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Review Paper

Ecology of Lake Bardawil: A Preliminary Review

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Abstract
Bardawil lagoon is considered as the cleanest marine water body in Egypt, as well as in the entire Mediterranean region and the vast hyper saline mud flat (known as Sabkhat El-Bardawil), occupying the eastern fringes of the Lagoon, is the largest in the country. The lagoon is an important wintering and staging area for large numbers of water-birds; consequently it has been designated as an Important Bird Area (IBA) by Bird Life International.

Key words: *Bardawil lake, Ecology, North Sinai.*

Introduction

With a growing world population and recurrent problems of hunger and malnutrition plaguing many communities, food security is of major societal and international concern. Fishery resources are an important source of proteins, vitamins and micronutrients, particularly for many low-income populations in rural areas, and their sustainable use for future global food security has garnered significant public policy attention. In the context of variable and changing ecosystems, and despite some progress, the challenges of maintaining or restoring fisheries sustainability and stock sizes, reducing environmental impact and degradation, and improving local and global food security remain immense.

Fish is highly nutritious, rich in essential micronutrients, minerals, essential fatty acids and proteins, and represents an excellent supplement to nutritionally deficient cereal-based diets. It provides more than 1.5 billion people, particularly in low-income food-deficit countries (FAO, 2009). According to World fish, 400 million poor people depend critically on fish for their food

The United Nations' Fisheries and Agricultural Organization (FAO, 2005) reported that 52% of world fisheries stocks are currently "fully exploited", meaning that they are being harvested at rates estimated to be near their maximum sustainable limit, 24% are overexploited or depleted, meaning that they are being harvested at rates not sustainable in the long term, and 1% are considered to be recovering from depletion .If well managed, fisheries can maintain a sustainable stream of economic benefits in the community, and in some cases can operate as a safety net when needed.

Bardawil lagoon (Fig. 1) is one of the northern lakes in Egypt and it is a part of the Mediterranean coastal lands of Sinai. It is a prominent landform feature of North Sinai and its water is highly saline. It is an important source of local and economic fishes in North Sinai, and it plays an essential role in the fish production in Egypt, where it produces very economically important species of fishes such as sea bass, sea bream, sole, grey mullet, eel, meager and white grouper. In Bardawil lagoon total annual commercial landings varied between 2226 and 5410 ton during the last 15 years (GAFRD ,2012). In 2013, the 4528.5 ton was landed corresponded to a value of almost 96 million Egyptian pounds.

Lake Bardawil plays an important role in lakes' fisheries since it is the least polluted wetland in Egypt and most of its catch is exported. It constituted about 22% of the total northern lakes' area and connected to the Mediterranean Sea via two inlets. It is a shallow hyper-saline lagoon. The expansion of both human activities and tourism in North Sinai make it faces the pollution challenge in near future. Sea water was enter the lake in the past through three inlets: two artificial tidal inlets (270 & 300 m wide and 4-7 m deep), and a natural eastern inlet of Zaranik which is now occasionally closed by silting. It is characterized by the presence of high valued fish species like sea bass, sea bream, flatfish and grey mullet. In recent years a serious decline in the fish production of the lagoon was noticed especially for European sea bass.

Most studies in Lake Bardawil are concerned with biological, ecological, chemical, fisheries management, and economical issues. Thus, it is important from the economic point of view, to have knowledge on evaluation the occurrence of parasites on marine fishes in Lake Bardawil. The Bardawil lagoon is a shallow hyper saline lagoon, located in the middle of the Mediterranean coast

of Sinai. The approximate length is 75 km and the maximum width is 19 km. The surface area is about 595 km2. The lagoon is extremely shallow and the water depth never exceeds 3 m. A long sand-bar, 1 km wide maximum, separates the lagoon from the adjacent Mediterranean.

Fig. 1: Bardawil lagoon taken by Google earth

The Bardawil lagoon is a shallow hyper saline lagoon. Its area is about 685 km2(165.000 Feddan) extends for a distance of about 95 km, from a point 45 km east of Port Said and extending to a point 18 km west of El-Arish. Its maximum width is 22 km and The average depth is 135 cm with a maximum depth next to inlets 1 and 2, whereas, reaches to 2 – 3 m, while in the main opening reach to 4–5.5 m. A long sand-bar, 200–1000 m wide maximum, separates the lagoon from the adjacent Mediterranean GAFRD (2009).

Lake Bardawil Fish is considered the only Egyptian marine fish required for export, but its output is disproportionate with its size and the reason for the low production of lake to lake lack of natural food and seed shortages and management problems and diseases, as well as administrative problems. To solving these constraints should use modern techniques and methods of unconventional solve the problem of shortage of natural food? In spite of the diseases of Lake Bardawil fish and method of control, variable problems and concepts were worldwide studied and most of them defined the problem as parasitic diseases or deficient of nutrients. Both of them lead to severely lack of natural communities. By other word, the parasitic diseases go back to bacterial and fungal diseases.

Water properties

Temperature and transparency

As it was reported by Stat Ministry of Environmental Affair (2011); water measurements proved the high environmental quality potential of the Bardwell Lake. The measurements include climatic, physical and chemical proprieties were assessed. Concerning temperature, 15.15°C – 19.2 °C was recorded, with high transparency degree (30- 180). The high transparency degree proved the high water quality in concern nutrient deficiency and poor phytoplankton status.

Salinity

Salinity of Lake Bardawil is relatively higher than Mediterranean Sea due to the its closing structure. Salinity margin ranged between 36.98 to 42.26 g.l-1. Such concentrations severely determine the phytoplankton growth especially under high transparency degree that becomes nutrient deficiency. High salt margin goes back to evaporation with low water re-mewing rate.

Acidity (pH)

Acid reaction of water was found to be slightly alkaline due to high salt margin and ranged between to 7.83 to 8.54.

BOD/COD

The lowest values of BOD (0.47 – 5.01 mg .l-1) and COD (8.75 – 21.01 mg .l-1) indicated the highest water quality of lake in comparison with other water bodies Egypt. No evidence about the presence sulphides and other contamination due to high dissolved oxygen.

TSS and total chlorophyll

Biological profile of Lake Bardwell showed the very low content of phytoplankton content monitoring by chlorophyll content which reached about 2 µg .l-1. However, total suspended solids (TSS) were found in the safe range.

Nutrients

Nutrients term referring to the presence of both anions and cations. This included nitrogen compounds, phosphates, sulphates, carbonates, bicarbonate, silicates macro and micro-nutrients. In situ, all of these figures were very low and not meet the expected growth of phytoplankton.

Microbial Load

Microbial Load was found in pass than the world norms indicated the high suitability of the lake in fish production.

Phytoplankton

The most dominant algal categories found the lake were diatoms 81.27% equal to about 10 x 103cell.l-1followed by di-flagellates (16.17 %) equal to 2 x 103cell.l-1and 1.95% of green algae which reached about 235 cell.l-1.The mean of total count could be serve as 14 x 103cell.l-1.

This result was found to be very far of the recommended status as shown by the high transparency of lake water and might referring the main problem in fish production in Lake Bardawil. Otherwise, the natural structures of the lake determine how to solve this problem.

In commerce and prior cultivation, artificial ponds received 50 kg super phosphate, 50 kg urea and 3 ppm ferrous sulphate to enhance the growth of natural flora mainly algae. Two weeks later, about 70,000 fishes were inoculated. Renewing water in open lakes lead to improve water quality and minimize the contamination effect in contrast with closed lakes.

In Egypt, four aquaculture ponds (ca; 16m3 per each) were used to investigate the effect of algal addition on water quality and fish yield without water renewing. Addition of algae resulted in increasing of dissolved oxygen and reducing water pH (to become around the neutral pH reaction) due to ammonium consumption and high dissolved oxygen. Decreasing electric conductivity (E.C.) of the remained water, it was varied with respect to the former reasons. The results also showed that night respiration of algae was blocked as ponds were aerated by the circulated water pump and illuminated during night growth. Fish yield of algal treated ponds was increased by 10%increases, while such pond plus aeration was increased by about 25% as compared with the control pond (El-Sayed et al., 2008).

In this context, a lot of scientific research work proved that iron fertilization is the most effective reason in aquaculture improvement. Whereas, iron fertilization improve phytoplankton community, but no evidence about the mode of action especially in open lakes and ocean were reported. Otherwise, the main hypothesis in this action is to use ammonia and other degradable protein like compounds of fish wastes as a nitrogen source for algal nutrition.

As a fact and in contrast with plant nutrition, sodium could replace potassium. However organic phosphorus not able to utilize by algae, its content that varied from site to other might determine the phytoplankton status. To save the natural structure of Lake Bardawil, supporting iron will be done through algal carrier for this reason, algae that isolated from the lake will be studied in concern nutritional requirement and its chemical composition. Scaling up of such alga will be carry out in specific growth unit with excess of nutritional supplementation,

The previous studies revealed that gills gave a marbling (mosaic) appearance with an increase of mucus production and haemorrhages. Some crustaceans such as Podocotyleparupenai (Digenetic trematodes), Lernanthropuspsciaenae and Caliguscarangis (Copepoda), Cymothoa spp.(Isopoda) were attached on gills and tail fins. Stomach and intestines showed congestion and inflammation of their walls in some examined fish. Ahmed (2011).

Lake Bardawil plays an important role in lakes' fisheries since it is the least polluted wetland in Egypt and most of its catch is exported. It constituted about 22% of the total northern lakes' area and connected to the Mediterranean Sea via two inlets. Lake Bardawil is a shallow hyper-saline lagoon. The expansion of both human activities and tourism in North Sinai make it faces the pollution challenge in near future. Lake Bardawil is characterized by the presence of high valued fish species like sea bass, sea bream, flatfish and grey mullet. In recent years a serious decline in the fish production of the lagoon was noticed especially for European sea bass.

Sea water was enter the lake in the past through three inlets: two artificial tidal inlets (270 & 300 m wide and 4-7 m deep), and a natural eastern inlet of Zaranik which is now occasionally closed by silting. Most studies in Lake Bardawil are concerned with biological, ecological, chemical, fisheries management, and economical issues. Thus, it is important from the economic point of view, to have knowledge on evaluation the occurrence of parasites on marine fishes in Lake Bardawil.

The present project was undertaken to evaluate the quality of sea bass (D. labrax) in Lake Bardawil as well as to assess its fishery status. The Bardawil lagoon is a shallow hyper saline lagoon, located in the middle of the Mediterranean coast of Sinai. The approximate length is 75 km and the maximum width is 19 km. The surface area is about 595 km2. The lagoon is extremely shallow and the water depth never exceeds 3 m. A long sand-bar, 1 km wide maximum, separates the lagoon from the adjacent Mediterranean.

The Bardawil lagoon is a shallow hyper saline lagoon. Its area is about 685 km2(165.000 Feddan) extends for a distance of about 95 km, from a point 45 km east of Port Said and extending to a point 18 km west of El-Arish. Its maximum width is 22 km and The average depth is 135 cm with a maximum depth next to inlets 1 and 2, whereas, reaches to 2 – 3 m, while in the main opening reach to 4–5.5 m. A long sand-bar, 200–1000 m wide maximum, separates the lagoon from the adjacent Mediterranean GAFRD

(2009).

The European seabass (D. labrax) and sea bream are migrate from Lake Bardawil to the sea, not only in maturity stage but also in less of year stage Barnabe (1976). Also, they migrate to the sea during the spawning season, which extends from October to March.

Spawning season
By examining the maturity stages and depending on the estimated values of GSI it was found that the spawning of D. labrax and sea bream in lake Bardawil was occurred in winter starting in late October extending to January with a peak in November and December. The sequence of the appearance of different gonad index in the ovary of D. labrax indicates that, the spawning season may extend to January and February, but these were the missing months (closed season). Generally, spawning seasons are depending on the geographical location of seabass and sea bream fish, spawning can take place in the February in the Bay of Biscay (Stequert, 1972), January of North Africa (BouAin, 1977), from January to April with a peak in February in Egyptian coast (Wassef and El-Emary, 1989), from December to March with a peak in January in the Mediterranean Sea and as late as June in Ireland (Barnabe, 1990), March and April in the Eastern Celtic Sea (Jenning and Pawson, 1992).Pickett and Pawson (1994) found that, April is the peak-spawning month for seabass around the UK. Mananos et al. (1997) reported that, seabass spawned from February to March (East Coast of Spain).

The production of fish from lake Bardawil in the period from 1994 to 1999 tended to increase by amounted to 3.2 ton, that is annual averaging 8% of the mean period that to suppose as 40.3 tons. The production in the period from 2000 to 2005 tended to increase by amounted to 1.58 ton, that is annual averaging 4.41% of the mean period that to suppose as 35.8 tons. Also, he recorded the condition factor (Kc) for D. labrax in Lake Bardawil. Kc ranged between 0.86 and 1.06 with average 0.93 throughout 2005. He detected that, Kc was large in the fish of lowest lengths than that of largest lengths. He added that, Kn ranged between 0.9 and 1.26 throughout 2005Gaber (2007).

The seabass (D. labrax) and seabreamare a predator, consuming small fish and a large variety of invertebrates especially shrimps. Its feeding behavior is related to its size. Juveniles feed mainly on small crustaceans (amphipoda, mysidacea, isopoda) and small fish like Atherina and Gobius. For fish larger than 20 cm, shrimps and crabs begin to be common preys Khalil andMehanna (2006). The presence of external and internal parasites may be due to some environmental factors such as water pollution and high water temperature.

Ethics
All the authors read and approved the manuscript and no ethical issues involved.

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