8. CONCLUSIONS

A good water quality is fundamental for the maintenance of ecosystem biodiversity and therefore for the sustainable development of humans, for water supply and recreational purposes.

Toxicants are addressed by the WFD in the assessment of the chemical status, through the comparison of the measured concentrations to the Environmental Quality Standards (EQS). Standard ("classical") monitoring based on spot sampling and chemical analysis can be helpuful but presents severe limitations. Spot water sampling therefore provides only a "snapshot" of the situation at the set time of sampling and fails to provide information in the bioavailability of pollutants in water and sediments. This is of major concern, because toxicants have been identified as one of the main driving forces of the deterioration of aquatic systems (Brunberg and Blomqvist, 2001).

In this context a possible successful implementation of the WFD relies on a number of factors including a series of emerging tools to implement monitoring. Many of the emerging tools and techniques that have been developed in recent years provide suitable alternatives for low cost and more representative monitoring respect to the standard procedures. Among these emerging tools ecological monitoring, biomarkers and toxicity tests have been identified particularly useful in providing a more realistic assessment of impacts and exposure of aquatic organisms to specific or mixture of contaminants in the water. They can provide additional information on temporal and spatial variability of pollutants, biological/toxicological effects, accounting for contaminant bioavailability, as well as early detection of pollution events.

The presented work aimed to provide an overview the value of of ecotoxicity tests both as a tool for the specific evaluation of potential effect of single pollutants (well-known pollutants such as chromium and DDE and also new potential pollutants such as zosteric acid used as antifoulant) on target aquatic organisms and as emerging monitoring tool to reach the FWD objectives.

Ecotoxicology has emerged as the applied science that addresses the central issues of contaminants in the biosphere. Thus in the 21st century, ecotoxicology needs to evolve, moving away from traditional toxicology approaches that are still in use by most regulatory agencies, and encompass integrative tools and models to evaluate the risk posed by existing and new contaminants as part of their registration, potential use, and application. Major challenges in this young science include the following: (1) the integration of causal explanations and knowledge arising at different levels of biological organization into a coherent whole; (2) integration of scientific, technical, and practical goals of ecotoxicologists; and (3) consideration of ecotoxicological issues at increasingly wider spatial and longer temporal scales.

On the basis of what emerged most recently in literature and on what mentioned in the present work, chemical characterization by itself does not provide specific biological information about potential hazards to organisms. Traditional ecotoxicological approaches that utilize individual endpoints are still valid tools to understand the fate of pollutants (their migration, transformation, sedimentation, and interactions) in the environment (aquatic environment in particula) and their impact on individuals, populations, communities, and ecosystems. By truly integrating monitoring strategies, involving chemical analyses, a set of ecotoxicological tools, the study of population/community responses in the same water body and, preferably, time of the year, a more holistic picture can be obtained.

Priority issue for a successful inclusion of emerging techniques in water monitoring programs is to improve communication between scientists and policy-makers, and to optimise the coordination between scientific development outputs and policy-research needs (Quevauviller et al 2005)

However, there is little doubt that the combination of these technologies, together with associated ecological monitoring, should enable the representative assessment of the health of an ecosystem, as required by the WFD. Strategic monitoring using all these tools in appropriate way could provide the representative information necessary for monitoring activity to fulfil the requirements of the WFD.

The protection of aquatic environments is often focused only on water compartment but more attention has to be posed to the sediment environment which is an essential, integral and dynamic part of water environments.

Though the WFD does not specifically deal with sediment, it is clear that there is a strong link between sediment quality evaluation and achieving of this WFD objective.

Furthermore the use of bioassays and sediment analysis to evaluate sediment quality is significant for assessing water quality, confirming the urgent need to correct current gaps in the WFD on water quality analysis. Bioassays and biomonitoring are two key tools for evaluating the chemical and ecological states of water, sediment and biota.

Results obtained from the present studies reinforced the significance of including these tools in water quality analysis, as already highlighted by the recommendations in some Member States legislation (e.d. French, Spanish, Nederlands).

The matter of port pollution even in freshwater environments is of concern still under discussion and evaluation. It is well-known that there is an urgent need to improve environmental data monitoring techniques in marine harbours in order to understand the environmental impacts of port activities (Darbra et al. 2009). It seems that even freshwater port sediment also could be affected from heavy micropollutants.

According to the European Water Framework Directive (WFD), these water bodies are classified as heavily modified water bodies (HMWB) because they continuously suffer from severe physical and chemical modifications due to anthropogenic activities.
Ecotoxicological sediment tests should be therefore recommended within the WFD adopting a standardized classification system for sediments according to their degree of chemical contamination.

The importance of an integrative evaluation of the aquatic ecosystem (water and sediments) is crucial, giving a comprehensive analysis of the environmental quality of the water bodies; this represents the implementation of remediation strategies for the modified water bodies to obtain a good ecological potential and a good chemical status as proposed in the WFD. Ecotoxicological approach results as a useful tool both in laboratory test on known chemicals to better understand their effect on target organisms and their behaviour in water or sediments and in a more holistic approach as new monitoring tools to support the chemical monitoring to assess the status of water ecosystems (water and sediments).

References

Allan I.J., Mills G.A., Vrana B., Knutsson J., Holmberg A., Guigues N., Laschi S., Fouillac A.M. and Greenwood R. 2006b. Strategic monitoring for the European Water Framework Directive. *Trend Anal Chem* 25 (7): 704-715.

Allan I.J., Vrana B., Greenwood R., Mills G.A., Roig B. and Gonzalez C. 2006a. A "toolbox" for biological and chemical monitoring requirements for the European Union's Water Framework Directive. *Talanta* 69: 302-322.

American Society for Testing and Materials. 2000. Standard Guide for Determination of the Bioaccumulation of Sediment-Associated Contaminants by Benthic Invertebrates. E 1688-00a.

American Society for Testing and Materials. 2010. Standard test methods for measuring the toxicity of sediment-associated contaminants with freshwater invertebrates. E1706–95. In Annual Book of ASTM Standards, Vol 11.05. Philadelphia, PA, pp 1138–1220.

Apitz S.E., Elliott M., Fountain M., Galloway T.S. 2006. European environmental management: moving to an ecosystem approach. *Integr Environ Assess Manage 2(1): 80–5.*

Barcelo D. and Petrovic M. 2006. New concepts in chemical and biological monitoring of priority and emerging pollutants in water. *Anal Bioanal Chem* 385 (6): 983-984.

Bartell S.M. 2008. Ecological Risk Assessment. In: S.E. Jorgensen and B. Fath, Encyclopedia of Ecology. Elsevier Science: 1097-1101.

Beyer J., Petersen K., Song Y., Ruus A., Grung M., Bakke T. and Tollefsen K.E. 2013. Environmental risk assessment of combined effects in aquatic ecotoxicology: a discussion paper. *Mar Environ Res* doi: 10.1016/j.marenvres.2013.10.008.

Blasco C. and Picó Y. 2009. Prospects for combining chemical and biological methods for integrated environmental assessment. *Trend Anal Chem* 28 (6): 745-757.

Brack W., Klamer H.J.C., López de Alda M., Barceló D. 2007. Effect-directed analysis of key toxicants in European river basins - a review. *Environ Sci Pollut Res* 14 (1): 30-38.

Brils J. 2008. Sediment monitoring and the European Water Framework Directive. *Ann Ist Super Sanità* 44 (3): 218-223.

Brunberg A.K. and Blomqvist P. 2001 .Quantification of anthropogenic threats to lake sin a low land country of Central Sweden. *Ambio* 30: 127–134.

Burton G.A. 2013. Assessing sediment toxicity: past, present, and future. *Environ Toxicol Chem* 32 (7): 1438-1440.

Burton G.A. and Scott K.J. 1992. Sediment toxicity evaluations. *Environ Sci Technol* 26:2068-2075.

Butt T. E., Lockley E., Oduyemi K.O.K. 2008. Risk assessment of landfill disposal sites--State of the art. *Waste Manage* 28: 952-964.

Chapman P.M. 1996. Presentation and interpretation of sediment quality triad data. E*cotoxicology* (5):327-39.

Chapman P.M., Hollert H. 2006. Should the Sediment Quality Triad Become a Tetrad, a Pentad, or Possibly even a Hexad? *J Soil Sediment* 6 (1): 4-8.

Connon R. E., Geist J., Werner I. 2012. Effect-Based Tools for Monitoring and Predicting the Ecotoxicological Effects of Chemicals in the Aquatic Environment. *Sensors* 12: 12741-12771.

Crommentuijn T., Polder M., Sijm D., De Bruijn J., Van de Plassche E. 2000. Evaluation of the Dutch environmental risk limits for metals by application of the added risk approach. *Environ Toxicol Chem* 19:1692–1701.

Darbra R.M., Pittam N., Royston K.A. Darbra J.P., Journee H. 2009. Survey on environmental monitoring requirements of European ports. J Environ Manage 90: 1396–1403.

Depledge M.H., Fossi M.C. 1994. The Role of biomarkers in environmental assessment.2. Invertebrates. *Ecotoxicology* 3: 161-172.

Diepens N.J., Arts G.H.P., Brock T.C.M., Smidt H., Van den Brink P.J., Van den Heuvel-Greve M.J. and Koelmans A.A. 2013. Sediment toxicity testing of organic chemicals in the context of prospective risk assessment: A review. *Crit Rev Env Sci Technol* DOI:10.1080/01496395.2012.718945.

Dworak T., Gonzalez C., Laaser C., Interwies E. 2005. The need for new monitoring tools to implement the WFD. *Environ Sci Policy* 8: 301-306.

European Chemicals Bureau (ECB) 2003. Technical Guidance Document on risk assessment in support of Commission Directive 93/ 67/EEC on Risk Assessment for New Notified Substances and Commission Regulation (EC) No 1488/94 on Risk Assessment for Existing Substances and Directive 98/8/EC of the European Parliament and of the Council concerning the placing of biocidal products on the market. Ispra, Italy.

European Commission Water Framework Directive (2000/60/EC). 2000. Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy. Official Journal of the European Communities L327/1,22 December 2000.

European Commission. 2003 Common Implementation Strategy Working Group. Guidance Document: Guidance on Monitoring for the Water Framework Directive. January 2003.

European Commission. 2003. Common Implementation Strategy for the Water Framework Directive (2000/60/EC). Guidance Document No. 7 on Monitoring Under the Water Framework Directive.

European Commission. 2003. Technical Guidance Document in support of Commission Directive 93/67/EEC on risk assessment for new notified substances, Commission Regulation (EC) No. 1488/94 on Risk Assessment for Existing Substances and Directive 98/8/EC of the European Parliament and of the Council.

European Commission. 2009. Common Implementation Strategy for the Water Framework Directive (2000/60/EC). Guidance Document No. 19 on Surface Water Chemical Monitoring Under the Water Framework Directive.

European Commission. 2010. Common Implementation Strategy for the Water Framework Directive (2000/60/EC). Guidance Document No. 25 on Chemical Monitoring of Sediment and Biota Under the Water Framework Directive.

European Commission. 2011. Common Implementation Strategy for the Water Framework Directive (2000/60/EC) Guidance Document No. 27 on Technical Guidance for Deriving Environmental Quality Standards.

European Commission. Directive 2008/105/EC of the European Parliament of the Council on environmeantal quality standards in the field of water policy, amending and subsequently repealing Council Directives 82/176/EEC, 83/513/EEC, 84/156/EEC, 84/491/EEC, 86/280/EEC and amending Directive 2000/60/EC. Official journal of the European Communities C, L 348/84 24/12/2008.

European Commission. Directive 2009/90/EC of 31 July 2009 laying down, pursuant to Directive 2000/60/EC of the European Parliament and of the Council, technical specifications for chemical analysis and monitoring of water status. Official journal of the European Communities C, L 201/36 1/08/2009.

European Commission. Directive 2013/39/EC of the European Parliament of the Council on environmeantal quality standards in the fiel of water policy, amending and subsequently repealing Directive 2000/60/EC and 2008/105/EC, Official journal of the European Communities C, L 226 24/06/2013.

European Union. Directive 2000/60/EC (2000) of the European Parliament and of the Council of 23 October 2000 establishing a freamwork for Community action in the field of water policy (Water Framework Directive). Official journal of the European Communities C, L 327 22/12/2000.

Farré M., Gajda-Schrantz K., Kantiani L., Barceló D. 2009. Ecotoxicity and analysis of nanomaterials in the aquatic environment. *Anal Bioanal Chem* 393 (1): 81-95.

Ferguson C., Darmenfraid D., Freir K., Jensen B.K., Jensen J., Kasamas H., Urzelai A., Vegter J. 1998. Risk Assessment of Contaminated Sites in Europe, Policy Frameworks, vol. 2, LQM Press, Nottingham, UK.

Fernández M.D., Cagigal E., Vega M.M., Urzelai A., Babín M., Pro J., Tarazona J.V. 2005. Ecological risk assessment of contaminated soils through direct toxicity assessment. *Ecotoxicol Environ Saf* 62: 174-184.

Fraunhofer-Institute Molecular Biology and Applied Ecology (FHI). 2001. Identification of quality standards for priority substances in the field of water policy. Schmallenberg (DE): Fraunhofer- Institute Environmental Chemistry and Ecotoxicology.

González-Martínez M.A., Puchades R, Maquieira A. 2007. Optical immunosensors for environmental monitoring: How far have we come? *Anal Bioanal Chem* 387:205-218.

Greenwood R., Roig B., Allan I.J. 2004. Draft Report: Operational Manual, Overview of Existing Screening Methods. Available at: http://www.swift-wfd.com.

Hering D., Borja A., Carstensen J., Carvalho L., Elliott M., Feld C.K., Heiskanen A.S., Johnson R.K., Moe J., Pont D., Solheim A. L., van de Bund W. 2010. The European Water Framework Directive at the age of 10: A critical review of the achievements with recommendations for the future. *Sci Total Environ* 408: 4007–4019.

Hernandoa M.D., Fernández-Albab A.R., Taulera R., Barceló D. 2005. Toxicity assays applied to wastewater treatment. *Talanta* 65: 358–366.

Heugens E.H.W., Hendriks A.J., Dekker T., van Straalen N.M., Admiraal W. 2001. A review of the effects of multiple stressors on aquatic organisms and analysis of uncertainty factors for use in risk assessment. *Critical Rev Toxicol* 3:247-84.

Hollert H., Ahlf W., Heise S., Manz W., Scrimshaw M., White S. 2007. Controversies and Solutions in Environmental Sciences. *J Soil Sediment* 7 (6): 360.

Höss S., Ahlf W., Fahnenstich C., Gilberg D., Holert H., Melbye K., Meller M., Hammers-Wirtz M., Heininger P., Neumann-Hensel H., Ottermanns R., Ratte H.T., Seiler T-B., Spira D., Weber J., Feiler U. 2010. Variability of sediment-contact tests in freshwater sediments with low-level anthropogenic contamination – Determination of toxicity thresholds. *Environ Pollut* 158 (9): 2999–3010.

Huschek G., Hansen P.D. 2005. Ecotoxicological classification of the Berlin river system using bioassays in respect to the European Water Framework Directive. *Environ Monit Assess* 121: 15–31.

Ishaque A.B., Aighewi I.T. 2008. Dose–Response. In: S. E. Jorgensen and B. Fath, Encyclopedia of Ecology. Elsevier Science: 957-967.

ISO International Organisation for Standardization, 1994. Water quality - Determination of the prolonged toxicity of substances to freshwater fish - Method for evaluating the effects of substances on the growth rate of rainbow trout (Oncorhynchus mykiss Walbaum (Teleostei, Salmonidae)).

ISO International Organisation for Standardization, 1996. Water quality - Determination of the acute lethal toxicity of substances to a freshwater fish Brachydanio rerio Hamilton-Buchanan (Teleostei, Cyprinidae). ISO 7346. Geneva, Switzerland.

ISO International Organisation for Standardization, 2008. Water quality - Determination of chronic toxicity to Ceriodaphnia dubia. ISO 20695. Geneva, Switzerland.

ISO International Organisation for Standardization, 2012. Water Quality - Determination of the mobility of Daphnia magna Straus (Cladocera, Crustacea). ISO 6341. Geneva, Switzerland.

ISO International Organisation for Standardization, 2012. Water quality - Fresh water algal growth inhibition test with unicellular green algae. ISO 8692. Geneva, Switzerland.

Jones M.A., Stauber J., Apte S., Simpson S., Vicente-Beckett V., Johnson R., Duivenvoorden, L. 2005. A risk assessment approach to contaminants in Port Curtis, Queensland, Australia. *Mar Pollut Bull* 51: 448–458.

Kahru A., Põllumaa L. 2006. Environmental hazard pf the waste streams of the Estonian oil-shale industry: an ecotoxicological review. *Oil Shale* 23: 53–93.

Kallis G., Butler D. 2001. The EU water framework directive: measures and implications. *Water Policy* 3: 125–142.

Klein W., Denzer S., Herrchen M., Lepper P., Müller M., Sehrt R., Storm A., Volmer J. 1999. Revised proposal for a list of priority substances in the context of the Water Framework Directive (COMMPS procedure). Final report 98/788/3040/ DEB/E1. Schmallenberg (DE): Fraunhofer Institute.

Lepper P. 2005. Manual on the methodological framework to derive environmental quality standards for priority substances in accordance with Article 16 of the Water Framework Directive (2000/60/EC).

Lidman U., The nature and chemistry of toxicants, in: K.C. Thompson, K. Wadhia, A.P. Loibner (Editors), Environmental Toxicity Testing, Blackwell Publishing, Oxford, UK, 2005, ISBN 1-4051-1819-9.

Liss W., Ahlf W. 1997. Evidence from whole-sediment, porewater, and elutriate testing in toxicity assessment of contaminated sediments. *Ecotoxicol Environ Saf* 36:140-147.

Loibner A.P., Szolar O.H.J., Braun R., Hirmann D. 2003. The use of toxicity tests in contaminated land analysis: ecological assessment and toxicity screening. In: K.C. Thompson, C.P. Nathanail (Editors), Chemical Analysis of Contaminated Land, Blackwell Publishing, Oxford, UK.

Loos R. 2012. Analytical Methods for the new proposed Priority Substances of the European Water Framework Directive (WFD) - Revision of the Priority Substance List, Technical Report.

Maas J. L. and M. J. van den Heuvel-Greve. 2005. Opportunities for bioanalysis in WFD chemical monitoring using bioassays, in: RIZA working document, Rijkswaterstaat RIZA, Lelystad, The Netherlands, pp. 51.

Manusadzianas L., Balkelyte L., Sadauskas K., Blinova I., Põllumaa L., Kahru A. 2003. Ecotoxicological study of Lithuanian and Estonian wastewaters: selection of the biotests and correspondence between toxicity and chemical-based indices. *Aquat Toxicol* 63: 27–41.

Newman M.C. and Y. Zhao. 2008. Ecotoxicology nomenclature: LC, LD, LOC, LOEC, MAC. In: Jorgensen S.E., B. Fath (Eds.), Encyclopedia of Ecology, Elsevier. pp. 1187–1193.

OECD 2004. Daphnia sp. Acute immobilization test. OECD guidelines for Testing Chemicals, 202.

OECD 2004. Sediment-Water Chironomid Toxicity Using Spiked Sediment. OECD guidelines for testing chemicals, 218.

OECD 2004. Sediment-Water Chironomid Toxicity Using Spiked Water. OECD guidelines for testing chemicals, 219.

OECD 2006. Freshwater Alga and Cyanobacteria, Growth Inhibition Test. OECD guidelines for testing chemicals, 201.

OECD 2008. Daphnia magna reproduction test. OECD guidelines for testing chemicals, 211.

OECD 2010. Sediment-Water Chironomid Life-Cycle Toxicity Test Using Spiked Water or Spiked Sediment. OECD guidelines for testing chemicals, 233.

OECD. 2007. Sediment-Water Lumbriculus Toxicity Test Using Spiked Sediment. OECD guidelines for testing chemicals, 225.

Persoone G., J. Gillet, 1990. Toxicological Versus Ecotoxicological Testing. In: Bourdeau P., Somera E., Richardson G.M. and Hickman J.R. Short-Term Toxicity Test for Non-genotoxic effects. Charter 17. Published by John Wiley and Sons Ltd.

Persoone G., Marsalek B., Blinova I., Torokne A., Zarina D., Manusadzianas L., Nalecz-Jawecki G., Tofan L., Stepanova N., Tothova L., Kolar B. 2003. A practical and user-friendly toxicity classification system with microbiotests for natural waters and wastewaters. *Environ Toxicol* 18 (6): 395-402.

Põllumaa L., Kahru A., Manusadzianas L. 2004. Biotest- and chemistry-based hazard assessment of soils, sediments and solid wastes. *J Soil Sediment* 4: 267–275.

Quevauviller P., Balabanis P., Fragakis C., Weydert M., Oliver M., Kaschal A., Arnald G., Kroll A., Galbiati L., Zaldivar J.M., Bidoglio G. 2005. Science-policy integration needs in support of the implementation of the EU Water Framework Directive. *Env Sci Pol* 8: 203-211.

Rand G., Petrocelli M., Sam R. 1985. Fundamentals of aquatic toxicology: Methods and applications. Washington: Hemisphere Publishing.

Rice G, MacDonell M., Hertzberg R.C., Teuschler L., Picel K., Butler J., Chang Y.S., Hartmann H. 2008. An approach for assessing human exposures to chemical mixtures in the environment. *Toxicol Appl Pharmacol* 233 (1): 126-136.

Rubach M.N., Ashauer R., Buchwalter D.B., De Lange H.J., Hamer M., Preuss T.G., Töpke K., Maund S.J. 2011. Framework for traits-based assessment in ecotoxicology. *Integr Environ Assess Manag* 7:172-186.

Sánchez P., Alonso C., Fernández C., Vega M.M., García M.P., Tarazona J.V. 2005. Evaluation of a multi-species test system for assessing acute and chronic toxicity of sediments and water to aquatic invertebrates effects of pentachlorophenol on *Daphnia magna* and *Chironomus prasinus*. *J Soil Sediment* 5:53-58.

Scroggins R.P. 1999. Guidance Document on Application and Interpretation of Single-species Tests in Environmental Toxicology, Report EPS 1/RM/34, Environmental Technology Centre, Environment Canada, Ottawa, Ontario.

Suter II G.W., Efroymson R.A., Sample B.E., Jones D.S. 2000. Ecological Risk Assessment for Contaminated Sites. Lewis Publishers, CRC Press, Boca Raton, FL, USA.

Tassou K.T., Schulz R. 2011. Two-generation effects of the chitin synthesis inhibitor, teflubenzuron, on the aquatic midge *Chironomus riparius*. *Ecotoxicol Environmen Saf* 74:1203-1209.

Truhaut R. 1977. Eco-toxicology—objectives, principles and perspectives. *Ecotoxicol Environ Saf* 1: 151–173.

US EPA 2002. Methods for measuring the acute toxicity of effluents and receiving waters to freshwater and marine organisms, 5yh ed.; US Environmental Protection Agency, Office of Water: Washington, DC, USA.

US EPA 2002. Short-term methods for measuring the chronic toxicity of effluents and receiving waters to freshwater organisms; US Environmental Protection Agency, Office of Water: Washington, DC, USA.

US EPA, 2000. Bioaccumulation testing and interpretation for the purpose of sediment quality assessment—status and needs. US Government Printing Office, Washington, DC.

Vasseur P., Cossu-Leguille C. 2003. Biomarkers and community indices as complementary tools for environmental safety. *Environ Int* 28(8):711-717.

Wadhia K., Clive Thompson K. 2007. Low-cost ecotoxicity testing of environmental samples using microbiotests for potential implementation of the Water Framework Directive. *Trends Anal Chem* 26 (4): 300-307.

Warren N., Allan I.J., Carter J.E., House W.A., Parker A. 2003. Pesticides and other micro-organic contaminants in freshwater sedimentary environments—a review. *Appl Geochem* 1: 159-194.

Wharfe J. 2004. Hazardous Chemicals in Complex Mixtures – A Role for Direct Toxicity Assessment. *Ecotoxicology* 13: 413-421.

List of papers and posters produced

Papers

Ponti B., Q. Silvia, Bettinetti R. 2013. An ecotoxicological approach to assess the environmental quality of freshwater basins: a possible implementation of the Water framework Directive? *In preparation*.

Ponti B., Bettinetti R., Dossi C., Vignati D.A.L. 2013. Cr(III) behavior in freshwater environments: how reliable are ecotoxicological data of for *Daphnia magna*? Accepted with major revisions by *Environmental Ecotoxicology and Chemistry*.

Polo A., Foladori P., Ponti B., Bettinetti R., Gambino M., Villa F., Cappitelli F. 2013. The Potential of Zosteric Acid as New Strategy for Mitigating Biofouling in Membrane Bioreactor Systems. Accepted with minor revisions by *Internation Journal of Molecular Sciences*.

Bettinetti R., Croce V., Noè F., Ponti B., Quadroni S., Galassi S. 2013. Ecotoxicity of pp'DDE to *Daphnia magna*. *Ecotoxicology* 22:1255–1263.

Ponti B., Bettinetti R., Galassi S., Vignati D.A.L. 2012. Ecotossicità del cromo trivalernte. *Acqua&Aria* 6: 28-34.

Bettinetti R., Ponti B., Marziali L., Rossaro B. 2012. Biomonitoring of lake sediments using benthic macroinvertebrates. *Trends in Analytical Chemistry* 36: 92-102.

Posters

Ponti B., Dossi C., Vignati D.A.L. 2013. Ecotoxicity of trivalent chromium to *Daphnia magna*: importance of Cr(III) solubility. Published on abstract book of III Young Environmental Scientists Meeting 11-13 February 2013.

Ponti B., Guilizzoni P., Lami A., Gerli S., Vezzoli L., Bettinetti R., Salemo F., Salmaso N., Veronesi M., Simona M., Marchese G., Pola A., Vignati D.A.L. 2012. Geochronology of Hg pollution in Italian sub.Alpine Lakes. Published on abstract book of XXII SETAC Europe Annual Meeting 20-24 May 2012, Berlin.

Ponti B., Vignati D.A.L, Bettinetti R., Pasquarè F.A. 2012. Benefits vs. Risks of Fish Consumption in Italy. Published on abstract book of XXII SETAC Europe Annual Meeting 20-24 May 2012, Berlin.