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The Fate of Terns in the Course of Development at Musa Multi-Branch Creek, Northwest of the Persian Gulf

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Abstract

Through population growth, the passage of time, and the advancement of technology, development inevitably happens, but how to create development and pay attention to its sustainability by considering various indicators and comprehensive foresight is principal. Examining the biological and ecological conditions of seabirds over time at Musa multi-branch Creek (Khur-e Musa) and offshore Islands is one of the indicators in an aquatic ecosystem that can indicate the success or failure of sustainable development management. This study measured the status of the population and breeding habitats of the Lesser crested Tern, Swift Tern, and Bridled Tern in Khur-e Musa Islands and nearby areas, and the changes of the last decades in the development path were examined. The results indicated unbalanced development at Khur-e Musa. Lack of education and promotion, lack of attention to scientific standards and guidelines, lack of adherence to international protocols and agreements, and lack of adequate budget allocation for independent environmental studies were evaluated among the principal factors of development instability and need to be modified. It is recommended to change the management approach and become environmentally friendly.

Keywords: Sustainable Development; Khur-e Musa; Migration; Tern; Breeding Habitat

Abbreviations: GDP: Gross Domestic Product; HDI: Human Development Index; EPI: Environmental Performance Index; IFO: Iranian Fisheries Organization.

Introduction

The strategic goal of sustainable development in its most consequential sense is to promote harmony between humans and between humanity and nature. The Brundtland Commission in 1987 defined sustainable development as development that not only meets the needs of the present but also addresses the needs of the future and protects the environment. This report was decisive and introduced to the world the concepts of sustainability such as 'we cannot consume until we perish'. Brundtland proposed the concept of three pillars of sustainable development, namely economic, social, and environmental protection [1]. Sustainable development requires economic growth and must be accompanied by fair distribution of social benefits and protection of natural resources [2,3]. Musa Multi-branch Creek (khur-e Musa) in Khuzestan province is considered one of the main economic gateways of Iran. This multi-

branch creek with unique ecosystems is located northwest of the Persian Gulf, and in the Northern shoreline of this Creek, Imam Khomeini Port, Mahshahr Port, and Mahshahr Petrochemical Special Economic Zone are located. At the mouth of this Creek, there are four islands, Dara, Booneh, Nedelgar, and Ghabr-e Nakhoda, and there are several small uninhabited Islands and Islets in the Creek. Among the important indicators of sustainable development evaluation are gross domestic product (GDP), human development index (HDI), environmental performance index (EPI), income volatility index, urban sustainability development index, regional economic development index, water sustainability index and Social sustainable development index mentioned [4]. Environmental performance is measured based on indicators such as air quality, protection of biotopes, and water resources management [5]. If considering Khur-e Musa as the main ecosystem, one of its most important components that are worth environmental monitoring is its uninhabited islands, which are the natural habitat of several seabird species.

Terns with well-known species such as Lesser Crested Tern, Swift Tern, and Bridled Tern have been breeding for years in Khur-e Musa islands such as Ghabr-e Nakhoda and Booneh (Qamar). These migratory seabirds come to the Persian Gulf and islands with favourable conditions in the warm season to breed and chick raring [6]. Like most seabirds, they have fidelity to their habitat and do not change their habitat until favourable breeding conditions have changed [7]. This study tries to provide suitable data for sustainable development by reviewing the trends of population changes and reproductive habitats of the Terns in the last decades in the form of an Environmental Performance Index (EPI) by examining their fate in the way of development. The hypothesis is that balanced development does not affect seabirds and breeding habitats; so this study aims to indicate the fate of Terns in the path of development that directly concerns the sustainability of development.

Material and Methods

Study Area: This study was held on the Northern part of the Persian Gulf from Bahregan Bay to Musa Creek and the North-western tip of the Persian Gulf. Khur-e Musa is a part of Shadgan wetland in Khuzestan province as a Ramsar site (Figure 1).

Figure 1: Situation of Khur-e Musa in the Northwest of the Persian Gulf (part of Shadgan wetland as a Ramsar site).

Research Methodology

There are three islands in Khur-e Musa, where the presence and breeding of Terns have been reported (Dara, Booneh, and Ghabr-e Nakhda Islands). Therefore, any Tern presence in these Islands and nearby areas was investigated by field or library study of available reports. The studies of different censuses of hatching seabirds in the region were studied and finally the process of changes during the recent decades was investigated and according to these definitions, the level of development sustainability was deduced. Charts drawing and data analysis were done with Excel software and the trend of changes in the study area was surveyed by images of Google Earth Pro software.

Results

Human development

The survey of the census statistics of the human population in the two big coastal cities of the Khur-e Musa region, namely Bandar Mahshahr and Bandar Imam Khomeini, shows a total increase of 1241 % of the population in the last 70 years [8,9] (Table 1, Chart 1). The industrial development program of Mahshahr and Sarbandar (Imam Khomeini port), imposed war (Iran-Iraq war 1980-88)

and migration from war-torn areas, stability after the war, multiple economic growth and development of Imam Khomeini port in goods exchange were identified as factors of human resources growth.

Year	1956	1966	1976	1986	1996	2006	2016
Bandar Imam Khomeini	3725	6013	11806	51362	55936	67467	78353
Bandar Mahshahr	15694	16594	29940	71808	88349	111448	162797
Total	19419	22607	41746	123170	144285	178915	241150

Table 1: Human population of overlooking cities of Khur-e Musa in ten-year time periods.

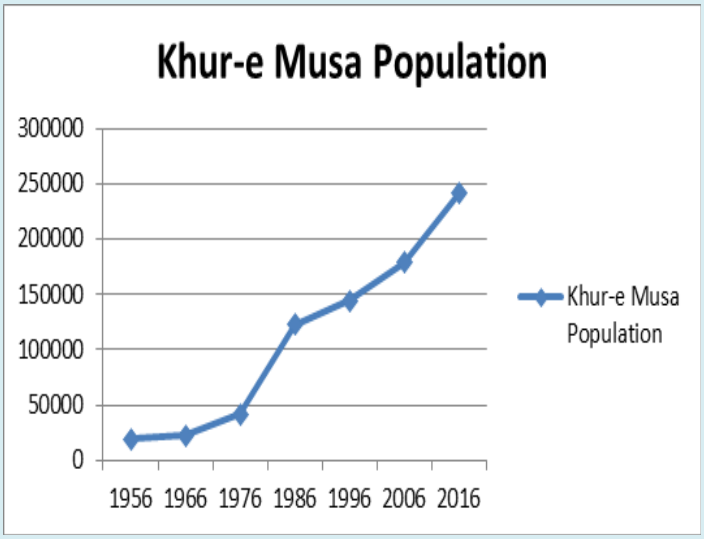

Chart 1: Population growth trend around Khur-e Musa (Mahshahr & Imam Khomeini cities) in the recent seven decades.

Economic Development

The creation of port facilities and the development of Imam Khomeini Port, which after the war somehow replaced the commercial port of Khorramshahr, as well as the development of petrochemical industries in Mahshahr and Imam Khomeini ports are among the most important changes of the last four decades (Figure 2).

Figure 2: Location of Mahshahr and Imam Khomeini ports and comparison of urban and commercial economic development during the last four decades.

Military development

Booneh Island is located at the mouth of Musa multi-branch Creek and has become a military island due to its strategic location. The construction of the jetty, the creation of military facilities, and the presence of mankind along with military equipment and tools in the eastern hemisphere are among the changes in this island in the last few decades (Figure 3).

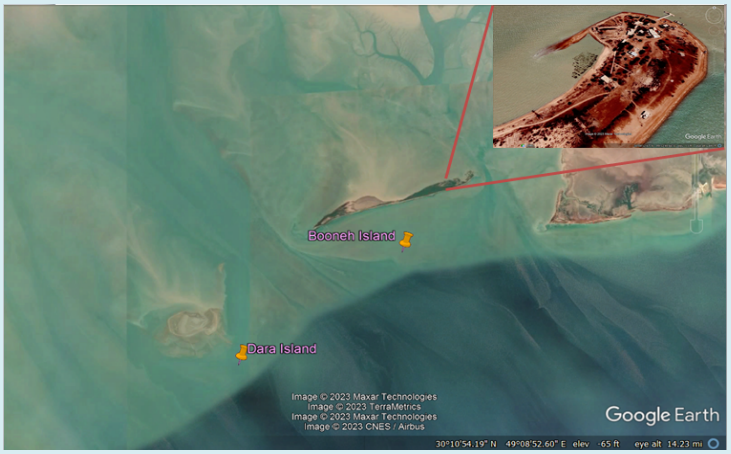

Figure 3: Booneh Island and the establishment of the jetty and military facilities in the Eastern Cape.

Fishing development

According to the official statistics of the Fisheries Organization, 19 fishing cooperatives with 1,701 vessels with fishing licenses (1,077 boats and 624 barges) are working in Khuzestan province [10] and according to unofficial statistics, for every vessel with a legal fishing license, four vessels without fishing identity are engaged in fishing. (Approximately 4,000 fishing vessels without fishing license, which have been activated mostly in the last two decades) and put heavy pressure on fishing stocks and food sources of seabirds, including Terns.

Figure 4: Situation of Musa Creek and its important islands along with the approximate distance of 60 miles (100 km˜) from the sunken ship "Iran Reshadat" and the southern areas of Iraq where the presence of Tern has recently been reported.

The state of the breeding habitats of Terns

Based on field observations and review of available articles and manuscripts, Booneh and Ghabr-e Nakhoda Islands were the main breeding sites for Terns in Musa Creek until two decades ago, and the population of nestling Terns in these two Islands gradually decreased, and the population of Terns in Dara Island, which is the southernmost island of Musa Creek,

the Persian Gulf side is increased [6]. Also, recently, in two case reports, the presence of Terns, including the species of Lesser Crested Tern, Swift Tern, and Bridled Tern, at distances of about 100 kilometers (˜60 miles) East and West of Musa multi-branch Creek from the sunken ship "Iran Rashadat" in Bahregan Bay and south of Arvand River, southern Iraq, was reported for the first time [11,12] (Figure 4).

Discussion

The results of the survey indicate that the number of Tern nests at breeding season in the last two decades has decreased in Ghabr-e Nakhoda, and Booneh Islands and has increased in Dara Island [6]. Dara Island is the last Island of Khur-e Musa towards the Persian Gulf. Therefore, it can be concluded that habitat suitability in the inner Islands has decreased for the Terns and they have been forced to change their breeding site. Some have taken refuge in Dara Island [6] some have gone to new areas in the East and the West [11,12] and probably to the Southern islands of the Persian Gulf, which were not investigated in this study.

With the population growth [8,9] the transformation of the joint-stock fisheries company into a governmental organization, and the reduction of equipment and personnel to monitor fishing violations in the past twenty years [10] on the other hand, the lack of synergy between the responsible institutions, including the Iranian Fisheries Organization (IFO), the Ports & Maritime Organization (PMO), admiralty and coast guard to organize unlicensed fishing vessels have reached the point where at least four unlicensed vessels are engaged in fishing for every licensed vessel and have put additional pressure on aquatic resources. Naturally, this reduces the access of Terns to nutritional sources.

Booneh Island, the habitat of seabirds, has become a military base in the Eastern part. The creation of military jetty and facilities and the permanent presence of a human, even though it is concentrated in the Eastern part, probably caused a feeling of insecurity for the chicks and forced part of the population to change their habitat from the western part too. On the other hand, it seems that education and promotion have not been done well and environmental protection has not been institutionalized in society in general and in fishing communities in particular. Belief in the magical properties of consuming the eggs or meat of marine reptiles and seabirds and the lack of proper culture and monitoring have caused illegal hunting and serious damage to the breeding population of Terns and Crab Plover specially in Ghabr-e Nakhoda Island [13] and according to the results obtained, it is one of the most favourable breeding habitats for seabirds in the Persian Gulf has become an unsafe and undesirable environment.

Since its implementation (ratified in 1971 and implemented in 1975) the Ramsar Convention has been recognized as one of the most effective tools for the protection of wetlands, and its members (more than 170 countries so far) have declared their obligations to protect wetlands. Considering the connection of Musa Creek to Shadgan Wetland, following the provisions of the Ramsar Convention and other international agreements will contribute to the sustainable development and protection of the habitats of the wildlife, including Terns.

In 2003, the Convention on the Protection of Living Resources in Regional Bays was signed in Tehran (Tehran Convention), which focused on protecting the environment in the Caspian Bay and Mazandaran Bay and promoting the sustainable use of natural resources in these areas, but its expansion to important bays and estuaries in other areas as well as Musa Creek will also be beneficent.

Conclusion

Different factors such as unsustainable fishing and overexploitation without considering the capacity of the ecosystem, along with the use of destructive trawling methods, the increase in population and urban sewage, the growth of polluting industries, and the lack of purification of pollution to the standard level, the lack of equipment and personnel of Fisheries Organization and Department of Environment, the expansion of facilities Military, destruction of eggs and habitat of seabirds due to lack of education has caused damage to aquatic animals and seabirds, including Terns, in Khur-e Musa. The environmental performance index in the 50-year development of Khur-e Musa has been evaluated as unbalanced, which will cause development instability. Therefore, it is recommended to allocate sufficient funds for independent environmental monitoring and to change the perspective of macro management to adhere to the criteria of the Environmental Performance Index (EPI). It recommended environmentally friendly management for decision-makers, and considering the natural influencing factors along with human interventions, which of course are sometimes intertwined, such as the effect of climate change, in future studies.

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