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Anthropogenic impact on the environment (case study)

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Abstract
Human activity leads to environmental transformations, frequently on a large scale. There are places where anthropogenic consequences are unprecedented and disadvantageous to the extent that can be perceived in terms of an ecocatastrophe that goes beyond the local range. The article presents three anthropogenically degraded areas that pose danger for ecosystems in various parts of the world.

1. INTRODUCTION

Owing to the economic growth humans, have been affecting the environment more and more radically. In the past decades, anthropopressure has gained a special meaning because of rapid increase in the world population and development of environmental economisation [Klimska, Kaniewska 2015]. It has determined forming new kinds of ecological threats and contaminated areas of wide range impact. The areas include the Aral Sea and its surroundings (Kazakhstan, Uzbekistan), Hazaribagh (Bangladesh) and the northeast Pacific (Figure 1).

2. ANTHROPOGENIC IMPACT ON THE ENVIRONMENT IN THE REGION OF THE ARAL SEA (KAZAKHSTAN, UZBEKISTAN)

The Aral Sea, at present also called the Aral Karakum Desert [Breckle et al. 2012], is located in the eastern part of Central Asia (Fig. 1) in the area of Kazakhstan and Uzbekistan. It is situated in an endorheic basin and fed by the Amu Darya and Syr Darya rivers and rainfalls. Its vast (approximately 2.2 million km^2) river basin (Fig. 2) is mainly typical of a lowland desert [Micklin et al. 2014].

During the inter-war period, a decision was made to cultivate cotton on a massive scale on the deserts situated in the Aral Sea basin. That is why in the first half of the 20th century significant amounts of artificial fertilisers were applied in the plantations and the construction of irrigation canals was begun so as to drain the Amu Darya and Syr Darya rivers (Fig. 2) [Bielecki 2010]. As a result, the amount of water in the watercourses feeding the lake decreased, which, in the past half-century, led to disappearing of the reservoir. Since 1960, its water volume was decreased by approximately 1000 km^3 (Fig. 3). The fourth, in terms of size, lake in the world (68 000 km^2) has changed into a salt desert with relic reservoirs (Fig. 4) [Breckle et al. 2012, Gaybullaev et al. 2012], contaminated with chemical substances (amongst others, herbicides and DDT) coming from the nearby cotton plantations [Bielecki 2010].

The gradual disappearance of the lake within the years has led to local climatic changes which conduced to the desertification. Along with the growth of continentalism, salinity of the reservoir and the soils was increased. Dust storms relocated the toxic dust, destroying biological life to areas as far as 300–500 km away. In consequence, apart from local and nearby ecosystems degradation (e.g. the Amu Darya delta), the incident rate of respiratory, digestive and oncological diseases was increased [Kuciński 2007, Bielecki 2010], decimating, amongst others, Carpathian people. The areas of the former lake, now the desert, connected the former islands with the mainland. On one of them, up to late 1940s, biological weapon (strains of anthrax and cholera) was stored and it is supposed that it was not fully secured or destroyed. The likelihood is that

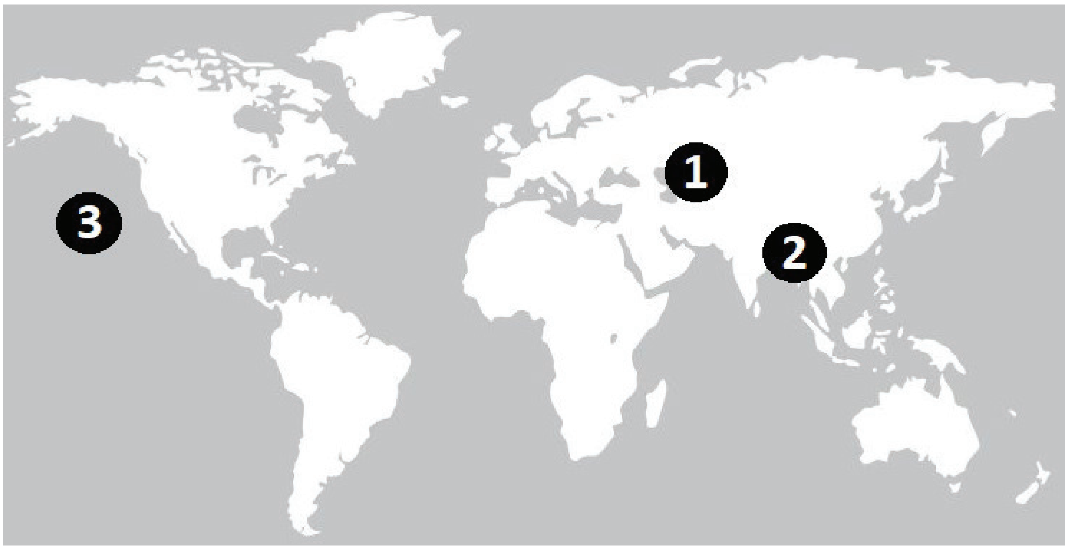

Figure 1. Selected areas affected by disastrous, environmental anthropopressure shown on a schematic map of the world. 1, The Aral Sea and the area; 2, Hazaribagh; 3, the northeast Pacific.

Figure 2. River basin and location of the Aral Sea [Micklin 2007, modified].

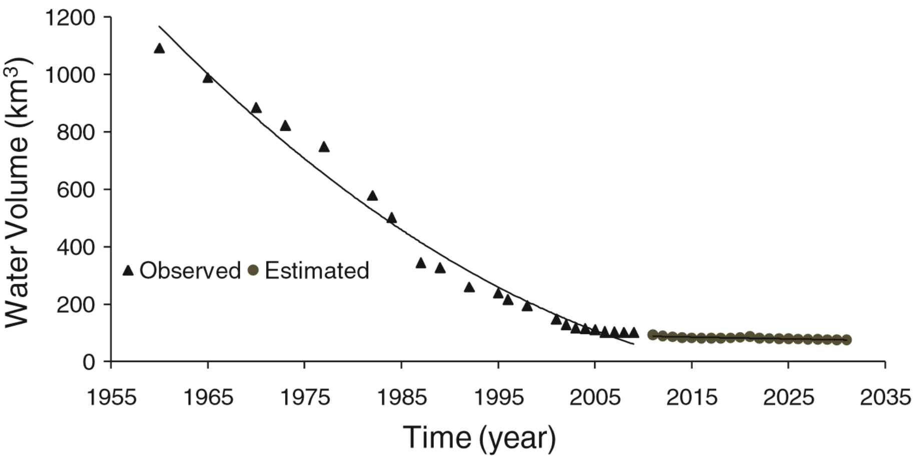

Figure 3. Changes in the water volume of the Aral Sea after 1960 based on the observed and estimated values [Gaybullaev et al. 2012, modified]

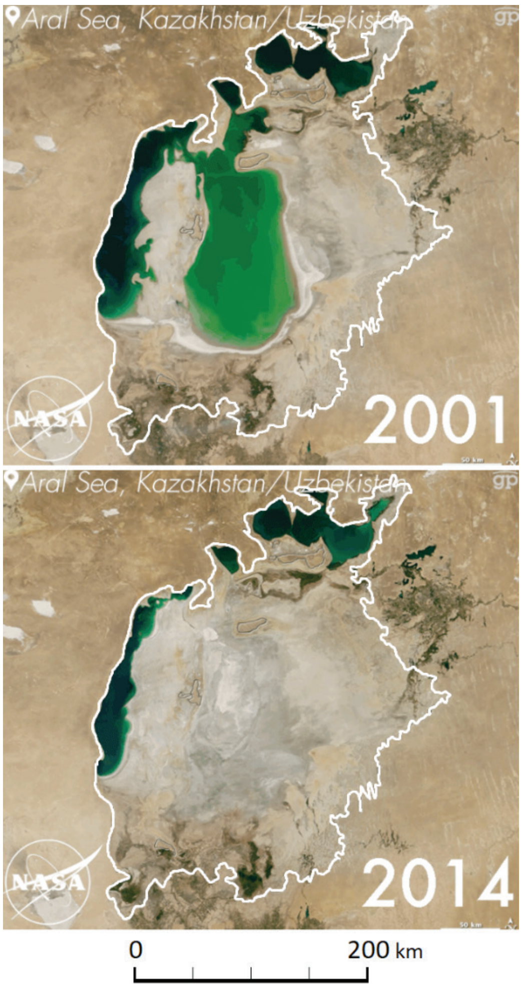

Figure 4. Disappearing of the Aral Sea after the hydrotechnical regulations of the Amu Darya and Syr Darya (white line, estimated waterline in 1960; the situation in 2001 and 2014 in the satellite imagery) [www.earthobservatory.nasa.gov, photo by NASA]

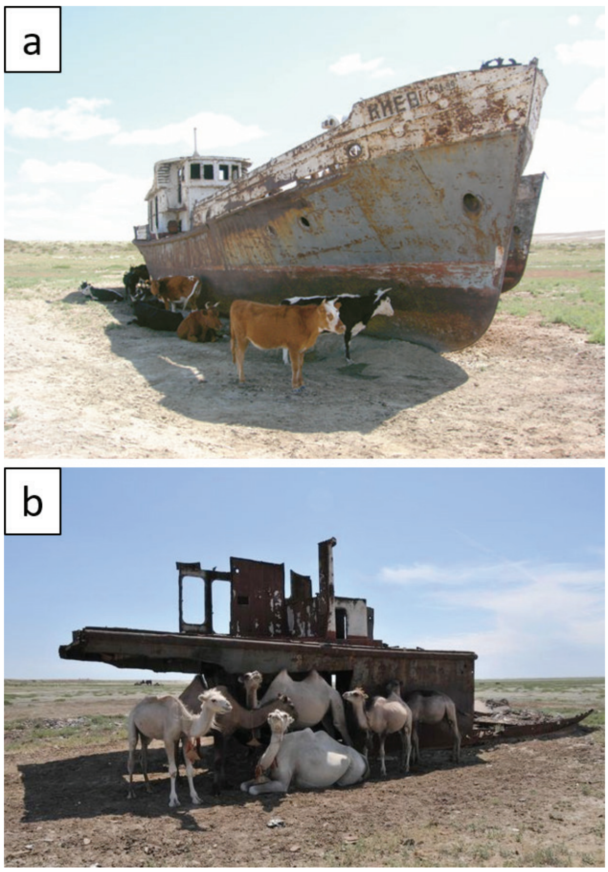

Figure 5. Land mammals seeking shelter in shipwrecks in the area of the former Aral Sea, now the Aral Karakum Desert [(a) Micklin 2007, photo by P. Micklin; (b) www.fly4free.pl, photo by M. Pitcher]

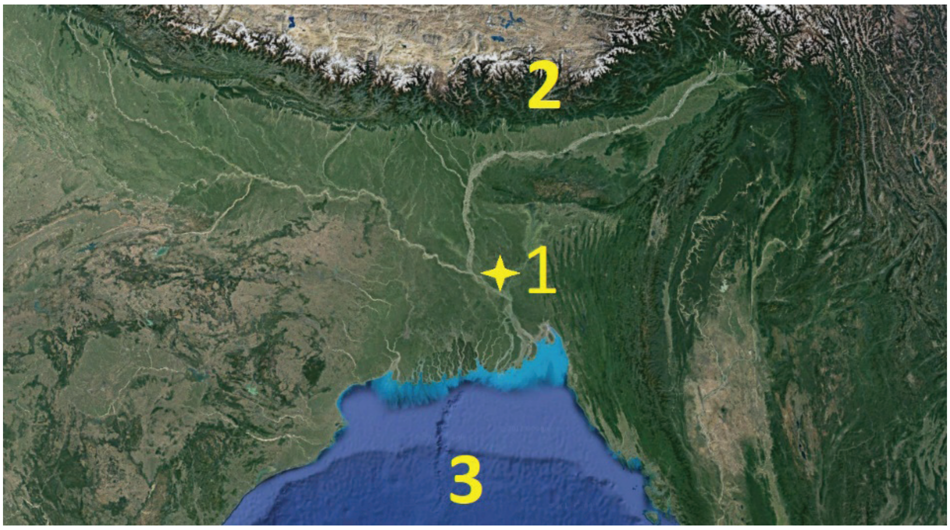

Figure 6. Physico-geographical location of Hazaribagh [www.google.com/earth]. 1, Hazaribagh; 2, the Himalayas; 3, the Bay of Bengal.

Figure 7. The contaminated Buriganga, the only river in Hazaribagh [Varene, Darblay 2012].

local animals that shelter in deserted shipwrecks (Fig. 5) will spread the dangerous microbes [Bielecki 2010] or that it has happened so far.

3. ANTHROPOGENIC IMPACT ON THE ENVIRONMENT IN THE HAZARIBAGH REGION (BANGLADESH)

Hazaribagh, located in the southern Asia (Fig. 1), is a densely populated area of slums placed on the outskirts of Dhaki (the capital of Bangladesh), along the Buriganga river (Fig. 7) [Varene, Darblay 2012]. It is situated in the eastern part of Hindustan, between the Himalayas (in the north) and the Bay of Bengal (in the south) (Fig. 6), within the reach of monsoons [Makowski 2013].

In Hazaribagh, on the area of nearly 10 ha, there are more than 200 primitive tanneries. Every year, they produce millions pieces of leather, which are used to make products delivered to the European market. Every day, raw (toxic) liquid industrial waste from the workshops is poured directly into the sewage system and then to the Buriganga river, which resembles a gutter (Fig. 7). As for the contaminated macrowaste, it is stored unsecured and reused for other purposes (amongst others, to produce soap or animal food) [Varene, Darblay 2012]. This situation causes environmental pollution and creates health hazards to living organisms (including humans). Chemical research into the surface sediment and liquid industrial waste has revealed that the soil is contaminated mainly with chromium (used in the industrial processes) [Abedin et al. 2015], whilst the sewage contains not only chromium but

Table 1. Concentrations of selected metals in tannery sewage from Hazaribagh in comparison to the concentration limits (according to NEQS 2000) considered for directing sewage to inland waterways [Kabir et al. 2017, modified].

	Concentration [mg/L]		
	Chromium [Cr]	**Ferrum [Fe]**	**Lead [Pb]**
Sample 1	5,866.942 ± 1.02	1.37 ± 5.44	28.976 ± 6.68
Sample 2	6,769.554 ± 1.59	108.556 ± 2.97	32.026 ± 6.92
Sample 3	288.454 ± 1.87	98.292 ± 1.42	20.842 ± 4.88
Sample 4	1,474.020 ± 4.99	14.26 ± 1.41	23.384 ± 2.53
Sample 5	2,857.182 ± 3.23	41.952 ± 7.56	21.858 ± 2.33
Sample 6	144.604 ± 2.21	64.392 ± 4.00	20.334 ± 2.50
Sample 7	50.792 ± 1.22	23.57 ± 6.22	18.808 ± 4.09
Sample 8	14.282 ± 1.17	30.732 ± 5.47	24.400 ± 1.21
Sample 9	26.984 ± 6.57	19.512 ± 4.83	22.368 ± 5.68
Standard acceptable limits for directing to inland waterways according to NEQS 2000 [www.elaw.org] NEQS 2000 [www.elaw.org]	1.00	8.00	0.50

also other harmful metals (Table. 1), whose concentrations significantly exceed the acceptable levels [Kabir et al. 2017].

The way in which the tanneries operate results in the ecosystem degradation. Individual geo-components affect one another and, in consequence, chemicals from the workshops circulate in the environment and are currently pervasive in Hazaribagh. The workshops generate 15,000 m3 of waste daily, which lies around near human habitations and on the river banks (Fig. 7). Monsoon rains wash the toxic substances which permeate into the soil and groundwater. The sewage pollutes the river and farmland, which negatively affects the wildlife. Toxic vapour from the waste spreads across the region as far as 15 km or even further, making the local air harmful to all living creatures. The food produced from offcuts (amongst others, meat or fat scraps and pieces of dyed leather) poisons breeding animals, and products made of them reach foreign markets. That is how the chemicals spread beyond the area source [Varene, Darblay 2012].

4. ANTHROPOGENIC IMPACT ON THE ENVIRONMENT IN THE NORTHEAST PACIFIC

Polymer waste (Fig. 9) drifts across the world ocean and, in total, weighs more than 100 million tonnes and covers the area as big as Australia. Its large concentrations are situated in the northern Pacific and are called the Great Pacific Garbage Patch [Heimowska 2016]. One of them can be seen between Hawaii and the western coast of the United States [Heimowska 2016, Moore et al. 2005] (Figs. 1 and 8).

It is estimated that every year, more than 6 million tonnes of plastics (plastic bottles, caps, bags, microwaste, etc.) get into the world ocean [Sato 2014]. The major part is washed into the world ocean through rivers [Heimowska 2016]. They include Los Angeles River, San Gabriel River, Coyote Creek which drain the urban areas in the southern California (the western coast of USA), from which more than 20 tonnes of plastic waste floating towards the Pacific were trapped within 24 hours (22 November 2004) (Table 2) [Moore et al. 2011]. The rivers are key emitters of the waste that gets into the analysed concentration of polymers (Fig. 8), which is conditioned by the sea currents system [see Sato 2014].

Plastics do not usually fully biodegrade. When exposed to light and turbulence, photodegradable waste decomposes into minuscule fragments, yet they do not disappear but float in a form of dense suspension capable of attracting chemicals and bacteria and is consumed by sea organisms [Heimowska 2016]. Owing to these properties, the plastic debris transports heavy metals and toxic organic substances from the mainland to the sea [Sato 2014], this way poisoning zooplankton and oceanic ichthyofauna that,

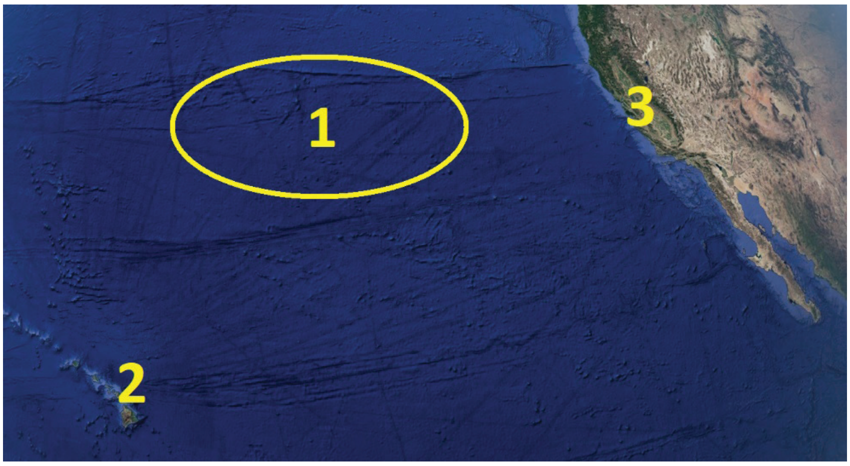

Figure 8. The area of polymer waste concentration (1) in the northeast Pacific between Hawaii (2) and the western coast of the United States (3) [based on Moore et al. 2005 and www.google.com/earth].

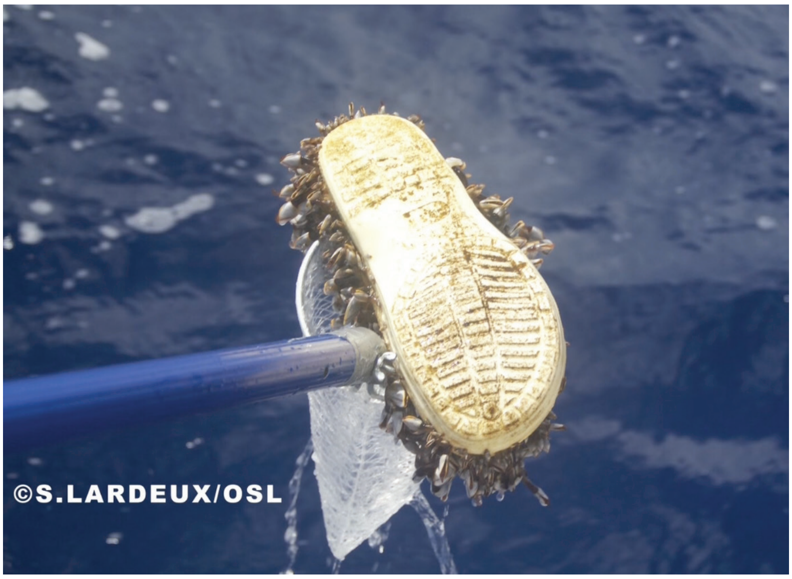

Figure 9. Plastic macrowaste found in the ocean (the northeast Pacific) [Sato 2014, photo by S. Lardeux].

Table 2. Average weight (kg) of marine waste (based on the size range) caught within 24 hours (22 November 2004) from three rivers in the southern California [Moore et al. 2011].

Coyote Creek		San Gabriel River		Los Angeles River		Total
1.0-4.75 mm	>4.75 mm	1.0-4.75 mm	>4.75 mm	1.0-4.75 mm	>4.75 mm	
4.06	257.59	106.86	18,429.41	3,851.81	1,175.42	23,825.15

Figure 10. Plastic waste in a dead seabird [Sato 2014].

as some studies suggest, eat the plastic debris [Boerger et al. 2010]. Bigger pieces of marine plastics (e.g. plastic caps) floating on the ocean surface are swallowed by sea mammals and birds, which block their digestive systems causing death (Fig. 10). Drifting masses of debris forms a new symbiotic system called plastisphere, within which microorganisms develop differently from ecosystems known so far. It may irreversibly change the marine environment and disturb functioning of the food chain, which also includes humans [Heimowska 2016]. That is why marine debris in forms of dense and widespread concentrations, for example, in the northeast Pacific (Fig. 8), needs to be seen as a global threat.

5. CONCLUSIONS

1. Anthropopressure results in significant environmental degradation in various parts of the world. The environmental changes are permanent and negatively affect large areas.
2. The catastrophes presented above are the consequences of thoughtlessness, greed and unlimited production.
3. The presented examples of degradation of ecosystems are a testimony of low ecological awareness and should be a warning when setting directions for rational management and use of the environment.

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