

## Ecological Problems of Gorgan Bay in the Southeast Corner of the Caspian Sea (Iran) and Ways of Improvement

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Gorgan Bay, with an area of about 40 to 50 thousand hectares, is located in the southeast corner of the Caspian Sea in Iran (Figure 1) as a valuable biological reserve. In 1975, Gorgan Bay along with Miankaleh peninsula and surrounding wetlands were registered as international wetlands in the Ramsar Convention and its conservation degree was promoted to the "wildlife refuge" in the same year. In 1976, the UNESCO considered it a "natural biosphere reserve"<sup>1</sup>. In this geographical area, there are about 200 species of migrating and breeding

water birds such as flamingos, white and gray pelicans, various types of swan species (small, mute, whooper), white-headed ducks, Lesser and Greater white fronted geoses, Mergus mergansers, Western marsh harriers, and White-tailed eagles that come there to spend the winter<sup>2,3</sup>. In addition, the relatively low depth, low current intensity, suitable temperature, biogenic materials, and abundant feed have made Gorgan Bay to be a suitable place for marine fish such as sturgeons, carps, mullets, *Rutilus caspicus*, and Caspian kutum<sup>4,5</sup>.

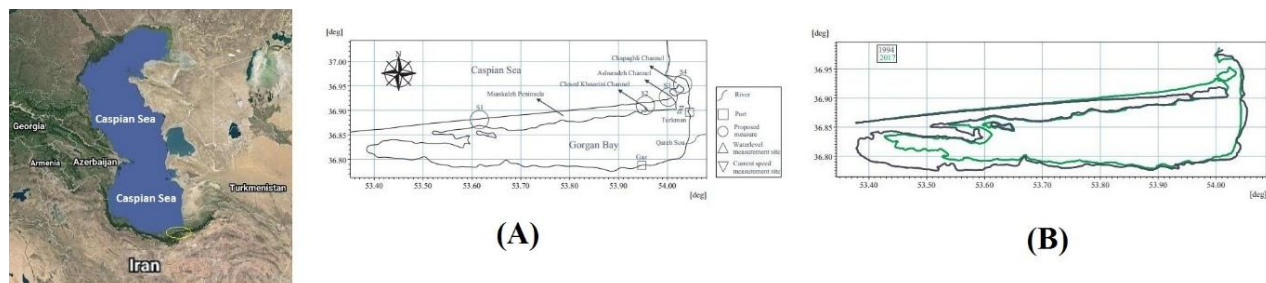


Figure 1: (A) The locations of Gorgan Bay, and (B) fluctuations of area from 1994 to 2017<sup>6</sup>

In recent years, the Gorgan Bay ecosystem has been seriously injured due to the development of agricultural, industrial, and tourism activities, along with the decrease in water area<sup>1</sup>. According to research and governmental reports, about 8 thousand hectares of the Gorgan Bay area have been reduced during the last two decades, and its depth has decreased from 4 to 1.5 meters in some places (figure 1(B))<sup>6, 7</sup>. Microbiological and physicochemical quality, heavy metals, agricultural pollutants, poisons, and oil compounds researches have demonstrated the presence of some pollutants in the Gorgan Bay. In our study, the water sample were quantified for a series of indicators microorganisms included *total bacteria*, *total coliform*, *fecal coliform*, *fecal streptococcus*, *Escherichia coli*, *Clostridium perfringens*, and *Pseudomonas*., which were above the acceptable limit as suggested by WHO for recreational activities<sup>8-11</sup>. The analysis of chemical pollutants also showed that heavy metals (arsenic, cadmium, chromium, lead and etc.), pesticide's (Aldrine, Delderine, Lindane, DDT and etc.), petroleum and detergent compounds were present in the samples of water, sediments and fishes<sup>4, 12-14</sup>.

All of these studies indicated that the Gorgan Bay ecosystem is exposed to a variety of environmental challenges mostly due to rapid urbanization growth, agricultural development, fishing, and ecotourism industry as well as climate change. Therefore, it is indispensable for both government organizations and environmental NGOs to plan a precise program in order to improve the quality of this unique ecosystem. The most important solutions that can be proposed are as follows: (A) dredging of all water river leading to Gorgan Bay include Qarasou, Kordkuy, Karkonde, Bagho, Gaz, Nokandeh, Galuga, Behshahr and Zagh-Marz (B) dredging channel of Khozeini, Ashuradeh and Chapaghli (C) increasing water discharge rate from the Caspian Sea to Gorgan Bay (D) ceasing all new projects and vulnerability assessment of existing projects on the regional ecosystem and human health, (E) stopping the entry of wastewater of domestic, agricultural and industrial into Gorgan Bay. Inattention to

current problems and recommendations set out above can lead to more problems for both environment and human health.

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