

**POTENTIAL TOXICOLOGICAL RISKS OF INDUSTRIAL HEAVY METALS
ON WILDLIFE ECOLOGY: A REVIEW TO DRAW ATTENTION TO AN
IMPORTANT ECOLOGICAL REGION**

MUSTAFA Y PEL¹, BRAH M OZAN TEKEL²

¹ *Namik Kemal University, Faculty of Veterinary Medicine, Pharmacology and Toxicology
Department, 59030, Tekirdağ, Turkey, e-mail: musyip@hotmail.com*

² *Mustafa Kemal University, Faculty of Veterinary Medicine, Pharmacology and Toxicology
Department, 31040, Hatay, Turkey, e-mail: ozantekeli@hotmail.com*

Many pollutants like heavy metals that are created as a result of increasing population and industrial production in parallel with the increasing population effects the ecological balance adversely with each passing day. The reflections of these developments on the wild life is higher because of their effects of life time, feeding and physiological properties. Hatay region comprises the Samandağ beach and Gulf of Iskenderun which hosts the endangered Loggerhead and Green Sea Turtles and Mediterranean seals, Amanos Mountains which are located on the migration route of many migratory birds, Amik plain which hosts Mountain gazelle and Striped hyena and many other endemic species. Because of this ecological importance, the region must be monitored periodically for the presence of pollutants beginning with industrial heavy metals and their effects on living systems and the potential toxicological risks and stress that these pollutants caused on the living systems must be determined in advance and regional protection policies must be developed. For that purpose, the regional stations must be established in the jurisdictions of the general and local governments where take the responsibility mutually that can manage the processes according to local parameters with the information and technology communion at first for information and technology communion.

Keywords: ecotoxicological risk, environmental pollution, heavy metal, wildlife, Hatay

INTRODUCTION

In recent years, one of the most underlined subjects by countries is the protection of the environment by utilization of natural resources in an efficient and sustainable way. For that purpose the prevention and control of harmful effects of chemicals by investigating their toxic effect potentials and assessing the risk of these chemicals has become one of the principal objectives of the developed countries. Despite the increasing international and national policies, the natural resources is continued to be effected adversely and the environment become receded from a livable ideal environment. The effects of environmental pollution are appeared in a wide dimensional way that blankets the ecosystem beyond personal effects (Kaya *et al.*, 2002; Republic of Turkey Ministry of Environment and Urbanization, 2011; Yarsan *et al.*, 2014; Yipel and Yarsan, 2014; Yipel *et al.*, 2015; Yipel *et al.*, 2016).

The industrial, urban and agricultural activities that emerge with the increasing population in the Turkey which ranks along with the developing countries causes the undesired but constantly growing environmental problems and cause the natural balance become unbalanced. When evaluated by sectors, it is determined that 60 % of the waste water discharged to the recipient environments are mainly originated from fossil-fuel based thermal power plants and industry (Republic of Turkey Ministry of Environment and Urbanization, 2012).

While the global chemical production was increased from 7 million tones at 1950 to 63 million tones at 1970 and 250 million tones at 1985. Today it is estimated that this

production has reached 400 million tones (Yarsan and Yipel, 2013; Yipel *et al.*, 2015; Yipel *et al.*, 2016).

Metals are the elements that found naturally on the earth crust. 59 of the 90 element characterized as “Heavy Metals” in the periodic table. This term is generally is used as a group name for metals that are connected with contamination and potential toxicity or eco-toxicity and half-metals (metalloids). These can be classified as essential ones for the execution of biochemical processes completely (Cu, Co, Cr, Fe Mn, Mo, Se, Zn), ones which are not essential and beneficial but when exposed to minute quantities that can be beneficial (B, Ni, Si, V) and the ones which are important environmental pollutants an don’t have any determined biological function and don’t undergo the disintegration process that diminish their their concentration and toxicity (Ag, Al, As, Ba, Be, Cd, Hg, Pb, Sb, Sr, Tl) (Duffus, 2002; Yipel, 2014; Yipel *et al.*, 2015; Yipel *et al.*, 2016).

Not only humans but also plants and animals are suffered from the pollutants. Thus in our day where the pollution is increasingly continues primarily because of heavy metals and natural resources are continuously dwindles, the understanding how the wild animals affected from pollution become an obligation. In this point the potential adverse effects that form over the ecosystem as a result of fast industrialization are disclosed by Ecological risk assessment methods. Ecological risk assessment means that the determination of potential negative affects aroused when aquatic animals like fish and invertebrates, terrestrial animals like birds and wild mammals and other out of target organism like plants and insects exposed to more than one pollutant (USEPA, 1992). Among the ecological risk Assessment Methods that are employed currently, “Regional Risk Model” is one among the one of the most preferred models (Kanwar *et al.*, 2015).

WILDLIFE AND ECOLOGICAL IMPORTANCE OF AREA

Wildlife term is used to refer all non-domestic animals (birds, mammals, fish amphibians and reptiles) that live on their natural habitat and their habitats mutually. Only 1.5 million of the species are defined among the total number of species predicted to be between 10 and 30 million (Ünal, 2011). Turkey has a very important potential in terms of wild life resources and species diversity and carrying capacity of its habitat but these potentials is affected adversary as a result of various reasons (deterioration, destruction, disintegration of habitats, over consumption, environmental pollution, foreign species, global climatic changes, industrial architecture, industrial forestry, hunting) (afak, 2006; Ünal, 2011). Ecosystem is especially polluted by agricultural pesticides and industrial wastes and this pollution harms the wild animals (afak, 2006).

Turkey is among the rare countries that are able to protect the majority of its wild life and wild species. Many wild that survive with special measures and artificial techniques are surviving and live naturally in our land. The location of Turkey between the Asia, Europe and Africa continents leads the diversification of the ecological conditions, diversity of the geological structure, formation of the different ecological conditions and thus emergence of a very rich biodiversity. Turkey is one of the most richest countries in the world in terms of biodiversity when compared with its land area (Ünal, 2011).

Besides many bird species that some of them are migratory, 7 of the 21 varieties of the salamander varieties which are known as urodela and anura that live in Turkey, 6 of the 9 turtle species, 14 of the 54 lizard species, 16 of the 44 snake species lives in the Hatay and Amanos region (Tok, 2008). Besides it is known that wild species like

Roedeer (*Capreolus capreolus*), Hatay Mountain Gazelle (*Gazella gazella*), Wild goat (*Capra aegrus*), Amanos snake (*Rhynchocalamus*), Striped hyena (*Hyaena hyana*), Bighead Turtle (*Caretta caretta*) and Green Sea Turtle (*Chelonia mydas*) that are classified as “Endangered (EN)” by The World Conservation Union, IUCN (Ergün, 2006, IUCN, 2014), Wild Cat, Coyote, Red Deer, Rock Marten, Pine marten, Marbled Polecat, badger, Crested porcupine, Meer cat, Weasel, Wolf, Sea Otter, Jerboa, Puss, Hare, Lynx, Wild Boar, Mole, Fruit Bat lives in the region. There are 3 natural conservation area (Tekkoz, Kengerlidüz, Habibineccar Mountain) and 2 natural life development areas (skenderun-Arsuz, Altınözü) are present in Hatay. In the borders of the province there are 150 endemic flora, 3 endemic fauna are observed. Species of Hatay Mountain Gazelle which have the population of 150 according to the latest inventory study at the vicinity of Kırıkhan district ncirli village is endangered. Samanda beach is 14 km long and is a sea turtle (*Caretta caretta*, *Chelonia mydas*) nesting. Besides the populations of wild goat, roe deer, squirrel, wild boar, fox, coyote, wolf, sea otter, crested porcupine and stripped hyena which is an important member of the wild life is identified. The properties of the ecosystem are significantly affected from the industry and agriculture based pollution and domestic wastes (Republic of Turkey Ministry of Environment and Urbanization, 2011; Republic of Turkey Ministry of Environment and Urbanization, 2013).

POTENTIAL TOXICOLOGICAL RISKS OF INDUSTRIAL IN AREA AND HEAVY METALS

The fast developments in the area of industry and technology while increasing the life quality of the people, on the other hand lead the disruption of the natural balance and environmental pollutants that threaten all creatures. When considering the amount of dangerous wastes in Turkey, Hatay ranked 4th after Izmir, Kocaeli and Manisa. Hatay province is an important center of the iron and steel industry and thus majority of the dangerous wastes formed in the province is iron-steel industry based. The declared dangerous waster are principally wastes that formed from iron-steel industry, solid wastes formed as a result of treatment of gases that include dangerous substances, wastes formed from physical and mechanical surface processes and shaping of the metals and plastics, metallic slushes that include oil. The >98% of produced dangerous wastes in Hatay can be disposed by recycling-burning (Ta kan, 2013). Constant increase of the requirement of increment in the production and necessity of heavy metals in developing and developed countries increases their scattering probability around. This situation shows that the urban and industrial activities are increasing the heavy metal cycles all over the world. The determination of the heavy metal concentration of an area is determined by determination of dangerous chemical content in organisms in that area (Yarsan and Yipel, 2013; Yipel *et al.*, 2015; Yipel *et al.*; 2016).

Air pollution is the first priority problem in Hatay (Republic of Turkey Ministry of Environment and Urbanization, 2014). The emissions of industrial facilities in the area (cement plants, refineries, fossil-fuel based thermal power plants etc.) create adverse effects by being carried by the wind, clouds and rains and mixing with in the agricultural land, soil and water (Republic of Turkey Ministry of Environment and Urbanization, 2011). The principal stress factors for the water resources are domestic, agricultural, industrial, mining based, sewage wastes and lack of infrastructure. While there are Antakya, skenderun and Payas OIS (Organized Industrial site) in the Hatay

water basin, only the Iskenderun OIS has the water treatment facility. It is estimated that 100 m³ of untreated water is discharged daily into the Asi River where the cities and Hamah and Humus cities of Syria which are concentrated on the industries of fertilizer, iron, plastic, petroleum and energy production are located. Especially the industrialization, population increase, agricultural activities, land and sea transportation, erosion, pesticides, inadequate sewer system, water infrastructure systems, mining and tourism in the Adana Osmaniye and Hatay which are neighboring the same Gulf forms the principles stresses of Asi River and the Gulf (Republic of Turkey Ministry of Environment and Urbanization, 2011). There haven't been any study performed on the properties, amount, types and disposal systems of the dangerous and harmful for the industrial facilities in the province. Even a waste water treatment facilities are present in a small number of industrial facilities it has been determined that these facilities are not operated in some industrial facilities (Republic of Turkey Ministry of Environment and Urbanization, 2011).

HEAVY METALS AND THEIR ACCUMULATION IN WILD ANIMALS

Metals which are resistant to the physical, chemical and biological degradations cannot be turned into benign forms. Thus they can reach high levels that can be harmful for living organisms by accumulating into the organs and tissues of organisms (bioaccumulation) that establishes a food chain or mild exposure from the living environment. More than one metal is present in the environmental mediums. Thus living creatures are exposed to physical-chemical forms of more than one metal. Metals can be utilized for principle biochemical objective after undergoing a series of biochemical process after taken into the body in trace amounts, stored in the body and disposed from the body. But the remaining unutilized portion of the metal can act as toxic to the body immediately or accumulate in the body and form a toxic effect. Wild animal's intake the heavy metals via foods, drinking water or breathing and through their skin into their bodies. Toxic properties of the metal vary for every metal and property of the tissue. But generally more than one organ or system is affected. Thus a single enzyme system or single biochemical process is not affected alone (Yarsan and Yipel, 2013; Yarsan *et al.*, 2014; Yipel *et al.*, 2015; Yipel *et al.*, 2016).

CONCLUSIONS

Investigation of wild animals and their habitat that are exposed to environmental pollution in terms of heavy metals which is one of the important parameter of pollution is very important both for disclosure of dimensions of environmental pollution and exposure level of the species from this pollution. Components of wild life are under according to the National and international Agreements. Thus ecotoxicology and protection of wild life in terms of animal health from chemical pollution is a legal obligation. Ecologically important Hatay region is highly exposed to environmental problems as a result of intense industrial activities. Thus the solution proposals of the regions environmental problems must be revealed. Thus, establishment of "Regional Pollution Monitoring Station" where the effects of the primarily chemical, biologic and physical pollution on the environment can be monitored periodically with information and data communion and the e risks and solutions with the reasons and dimensions of the pollution can be revealed in important ecological regions with intense industrial

activity by taking the mutual responsibility in the frame of local and national authorities jurisdictions will be a positive development in short and medium term.

REFERENCES

- Duffus, J.H. (2002), “*Heavy metals* a meaningless term? (IUPAC Technical Report)”. *Pure and applied chemistry*, 74(5), 793-807.
- Ergün, Y. (2006), Hatay’da on sıcak gün. Mustafa Kemal University Press., No: 19, Hatay.
- IUCN The World Conservation Union) (2012), *Red list of threatened species*, Version 2012.1. International Union for Conservation of Nature, <http://www.iucnredlist.org>.
- Kanwar, P., Bowden, W.B. and Greenhalgh, S. (2015), “A regional ecological risk assessment of the Kaipara harbour, New Zealand, using a relative risk model”, *Human and Ecological Risk Assessment: An International Journal*, 21(4), 1123-1146.
- Kaya, S., Pirinççi, . and Bilgili, A. (1998), *Environmental Science and Environmental Toxicology*, 2nd ed., Medisan Press., Ankara. p.: 12-78.
- Kaya, S., Pirinççi, . and Bilgili, A. (2002), *Toxicology in Veterinary Medicine*, 2nd ed., Medisan Press., Ankara. p.: 203-842.
- Republic of Turkey Ministry of Environment and Urbanization (2011), *Directorate General of Environmental Impact Assessment, Permit and Inspection. Environmental Status Report of Turkey*.
- Republic of Turkey Ministry of Environment and Urbanization (2013), *Directorate General of Environmental Impact Assessment, Permit and Inspection. Hatay Provincial Environmental Status Report*.
- Republic of Turkey Ministry of Environment and Urbanization (2014), *Directorate General of Environmental Impact Assessment, Permit and Inspection. Turkey Environmental Problems and Priorities Assessment Report*.
- afak, . (2006), “Problems and Solutions in Game Management in Aegean Region”, *1st International Symposium on Non-Wood Forest Products* (1-4 November), KTU Faculty of Forestry, pp:66-73, Trabzon.
- Ta kan, . (2013), “The Formation Of Hazardous Waste And Disposal In Turkey”, Marmara University, Institute of Science and Technology. Master's thesis. Istanbul.
- Tok, V. (2008), Hatay bölgesinde ya ayan iki ya amlılar (Amphibia) ve sürüngenler (Reptilia). Ekolojik Okur Yazarlık. Ed: Ergün, Y., Özdilek, ., Pamir, H. Mustafa Kemal University Press., No: 20. Hatay.
- Turkish Statistical Institute (TSI) (2012), *Environmental Statistics, 2010*. Newsletter, Issue: 13134.
- U.S. Environmental Protection Agency (USEPA) (1992), *Framework for ecological risk assessment*, EPA/630/R92/001. Risk Assessment Forum, Washington, DC.
- Ünal, Y. (2011), “Game and wildlife inventory in Isparta - Yazilikaya”, Süleyman Demirel University, Institute of Science and Technology. PhD thesis. Isparta.
- Yalçın-Özdilek, . (2008), Asi nehri ve Amanos derelerine ekolojik bakı . Ekolojik Okur Yazarlık. Ed: Ergün, Y., Yalçın-Özdilek, ., Pamir, H. Mustafa Kemal University Press., No: 20. Hatay.
- Yarsan, E. and Yipel, M. (2013), “The Important Terms of Marine Pollution 'Biomarkers and Biomonitoring, Bioaccumulation, Bioconcentration, Biomagnification’”, *Journal of Molecular Biomarkers & Diagnosis*, S1:003.
- Yarsan, E., Yipel, M., Dikmen, B., Altinta , L., Ekici, H. and Köksal, A. (2014), “Concentrations of essential and non-essential toxic trace elements in wild boar (*Sus Scrofa* L., 1758) tissues from southern Turkey”, *Bulletin of Environmental Contamination and Toxicology*, 92(1), 10-14.
- Yipel, M. and Yarsan, E. (2014), “A risk assessment of heavy metal concentrations in fish and an invertebrate from the Gulf of Antalya”, *Bulletin of Environmental Contamination and Toxicology*, 93(5), 542-548.
- Yipel, M., O uz, H. and Tekeli, .O. (2015), “An Overview of Hatay Environmental Pollution”, *Hatay Environmental Problems and Solutions Symposium*, p.:27, 28-30 May, Hatay, Turkey.
- Yipel, M., Tekeli, .O., Dikmen, B. and Yarsan, E. (2016), “Distribution and Ecotoxicological Risk Assessment of Heavy Metals: A Case Study in Streams of Amanus Mountains from Southern Turkey”, *2nd International Congress Of Forensic Toxicology. Industrial and Environmental Toxicology*, p:43, 26-30 May, Ankara, Turkey.

Potential Toxicological Risks of Industrial Heavy Metals on Wildlife Ecology: A Review to
Draw Attention to an Important Ecological Region
