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ORIGINAL ARTICLE

Greek overseas fishing catches: historical analysis and trends

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Abstract: The present study aims to describe Greek overseas fisheries from the beginning of the sector in the mid-20th century up to today. The Greek overseas fisheries expanded, from the northern African countries to the Atlantic and Indian Ocean, peaking in the 1970s. However, starting in the 1990s, the sector exhibited a sharp decline in landings and active vessels, which was caused by several issues, such as the increased territorial restrictions, high operational costs, unorganized market structures, and insufficient fish processing facilities. The historical evolution of the Greek overseas fisheries highlights the need for improved market integration and smart policy interventions.
Keywords: fisheries catches; landings reconstruction; discards; overseas fisheries; long-term trends

Sažetak: GRČKI PREKOMORSKI RIBOLOV: POVIJESNA ANALIZA I TRENDOVI. Cilj ovog rada je prikazati razvoj grčkog prekomorskog ribolova od njegovih početaka sredinom 20. stoljeća do danas. Grčka prekomorska ribarska industrija se širila, počevši od sjevernoafričkih zemalja do Atlantskog i Indijskog oceana, a dosegnula je vrhunac tijekom 1970-ih. Međutim, od 1990-ih, prekomorski ribarski sektor bilježi nagli pad u količini ulova i broju aktivnih plovila. Uzroci tog pada uključuju pojačana teritorijalna ograničenja, visoke operativne troškove, neorganiziranu tržišnu strukturu te nedostatnu infrastrukturu za preradu ribe. Povijesni razvoj grčkog prekomorskog ribolova naglašava potrebu za poboljšanim uključivanjem tržišta i promišljenim političkim intervencijama.
Ključne riječi: ulov; rekonstrukcija ulova; odbačeni ulov; prekomorski ribolov; dugoročni trendovi

INTRODUCTION

Official fisheries landings data has often limited accuracy (Pauly and Froese, 2012) and false statistics may systematically distort world landing trends, whether over-reported (Watson and Pauly, 2001) or underreported (Pauly and Maclean, 2003). These data may also lead to an underestimation of the total commercial harvests because they do not include discarded, subsistence, recreational and non-reported catches. All these components are referred to as Illegal, Unreported and Unregulated fisheries (IUU). The proper and regular estimation of IUU is a primary target of the European Union policy (European Commission, 2011). In the past two decades, the interest in acquiring, quantifying, and analyzing historical data on fisheries use has significantly contributed to marine historical ecology (for literature review: Engelhard *et al.*, 2016; Thurstan *et al.*, 2024). Historical fishing data can be used to establish benchmarks and recovery targets in marine resource management (McClenachan *et al.,* 2012) as well as to assess the status of fish stocks (Cashion *et al.,* 2018).

In this context, significant attention should be given to data-poor areas such as the Greek Seas (Pilling *et al.,* 2008), where the multi-species and multi-gear nature of the fishery presents certain difficulties for the monitoring of the fisheries, especially for the small-scale component (Moutopoulos and Koutsikopoulos, 2014). These problems necessitate the reconstruction of fisheries catches by shifting the baseline of the Greek fisheries (Pauly, 1995) back to its early stage using scattered sources of information (Zeller and Pauly, 2006).

Greek overseas fisheries include large vessels fishing operating outside Greek waters, as the Exclusive Economic Zone (EEZ) has not been defined (i.e., Atlantic and North African Mediterranean coasts), and quantities caught are reported as "frozen". Fishing vessels licensed to operate with trawlers outside territorial waters, in the waters of foreign jurisdictions, are granted fishing licenses by third countries according to the procedures established by the European Commission, in accordance with the Protocols of fisheries agreements established under European Regulation 1006/2008. Furthermore, vessels licensed to fish with trawlers outside territorial waters may also operate: (a) in the waters of third countries with which the European Union has not concluded fisheries agreements, based on private agreements made by the vessel owner with the third country, and (b) in international waters, outside the six nautical miles limit for Greece, and beyond the waters of sovereignty or jurisdiction of any country. In this case, fishing is conducted in compliance with international measures

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for the management and conservation of stocks, as decided by regional fisheries management organisations.

The history of the Greek fisheries, the administrative organization of fisheries, the methodology of sampling, and the reconstruction of the Greek professional fisheries landings during 1928-2007 have been presented in Moutopoulos and Stergiou (2011, 2012). These studies did not include Greek overseas fisheries, which are presented and analysed here for the period from 1950 to the present.

MATERIALS AND METHODS

Since 1952, Greek overseas fisheries started exploiting the Atlantic Ocean and the African Mediterranean coasts, whereas since 1965, it expanded in the Persian Gulf and Indian Ocean (Ananiadis and Chondronikolas, 1970). Fisheries landings and effort data (i.e., number of vessels, engine horsepower and gross tonnage) are derived from: (a) the Directorate of Fisheries (former Ministry of Industry) through fisheries co-operations in collaboration with the Hellenic Statistical Authority (ELSTAT) and the Agricultural Bank of Greece during 1952-1963 (Ananiadis and Chondronikolas, 1970) and (b) ELSTAT during 1964-2015. Fisheries data concerning overseas fishing for the years 2016-2023 are not published as they are confidential (ELSTAT, 1966-2016). This is because, since 2016, only one Greek overseas fishing vessel has been active.

During 1952-1963, Greek official data for overseas landings refer to total landings for all species and areas combined (Ananiadis and Chondronikolas, 1970). Landings were spatially allocated in Atlantic and North African waters using the mean proportion of the overseas landings between Atlantic and North African waters as recorded by ELSTAT for the period 1965-1973. Thereafter, landings were taxonomically disaggregated by species using the mean (1952-1963) landings per area (i.e., Atlantic and North African) reported by Ananiadis and Chondronikolas (1970).

During 1964-2015, ELSTAT reports overseas landings data per species for two fishing areas (Fig. 1) (ELSTAT, 1966-2016); S1 for Atlantic waters (and Indian Sea) and S2 for North African Mediterranean coasts. For the period 1964-1981, ELSTAT overseas landings data per area are available for 23 species (or groups of species, henceforth called taxa), while during 1982-2015, ELSTAT overseas landings data are available for 66 fish, cephalopod and crustacean taxa. To harmonize the taxonomically aggregated landings for the period 1964-1981 to species as recorded for the period 1982-2007, the procedure used in Tsikliras *et al.* (2007) was adopted. Discarded catches for the overseas fisheries were based on the logbook reports derived from three overseas vessels as presented in Ananiadis and Chondronikolas (1970), and were estimated as a proportion of the discarded catches to the total number of catches (discards to catches ratio is 0.166 as provided by Ananiadis and Chondronikolas (1970)).

Furthermore, the differences in the mean percentage composition of the species or group of species caught *per* fishing area from the Greek overseas vessels were showed for the different sources of information provided, those based from Ananiadis and Chondronikolas (1970) during 1952-1963 and from the ELSTAT during 1964-2015. In this context, to assess species composition changes for the data derived from ELSTAT during 1982-2015, we used the non-parametric PERMANOVA

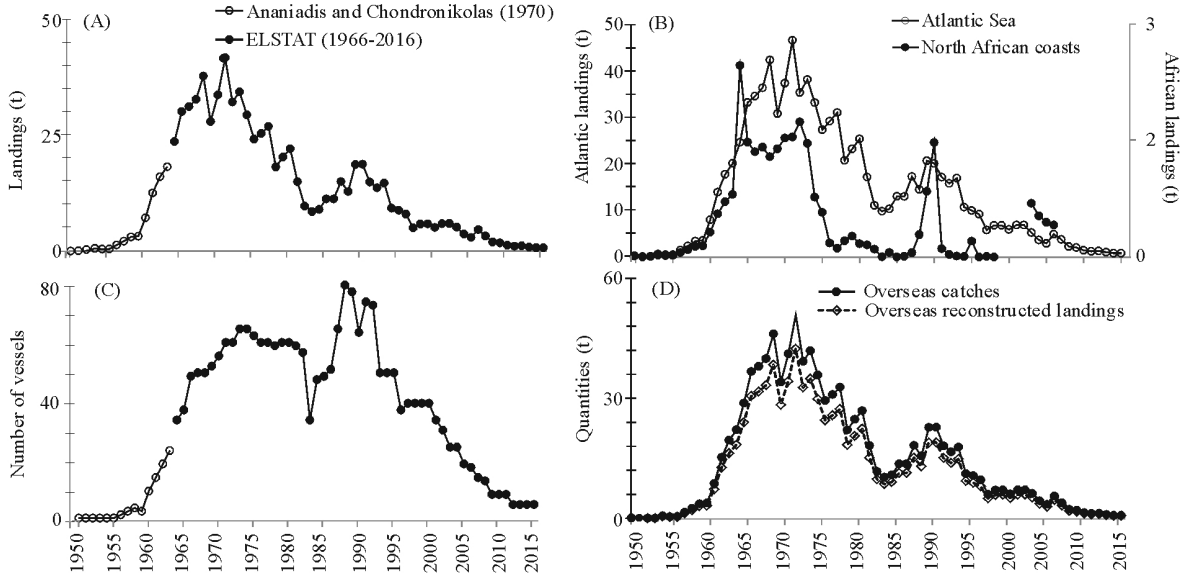

Fig. 1. Total overseas landings in tons (all areas combined) from data derived by different sources during 1952-2015 **(A)**; overseas landings disaggregated by area **(B)**; number of overseas fishing vessels **(C);** and reconstructed overseas fisheries catches and landings during 1952-2015 **(D)**.

test (Anderson and Walsh, 2013) based on a cluster analysis that would reveal whether the year period groups formed differed in terms of species composition. We performed this analysis separately from the aforementioned year period, because it was the longest time series compared with the 1964-1981 period. Subsequently, we constructed two matrices (rows X columns; species X years) consisting of the percentage species composition by year for the landings derived from Atlantic and North African waters, respectively. Matrices were converted into triangular matrices of similarities using the Euclidean distance and were analysed using the Ward's method (Field *et al*., 1982).

RESULTS

Overall, overseas reported landings from all Greek fishing vessels increased from 150 t in 1952, to 41957 t in 1971 and then gradually decreased to 725 t in 2015 (Fig. 1A). Disaggregated by area overseas landings derived from Atlantic Ocean (ELSTAT subarea S1) sharply increased from 144 t in 1952 to 40475 t in 1971 and then gradually decreased to 725 t in 2015 (open circles in Fig. 1B). North African Mediterranean landings (ELSTAT subarea S2) steeply increased from 6 t in 1952 to 2384 t in 1964 and decreased to zero values in 2007 and onwards (black circles in Fig. 1B). Number of overseas vessels gradually increased from 1 in 1952 to 70 in 1988 and then vastly decreased to five vessels in 2015 (Fig. 1C).

Discards derived from the Atlantic Ocean sharply increased from 29 t in 1952 to 8093 t in 1971 and then gradually decreased to 254 t in 2010 (figure not shown). Discards derived from the North African Mediterranean coasts steeply increased from 2 t in 1952 to 476 t in 1964 and decreased to zero values in 2007 and onwards. Overseas catches (Fig. 1D) followed the same pattern as the landings one, exhibiting a huge increase during the first two decades (1952-1971) from 180 t to 50348 t and then a considerable decrease to 870 t up to 2015 (Fig. 1D).

During the "early" period of overseas fisheries (1952-1963), *Pagellus erythrinus* (25.8%) and *Pagrus pagrus* (23.2%) mostly contributed to Atlantic overseas landings (Table 1), whereas *Spicara smaris* (22.5%), *P. erythrinus* (20.0%), *Mullus surmuletus* (14.2%) and *Mustelus* sp. (13.0%) mostly contributed to North African ones (Table 1). During 1964-1981, *P. pagrus* (15.7%), *P. erythrinus* (14.6%) and *Merluccius merluccius* (12.6%) mostly contributed to the Atlantic overseas landings, whereas *M. surmuletus* (25.3%), *Spicara maena* (17.0%), *Spicara smaris* (15.7%) and *P. erythrinus* (12.7%) dominated the corresponding from North African waters (Table 2). For the period 1982-2015, multivariate analysis on the species composition per year for the landings derived from Atlantic waters revealed three significant (PERMANOVA test: pseudo F-ratio = 35.6; $p < 0.05$) year-groups (Table 1b): 1982-1993, 1994-2002 and 2003-2015, during when the contribution of Sparidae species were reduced, whereas those for Cephalopods were increased across years. Multivariate analysis on the species composition from North African waters during 1982-2006 revealed (Table 1b) two significant (PERMANOVA test: pseudo F-ratio = 29.4; $p < 0.05$) year-groups, 1982-1992 with *Spicara smaris* (15.5%) and *Merluccius merluccius* (10.4%) being the dominant species, and 1993-2006 with *Nephrops norvegicus* being the dominant species.

DISCUSSION

The emergence of overseas fisheries in Greece coincided with the end of World War II and the Greek Civil War. During the subsequent period (1946-1954), Greece benefited from international economic aid and agreements with third countries (Ananiadis, 1968). The expansion of overseas fisheries was further facilitated by the annexation of the Dodecanese Islands to Greece in 1948, local fisheries had a long tradition in overseas trips, particularly for sponge fisheries in Mediterranean African countries. However, in 1947, the first attempts to establish offshore fisheries in Canada had failed (Tsakakis, 1950), and the initial overseas fishing trip to Benghazi resulted in significant financial loss-

Table 1. Mean percentage composition of the species or group of species *per* fishing area for the landings derived from Greek overseas vessels based on Ananiadis and Chondronikolas (1970) during 1952-1963. Species are listed in alphabetical order.

Atlantic Ocean	%	North African Mediterranean waters	%
Dentex macrophthalmus	3.6	*Boops boops*	7.4
Epinephelus sp.	4.8	*Mullus surmuletus*	14.2
Loligo vulgaris	7.0	*Mustelus* spp.	13.0
Mustelus spp.	3.7	*Pagellus erythrinus*	20.0
Octopus vulgaris	7.0	*Pagrus pagrus*	7.0
Pagellus erythrinus	25.8	*Solea* spp.	3.0
Pagrus pagrus	23.2	*Spicara flexuosa*	5.5
Sepia officinalis	4.2	*Spicara maena*	4.0
Spondyliosoma cantharus	6.5	*Spicara smaris*	22.5
Other recorded species	10.1	Other recorded species	1.7
Other non recorded species	4.1	Other non recorded species	1.7

Table 2. Mean percentage composition of the species or group of species *per* fishing area for the landings derived from Greek overseas vessels based on the Hellenic Statistical Authority during 1964-2015. Species are listed in alphabetical order.

Atlantic Ocean	**1964-1981**	**1982-1993**	**1994-2002**	**2003-2015**
	%	**%**	**%**	**%**
Carcinus aestuarii		3.0	1.1	0.5
Dentex dentex		4.4	5.0	2.1
Epinephelus sp.	3.4	4.0	2.8	0.5
Epinephelus marginatus	2.7	0.1	0.0	0.0
Helicolenus dactylopterus		1.9	2.6	0.0
Loligo vulgaris	2.6	10.3	0.5	2.4
Merluccius merluccius	12.6	0.5	0.9	0.0
Mullus surmuletus	4.6	4.7	13.1	4.4
Natantia	4.4	15.2	10.4	7.6
Octopus vulgaris	2.4	1.7	3.3	20.3
Pagellus erythrinus	14.6	7.3	8.3	0.6
Pagrus pagrus	15.7	11.6	10.0	5.0
Sepia officinalis	6.0	7.7	10.0	10.0
Solea spp.	2.4	2.1	1.2	1.2
Other recorded species	7.3	7.3	8.5	19.5
Other non recorded species	21.4	18.2	22.0	26.2

North African Mediterranean waters	**1964-1981**	**1982-1992**	**1993-2006**
	%	**%**	**%**
Boops boops	2.7	4.3	1.2
Merluccius merluccius		10.4	1.4
Mullus barbatus		7.6	0.1
Mullus surmuletus	25.3	9.7	2.4
Mustelus spp.		1.9	
Nephrops norvegicus		4.1	7.2
Pagellus erythrinus	12.7	8.8	0.6
Pagrus pagrus		0.5	2.2
Solea spp.		0.2	0.2
Spicara flexuosa	7.1	1.4	
Spicara maena	17.0		0.5
Spicara smaris	15.7	15.5	4.4
Thunnus spp.		3.9	2.9
Xiphias gladius		3.0	4.8
Other non recorded species	4.8	9.1	13.3
Other recorded species	14.7	10.7	58.4

es (Tsakakis, 1950). In the early 1950s, international funding supported the first studies on organizing of the overseas fishing sector in Greece (Serbetis, 1948), the construction of the first overseas fishing vessel (vessel "Santa Barbara") and exploratory fishing trips to North Africa (1951) and the Atlantic Ocean (vessel "Evridiki") (1952), respectively (Ananiadis and Chondronikolas, 1970).

Only after 1952, when the first overseas bottom trawls appeared, and for the next two decades, Greek overseas fisheries gradually expanded their operation from the North African Mediterranean waters to the Atlantic and Indian waters along the coasts of Senegal, Nigeria, and the Persian Gulf (Ananiadis and Chondronikolas, 1970). It is worth mentioning here that overseas fisheries beyond the Greek maritime borders were also conducted along the northern coasts of the Mediterranean African zone by approximately 100 small-scale coastal fishing vessels using longliners, reaching an annual fishery landing of 160 t in 1951 (Tsakakis, 1950). These estimates are out of the scope of the present study. However, up to 1956, the active offshore fishing vessels engaged in Atlantic fishing were only three, whereas only one, "Evridiki", efficiently fished, as the other two

vessels failed to achieve fishing due to constant repairs and inadequate operation of their refrigeration systems. A significant increase in Greek overseas fisheries landings was depicted after 1957, with the construction of more fishing vessels. Between the mid-1950s and mid-1960s, the number of overseas fishing vessels increased from 3 in 1956 to 43 in 1966, accompanied by a rise in annual mean landings from 600 t to 13,695 t. This, in turn, significantly contributed to an 80% increase in fish consumption between 1956-1971. This trend mirrors the peak of the contribution (up to 61.2%) of overseas landings in relation to the overall total Greek fisheries landings up to 1971 (data from Moutopoulos *et al*., 2015a, b). Since then, this contribution degraded to less than 1% up to mid-2010s.

During the 1960s, many of the newly established African countries undertook initiatives to exploit their resources, to address serious protein deficiencies in the diets of their inhabitants (FAO, 1960). In this framework, certain Mediterranean countries, including Portugal and Spain, approved plans for the modernization of their overseas fisheries (FAO, 1960). At the same time, the Greek government allocated funds for the exploration of new fishing grounds and the construction of a new 52-meter-long overseas fishing vessel. In addition, since 1965, a fleet of trawlers equipped with refrigeration facilities has been operating for shrimp fishing in tropical waters along the coasts of Senegal, Nigeria, and within the Persian Gulf. By the mid-1970s, this fishery had expanded to include 20 vessels with a total capacity of approximately 1,500 tons and a combined engine power of 8,000 HP (Ananiadis *et al.,* 1978). Consequently, the spatial expansion of the Greek overseas vessels led to an increase in their operational fishing time, both daily (i.e., from 12 to 24 hours per day) and annually (i.e., the number of active fishing days increased from 70 days before the 1960s to 90 days in the 1970s) (Ananiadis and Chondronikolas, 1970). These changes contributed to increased fisheries landings up to 1972. By the mid-1970s, the overseas fleet consisted of vessels ranging in size from 50 to 75 m, with total capacities between 450 and 1,540 tons and engine horsepower ranging from 500 to 1,200 HP.

The gradual decrease in overseas landings since 1973 is attributed to the global oil crisis of October 1973, which subsequently increased production costs by 40% within 5 months (June to November of 1973). In an effort to reduce maintenance and storage costs, shipowners often discarded part of their catch, particularly species of low commercial value, such as scorpionfish, horse mackerel, and mackerel (Ananiadis *et al*., 1978). However, the renewal and establishment of new bilateral fishing agreements between 1973 and 1977 - with countries in the Mediterranean (Libya), the Atlantic Ocean (Mozambique and Senegal), the Pacific Ocean (New Guinea, for shrimp), and South America (Argentina, with two fishing vessels, and Uruguay, with one vessel, for the cod fishery) - collectively helped maintain Greek overseas fisheries landings at approximately 25,000 tons annually through 1980 (Ananiadis *et al*., 1978). Also, the majority of Greek overseas vessels (58%) were outdated - over 17 years old - with limited storage capacity (only three had a usable capacity exceeding 1,000 tons) and lacked mechanical equipment for processing or producing fish meal (Ananiadis *et al.,* 1978).

Since 1981, when Greece joined the European Union, there has been a consistent downward trend in fisheries landings over the years. In this context, the increasing import of frozen fish products has negatively impacted overseas fisheries. As a result, the average annual fisheries landings steadily declined, reaching levels by 2015 comparable to those of the "early stage" of overseas fisheries 60 years earlier (Fig. 1D). This decline may be attributed to structural weaknesses within the Greek overseas fisheries sector, as well as broader international factors. Regarding the former, Greek overseas fisheries was characterized by: (a) unplanned development as it consisted of small business units (i.e., only three out of 26 total overseas fishing companies had more than 15 vessels), which resulted in the reduction of net profits; (b) a 30-35% reduction in its fishing grounds due to the extension of the territorial waters of coastal African countries (i.e., from three to 12 nautical miles); (c) the lack of a fish processing industry (i.e., only 0.05% of the overseas landings were directed to the Greek processing industry); (d) the lack of well-organized market distributional routes which increased labor costs; and (e) the absence of market policies for encouraging the marketing of frozen fish. In terms of international issues, European Union agreements have gradually shifted towards tuna fisheries rather than demersal ones, as tuna species are less affected by industrial fishing and less exploited by local fisheries compared to demersal species. Additionally, "mixed-species" agreements disproportionately benefit the European fishing industry (Le Manach *et al.,* 2013). On other occasions, fisheries rights in other European waters were not granted due to delays in harmonizing European regulations with national policies, as well as the absence of an Electronic Logbook system for transmitting fishing data through the flag state's network (EU Reg 1224/2009).

As a result, the Greek overseas fisheries experienced significant changes from the mid-20th century up to today, driven by historical, economic, and regulatory developments. Expanding in the Mediterranean, Atlantic, and later the Indian Ocean, Greek overseas fishing peaked during the 1970s. However, since the 1990s, the industry has experienced a steep decline in both landings and the number of active vessels. This downturn has been attributed to several factors, including increased territorial restrictions, high operational costs, unstructured market systems, and inadequate fish processing infrastructure. Greek overseas fisheries have thus shifted from a period of rapid expansion to one of constraint and decline, underscoring the need for strategic policy interventions and stronger market integration.

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