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Mini Review

Integrated Assessment of Oil Spills Impact (NOVEMBER 2007) on Kerch Strait Ecosystem

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South scientific centre of RAS was the only scientific organization, which could carry out the integrated monitoring research of all ecosystem parameters of Kerch strait, adjacent waters and shores both during the oil spills accident (November 13-21, 2007) and during the year after (until October 2008) [1]. The assessment of accidental oil spills impact on environment and biota was carried out and recommendations on minimization of ships wreck impact consequences were given. The generalized description of Kerch strait and Tamanskiy bay ecosystem was developed on the basis of previous expeditions data (2004 – 2007) to discover the steady-state parameters (oceanographic and hydrological characteristics, shores, plankton, benthic community, birds, fish, sea mammals) before the accident.

The charts of ecological situation, which developed in Kerch strait and nearby regions of Black and Azov seas (from Bugazskaya spit to Temryukskiy bay)) were plotted for November-December 2007, February, April and August 2008. The most vulnerable regions of the sea and shore were revealed. It was shown, that the significant pollution of coastal areas and Tamanskiy bay was avoided due to Tuzla dam and active remediation measures organized. At the same time during the accident the ineffectiveness of "Kavkaz" port plan for accidental oil spills liquidation was revealed. For example, the use of slick bars by EMERCOM to minimize the impact of black oil, spreading in storm conditions, was ineffective. Only the removal of broken "Volgoneft-139" tanker forebody from the region of the accident in June 2008 led to practically total disappearance of shore pollution source. The study of shore sediments showed that, in spite of cleaning the Kerch strait shore by EMERCOM and other organizations, the re-sedimentation and burial of polluted sand-oil mixture is taking place. The occurrence of oil-polluted layers of sand was noted in the whole research period. The study of soils at the temporary oil dumping and utilization sites in Temryukstiy district revealed no significant oil pollution of soils and plants. The concentration of oil products did not exceed the background level.

The assessment of oil carry-out to the Black and Azov seas was performed and regional oil pollution balance estimates were made with the use of black oil transfer calculations from the spill sites for the synoptic situation, observed for the accident period. It was shown, that the prevalent part of oil, spilled to the water, got to the Russian part of the shore (Tuzla dam and Chushka spit) and to the bottom of Kerch strait. The Ukrainian part of the shore got the minor part of the impact. The main part of oil (as well as sulfur), accumulated on the bottom of the strait, was spread and casted ashore, the minor part was buried in the bottom sediments.

The monitoring carried out in 2007–2008 revealed no significant changes in the general condition of plankton and benthic communities of Kerch strait. The new, sometimes more abundant communities were formed by 2008 spring at some sites, where the suppression of bottom life was observed. For example, at some regions the shift from filtrating to detritophagous dominant species occurred. This led to benthic community biomass increase at several times. The benthic community was affected at grater extent by severe storm on November 11–12 2007. At some sites of the strait the bottom was "scrapped" to the depth of 3–5 m. Mollusks and other invertebrates were casted ashore alive, forming piles of 10–15 kg/m2 biomass.

The oil products content in water and bottom sediments of Kerch strait and nearby waters in general corresponded to the level, observed before the accident. Oil content in bottom sediments and near-bottom waters at some sites in November – December 2007 exceeded the MPC for natural water bodies (end of Tuzla dam and Chushka spit, "Kavkaz" port region). By summer 2008 on the same sites the oil products content was similar to pre-accident

level. It was revealed that water birds (mallard and scaup ducks, dabchicks, cormorants, bald-coots) were the only ecosystem component, seriously suffered from the accident. The loss in November – December 2007 was no more then 12 thousands specimens, according to our estimates (the official estimate is 30 thousands). The events of birds' oil pollution and death were noted until the end of spring 2008. The negative influence of oil spills on fish and marine mammals was not noted neither during, not after the accident. The solitary dead specimens of gobies and two dead dolphins (bottlenose dolphin and harbor porpoise) were found in storm shore piles. The latter, judging on remains, were dead in the beginning of autumn 2007. The applied methods of Barents, Black and Azov seas macro-algae use as oil and heavy metals sorbents in marine environment are developed in SSC RAS and MMBI KSC RAS for 15 years. It was found that brown and green algae, growing in Northern and Southern seas of Russia (*Laminaria sp., Fucus sp., Cistoseira sp., Enteromorpha sp.*) together with sea grasses (*Zostera sp.*), could be the optimal sorbents in marine environment.

Macro-Algae Sorbents: The use of macro-algae shore piles (existing or specially formed) is the most efficient and easiest way of oil sorbing. It could include macro-algae spreading over the oil patch, or artificial macro-algae piles formation along the shore. The use of sea grasses (*Zostera sp.*) is the optimal way. This material is non-inflammable, light and easily transported. The use of certain cultures of oil-oxidizing bacteria together with *Zostera* could increase the positive effect [2].

The stocking of sea grasses is possible from storm piles on the shores. This requires a strict control, as unreasoned removing of piles from the shores can activate the washing-out of sand beaches and spits.

Biofilter Plantations: The installation of underwater plantations and artificial reefs in potentially or constantly polluted areas (ports, straits) is technically more complicated. It is possible to optimize the species composition of marine life and manage the "living surface" by installing the biotechnical system with given parameters. These systems from the one side could increase the marine productivity and from the other – maximize the oil utilization at places, where constant oil pollution takes place (ports like Novorossiysk, Tuapse, and Kerch strait). In cases of man-caused accidents (sudden spills of tens thousand tons of oil), these installations could form a barrier to prevent the oil pollution of the shores. It is possible to develop an integrated bio-barrier, which could include bio-technical installations, based on the bottom, in the water and on the shores. These integrated bio-barriers could surround the most environmentally and economically significant coastal areas.

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