COMET
COordination and iMplementation
of a pan European instrumenT for Radioecology

Issue 4
August 2016

# Welcome to the 4th COMET project newsletter

## COMET 3rd Annual meeting

Seville, 13 -15 June 2016, 40°C, about 30 project participants and steering committee members meet at the Centro Nacional De Aceleradores on the EXPO-1992 site.

A few highlights: project progress is good with all deliverables submitted on time. The roadmap working groups developed around priority research themes of the Strategic Research Agenda have each developed their Implementation Plan and can start the real work; the Initial Research Activities to improve and validate radioecological models in domains of human food-chain modeling, alternative wildlife models, forest ecology, NORM, hot particles and marine modelling have all made good progress. They now start to 'play' with the data collected to acquire improved process understanding and transfer models.

Also the internal COMET project FRAME is progressing well in data gathering and model development to assess the impact of releases from the Fukushima nuclear accident on the marine environment. The same can be said for RATE where hot particles of different origin have been characterised and studied to get the parameters to assess the relevant radioactive particle transformation processes. All field experiments for studying transgenerational and epigenetic effects have been conducted.

In the 3rd COMET year we also organised a very successful three day COMET session on the aftermath of the Fukushima accident at ICOBTE 2015 and appreciated the NORM training course held at the Silesian Centre for Environmental Radioactivity Central Mining Institute in Poland.

Yes, your feeling is right, we are somewhere in the middle. We are putting all the parts of the puzzle together during this last project year and will show at our final event where COMET has made a true difference.

**Text and picture provided by Hildegarde Vandenhove**

**Members of the steering committee and project participants**

The meeting was hosted by NMBU and the University of Seville. Brit Salbu and Rafael Tenorio were our hosts.

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# Chernobyl Fieldwork - *Hyla arborea* & *Arabidopsis thaliana*

For a week in May 2016, European tree frogs (*Hyla arborea*) and the plant *Arabidopsis thaliana* were sampled in the Chernobyl Exclusion Zone (CEZ) as part of the epigenetics work in COMET work package four. The campaign was a success thanks to the integrated effort delivered by Nele Horemans and Robin Nauts (plant experts) from SCK•CEN Belgium, Germán Orizaola (frog expert) from Uppsala University, Sweden and Sergey Gaschak and co-workers from the Chornobyl Center who were an invaluable help with detailed local knowledge of the CEZ.

The plant sampling aimed to collect the molecular model species *Arabidopsis thaliana* along a gradient of radiation. *Arabidopsis* plants were sampled from 12 different localities spread all over the CEZ (three controls within the CEZ, three low, medium or high contamination areas) and three external control sites near the town of Slavutych. Two types of tissues were sampled. The first objective was to collect fresh leaves which will be used for epigenetic and molecular analysis. This material was frozen as fast as possible to stop all metabolic processes. The aim here is to determine whether differences in DNA methylation can be linked to the level of radiation exposure. Other tests like DNA damage determination and gene expression analysis will be performed on these leaf samples to aid in the comparison between the results obtained under field and lab conditions. Seeds were also collected which will be used in the lab to study possible transgenerational differences on plant development in exposed compared with un-exposed plants. Finally, total plant tissue and soil samples were collected for radiological analysis which will be used to obtain good dosimetry data for the plants.

The frog sampling was done at night during the breeding season, in wetland areas where male frogs were recognisable by their calls. After four nights of sampling, a total of 84 male frogs were collected from six different localities ranging in contamination level. During the day, the time-consuming job of dissecting the frogs was done. For the COMET project, liver and muscle samples were collected for epigenetic analyses, as part of the wider investigations into the potential epigenetic effects of chronic radiation on a number of organisms. In addition, morphological anomalies were noted, and samples taken for a wide range of genetic, physiological and developmental traits to determine whether these could be affected by chronic exposure to radiation. These included: blood for physiological and micronucleus analyses; bones for skeletochronology; sperm for morphological abnormalities; liver for histology; and skin swabs for analysis of the skin microbiome.

Now the hard work of completing all these analyses begins! In the future, results will be compared with those obtained on frogs (*Hyla japonica*) and plant (*Capsella bursa-pastoris*) collected in the Fukushima prefecture.

**Text and pictures provided by Germán Orizaola**

You can read more about the European tree frog fieldwork at:
https://gorizaola.wordpress.com/blog/
and on Twitter at @GOrizaola, #ChernobylFrogs16

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# A highlight from the COMET-FRAME project

March 11, 2016 was the 5th anniversary since the Tohoku earthquake and the tsunami that damaged the Fukushima Dai-ichi Nuclear Power Plants (FDNPP) in Japan.

The result was the massive release of radioactivity into the atmosphere and the Pacific Ocean. Since then, the Tokyo Electric Power Company (TEPCO) and the Japanese authorities focused on dismantling of the damaged reactors (encircled in red line, Figure 1) but high radioactive

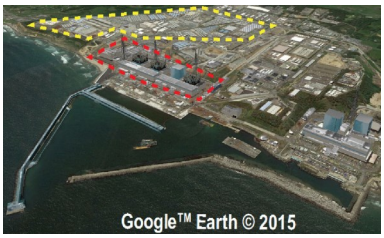
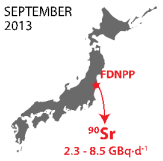



Figure 1: Satellite image of FDNPP in June 2015

levels posed a continuous challenge continuously delaying this task. Another big issue has been controlling the water flowing in and out of the FDNPP and decontaminating the highly radioactive water used as coolant for the damaged reactors (about 300 $m^3$ a day). Large amounts of this cooling water are to some extent decontaminated and stored in tanks (encircled in yellow line, Figure 1) that have frequently leaked in the past, constituting an additional risk.

Scientists from the COMET-FRAME project investigated the levels of radioactive strontium and cesium in the coast off Japan in September 2013,




and put it into a longer-time perspective including published data and TEPCO's monitoring data available until June 2015. This study, published in Environmental Science and Technology, reports concentrations up to 9, 124 and 54 Bq $m^{-3}$ for $^{90}Sr$, $^{137}Cs$ and $^{134}Cs$, respectively (Figure 2) in seawater collected from the sea surface down to 500 m between 1 and 110 km off the FDNPP. Although concentrations decreased about 1-3 orders of magnitude compared to June 2011 (Figure 3), they were still about 9, 100 and 50 times higher for $^{90}Sr$, $^{137}Cs$ and $^{134}Cs$, respectively, than pre-Fukushima levels.

The presence of $^{134}Cs$ (undetectable before the accident) and the distinct relationship between $^{90}Sr$ and $^{137}Cs$ in the samples suggested that FDNPP was leaking $^{90}Sr$ at a rate of 2.3 – 8.5 GBq $d^{-1}$ into the Pacific Ocean in September 2013. Such a leak would be 100-1000 times larger than the amount of $^{90}Sr$ transported by rivers from land to ocean. The presence of $^{90}Sr$ and $^{134,137}Cs$ in significant amounts until 2015 suggests the need of a continuous monitoring of artificial radionuclides in the Pacific Ocean.

**Text and pictures by Pere Masqué**

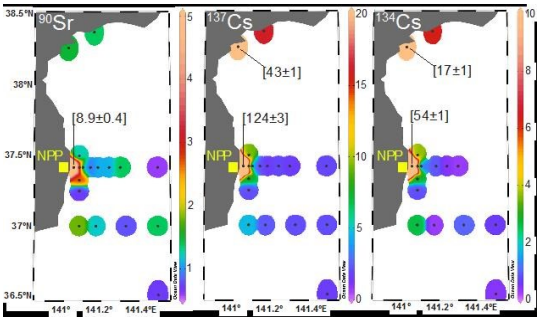



**Figure 2**: $^{90}Sr$, $^{137}Cs$ and $^{134}Cs$ in surface seawater in September 2013 (in Bq·$m^{-3}$). Figure taken from Castrillejo *et al*., Env. Sci & Tech, 2015.

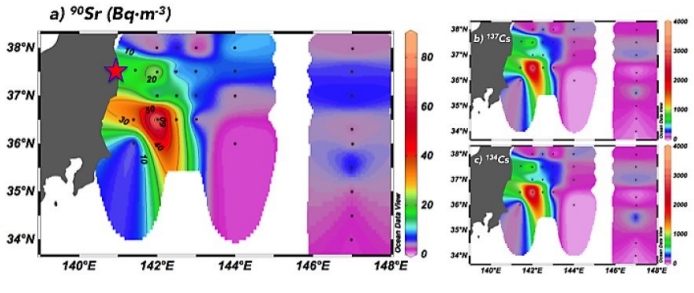



**Figure 3**: $^{90}Sr$, $^{137}Cs$ and $^{134}Cs$ in surface seawater in June 2011. Figure taken from Casacuberta *et al*., Biogeosciences, 2013, with Cs data from Buesseler *et al*., PNAS, 2012.

**Work in progress as part of COMET-FRAME project:**
$^{134,137}Cs$ and $^{90}Sr$ are currently being analysed from sampling cruises carried out during 2014 & 2015

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# Sampling wildlife in the Chernobyl Exclusion zone

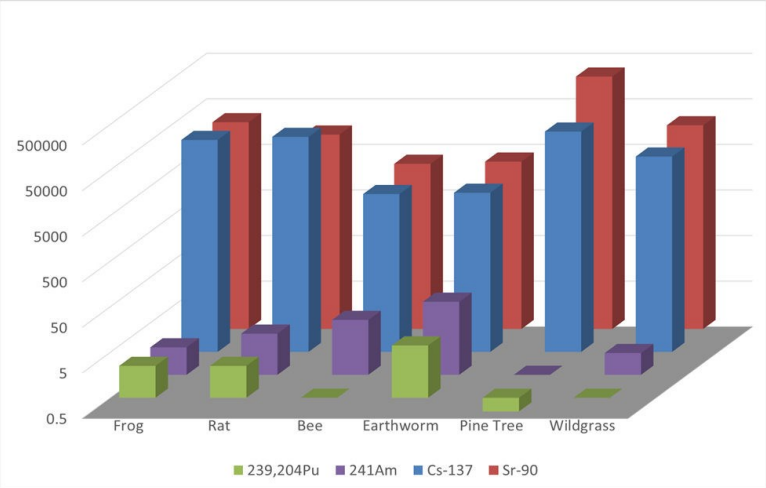


**Figure 1:** Activity concentrations (Bq $kg^{-1}$) for RAP organisms for the radioisotopes $^{239,240}Pu$, $^{241}Am$, $^{137}Cs$, $^{90}Sr$ from a site in the CEZ.

As part of COMET work package three, Chornobyl Center have determined radionuclide activity concentrations in a range of species representing the ICRP Reference Animals and Plants (RAPs). These samples were collected from a site on the edge of the Red Forest in the Chernobyl Exclusion Zone (CEZ).

Results will be used to establish alternative radionuclide transfer models for wildlife.

**Text and figure provided by Nick Beresford**

## Forthcoming events

- **COMET Workshop** 'Thirty years after the Chernobyl accident what do we know about the effects of radiation on the environment? Ukraine, August 30-31, 2016
- **COMET Field-course** 'Chernobyl fallout in the environment' Ukraine, September 5-8, 2016
- **Radiation Protection Week** Oxford, September 19-23, 2016
- **International Conferences on Research Infrastructures 2016** Cape Town, South Africa, October 3-5 2016
- **NORM VIII Symposium**, Rio de Janeiro, October 18-21, 2016
- **$EAN_{norm}$ Workshop**, Stockholm, December 5-7, 2016

## *Final COMET event*

***Save the dates now: 25-27 April 2017***

***information will be available soon on***

***www.comet-radioecology.org***

**For more information on COMET contact: Hildegarde Vandenhove**