly repeated by different institutes often studying the same or similar processes or ecosystems. Though priorities and problems may vary from region to region within the Mediterranean, it seems to us that there is ample room for a formulation of the basic scientific questions that are of interest to the nuclear industry.

For example, some questions (fission and activation product concentration factors) may already be largely answered in the scientific literature while others (e.g. transuranic speciation in aqueous systems and its role in bioavailability) may warrant further study. Unfortunately, often the former receive greater attention than the latter. Furthermore, surprisingly little effort is being expended on studying the behaviour of tritium, the most abundant radionuclide expected to be produced from nuclear power generation. An integrated multi-disciplinary approach to solving these problems, whether 'basic' or 'applied' would be most beneficial. Finally, from a geographic balance point of view, it seems that radio-ecological research is well underway in most northern and some eastern Mediterranean areas but is still dormant in the southern regions. Similar research programmes in areas of the southern Mediterranean would be most welcome, particularly as they would provide useful baseline data for assessing the radio-ecology of the Mediterranean ecosystem as a whole.

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Table 1. Power Reactors in the Mediterranean Region as of December, 1980 (from IAEA, 1981)*

Country	Operating		Under Construction		Percent Total Electricity in 1980
	Number	Total MWe	Number	Total MWe	
France	23	15409	29	30230	28.0
Italy	4	1382	3	1966	1.3
Spain	3	1073	7	6258	5.8
Switzerland	4	1940	1	942	22.9
Yugoslavia			1	632	

* The nuclear programme in Austria has been interrupted; plants are not included.

Table 2. Radioecological activities in Mediterranean and nearby countries, and goals of

Analysis of Natural Radionuclides	Analysis of Fission + Activation Products in Natural Samples	Analysis of Transuranics in Natural Samples	Biokinetics of Fission and Activation Products in Organisms	Biokinetics of Transuranics in Organisms
<p>France - tracers of marine biogeochemical cycles.</p> <p>Israel - tracers to study hydrological cycle.</p> <p>Monaco - ^{210}Po biogeochemistry; determination of natural radiation dose of marine organisms; tools to monitor geochemical processes.</p> <p>Turkey - ^{210}Po analysis in human sea-foods.</p>	<p>Austria - critical pathway assessment; monitoring and modulating inventories of the Danube.</p> <p>France - monitoring and studying discharge from nuclear power plants and reprocessing facilities.</p> <p>Israel - studying environmental behaviour.</p> <p>Italy - monitoring discharges from power plants.</p> <p>Monaco - studying environmental behaviour.</p> <p>Portugal - monitoring discharges from power plants.</p> <p>Romania - monitoring and modelling inventories in the Danube.</p> <p>Spain - monitoring power plant discharges; establishing pre-nuclear baselines.</p> <p>Switzerland - mobility of wastes from a dumpsite.</p> <p>Turkey - monitoring gross β activity in marine sediments and organisms.</p> <p>Yugoslavia - monitoring power plant discharges, pre-site surveys.</p>	<p>France - monitoring discharge from waste reprocessing plants, nuclear power installations and other related activities.</p> <p>Greece - establishing pre-nuclear baselines.</p> <p>Italy - monitoring discharges from power plants.</p> <p>Monaco - establishment of oceanic inventory; assessment of routes and rates of transport; examination of deep sea disposal options.</p> <p>Portugal - monitoring discharges from power plants; examination of impact of sea dumping on fishery.</p> <p>Switzerland - mobility of wastes from a dumpsite.</p> <p>Yugoslavia - future monitoring of northern Adriatic Sea.</p>	<p>Egypt - possible path to man.</p> <p>Greece - " " "</p> <p>Israel - " " "</p> <p>Italy - " " " also, use of tracers to study ecology of marine organisms.</p> <p>Monaco - possible path to man.</p> <p>Romania - tracer studies to establish concentration factors.</p> <p>Turkey - possible path to man; tools to develop pollutant-sensing test system.</p>	<p>France - possible path to man; role of organisms in transport processes; search for sentinel species for monitoring.</p> <p>Monaco - possible path to man; role of organisms in transport processes; search for sentinel species for monitoring.</p>

FISHER, N.S., FOWLER, S.W.

*"Radioecological research activities (particularly marine-related)
in the Mediterranean region and nearby countries"*

Paper presented by N.S. Fisher (IAEA)

Discussion

M. BRANICA: I would like to comment that we need a more unified and common scientific approach to this field of research in the Mediterranean. I am proposing that the IAEA take a more active role in defining existing work as well as suggesting future research needs. The review should be based on both existing knowledge and collected research efforts carried out over the last 20 years. The growing number of power stations on rivers feeding the Mediterranean or situated along the coastline itself, suggest that many radioecological problems currently exist for study. Many of the problems will be common to several of the surrounding countries while others may be unique to isolated situations. Taking this into account we will need a far better collaborative effort between Mediterranean nations to find common solutions to the problems. This means more exchange of information and technical methodologies to achieve these aims. Any move towards defining approaches to take would be most welcome.

