

Fisheries activity in the Bizerta lagoon (South Mediterranean Sea) from the 18th to the 21st century

Abstract

The Bizerte lagoon is characterized by its biological diversity and its wealth of species with high commercial values such as cuttlefish, seabass, seabream, mussels, prawn, and sole, and its fisheries provide employment for fishermen in the area. Indeed, artisanal fishing in the lagoon has been practiced for decades using traps, nets, and mobile gears such as straight nets and lines. The present paper focuses on the diagnosis of the fisheries' status in this area. This allows us to reflect on the exploitation of the species caught in the Bizerte lagoon since the 18th century. Large-scale hydraulic works taking place during the 20th century resulted in a reduction in the water volume inputs, inevitably affecting the fishing activity in the lagoon which we intend to analyze in the present work.

Keywords: fisheries, Bizerte lagoon, resources, fishing effort, monitoring

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Abbreviations: NOF, national office of fisheries; HP, horsepower

Introduction

Bizerte lagoon is an important socio-economic pole in northern Tunisia. Its shores and maritime space host lots of human activities, such as coastal fishing, shellfish farming, maritime traffic, military activity, recreational fishing, and nautical sports. The evolution of fisheries production in the Bizerte lagoon is strongly correlated to the environmental condition of the water body and the configuration of the passes. These passes connect the lagoon to the sea and Lake Ichkeul through Oued Tinja (Figure 1).

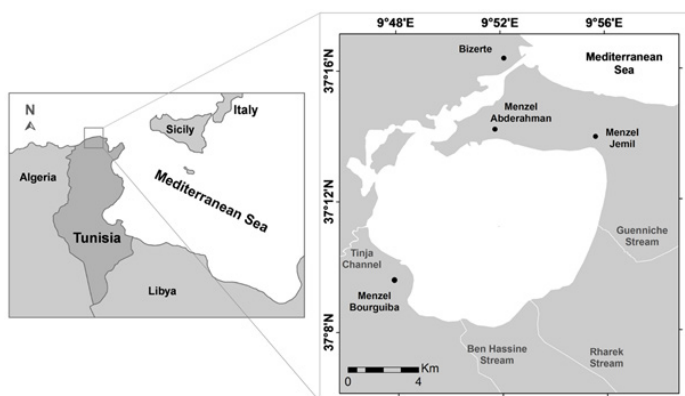


Figure 1 Bizerte lagoon.

In 1895, to facilitate the protection of the ships, which remained blocked in the roadstead of Bizerte, the decision was taken to dig a broad communication between the lagoon and the sea to replace the old sinuous and shallow gully (-3m). The old channel crossed the city spilled at sea (in the port) by a narrow broad opening of 28m. The old gully at that time isolated a small island. The latter is

attached to the city after filling in an area that doubles the surface of the town. Told port is the only current witness of this old gully that was blocked.¹ At the end of the 19th century, the installation of the French navy in Bizerte was accompanied by a study focusing on creating and installing a secure naval base at the bottom of the lagoon. To facilitate the access of large ships, the physiognomy of the lagoon was modified by ensuring wide and deep communication with the Mediterranean Sea.² The digging of the new wide and deep rectilinear channel has modified the hydrodynamics of the lagoon water body, which has changed from a confined type of environment. This radical modification of the previous ecosystem changed the environment from one with a dominant continental influence to another with a dominant marine influence.^{1,3} After the works made in the Suez Canal, all the works carried out in the Bizerte area represented one of the world's largest maritime public works enterprises.^{1,4-6}

History of the fisheries

Fishing activity before and during the 18th century

The strategic and economic importance of the Bizerte lagoon is attested since the most ancient times by the installation of three ports on the gully: Hippo Diarythus or Zaritus (Bizerte) in the north of the lake, Usalis (Menzel Abderhaman), in the south, and Thendalis (Tinja).¹ According to Guérin,⁸ the nickname of Zaritus (or Zarytus) seems to be borrowed from the Phoenician language and it would be due to the canal crossing the city. Founded by the Tyrians, Hippo-Zarytus owns its existence to the canal connecting the lake to the sea. Today, this canal is closed, and it corresponds to the cove of the old harbor. The port was later enlarged by Agathocte. Under the Romans, Hippo-Zarytus became a colony. Pliny the Younger (1st century A.D.) points out the presence of water currents in the lagoon going from inside to outside and in the opposite direction. It inflows sea water (dry period in summer) and outflows of slightly salty water (wet period in winter).^{2,7,9-11}

In 1116, Idrissi¹² describes fishing activities in the lagoon for the first time. This author points out that the lake presents a remarkable singularity: there are 12 different species of fish and during each month of the year, a single species was caught without mixing with other species.¹ In 1550, Leo, the African¹³ provided new information on fishing activity in the lagoon. He reports that important quantities of fish are caught, especially large breams weighing 5 to 6 pounds. During the month of October each year, the fishermen catch fish called “girafa” or “laccia”. Indeed, the author confuses this description of two phenomena. The first consists of the release of large mature seabream in November; fish are still called at present “girafa” or black seabream according to the local appellation while the small immature gilthead receive the name “ouarka”. The second consisted of the release of the Allis shad called “latcha” in Bizerte.¹ In 1743; Shaw described the richness of fish in the lagoon and referred to the Tunisian market as a good source of oysters considering the lake of Bizerte as the source.¹⁴

The above-mentioned studies are highly important as they indicate the great productivity of the Bizerte lagoon over the centuries. Additionally, this bibliographic summary elucidated the historic aspect of the fishing activity in the lagoon.

Fishing activity in the 19th century

In 1816, most of the fish sold in the central market of Tunis come from the Bizerte lagoon. The fishing in the lake is leased (auction). The fish is easily caught using a trap made of rushes (simplified edge) forming an enclosure from which it cannot leave once it enters.¹

In 1881, according to Coste, net fishing in the lagoon was prohibited by the farmer who paid the “Bey” an annual royalty of 110,000 francs for the fisheries made in Bizerte lagoon and Ichkeul lake.¹⁵ The lagoon kept its reputation as a highly productive area and the most important fishery in the world.¹⁶ The seasonal fisheries landing of the large bream (5 kg) was very important in 1897 with 266 tons.¹⁷ The same case was observed for Mullet (110 tons), Sand steenbras (33 tons), and Seabream (29 tons).

A total of 40 sailors and 3 fishing bosses operating in the lagoon are enumerated at the beginning of the 19th century.¹⁸ During the Seabream fishing season; all the citizens participate in this species' fishing festival.

With the beginning of the colonial period in North Africa, the strategic position of the port of Bizerte aroused foreign interest. In 1883, Abel Couvreur, contractor of the Suez Canal, requested a concession for the installation of a new port, and the work was entrusted to him in 1888.¹ The Company of the Bizerte Port was constituted in 1889 including as activities the creation of a fishing section with a concession for 75 years of fishing activity and fish farming in the Bizerte lagoon and the lake of Ichkeul.

In 1889, the catches in these two areas increased to 500 tons and 50,000 tablets of Boutargues. This is equivalent to the capture of 50,000 mature females of mullet, i.e. about 75 tons, coming essentially from Lake Ichkeul.¹ In 1895, the channel (wide and deep) connecting the lagoon to the sea is completed and the port of Bizerte is inaugurated.

During the same year, ships pass directly from the sea into the lagoon without crossing the city. From the old gully, where the fixed fisheries were installed, only the part on the sea (old port) remains filling in. The former traps were replaced by 1.2 km of a wide metal dam.¹

Fishing in the 20th century

In 1906, the channel connecting the lagoon to the sea is completely redeveloped and deepened (-9m to -12m). It was extended to Ferryville (Menzel Bourguiba currently) by a channel dug through the lake (-12m) in the extension of the Narrows. The fishery of Ras el Ouzir is removed upstream, and it was installed between the north shore of the lagoon and Jezira Kebira (large island) called the fishery of Sidi Ahmed.

The French navy bought back from the Tunisian government the concession of fishing in the Bizerte lagoon and the Ichkeul Lake (Convention of May 1st, 1906) for 10 years. The concessionaire of the lagoon gave up all his rights because he was plundered by the fishermen. In 1912, the concession was taken over by a Tunisian for 30 years, but the fishery located at the shallow channel is hardly exploited (5 t/year). The development of the French military activity in Bizerte induced an abundance of resources because it is located near the barracks.¹

After independence, fishing was completely reorganized by the Tunisian State. The law of November 4th, 1958 created the National Office of Fisheries (NOF) which is responsible for the exploitation and fishing in inland waters and lakes. Therefore, the lagoon heritage passes from individuals to the State. However, the impact of these measures is nil because Bizerte lagoon has been exploited by its residents for a very long time.¹

In the Bizerte lagoon, the action of the NOF was carried out only on marketing by the creation of a purchase point for the fishermen of Menzel Abdurrahman. This small counter was taken over by the local residents at the end of the 1960s.¹

Towards the end of the 2nd millennium, small-scale fishing activity in the lagoon found an animation under the impulse of state aid. Unfortunately, this area is poorly maintained and has only a small, dilapidated wharf of 40 m in length and a dock where the draft is zero. Besides, the infrastructure is nonexistent (no ice factory and no fuel station).

In the 1970s, there were 117 boats, 25 of which were motorized (average power 24 HP). The rest are rowed (average length 4.5m; average tonnage 0.7t). The population of fishermen is excessive; it is estimated at 700 workers. However, many sailors and collectors of clams are registered, and they work on trawler and seiner boats in the offshore area of Bizerte.¹

In the 1980s, the number of fishermen declined and there was no modernization of the fleet (62/84 boats are rowboats). The number of maritime workers is estimated at 450.¹

In 1997, we noted a significant increase in the number of boats in the lagoon, coupled with the modernization of an important number of motorboats which doubled compared to the previous decade. The fleet includes 195 units, of which 144 are rowing boats and 51 are motorboats. The population of sailors returned to the level of the 1970s with 700 sailors.¹

The fishing effort was estimated at 106 boats in 2010, of which 44 were motorized and 216 in 2020 (of which 98 were motorized). Additionally, between 2010 and 2020, the workforce doubled from 344 in 2010 to 755 in 2020.^{4,6,19-23}

Production of the fisheries

Until 1905, the production of the lagoon was essentially ensured by fixed traps. The most important landings were recorded at the old

gully. According to data collected by Zaouali,¹ the average annual production is 350 tons, including 220 tons of gilthead bream. The available fishing statistics reappeared only in the 1920s. They were published by the Salammbô Oceanographic Station which just had been created. There was a spectacular drop in the catches of seabream, which did not exceed 2 tons.¹

From the 1940s onwards, the statistics cannot be found. They were available only for Menzel Abdurrahman in the 1970s with an average annual production of 70 tons, including 3 tons of Seabream. From the beginning of the 1980s, the production is represented by cuttlefish, while seabream represents a small percentage. According to Zaouali,¹ the gilthead bream has disappeared from the lagoon.¹

From 1989 to 1995, fish production hovered around 50 tons. In 1993, the number of motorized boats doubled. Since 1996, the production statistics show an increase with tonnages of 140 tons in 1998. This increase in landing is explained by the volume of cuttlefish catches (more than 50% of the catch). This species shows good resistance to stress factors.^{23–29} Sand Steenbras, which present equal tonnages to those of cuttlefish at the beginning of the 1990s, have decreased.^{6,19–21}

In recent years (2010–2020), total production has fluctuated around 60 tons. The latter is mainly composed of cuttlefish, which represent more than 50% of landings. Despite the doubling of the workforce and fishing effort, production in the lagoon is stagnant, indicating a state of overexploitation of fishery resources.^{4,6,19,21–23}

Tonnages landed

At the beginning of the 19th century, the tonnages recorded are very low. It is difficult to increase fish production in the lagoon since the rise of the fishing efforts, which globally led to a stagnation of yields. Indeed, in 1990, the average annual yield per boat was 200 kg and less than 1 kg per day.¹ In 1998, despite the doubling of the fishing effort, the annual yield was estimated at 230 kg. In 2010, the total production landed is estimated at 61570 kg (average: 580 kg per boat). In 2020, this yield decreases to 289 kg per boat, with a total production of 62417 kg.

The monitoring of fish production in the Bizerte lagoon (Figure 2) shows a decreasing trend over the years (1988–2020) according to the equation:

$$P = 0.041y^3 - 1.883y^2 + 20.68y + 57.59 \quad (R^2 = 0.638)$$

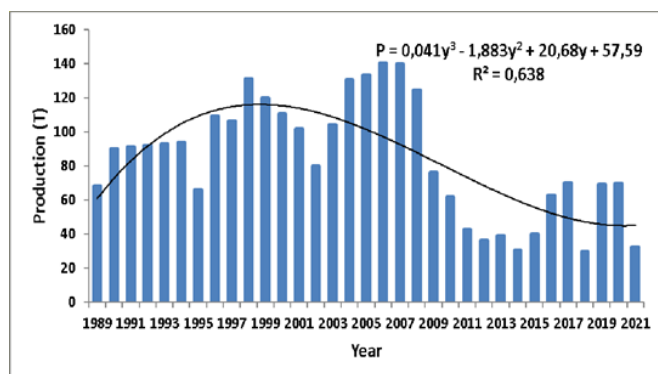


Figure 2 Evolution of fisheries production in the lagoon of Bizerte (1988–2020).

This pattern indicates a state of overexploitation; even though most of the resources in the lagoon belong to the category of fast-growing and short-lived species (cuttlefish, shrimp, etc.).

During the 2000s, autumn and late spring seasons were most productive 20% and 43%, respectively. This seasonal variability is mainly due to the migratory flows, to and from the lagoon, of spawners of many species such as cuttlefish and shrimp for reproduction.

Species caught

From the beginning of the exploitation of the fisheries in the lagoon of Bizerte until 2000, the main observations are (i) the decrease of the seabream landing: this phenomenon began when the canal was closed to the sea and the trap was dismantled. In the past, the young specimens of seabreams entered the lagoon and did not leave until they were caught. Today, these species continue to enter the lagoon but, in the absence of fixed traps, they quickly leave,¹ (ii) cuttlefish catches are related to the highly targeted fishing activity. It seems that an increase in eutrophication and the low vulnerability to the toxic elements do not hinder the penetration of these mollusks into the lagoon,^{30,31} (iii) the production of clams is based on the exploitation of the autochthonous species *Ruditapes decussatus* (currently *Venerupis decussata*) often called clamshell. It is a simple collection done by fishermen on foot. This activity is hampered by sanitary problems because it was made in the coastal areas near the urban zones of Menzel Jemil and Menzel Bourguiba,³⁰ (iv) *Venus verrucosa* is a typical marine species known to occur in the lagoon's gully. Since 1997, this resource has been commercialized, but the production statistics are not available. Scallops (*Chlamys glaber*) are small scallops collected and grown on the northeast coast of the lagoon.¹ As for murex (*Phyllonotus trunculus*), this gastropod is very abundant in areas where shellfish die.²¹ It is the object of a targeted fishery according to the commercial demand. However, no reliable statistics are available to identify its exploitation state.²¹

During the 2000s, landings were mainly composed of Cuttlefish *Sepia officinalis*, Shrimp *Penaeus kerathurus*, Golden grey mullet *Chelon auratus*, seabass *Dicentrarchus labrax*, Sole *Solea aegyptiaca*, Salema *Sarpa salpa*, Sand Steenbras *Lithognathus mormyrus*, Gilthead seabream *Sparus aurata*, Blue jack mackerel *Trachurus picturatus*, and Annular seabream *Diplodus annularis*. It should be noted that cuttlefish is the dominant species in terms of landings, with a percentage exceeding 50%, followed by shrimp (15% in 2010; 11% in 2020). The other species are present, but their landing fluctuates depending on the season. These resources have undergone a valuation of their fisheries following the considerable increase in prices of seafood and the state of overexploitation of fisheries resources in Tunisia.^{23,32–34}

Conclusion

The history of the fishing practice in the Bizerte lagoon allowed us to highlight two different situations:

From antiquity until the beginning of the 20th century, there was an important production with a high percentage of seabream catches in the lagoon. In this period, the lagoon was connected to the sea and surrounded by shores dedicated to agriculture, sparsely populated, and enriched in winter by the inflow of nutritive elements from Lake Ichkeul. Since the beginning of the 20th century, a permanent decline in production has been recorded. The digging of the channel allowed an important marine water vivification. However, it induced a drop in catches due to the low seawater nutrient content. Additionally, the sea breams make brief intrusions in the lagoon due to the lack of traps. The stress pressure on the fishery resources worsened since the 80s. In this period began the construction of dams on the rivers flowing into Lake Ichkeul, which induced a significant decrease in freshwater inputs and nutrients carried by the rivers in winter. The

stress is marked by the important increase in urbanization bordering the lake (Bizerte, Menzel Abdurrahman, Menzel Bourguiba, Tinja), as well as the establishments of an industry strongly polluting (steel industry in the southern zone of the lagoon, cement factory in the zone close to Bizerte, and industrial units in the northeast zone). The polluting sources induced eutrophication and intoxication with the increase of heavy metals, polycyclic aromatic hydrocarbons, polychlorinated biphenyls, and organo chlorine pesticide spills. Currently, the ECOPACT program is carried out within the framework of a participatory approach led by the Ministry in charge of the Environment and involves the various components of civil society, the economic actors of the region, and the regional and central authorities. This program aims not only to improve the quality of the waters of the lagoon and the state of its ecosystems but also to promote sustainable socio-economic development.

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Conflicts of interest

The author declares no conflict of interest.

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