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THE RECONSTRUCTION AND UNIFICATION OF CYPRUS'S MARINE FISHERIES CATCH DATA, 1950-2010

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ABSTRACT

The island of Cyprus has been divided since 1974 into the Turkish Cypriot north and the Greek Cypriot south. Here, we have reconstructed the total marine fishery removals for the island in its entirety, and then for each side from 1950-2010. Cyprus's total marine fisheries catches were reconstructed for the 1950-2010 time period by estimating all fishery removals, including unreported commercial, subsistence and recreational catches, and major discards. These estimates were added to the 'officially reported' data, as represented by data submitted by countries to the Food and Agriculture Organization (FAO). Such data were submitted by the south, but were absent from the north for years following the 1974 partitioning of the island. The total reconstructed catch for 1950-2010 was about 247,000 t, which is over 2.6 times the 93,200 t officially reported by FAO on behalf of Cyprus. The unreported components consisted of nearly 57,000 t of large-scale commercial landings, 43,000 t of small-scale commercial landings, 15,500 t of subsistence landings, 11,000 t of recreational landings, and nearly 28,000 t of discards (55% from the small-scale sector and 45% from the large-scale sector). Improving the accuracy of fishery statistics by accounting for all removals is fundamental for better understanding fisheries resource use and enhancing fisheries management capacity.

INTRODUCTION

Renewable natural resources have the ability to sustain exploitation for long periods of time, and ideally forever if properly managed. It was once common belief that the ocean's marine resources were

inexhaustible (Thomas Huxley, London Fisheries Exhibition, 1883). Only since after World War II have human impacts on marine ecosystems been realized and understood to significantly alter marine biodiversity and ecosystem interactions (Pauly 2012). Given the growing emphasis on ecosystem-based management, a comprehensive understanding of total fisheries removals[1] can help understand the ecosystem's past capabilities and thus help more informed decisions regarding future resource use.

The publicly available national catch data provided to the United Nation's Food and Agriculture Organization (FAO) accounts for only a portion of total fisheries catches from the marine environment. Here, we present a time-series of total marine fishery removals for all sectors and components from 1950-2010 for Cyprus in its entirety, using a catch reconstruction technique described in Zeller *et al.* (2007). This study provides important baseline biological data, and can aid in sustainable fisheries management of these renewable resources. Cyprus's alignment with the "EU acquis" and the benefits of artificial reefs are also discussed.

History of Cyprus

Cyprus had its earliest inhabitants arrive during the Neolithic, likely from the coastal areas of the Eastern Mediterranean, such as present-day Syria and Anatolia. Since then, several groups of peoples of different ethnic origins have settled on Cyprus. The island's natural resources such as copper, and availability of arable land, attracted early farmers as well as copper miners and processors. Since the island holds a strategic location in the eastern Mediterranean, it has been occupied by many major powers during its long history, such as Assyrians, Egyptians, Phoenicians, Hittites, Achaeans, Romans, Byzantines, Crusaders, Turks and British. Ancient Greeks settled in Cyprus as early as the second

[1] Fisheries catches for our purposes include fish and invertebrate species, but exclude seaweed, sponges and marine mammals.

millennia B.C., and legend has it that these were heroes from the Trojan War (Brown and Cattling 1986). St. Barnabas, originally a Jewish-Cypriot who guided St. Paul to Cyprus, is thought to have brought Christianity to the island in 45 A.D. (Hill 1949), while the first encounter of Cyprus with the Islamic religion began in 632 A.D. when the Arab invaders under Abu Bakr (according to Arab and Greek chronicles) presented themselves in Cyprus capturing the Byzantine city Salamis (Constantia) and converted the large basilica of St. Epiphanios into a mosque. Cyprus was under Ottoman rule from 1570-1878, during which time many Turks settled on the island (Gazioğlu 1990). In 1878, Cyprus came under British rule, which lasted until 1960.

On August 16, 1960, Cyprus became independent as 'The Republic of Cyprus'. In 1963 tension and conflict arose on the island between the Turks & Greeks. In 1963, a United Nations officer drew a cease-fire line partitioning the island's capital Nicosia, on a map using a green crayon, ever since referred to as the 'Green Line'[2]. The 'Green Line' runs east-west through Cyprus and Nicosia, thus bisecting the capital, and making it the only divided capital in the world (Figure 1).

On July 20, 1974, the first president of Cyprus, Archbishop Makarios, was overthrown in a coup d'état by rebels backed by the then ruling Greek junta and this led to the death of several hundred Greek and Turkish Cypriots. This provided the Turkish government with a pretext to send in troops to protect the Turkish Cypriot population; these troops have since occupied the northern part (37%) of the island. Around 180,000 Greek-Cypriots[3] moved from the north to the south of the island, and approximately 40,000 Turkish-Cypriots moved from the south to the north. The previous homes of Greek-Cypriots in the north were distributed to the new Turkish settlers (Kacowicz and Lutomski 2008), but many homes

[2] http://www.mof.gov.cy/mof/customs/customs.nsf/All/05AEEF243C9BFC8BC22572BF002D0A28?OpenDocument
[3] An estimate based on 40% of the Greek Cypriot population at the time which also correlates with the percentage of land lost.

in the north remained deserted as the number of displaced Turkish Cypriot's represented close to half the previous Greek Cypriot population. The absorption of Greek Cypriots into the south was disadvantaged by their larger population and a smaller inventory of vacated properties (Kacowicz and Lutomski 2008). Both parties lost all of their possessions and required assistance.

In 1983, the north was unilaterally declared the 'Turkish Republic of Northern Cyprus (TRNC)', which is recognized as a separate state only by Turkey. Since 2003, a handful of check–point crossings on the 'Green Line' in Nicosia have opened, granting entry to either side. In April 2004, the entire island of Cyprus was admitted into the European Union, but only the south is protected by EU legislation until the current political problem is resolved. The Republic of Cyprus has the only internationally recognized government on the island. Cyprus lies on many geopolitical fringes, between Greece and Turkey, Christianity and Islam, East and West, Europe and Asia, and now inside and outside the EU (Papadakis *et al.* 2006).

The eastern Mediterranean Sea, and particularly the Levantine Basin, are extremely oligotrophic environments, with very low primary production and nutrient levels[4], owing to a lack of rivers and the establishment of dams, both of which have greatly impeded biological productivity. The demersal fisheries of the Mediterranean are known to be over-exploited[5], resulting in low profits, and many marginalized fishers. High costs normally inhibit overfishing, but certain types of subsidies mask true operating costs.

[4] http://www.marbef.org/training/FlowCytometry/Posters/Psarra.pdf
[5] http://www.biopolitics.gr/BIOPOLITICS/HTML/PUBS/VOL2/hj-demet.htm

Cyprus is the third largest Mediterranean island, after Sicily and Sardinia and geographically lies approximately 75 km south of Turkey, 170 km west of Syria, and about 900 miles south-east of the Greek mainland. The population of Cyprus in 1950 was 488,000 (Anon 1951), which more-than doubled to over one million by 2010[6], 78% of which are of Greek descent, 18% of Turkish descent and 4% consisting of 'other' nationalities. Primary production and fisheries productivity are about 3.3 times and 2.7 times (respectively) lower in the eastern Mediterranean compared to the western (Zenetos *et al.* 2002) while population pressure is constantly rising due to tourism (Zenetos *et al.* 2002), further stretching limited resources.

In 2011, the north was comprised of approximately 60,000 Turkish Cypriots and about 150,000 Turkish immigrants[7], and the population of the south in 2011 was 803,000[8]. For the purposes of this paper 'north' refers to the area on Cyprus primarily inhabited by Turkish Cypriots north of the 'Green Line' unofficially called the Republic of Northern Cyprus, and 'south' to the area inhabited by Greek Cypriots, officially known as the 'Republic of Cyprus'.

History of Fishing

The fishing history of Cyprus since 1950 is presented in three distinct time periods: [British] Colonial Rule (1950-1960); United Cyprus (1961-1973) and Two Solitudes (1974-2010), where applicable. Appendix Tables A7 & A8 list all fish and invertebrates taxa mentioned in the text, along with their English, Cypriot, Turkish and scientific names.

Colonial period (1950-1960)

[6] http://www.tradingeconomics.com/cyprus/population-total-wb-data.html
[7] http://www.windowoncyprus.com/politics.htm
[8] http://www.indexmundi.com/cyprus/demographics_profile.html

The basic fisheries laws were enacted in 1931 in Cyprus. Some of the most important sections were (Fodera 1961):

- Section 3: every fishing vessel was to be licensed, which was free of charge. Penalties for fishing without a license were up to three months imprisonment or a £25 fine, or both;
- Section 5: the use of poison and explosives was prohibited, and the transport and sale of fish caught with these methods was also prohibited. Penalties included up to two years imprisonment or fines of up to £100, or both;
- Section 7: vessels would be confiscated if owned by a person convicted of an offense in Section 5, or if were used to fish with the use of poison or dynamite.

During the colonial period, although the use of dynamite carried a heavy penalty, regulations at this time were poorly enforced due to insufficient monitoring and inaccessibility issues.

In 1950, the Cypriot fishing fleet consisted of 320 sailboats, 19 motorized sailboats and 10 trawlers, which together employed 960 people and caught 460 t·year of fish (Anon 1951)[9]. Only the coastal area was fished, which extended two miles out to sea (Anon 1960). Catches increased slightly, and averaged just under 500 $t \cdot year^{-1}$ for the 1950s. In 1961, the small-scale fishery landed about 40% of the catch (Fodera 1961), the rest being landed by the trawlers, which are deemed large-scale or 'industrial' in the present context. By 1960, there were approximately 700 fishers in total (Fodera 1961), the majority being Greek Cypriots. The fishing sector was under-developed at this time due to a lack of natural ports and shelters for vessels. Historically, villages were built at a distance from the coast , due to frequent raids from pirates (Fodera 1961). In the past, the road network was not connected to the sea in many places (Fodera 1961), thus limiting transport. Only demersal inshore stocks were exploited due to a steep continental shelf and limited pelagic stocks, mainly using destructive fishing techniques such as

[9] The *oke* was the standard measuring unit commonly used in the Ottoman Empire until the late 1980s in Cyprus. 1 oke's standardized measure in the late Ottoman Empire is 1.28 kilograms or 0.00128 t. Okes have been converted to kg or t , throughout this document. Oke is the contemporary English spelling of the measure, while okka is the modern Turkish spelling (http://en.wikipedia.org/wiki/Oka_(mass).

dynamite fishing, which was common. Some stocks experienced declines in their catches, along with reductions in average fish size (Fodera 1961). Pelagic fishing was not practiced, and hence populations of, e.g., greater amberjack (*Seriola dumerili*) were abundant in coastal waters (Fodera 1961). Demersal fishing lines to target shark and other large pelagics were made from hemp, with the top end secured to a "dried hollow pear-shaped pumpkin" as a float (Fodera 1961), and hemp was used for all demersal longlines at this time.

From 1951-1960, the national seafood consumption rate increased by a factor of three due to an increase in fish imports. The per capita seafood consumption rate for Nicosia circa 1961, was 8 $kg \cdot person^{-1} \cdot year^{-1}$ (Fodera 1961), and seafood comprised 7.4% of total protein consumption. Fishing contributed 0.17% to the Gross National Product (GNP) and commercial fishers made-up 0.12% of the population in 1961 (Fodera 1961).

United Cyprus (1961-1973)

Cyprus's main harbour, the Bay of Famagusta, was the islands largest natural harbour (Figure 1). It had a wharf length of 1,750 feet and berthed vessels up to 20 feet long. Two other significant harbours during this period were in Paphos and Kyrenia (Figure 1). Boats sought shelter by hauling out onto beaches for protection from stormy seas (Fodera 1961). Moorage was an issue on the island in the past, and still remains an issue in the north. The north-eastern coast of Cyprus was not suited for bottom trawling, but was excellent for line, basket and net fishing (Fodera 1961). The bottom trawl fleet was limited to 12 vessels, two of which were reserved for the Turkish Cypriot community (Fodera 1961).

Two Solitudes (1974-2010)

North

In 1974, the south lost [and hence, the north gained] some of the better fishing areas of the island (Solsten 1993). The 'north' today has about 40% of the island's available fishing grounds (545 km^2), whereas the 'south' has about 60% of available fishing grounds (816 km^2) (Garcia and Demetropoulos 1984). The continental shelf areas and Inshore Fishing Areas (IFA, Chuenpagdee *et al.* 2006) were calculated by the *Sea Around Us* (www.seaaroundus.org) and found that the north has 46% (1,467 km^2) of the island continental shelf area, and the south 54% (1,734 km^2). Also the north has 44% (1,734 km^2) of the island's Inshore Fishing Area, and the south 56% (1,379 km^2).

There were only about 30-40 Turkish-Cypriot fishers on the island circa 1974 (E. Sinay, pers. obs.), but post-1974, more Turkish Cypriots took to fishing as they now had access to previously-abandoned vessels and gear in the north, which they slowly gained experience with.

Large-scale commercial bottom trawling and purse seining have been banned since 1999 (Çiçek 2011a) due to observed direct damage that trawling exerted on the environment and its resources.
In 2012, about 5 fishers in the north used drift nets with mesh sizes > 65 cm to target large pelagics such as swordfish (*Xiphias gladius*), bluefin tuna (*Thunnus thynnus*) and other large scombroids (B.A. Çiçek, pers. obs.).

Longliners also target large pelagics; there were approximately 60 operational longline fishers in 2012, each longline averaging a total length of about 2,500 m. Mainly cephalopods (octopus, squid and cuttlefish) are used to bait longline hooks, but sometimes sardines, shrimps and unmarketable by-catch

are also used. One average-sized common octopus (*Octopus vulgaris*) baits approximately 120 longline hooks (I. Salihoglu, pers. obs.). Three types of longlines are used in the north: the first being the thin demersal longline which has an 18 m length with sidelines extending 10-12 m, and targets small fish such as common pandora *(Pagellus erythrinus*), common dentex (*Dentex dentex*), rabbitfish (*Siganus* spp.), and seabreams (Sparidae), and is used at depths between 0-50 m. The second type is the mid-water longline which targets medium-sized fish such as larger common dentex, dusky grouper (*Epinephelus marginatus*), mottled grouper (*Mycteroperca rubra*), bonito (*Sarda sarda*), greater amberjack (*Seriola dumerili*) and leerfish (*Lichia amia*), and is used at depths between 30-300 m. The third type of longline (pelagic) targets swordfish or bluefin tuna, its main line floats on the surface, but its sidelines go to depths of approximately 150 m and carry between 500 to 2,000 hooks.

Between mid-February to late March, picarel (*Spicara smaris*) are targeted with 18 mm mesh size nylon nets. Demand and market prices are both low for picarel, but one co-author (Burak A. Çiçek) is trying to boost this taxon's sales by promoting a 'Picarel festival' to help boost the fish's popularity, as consuming fish with a lower trophic-level fish is good for the environment (less wasted transfer-efficiency) and our health (omega 3's), and are lower in pollutants such as mercury.

Approximately 500 families in the north rely solely on fishing for survival (Çiçek 2011a), while many families have left the industry due to declining incomes. Some issues affecting these fishers include low marine productivity, lack of insurance, inadequate cold storage facilities, no access to more modern fishing techniques and a lack of monitoring and control and surveillance to deter illegal fishing. There is also a scarcity of fish markets in the north, thus requiring the use of a middleman to market their

catches in the south; middlemen which make over a 100% profit and do not purchase low-value catches due to spatial restrictions on their transport vehicles. The continental shelf is a little narrower in the north than the south, which further decreases inshore fishing opportunities, explained in detail later.

Recreational fishers are referred to as 'amateur' fishers in the north. They are not permitted to use fishing nets >400 m in length or mesh sizes <32 mm. Use of longlines is allowed, but each line is limited to 100 hooks or less. Soon, the use of fishing nets and longlines may also be banned for recreational fishers as the topic is currently under discussion (2013).

Laws were developed for the recreational sector in 2006, and amended in 2010. The following actions are illegal (Anon 2010a): fish sales, use of explosives, use of toxic substances, use of lights or electrical currents, removal of live seagrass, collection of black sponges, removal of shellfish species for decoration purposes, harvesting octopus inshore, the use of monofilament fishing nets (effective as of Jan. 1, 2011), driftnets, and the harvest of female spiny or female European lobsters (*Palinurus vulgaris* and *Homarus gammarus)*. Daily catch limits for select species are restricted to 5 kg per fisher, and/or for any combination of those select species. It is also illegal to scuba dive or use light in Mediterranean monk seal habitats. Seasonal fishing closures include swordfish (Jan. 31-Oct. 1), tuna (Jul. 16-Aug. 15), brown meagre (Apr. 15-July 16), and grouper (June 1-July 15th).

South

Post-1974, the Department of Fisheries and Marine Research provided investment to the fishing industry in the form of subsidies and new vessels to help increase catches, since their inshore fishing area was reduced from 1,360 to 800 km^2, about 40% (Garcia and Demetropoulos 1984). By the late 1980s, Cyprus's annual marine fishery catches had exceeded their catches prior to 1974 (Solsten 1993),

largely due to a geographical expansion of fishing area, which commonly occurred across the globe during the 1980s and 1990s (Swartz *et al.* 2010).

The commercial fishing fleet had four main sectors: small-scale (artisanal), multi-purpose, large pelagic, and bottom trawl; the last three of which are considered large-scale or industrial due to vessel lengths > than 12 m.

The small-scale fishery, as defined by the national Fishery Law 132(I)/2007, is conducted by vessels 4-12 m in length, which use trammel nets, bottom gillnets and bottom longlines to target demersal species (European Union 2007). The small-scale sector fishes exclusively inshore and their average effort had increased by a factor of 8 from 1967-1984, measured in horsepower (hp) times the number of fishing days (Garcia and Demetropoulos 1984). Total catches for this sector were stable from 1967-1982 (averaging 500-800 t per year), despite a 3.5 fold increase in average hp (Garcia and Demetropoulos 1984), signifying a decline in catch per unit effort (CPUE). Since the early 1980s, this increase in effort was enhanced by modernization of fishing gear and technology, i.e., the introduction of hydraulic nets and longline haulers (Garcia and Demetropoulos 1984). The proportion of small-scale catches in total reported commercial catches increased from 40% in the 1950s to 70% by the late 1980s (Hannesson 1988). One third of their catches were represented by 6 species: red mullet (*Mullus barbatus*), striped red mullet (*Mullus surmuletus*), pandora (*Pagellus erythrinus*), red porgy (*Pagrus pagrus*), parrotfish (*Sparisoma cretense*)and bogue (*Boops boops*) (Anon 2010b), all fished by trammel nets. Another significant trend worth noting is that the composition of catches shifted from high-valued species to low-valued species from 1975-1984 (Garcia and Demetropoulos 1984); higher priced species valued at $ 8.03 U.S./kg and above declined from 36% of total catch composition to 21%, while low-valued species

valued below $ 1.56 U.S./kg increased from 42% to 63%. In the 2000s, there was a limit of 500 permitted small-scale vessels (Rousou 2009)[10], with enforced minimum landing sizes and gear restrictions in place (European Union 2007).

Multi-purpose vessels are between 12-24 m in length and use passive fishing gear such as nets, bottom longlines, and occasionally drifting surface longlines[7] which target both inshore demersals and large pelagics (European Union 2007). Minimum landing sizes only exist for bluefin tunas, but limited entry, closed seasons and gear restrictions are also used as management measures (European Union 2007).

The large pelagic fishery uses mainly drifting longlines to target swordfish, bluefin tuna and albacore tuna (*Thunnus alalunga*) and operates in waters around Cyprus and the eastern Mediterranean. Longline hooks traditionally were baited with fresh squid and octopus (as in the north), but have recently switched to imported sardines and squid (A. Petrou, pers. obs.). Mean weight of landed swordfish decreased from 60 kg in 1976 to 20 kg by 1993 (Economou and Konteatis 1995), and the CPUE per hook decreased by a factor of six, from 580 grams per hook in 1976 to 100 grams per hook by 1993 (Economou and Konteatis 1995), which may be due to the unintentional large proportion of juvenile swordfish caught on surface hooks targeting larger swordfish, but are then used as marketable bycatch. Sixty-five percent of swordfish catches in the eastern Mediterranean consisted of young fish less than three years in age (Alıçlı *et al.* 2012). Fishing trips last between one to seven days (Anon 2007). The pelagic swordfish fishery, according to Act 273/90, was limited to 60 vessels operating outside Cyprus's territorial waters, each of which had to be > 9 m and have a V.H.F. radio.

Bottom otter trawlers are between 21-27 m in length and have engines between 220-750 hp. They are licensed for either their inshore fishing area (Exclusive Economic Zone, EEZ) or for international waters

[10] http://www.fao.org/fi/oldsite/FCP/en/CYP/profile.htm

of the eastern and central Mediterranean (European Union 2007). Five main species are targeted (European Union 2007): bogue, red mullet, striped mullet, common pandora and picarel. In 2003, 144 full-time fishers were employed on 8 inshore trawlers and 14 offshore trawlers[7]. Since 2006, there have been four active bottom trawlers operating in territorial waters which land about 30% of the total commercial catch (in value), and 8 operating in international waters. The declining catches of the small-scale sector are attributable to bottom trawlers landing a high proportion of juvenile fish. Trawlers have been known to illegally fish inshore, i.e., under the 30 fathom limit, to catch picarel, which frequently damaged the trammel nets of the [small-scale] inshore fishery (Garcia and Demetropoulos 1984), creating further tension between the two sectors. Since 2004, adherence to EU regulations and their Vessel Monitoring System has ensured trawlers operate at depths greater than 50 m.

Bottom trawling expanded in depth, engine size and range during the 'United Cyprus' and 'Two Solitudes' periods. An expansion first occurred into depth, to target hake (*Merluccius merluccius*) and shrimp (Penaeidae*)*, then mean engine size increased from approximately 160 to 240 hp by 1983 (Garcia and Demetropoulos 1984). Also the geographical range expanded, with the area trawled increasing from an average of 2.8 $km^2 \cdot day^{-1}$ in 1967 (Fodera 1961) to 4 $km^2 \cdot day^{-1}$ by 1984, despite the 40% reduction in fishing grounds due to the split of Cyprus in 1974 (Garcia and Demetropoulos 1984).

Since the early 1990s, annual stocks assessments of the five most commercially important demersal fish species have been undertaken: bogue, red mullet, striped red mullet, common pandora and picarel (Hadjistephanou and Vassiliades 2004), which together account for over 60% of demersal catches (DFMR 2007). Four of which have been 'fully exploited' from the mid-1980s to present (DFMR 2007), with the exception of picarel stocks, which are considered healthy and some years even under-exploited (DFMR 2007).

There is a substantial recreational fishery in the south, locally referred to as the 'sports fishery'. A fishing license is always required when fishing from a boat, using lights, spear guns, fishing nets, or longlines (Hadjistephanou and Vassiliades 2004). In the 1980s, there were approximately 300 recreational fishers using boats and several thousand anglers fishing from shore (Pawson *et al.* 2007). There are six angler clubs, which work in close contact with the Department of Fisheries and Marine Research (DFMR), and the DFMR transfers the relevant rules and regulations to anglers through these clubs. Recreational vessels are encouraged to moor in marinas associated with the Cyprus Tourism Board; the Tourism Board actively supports DFMR initiatives to help increase angling. Boats and tours for sport fishing can be arranged from all harbours, fishing stations and most tourist shops (Pawson *et al.* 2007). Cyprus is a popular place to purchase fishing gear with the best brands readily available and reasonably priced.

In the early 2000s, there were approximately 2,000 licensed recreational fishers fishing from boats and shore using spearguns, hook and line, nets, longlines, towed lines and jigging lines. Jigging is practiced mainly to target squid and octopus. The vessel-based albacore tuna fishery has recently gained popularity in summer months. Interestingly, the recreational sector is only permitted to fishing on weekends, holidays and Wednesdays (A. Petrou, pers. obs.), which has been the case for many decades. The 2000s have seen the modernization of fishing gear, for example, downriggers now tow lines at 200+ m deep to target benthopelagic species such as the blackspot seabream (*Pagellus bogaraveo*).

Exclusive Economic Zone (EEZ)

The territorial sea boundary at 12 nm was established in 1964[9], and any catches taken beyond this limit were considered 'international waters' in Cyprus. For the purposes of this study, all catches taken within the EEZ, or EEZ equivalent for years prior to EEZ declaration[11], which is 200 nm out to sea, or the equidistant line drawn between two countries coastlines if less than 200 nm (as is the case between Turkey, Egypt, Israel, Lebanon and Syria), are considered catches taken within Cyprus's EEZ or EEZ equivalent.

North

The territorial sea was expanded to 12 nm in January 2002[12]. In 2011, Turkey a delineated their maritime boundaries in the eastern Mediterranean, as a direct response to the South's commencement of exploratory oil drilling in its EEZ.

South

Cyprus's EEZ was declared in 2003[9]. Cyprus has made agreements with Egypt (2003)[10], and Israel (2010) delineating their respective EEZ's. An agreement has not yet been reached with Lebanon, due to Lebanon's dispute with Israel over their delineation between their EEZ's[13].

Marketing

Colonial period

[11] Cyprus declared an EEZ in 2003. (www.un.org/Depts/los/LEGISLATIONANDTREATIES/STATEFILES/CYP.htm)
[12] http://www.jag.navy.mil/organization/documents/mcrm/cyprus.pdf
[13] http://www.cyprus-mail.com/lebanon/lebanon-has-no-eez-quibble-cyprus/20120317

Practically all fish landed in Cyprus were sold fresh, except octopus which was sometimes sundried for home consumption (Fodera 1961). Processed and frozen fish on the island was generally imported from Portugal, Japan, the United Kingdom and Norway. There were no national fish exports during the colonial period. Refrigeration, running water, quality control and inspection of fish for the use of explosives were commonplace in fish markets. Picarel catches (*Spicara smaris*), which constituted a significant portion of trawler catches did not often have established markets; hence, trawlers would pre-advertise these catches with flyers in advance of the shipment coming to port, and the catch was then distributed on tricycles equipped with coolers (Fodera 1961).

Two solitudes

NORTH

A bylaw titled 'The Green Line Trade Regulation', operational in 2008, granted fishers from the north rights to sell their catches in the south. At present, 10 fishers and 8 middlemen market catches from the north, in the south (in 2012; E. Sinay, pers. obs.). Some middlemen purchase fish directly from Turkey and sell both in the north and south (although it is not allowed to sell catches from Turkey directly to the south). The Cypriot government seems suspicious about some sales of catches possibly emanating from Turkey but cannot prove this, especially for specific taxa such as rabbitfish (Siganidae), i.e., dusky spinefoot (*Siganus luridus*) and the marbled spinefoot (*Siganus rivulatus*), which have no demand in Turkey, but are highly valued in Cyprus[14]. In 2010, the following taxa were traded from the north to the south (E. Sinay, unpubl. data): bogue (35.2 t), rabbitfish (12.7 t); red mullet (11.5 t), dusky grouper (7 t),

[14] Siganidae sell for 45 TL (U.S. $ 25.26) per kilo in the north, and 45 € (U.S. $ 59.54) per kilo in the south (E. Sinay, pers. obs.). In the south €20 is the normal price per Kg at Fishmonger level.

common dentex (4.7 t), picarel (4.7 t); red porgy (3.9 t); white seabream (*Diplodus sargus sargus*; 3.9 t); and salema (*Sarpa salpa*; 2.9 t).

Some species which are very expensive in other countries are very inexpensive in the north, namely bluefin tuna, bonito, and other tuna-like species. These species sell for between U.S. $1.70-2.85 per kilo, i.e., the same as picarel.

SOUTH

Most small-scale and all trawler catches are bought by fishdealers / fishmongers. Prices set between the boat and dealers are low and each vessel has specific dealers it sells to, which changes seasonally.
Fish processing is new, but rapidly increasing (DFMR 2011). As of 2010, there were 20 processing plants which employed over 120 people and had nearly US$ 37.4 million of processed product value (DFMR 2011). In comparison, imported processed fishery products were valued at US$ 32.6 million in 2010.

Flag of Convenience (*FoC*)

Some countries, allow boats from other countries to fly their national flag for a nominal fee. In Cyprus, the cost of flying the Cyprus flag for a non-Cypriot vessel is US$ 2,200 a year[15]. In 1999, Cyprus had 45 vessels flying Cypriot FoC flags[16], although by 2009 it was markedly reduced to only 18 fishing vessels › 24 m.

[15] http://www.illegal-fishing.info/uploads/Loweringtheflagfinal.pdf
[16] http://archive.greenpeace.org/oceans/piratefishing/dodgingrules.html

Vessels operating under Flags of Convenience (FoC) tend to try to avoid enforcement of regulations. Thus, when they are caught illegally fishing, they often change vessel name and flag country through 'flag hopping'[15].

According to the FAO, the number of large-scale and industrialized fishing vessels that fly flags of convenience are increasing[1]. Understanding the nature and extent of a country's number of vessels using Flags of Convenience is important for the monitoring of their marine resources, since many FoC vessels are associated with illegal fishing activities.

The trawling ban and the 'Cyprus Effect'

NORTH

Trawlers and purse-seiners have been banned since 1999 (Çiçek 2011b) and the areas trawled prior to that were negligible, but likely negatively affected Mediterranean seagrass meadows (*Posidonia oceanica)*, which is a keystone species which much other marine life depends on (Ilkay Salihoglu, pers. obs.). Prior to 1974, the trawlers operated at depths greater than 45 m, and later at depths from 8 m to 45 m.

SOUTH

Prior to 1982, the south was heavily fished and a large share of the trawlers' landings consisted of young recruits (Garcia and Demetropoulos 1984). When recruits are predominantly captured, this is referred to as 'recruitment overfishing' and is defined as: "A decreasing proportion of older fish in the catch

[brought on by] the catching of so many adults, that there are no longer enough young adults to maintain the population."[17]

Both the small-scale inshore and bottom trawl fisheries target similar species. As previously explained, fishing intensity increased substantially in the south after the removal of the northern fishing grounds in 1974. By 1982, the effects of overfishing from trawlers was evident depicted by the small fish sizes and the large proportion of new recruits in landings during October and November, their main recruitment period (Garcia 1986).

An initial temporal closure of bottom trawling in Cypriot waters was initiated in the early 1970s, from June 1st to September 30 , and spatially in waters shallower than 30 fathoms or 180 feet (DFMR 2007), although the latter proved difficult to enforce. In 1982, the ban was extended to include the month of October, to protect the recruitment of target stocks, and was thirdly extended in the mid-1980s, from June 1st to November 7th (DFMR 2007).

This extended trawling ban was much more successful than anticipated, and is referred to as 'The Cyprus Effect' (Garcia and Demetropoulos 1984). From 1978 until 1982, trawler catches decreased by about 17% per year, but after the inclusion of October in the ban (by the 1983 season), catches increased approximately by 40% from the previous year, despite the shorter fishing season (Hannesson 1988). The small-scale inshore fishery also immediately showed positive results as their daily catch per vessel suddenly increased by about 40% in 1983 and remained at that level for some time (Hannesson 1988).

In 1981, the trawling fleet were given subsidies as a support measure to assist them to expand outside their territorial waters during the extended inshore closed-season (Garcia and Demetropoulos 1984),

[17] http://aquafind.com/articles/Overfishing-Report.php

during which time the small-scale fishery helped monitor the trawlers at no extra cost to the Fisheries Inspectorate Service (Garcia and Demetropoulos 1984).

One negative outcome of 'The Cyprus Effect' was that due to the absence of effort controls, the increase in profit from higher catches attracted new players to the industry, and encouraged part-time fishers to fish full-time, thus increasing the amount of effort by about 20% from 1983-1984 (Hannesson 1988).

The silver-cheeked toadfish

The Eastern Mediterranean is host to many populations of 'Lessepsian' fish species, which have migrated from the Red Sea, through the Suez Canal to the Mediterranean. In Cyprus, a total of 133 non-native species have been found, and of these, 109 are Lessepsian migrants (EastMed 2010), four of which are considered invasive: dusky spinefoot (*Siganus luridus*) , marbled spinefoot (*Siganus rivilatus*), silver-cheeked toadfish (*Lagocephalus sceleratus*) and the blue-spotted cornetfish (*Fistularia commersonii*).

The number of lessepsian species found in catches was much greater in the 2000s than the 1980s, and increased at a rate of one per year. This may indicate that there is either increased awareness in 'lessepsian migrants', or increased scientific interest, or that these lessepsian species are out-competing local pelagic species, or are increasingly retained by fishers (EastMed 2010) .

The silver-cheeked toadfish has negatively affected the fishing and fishers in Cypriot waters. Pufferfish contain a very complex neurotoxin called tetrodotoxin (TTX) found in their liver, gonads, intestines and skin, fatal if ingested (EastMed 2010), with no known antidote. Fishers are increasingly affected by this species, as the toadfish get entangled in nets, damage nets and lines with their large beaks and fused front teeth, swallow copious amounts of fishing hooks, target commercial fish species (competition with

fishers), and are toxic to eat and thus have no commercial value. Their reproductive success may be attributed to their fast growth, early reproduction (2 years), high adaptation, lack of fishing pressure, and absence of predators (EastMed 2010).

A commercial application for the invasive toadfish is currently being explored although it is illegal for EU countries to export fish containing the tetradotoxin poison.

Attempts have been done to combat this highly successful alien species. From 2005-2010, in the north, fishers were paid a total of 36,286 TL, or 2 Turkish Lira for each toadfish caught, (E. Sinay, unpubl. data). The south funded by the EU's Operational Programme for Fisheries, aimed to have fishers catch this species during its mating season, and were to receive €1 per fish, or €3 per kilo[18]. This reduction scheme took place in 2009-2011 and was then abandoned. The DFMR found that a significant portion of prey found in toadfish stomachs were previously entangled in nets, indicating that the silver-cheeked toadfish may target prey in fishing nets for feeding (DFMR 2011). Catch and effort statistics for each invasive species should be collected to help track their populations (EastMed 2010).

In the upcoming methods section, our best estimations for pufferfish catches are presented along with the methods used for estimating the unreported catch components for both the north and south of Cyprus, and then the results for the island as a whole, and the north and south are presented.

METHODS

Officially reported landings

Here, catches reported by Cyprus to the FAO (Garibaldi 2012) were treated as baseline of 'reported' catches. However, the FAO data excluded catches from the north since 1974. The data reported by the

[18]http://www.cyprus-mail.com/cyprus/cyprus-declares-war-pufferfish/20120314

south for the entire 1950-2010 period included commercial small-scale and large-scale catches. Other types of marine fisheries extractions such as recreational and subsistence catches, unreported commercial catches (from the north and south), and discards were missing from the FAO data.

From 1950-1973, the island was unified and commercial catches reported for the whole island. To separate the FAO reported catches into theoretical 'north' and 'south' components for the 1950-1973 period (to aid in data estimation by island part for the subsequent period), the percentage of area (km^2) of available coastal fishing ground for each of the two areas was used to separate catches. These were defined as 545 km^2 or 40% for the north and 816 km^2 or 60% for the south (Garcia and Demetropoulos 1984).

In the south, fishing vessels ≤ 12 m in length were considered artisanal (i.e., small-scale commercial), while vessels >12 m were considered industrial (i.e., large-scale commercial). Therefore, the inshore fishery is entirely artisanal (i.e., vessels 6-12 m), while bottom trawlers (21-27 m), bottom longliners (about 16 m), multi-purpose vessels and pelagic swordfish and bluefin tuna vessels are industrial, and their catches were classified accordingly.

Trawlers accounted for 60% of the island's reported catch in the late 1950s (Fodera 1961), which decreased to 15% of reported catches by 2004-2006 (DFMR 2007). Total industrial catches, combining trawlers, longliners, multi-purpose vessels and pelagic fisheries, accounted for 44% of reported catches in the early 2000s (calculated by comparing the national data for each sector and its catches, which were made available to us from 2003-2005). Thus, here the reported catches were allocated as 60% large-scale for 1950-1961. Thereafter, the large-scale percentage was linearly decreased to 44% by 2003, and then held constant to 2010.

Colonial Period and United Cyprus

Species allocation

In the colonial period, fish catches were categorized by four size-classes (Fodera 1961), not to species level. In the reported data from 1950-1962, all catches were assigned to one 'miscellaneous marine fish (MMF)' category, which was gradually improved upon afterwards. Here, the catches of this 'umbrella' category for the 1950-1973 period were disaggregated to the most abundantly caught 11 taxonomic categories based on each taxa's three-year reported proportional percentage of occurrence from 1972-1974 (Table 2), each taxon's percentage was rounded up to the next whole number, and then 'miscellaneous marine fish' were allocated the remaining percentage. When a specific taxon was reported from 1950-1963 (i.e., picarel, striped red mullet and cuttlefish), only the reported tonnage was used, except for red mullet which was under-represented in comparison to the 1972-1974 individual taxonomic occurrences.

Unreported catches

NORTH and SOUTH

During the colonial period, fisheries statistics were collected and compiled by the Chief Port Officer. Data were collected from a portion of the inshore fishery at the completion of each year and from all trawlers after each fishing trip, but all these data were "unchecked and severely underestimated" (Fodera 1961). As outlined by Fodera (1961), an FAO expert checked the reported catch amounts and found that they were underestimated by about half for both the industrial and artisanal fisheries during the colonial period. To derive improved catch estimates, the same FAO expert used improved knowledge of the actual number of full-time and part-time artisanal fishers in combination with their average catch rates which thus suggested catches of 480 $t \cdot year^{-1}$ for the small-scale fishery. For industrial trawler catches, the expert used reliable trawler catches published in both 1951 and 1957,

which suggested an average annual catch rate per trawler of 57.6 t, which if multiplied by the 10 active trawlers, suggested catches of 576 t·year^{-1} for trawlers. The conclusion from the assessment was that 'true' catches for both small-scale and large-scale were a little more than double (i.e., around 1,050 t) the reported amount of 500 t in 1960 (Fodera 1961). To account for this underreporting, catches were doubled for the north from 1950-1973, and for the south from 1950-1979. Although systematic under-reporting had occurred at all times (Garcia and Demetropoulos 1984), the reporting system gradually improved from 1980 onwards for fisheries in the south (A. Petrou, pers. obs.). For the south, the under-reported percentage was linearly decreased from 100% in 1979 to 20% by 1996, and held constant thereafter to 2010. Furthermore, a small percentage of the industrial catch from trawlers (~5%) was commonly consumed by the crew and went unreported (Garcia and Demetropoulos 1984). In addition, we assumed that the small-scale commercial sector also utilized 5% of their catch as take-home catch for self- and family-consumption. Here, both these components were treated as 'subsistence' catches for the south from 1950-2010 and for the north from 1950-1973, and were allocated the same catch composition as the reported data (Ulman *et al.* 2013).

For the north, the generalised 100% under-reporting rate was only applied until 1973 when Cyprus was still one entity. For 1974 onwards, after the division of the island, separate unreported components were estimated for the north. With the division in 1974, all large-scale fishing vessels (all operated by Greek Cypriots at that time) left northern waters. Hence, no industrial fishing occurred in the north between 1974 and 1993.

Large-scale catches

NORTH

Large-scale commercial catches in the north after 1974 included bottom trawlers and one exploratory purse seiner since both were greater than 12 m length. Both these large-scale fishing methods were banned completely starting in the 1997-1998 season. From 1993 until 1997 only, there were five bottom trawl vessels <15 m in length in operation. Three trawlers had wooden hulls with 135 hp engines, and the other two had hulls made of steel. The trawlers operated inshore, at depths of <50 m. They fished between 150-180 days·year^{-1}, with an average catch of 8 t·vessel^{-1}·day^{-1} from September to May only, as inshore trawling was banned in summer months. In 1995, each trawler would do four trawl hauls a night, each in different locations, thus a decline in CPUE was not likely (E. Sinay, unpubl. data). To calculate annual bottom trawler catches, the number of trawlers was multiplied by 165 fishing days per year (an average of trawling days), which was then multiplied by the daily catch rate of 8 t. This catch rate was assumed to be constant for each of the five years since trawling was practiced only for a short period, which left areas unexploited. The results from a 2003 exploratory trawl survey in the north were used to allocate our estimated trawl catches to taxa (Benli *et al.* 2003).

Before bottom trawling was officially banned in 1998, trawling operations had already ceased. The government enacted a 3-mile trawler limit from the coast, and the fleet rapidly experienced a sharp decline in catches likely due to gear not being usable at greater depths. Bottom trawling has not been practiced since 1997.

There was one 36 m purse seiner hired from Turkey for a three month trial period in 2002, but which only fished for two months (E. Sinay, pers. obs.). Purse seine catches were bountiful which caused fish market prices to decrease, as supply exceeded demand. The catches were approximately 20-30 t·day^{-1}, and the extra catches were exported to Turkey (E. Sinay, unpubl. data). We assumed this purse seiner to have fished for 20 days per month, for its two months of operation. To calculate its catches, 20 fishing

days were multiplied by a catch rate of 25 $t \cdot day^{-1}$ which was multiplied by two months of operation. No other purse seiner was known to operate in the north during the 1974-2010 period. According to one fisher previously employed on this vessel (*Oruç Reis*), the catches consisted mainly of greater amberjack, leerfish (*Lichia amia*) and little tunny (*Euthynnus alletteratus*), respectively. Purse seine catches were allocated to these three species as 50%, 30% and 20%, respectively.

SOUTH

Within Cyprus, all fishing vessels ≤ 12 m in length are considered to be in the small-scale commercial sector, while all vessels › 12 m are considered to be in the large-scale commercial sector. Therefore, the inshore fishery are entirely small-scale (i.e., vessels range from 6-12 m). Bottom trawlers (21-27 m), longline vessels (about 16 m), and pelagic swordfish and bluefin tuna vessels are all considered large-scale, and their catches classified accordingly.

The trawlers caught 60% of the islands reported catch in the late 1950s (Fodera 1961), which was decreased to 15% of reported catches by 2004-2006 (DFMR 2007). Total large-scale catches, combining trawlers, multi-purpose vessels and pelagic fisheries, accounted for 44% of reported catches in the early 2000s, (calculated by comparing the reported catches of each sector's data, made available from 2003-2005). Thus, the reported catches were allocated as 60% large-scale (industrial) for 1950-1961, and then were linearly decreased to 44% large-scale by 2003-2010.

Small-scale (artisanal) commercial catches

NORTH

In the north, artisanal catch data have been collected since 2004, but are deemed far from reliable, and have not been reported to the FAO (Table 1). Only a fraction of fishers have reported their catches (or

parts of their catches) to the Dept. of Animal Husbandry, which is in charge of collecting these data. Even the department's fully expanded estimates (expanded by a factor of 2-3 compared to the actual catch date provided to them by the subset of fishers) is still deemed by officials as being unrepresentative of actual catches (Table 1). Due to the unreliable nature of the available 'official' data from the north, an interview survey using a categorization of the artisanal commercial sector into four fisher classes was conducted by one of us (B. Çiçek, unpubl. data) in 2012 to better estimate small-scale catches. During this survey, 36% (n = 150) of all registered artisanal fishers (n = 410) were interviewed (for some survey results see Table 2).

A professional fisher must have a registered boat and be registered to a fishery co-operative association or the 'General Fisherman Association', to which they pay an annual fee of U.S. $28.00.

A survey was done to determine a more accurate account of small-scale landings by using a categorization of the artisanal commercial sector into four fisher classes (B. Çiçek, per. obs., 2012), and 40% of registered commercial small-scale fishers were interviewed (150/410 small-scale fishers).

Class 1: Experienced full-time fishers with own fishing vessels and gear, 11% of small-scale commercial fishers were in this class. They fish when conditions allow, and averaged 283 fishing days·year^{-1}. Annual catches averaged 2.7 t·year^{-1}·vessel^{-1} and they target the following species: red mullet, striped red mullet, seabreams, bogue, common pandora, common dentex, marbled spinefoot, dusky spinefoot, and spiny lobster (*Palinurus elephas*).

Class 2: Experienced part-time fishers with own fishing vessels and gear, 31% of small-scale commercial fishers were in this class. This group depends partly on fishing, and averaged 166 fishing days·year^{-1}. Annual catches averaged 0.62 t·year^{-1}·vessel^{-1} and they target the following species: dusky grouper, mottled grouper, greater amberjack, leerfish, and swordfish.

Class 3: Experienced part-time fishers with inadequate vessels and gear, 46% of registered fishers fall into this category. This group depends partly on fishing (mostly retired fishers), whom averaged 98 fishing days·year^{-1}. Annual catches averaged 0.16 t·year^{-1}·vessel^{-1} and they target mainly cephalopods such as cuttlefish (*Sepia officinalis*), octopus, and squid (*Loligo vulgaris*).

Class 4: Inexperienced fishers or novices with basic fishing vessels and gear, 12% of registered fishers fall into this category. They generally fish for subsistence purposes, but share their catches if they are high, and averaged 59 fishing days·year^{-1}. Annual catches averaged 0.06 t·year^{-1}·vessel^{-1} and they target bogue, Atlantic horse mackerel (*Trachurus trachurus*), Mediterranean horse mackerel (*Trachurus mediterraneus*), Atlantic mackerel (*Scomber scombrus*), brushtooth lizardfish (*Saurida undosquamis*), whiting (*Merlangius merlangus*) and European barracuda (*Sphryaena sphryaena*).

Although all these fishers are registered as small-scale commercial fishers, only categories one and two 'truly' represent full-time small-scale commercial fishers. The class percentages were confirmed with heads of local fishing shelters, which almost all small-scale fishers are associated with. All surveyed small-scale commercial fishers were registered with the Animal Husbandry Department, which enables them to berth their vessels, use fishing nets, and receive a fuel subsidy. This survey was successful because the surveyor (B. Çiçek) had established trusted relationships with many of the fishers and thus, the fishers were assured that their responses would not be used for tax purposes by the government. Catch composition and discard information were also collected.

To create a time series of the number of small-scale vessels in the north, 40 Turkish Cypriot artisanal vessels were assumed to fish actively in 1974 (B. Çiçek, pers. obs.). The number of active vessels was linearly increased from 40 in 1974 to the reported 269 artisanal boats in 2007 (E. Sinay, pers. comm.). An average catch rate of 0.571 t·vessel^{-1}·year^{-1} was derived from the survey data, and used as 2010 CPUE

anchor point. This catch rate was adjusted for earlier time periods using changes in fishing net length as a proxy. The average length of gillnets (effort) deployed has drastically changed (B.A. Çiçek, unpublished data), which was used to demonstrate changes in fishing effort over time. Gillnets are packaged according to length or '*zembil*'. '*Zembil*' is a measurement unit of nets and its length depends on how many segments of net are strung together, one section being 60 m. Fishers, upon ordering gillnets, request net lengths of 2, 2.5 or 3 pieces (120, 150 or 180 m in length). Until the end of the 1990s, a fisher would typically use 6 to 8 segments, equalling a total gillnet length of 360-480 m. Since the 2000s, total gillnet length per fisher increased to between 3,000 and 7,500 m (B.A. Çiçek, pers. obs.). Targeted species include red mullet, striped red mullet, common pandora, red porgy, common dentex , marbled spinefoot and dusky spinefoot, common two-banded seabream (*Diplodus vulgaris*), common octopus, common squid and cuttlefish (*Sepia officinalis*). It was assumed that the increase in gillnet lengths was inversely proportionate to the catch rate, therefore the same change in '*zembil*' length was used to demonstrate the successive change in catch rate: in 2000 catch rates were three times higher than 2010 ($0.571\ t \cdot vessel^{-1} \cdot year^{-1} * 3 = 1.71\ t \cdot vessel^{-1} \cdot year^{-1}$), in 1990 catch rates were five times higher than 2010 ($0.571\ t \cdot vessel^{-1} \cdot year^{-1} * 5 = 2.85\ t \cdot vessel^{-1} \cdot year^{-1}$); in 1980, catch rates were 10 times higher than 2010 ($0.571\ t \cdot vessel^{-1} \cdot year^{-1} * 10 = 5.71\ t \cdot vessel^{-1} \cdot year^{-1}$), and in 1970 catch rates were 20 times higher than 2010 ($0.571\ t \cdot vessel^{-1} \cdot year^{-1} * 20 = 11.42\ t \cdot vessel^{-1} \cdot year^{-1}$). The catch rate coefficients were held constant for each decade, except for the 2000s, which were only held constant until 2006, and from 2007-2010, each of the four individual fisher classes were used to determine catch rates. To determine catch amounts for the small-scale sector from 1974-2006, the number of fishing vessels was multiplied by the weighted catch rate, and then by the catch rate adjustment co-efficient.

Thus, the 2000, 1990, 1980 and 1974 artisanal catch rates in the north were assumed to have been three times, five times, ten times and twenty times higher than in 2010 (i.e., 2000: 1.71 t·vessel^{-1}·year^{-1}, 1990: 2.85 t·vessel^{-1}·year^{-1}, 1980: 5.71 t·vessel^{-1}·year^{-1}, 1974: 11.42 t·vessel^{-1}·year^{-1}). The catch rates were interpolated linearly for intervening years. To determine total artisanal catches (all unreported with respect to FAO data) for the small-scale sector in the north from 1974-2010, the estimated number of fishing vessels was multiplied with the derived catch rate.

The average length of gillnets (effort) deployed has drastically changed (B.A. Çiçek, unpublished data), which was used to demonstrate changes in fishing effort over time. Gillnets are packaged according to length or '*zembil*'. '*Zembil*' is a measurement unit of nets and its length depends on how many segments of net are strung together, one section being 60 m. Fishers, upon ordering gillnets, request net lengths of 2, 2.5 or 3 pieces (120, 150 or 180 m in length). Until the end of the 1990s, a fisher would typically use 6 to 8 segments, equalling a total gillnet length of 360-480 m. Since the 2000s, total gillnet length per fisher increased to between 3,000 and 7,500 m (B.A. Çiçek, pers. obs.). Targeted species include red mullet, striped red mullet, common pandora, red porgy, common dentex , marbled spinefoot and dusky spinefoot, common two-banded seabream (*Diplodus vulgaris*), common octopus, common squid and cuttlefish (*Sepia officinalis*). It was assumed that the increase in gillnet lengths was inversely proportionate to the catch rate, therefore the same change in '*zembil*' length was used to demonstrate the successive change in catch rate: in 2000 catch rates were three times higher than 2010 (0.571 t·vessel^{-1}·year^{-1} * 3 = 1.71 t·vessel^{-1}·year^{-1}), in 1990 catch rates were five times higher than 2010 (0.571 t·vessel^{-1}·year^{-1} * 5 = 2.85 t·vessel^{-1}·year^{-1}); in 1980, catch rates were 10 times higher than 2010 (0.571 t·vessel^{-1}·year^{-1} * 10 = 5.71 t·vessel^{-1}·year^{-1}), and in 1970 catch rates were 20 times higher than 2010 (0.571 t·vessel^{-1}·year^{-1} * 20 = 11.42 t·vessel^{-1}·year^{-1}). The catch rate coefficients were held constant for each decade, except for the 2000s, which were only held constant until 2006, and from 2007-2010, each

of the four individual fisher classes were used to determine catch rates. To determine catch amounts for the small-scale sector from 1974-2006, the number of fishing vessels was multiplied by the weighted catch rate, and then by the catch rate adjustment co-efficient.

SOUTH

The small-scale commercial fishery in the south is a mixed-species fishery which caught an average of 56% of total reported catches between 2003 and 2005 (data accessed by A. Petrou). In a separate study, total small-scale catches were averaged for the 1996-2008 period for an average annual catch of 1,191 $t \cdot year^{-1}$ (Rousou 2009), which also represented 56% of total catch and verified the first percentage. This percentage was used to allocate reported catches to the small-scale sector, and the remainder of reported catches were allocated to the large-scale sector.

Recreational and subsistence catches

There is no legal definition for recreational fishing in the south, although the term 'sport fishing' is commonly used (Pawson *et al.* 2007). Recreational fishing is defined here as fishing which is not for-commercial purposes, and not predominantly for subsistence purposes (Pawson *et al.* 2007). Much of the recreational fishing in the south occurs in its freshwater reservoirs, but for our purposes, only marine recreational catches have been considered.

Here, recreational fishing is defined as fishing primarily for enjoyment purposes, while subsistence fishing is defined as fishing with the primary purpose of providing food for self- or family-consumption.

In 1960, there were approximately 50 recreational fishing vessels on the island, with an average catch rate of 0.128 $t \cdot vessel^{-1} \cdot year^{-1}$ and a combined total catch of 6.4 $t \cdot year^{-1}$ (Fodera 1961). Thus, the 6.4

t·year^{-1} recreational catch was held constant from 1950 to 1973, and assigned as 40% to the north and 60% to the south, which equated to 2.56 t·year^{-1} for the north and 3.84 t·year^{-1} for the south.

In the south, the Department of Fisheries and Marine Research (DFMR, Hadjistephanou and Vassiliades 2004) estimated that the recreational catch in the south was equivalent to approximately 15% of the annual reported commercial catches. Thus, for the south, catch was linearly increased from 3.84 t·year^{-1} in 1973 to equate to 15% of the annual reported commercial catches for the south by 1990, and this rate was held constant to 2010. The south's recreational catch estimation was assumed to include recreational vessel catches, spearfisher catches and shore-based angler catches.

For the north after 1973, recreational catches were calculated by three separate fishing methods: recreational vessels, spearfishers and shore-based fishers. Most vessels registered with the Directorate of Ports and Harbours were known to fish recreationally in 2013 (B.A. Çiçek, pers. obs.), so it was assumed that 80% (i.e., 1425) of registered recreational vessels actively fished in 2010 and the estimated catch rate used was 0.2 t·vessel-1·year-1, which equated to 285 t of boat-based catches in 2010 (B. A. Çiçek and I. Salihoglu, pers. obs.). For shore-based recreational fishers in 2010, it was assumed that at least 2000 people were engaged in angling for approximately 20 weeks·year^{-1} with a catch rate of 3 kg·fisher^{-1}·week^{-1} (B. A. Çiçek and I. Salihoglu, pers. obs.), which equated to 120 t of shore-based catches in 2010. There were 368 licensed spearfishers in 2010, 10% of which fished for 150 fishing days·year^{-1} with an estimated catch rate of 20 kg·fisher^{-1}·fishing day^{-1} (i.e., they were considered high-liners or expert spearfishers); and 90% of which fished for 75 fishing days·year^{-1} with a catch rate of 4 kg·fisher^{-1}·fishing day^{-1} (i.e., average expertise), which equated to 209.4 t of spearfishing catches in 2010. These catch rates were based on expert consultation with about 20 local spearfishers from the north during 2013 (A. Ulman, B. Çiçek, unpublished data). Thus, for 2010, total estimated recreational

catches were 614.4 t (i.e., the sum of boat-based, shore-based and spearfishing). For the 1973 to 2010 time period, we linearly interpolated between the 1973 recreational catch (i.e., 2.56 t·year^{-1}) and the 2010 value of 614.4 t to establish a time-series of recreational catches in the north.

Furthermore, to differentiate between purely recreational (i.e., primarily for pleasure) and subsistence fishing (i.e., for personal and family consumption) for all 'recreational' catches estimated here, in 1950, 80% of the estimated 'recreational' catches were assumed to be caught for subsistence purposes, and 20% for purely recreational purposes, and by 2010, 40% of catches were assumed to be caught for subsistence purposes and 60% for recreational purposes, with the two rates linearly increased between 1950 and 2010 for both the north and the south.

All recreational and subsistence catches were allocated to the following taxa: rabbitfish (Siganidae, 26%), parrotfish (*Sparisoma cretense* 20%), seabreams (Sparidae, 14%), dusky grouper (*Epinephelus marginatus,* 12%), mottled grouper (*Mycteroperca rubra*, 10%), greater amberjack (*Seriola dumerili*, 6%) and leerfish (*Lichia amia*, 4%). A new target species, albacore tuna (*Thunnus alalunga*) was allocated 2% of recreational and subsistence catches in 2002 which was increased to 10% by 2010, and rabbbitfish and parrotfish contributions were proportionality decreased to compensate.

Discards

Discard's are defined as "the portion of total organic material of animal origin in the catch, which is thrown away, or dumped at sea" (Kelleher 2005). Discards may include both commercial and non-commercial species. Reasons for discarding include: damaged or spoiled catches, smaller than the legal landing size, no market preference, or having little or no commercial value (Rousou 2009).

NORTH

Discards may include both commercial and non-commercial species, and are all unreported. In the north, some taxa have always been discarded, such as moray eels (Muraenidae), dogfish (Squaliformes), stingrays (Rajidae) and picarel (Centracanthidae), while other species are commonly used for bait (B.A. Cicek, pers. obs.). While 'baitfish' are not technically 'discarded', their catches normally go unreported and hence, are classified here as discards, since they are neither sold commercially, nor directly consumed. Based on local advice from small-scale fishers for their sector, a 10% discard rate for 'true' discarding (for taxonomic composition of 'true' discards, see Table 5) and a 5% 'bait-use' rate was assumed. The baitfish composition was assumed to consist of *Diplodus annularis* (22%), *Serranus scriba* (14%), *Serranus cabrilla* (12%), *Octopus vulgaris, Eledone* spp.*, Sepia officinalis, Illex coindetii* and *Loligo* spp. (10% each), and *Sardinella maderensis* (2%). These discard rates (15% combined) were applied to reported and unreported small-scale commercial catch components from 1950-2000 for the north.

Due to the increasing impact of invasive species, discarding patterns changed after 2000s. Thus, for details for discarding for 2001-2010 in the north, see below. The large-scale sector in the north after 1974 (i.e., bottom trawlers that were in operation from 1993 to 1997) was allocated a 10% 'true' discard rate, since this gear-type does not use bait (See Table 3). Since the data sources used were based on artisanal fisheries, and in general trawl fisheries are known to have a much higher discard rate (Kelleher 2005) we view the trawl discards estimated here as minimal estimates (but also see relatively low discard rate for southern bottom trawlers below). The single purse seiner in operation for 2 months was deemed to have zero discards.

In the south, the pelagic longline fishery was deemed to have an average discard rate of 10% (European Union 2007), with ocean sunfish (*Mola mola*), pelagic stingray (*Pteroplatytrygon violacea*), and thresher shark (*Alopias* spp.) being the major discarded taxa. The bottom trawl fishery had a 13% discard rate,

the discarded taxa were mainly common pandora (*Pagellus erythrinus*) and picarel (Table 6; European Union 2007). For the small-scale artisanal fishery, a 10% discard rate was assumed (A. Petrou, pers. obs.), with crustaceans being the dominant discarded taxa (Rousou 2009). In light of all of the above discard rates, a conservative 10% discard rate was calculated for all reported and unreported commercial catches (i.e., excluding recreational and subsistence catches) from 1950-2010. Discards from the small-scale sector from 1950-1973 were allocated to the same taxa as in the north (Table 3) and discard allocation for the small-scale sector from 1974-2010, and the large-scale sector from 1950-2010 (Table 6) were based on European Union (2007) and Rousou (2009).

From 2001-2010, discard rates for the small-scale sector in the north, and for both the small-and large-scale sectors in the south were adjusted to account for two major invasive species (or 'Lessepsian migrants' from the Indian Ocean) which became established in the 2000s, the silver-cheeked toadfish (*Lagocephalus sceleratus,* a pufferfish species) and the redcoat (*Sargocentron rubrum,* a squirrelfish species). *L. sceleratus* was first observed in Cyprus's seas in the early 2000s and established a sizeable population by the 2007-2008 season, and has sharply increased in abundance ever since, owing to a lack of natural predators in the area. *L. sceleratus's* population explosion has had profound effects on the Cypriot fisheries and was estimated to account for an additional 5% of total commercial catches (which included reported and unreported commercial catches, excluding discards) in 2003 which was linearly increased to 50% of commercial catches held constant from 2008-2010 for both the north and south (Verified by experts from both the north and south, Table 4). As of 2012, this species constituted 80-90% of total discards and approximately 50% of total catches by weight (B.A. Çiçek, pers. obs.). *L. sceleratus* can grow up to 1 m in length and has a maximum recorded weight of 7 kg (DFMR 2011), for further details on *L. sceleratus*, see Ulman *et al.* (2013). The redcoat was estimated to account for 3% of discards in 2001 which was linearly increased to 9% of discards from 2007-2010.

Distant water fleets

The Republic of Cyprus has had fishing vessels operating outside the Mediterranean since the early 1990s. Cyprus's catches taken outside the Mediterranean are classified here as distant water catches. According to the FAO database (FishStat Software), between 1996 and 2001, Cyprus reported the majority of its distant water catches as taken from the eastern Central Atlantic, targeting jack mackerels, horse mackerels and anchovy. Also, from 1991 to 1998, Cyprus reported catches caught in both the eastern central Pacific Ocean and the southeast Pacific Ocean (FAO Fishstat), landing mostly skipjack and yellowfin tuna[19]. This study is exclusively concerned with Cyprus's catches taken within their EEZ and has excluded the above 'distant water fleet' catches from the present consideration.

Bluefin tuna

Since 2000, the spawning biomass of Atlantic bluefin tuna (*Thunnus thynnus*) has been rapidly declining due to highly excessive fishing pressure (Marion *et al.* 2010). Turkey and Malta share a Total Allowable Catch (TAC) quota with Cyprus, which was 823 t in 2006 (Anon. 2006), Cyprus's quota (alone) was 154.68 t for 2007[20] and 149.44 t for 2008 provided through the International Commission for the Conservation of Atlantic Tunas (ICCAT). Reported bluefin tuna catches for Cyprus from the Mediterranean Sea ranged from 1-149 $t \cdot year^{-1}$ in the 2000s, averaging 81 $t \cdot year^{-1}$ for the decade (www.iccat.es). The ICCAT committee suspects that rampant underreporting is occurring from illegal, unregulated and unreported fishery catches, which causes catch quotas to be ineffective (ICCAT 2009). Underreported bluefin tuna landings were not calculated here as no published estimates could be located.

[19] http://www.fao.org/fishery/statistics/software/fishstat/en
[20] http://www.wwf.or.jp/activities/lib/pdf_marine/tuna/onthebrinktunacollapse.pdf

RESULTS

Reconstructed catch for the whole island

The reconstructed total catch for the entire island from 1950-2010 amounted to approximately 247,500 t, which was nearly 2.7 times the reported landings of just over 93 200 t (Figure 2). For all of Cyprus, the components which had the highest estimated total fishery removals were industrial landings (40%), followed closely by the artisanal landings (36%), while discarded catches (11%), subsistence (7%), and recreational catches (5%) accounted for smaller proportions. The main taxa caught for all of Cyprus were picarel (Centracanthidae), seabream (Sparidae), red mullet (Mullidae), cephalopoda and the invasive silver-cheeked toadfish (*L. sceleratus*, Figure 3).

The officially reported data of just over 93 200 t for the 1950-2010 period pertain to the south only for periods after 1973 (Figure 2a). No data have been officially reported to FAO for the north since 1974. There was a decline in reported landings from 1973 to 1975 during the tumultuous period surrounding the 1974 division of the island, since many Greek-Cypriot fishers originally living in the north (deemed to have the better fishing grounds) lost their fishing vessels and gear in the north during the resettlement, and had to wait for state assistance for the rebuilding of the fishery sector in the south. Reported landings slowly increased to approximately 2,500 t·year^{-1} by 1986, peaked at 2,762 t·year^{-1} in 1994, and then gradually declined to 1,500 t·year^{-1} in 2004. After 2004, the reported landings rapidly increased to 2,431 t·year^{-1} in 2007, due to a new target species (i.e., albacore tuna), of which over 700 t was landed in 2007 alone.

North

The reconstructed total catch for the north totalled approximately 83,800 t, which included 40% (7552 t) of reported FAO data for the 1950-1973 time period prior to the division of the island, as well as unreported large-scale commercial, artisanal (small-scale commercial), recreational, subsistence and discarded catch components from 1950-2010 (Figure 3a). Thus, reconstructed total catches for the north were over 11 times the 7,552 t reported by FAO on behalf of the northern area of Cyprus.

From 1950-1973, the unreported component totalled nearly 10,000 t, which was 30% more than the 7,552 t of catches reported for the north to the FAO for the same period. Large-scale unreported landings for the north amounted to 34,000 t for the 1950-2010 period, and were mainly driven by bottom trawl landings during their 1993-1997 operational period (33,000 t, or 6,600 $t \cdot year^{-1}$, Figure 3a). Small-scale landings in the north totalled approximately 29,000 t for the 1950-2010 time period, of which around 26% were reported (pre-1974, Figure 3a). Estimated total recreational and subsistence and catches for the north from 1950-2010 were nearly 6,100 t and 6,050 t, respectively (Figure 3a). Discards from the large-scale amounted to 3,300 t and discards from the small-scale fisheries in the north amounted to around 5,300 t over the 1950-2010 period, most of the small-scale discards in the last decade were attributable to the invasive silver-cheeked toadfish.

South

The total reconstructed catch for the south of about 165,300 t for 1950-2010 included 60% of reported FAO data from 1950-1973 and 100% of reported FAO data from 1974-2010, plus unreported small-scale, large-scale, recreational, subsistence, and discarded catch components (Figure 3b). Thus, the

reconstructed total catches for the south of 165,300 t were 1.9 times higher than the approximately 86,000 t of reported data for the time-series.

Landings in the south were almost equally distributed between the large-scale sector (i.e., industrial) and the artisanal sector (i.e., small-scale commercial). The large-scale sector totalled around 65,500 t or just over 40% of total landings for 1950-2010, and the artisanal sector totalled around 64,300 t for 1950-2010 (Figure 3b).

Large-scale landings increased from 360 $t \cdot year^{-1}$ in 1950 to a peak of 2,119 $t \cdot year^{-1}$ in 1986, before declining to about 740 $t \cdot year^{-1}$ by 2010. Artisanal catches increased steadily from 240 $t \cdot year^{-1}$ in 1950 to a peak of 2,240 $t \cdot year^{-1}$ in 1986, before declining to 940 $t \cdot year^{-1}$ by 2010 (Figure 3b). Estimated subsistence and recreational catches for the south from 1950-2010 were just over 9,400 t and 5,000 t, respectively (Figure 3b). Discards from the large-scale and small-scale fisheries in the south amounted to around 19,000 t over the 1950-2010 period, of which around 9900 t were from the large-scale sector, and 9400 t from the small-scale sector, with nearly 6,000 t due to the silver-cheeked toadfish. The substantial increase in discards during the 2000s (Figure 3b) is due to the rapid increase in incidental and unwanted catches of the invasive silver-cheeked toadfish.

DISCUSSION

The FAO 'Fishstat' global capture production database relies on voluntary reporting by member countries(Garibaldi 2012). However, given the lack of recognition of northern Cyprus by the international community (only recognised by Turkey), any catches for the 'north' of the island have not been reported to or by FAO since Cyprus's division. Here, we found that reconstructed total catches for both parts of the island from 1950 to 2010 were nearly 2.7 times the officially reported data (as per FAO

data). The majority of this difference was due to catches in the north after 1974 missing from the reported data.

Total catches for Cyprus as a whole have generally been on a declining trend since the mid-1990s, if catches of the invasive silver-cheeked toadfish (*Lagocephalus sceleratus*) are excluded (see Figure 2b). The declining trend is more apparent for the island as a whole (Figure 2b) and the south (Figure 3b), rather than the north (Figure 3a). This could be influenced by the reconstruction approach used, since the north's catches were only properly assessed in 2012, and simplifying assumptions had to be made to derive historical catches. However, fishers in the north have reported substantial declines in their Catch Per Unit Effort (CPUE), especially over the last two decades (A. Ulman & B.A. Çiçek, pers. obs.), which strongly suggests that stocks in the north may have begun to decline as well.

Discards, as well as subsistence and recreational catches were all shown to contribute sometimes significant tonnages to total fisheries removals. Recreational spearfishers and commercial longline fishers have been known to catch more fish than registered small-scale commercial fishers, yet these catches are often unreported (B.A. Çiçek, pers. obs.). It would assist management initiatives if there were regular assessments of these currently undocumented sectors, and such estimates were incorporated into official records.

It is noteworthy, and to be highly recommended in an ecosystem-based fisheries management context, that large-scale fishing practices (especially bottom trawling) have been banned in the north, and have been substantially reduced in the south (as of late 2013 there were only two active bottom trawlers and no active purse seiners in the south). These industrial practices benefit few people and have substantial ecosystem costs associated with them (Pauly 2006).

This study has highlighted some of the differences and commonalities with regards to the fisheries of Cyprus' two entities, and presented a continuous time-series of total fisheries extractions for the entire island of Cyprus, as well as its two components. It is become apparent that both north and south have become increasingly proactive in marine resource conservation, and may indeed be shifting towards more sustainable fishing methods.

NORTH

The Cyprus issue led to a stagnation of economic development in the north, triggering a decrease in GDP and economic recession throughout the 1980s and 1990s. This recession pushed many Turkish Cypriots towards urbanization, leaving many rural areas abandoned. Since the government operates with very limited resources and personnel, services are essentially only provided for urban areas, which have pulled people away from rural ones. Famagusta used to be one of the Mediterranean's most popular tourist destinations, but post-1974, it resembles a 'ghost town'. In 2010, the Global Heritage Fund, who strives to protect, preserve and sustain the most significant and endangered cultural heritage sites named Famagusta city "on the verge" of irreparable loss and destruction[21]. However in the 2000s, due to the stabilization of the Turkish Lira and also the opening of its borders, the average economic growth rate in the north between 2003-2009 was nearly 6.5%, showing much faster economic growth than most European countries[22].

Turkey is the only country which recognizes the 'TRNC' as a separate state, but since the 'TRNC' is not a FAO member country; they do not report their annual catches to the FAO. In the north, there is some fisheries management, but it is conducted on a very limited budget and lacks monitoring, control, and surveillance. The reported data from the Department of Animal Husbandry cannot be used to make

[21] http://globalheritagefund.org/onthewire/taglist/Famagusta
[22] http://www.investinnorthcyprus.org/economyinnortherncyprus.html

effective management decisions since reported fishery catches appear to represent just 10-20% of actual fisheries removals, while the department's estimation of total catches reaches closer to 50% of the findings from this study (Table 1).

In order to further develop marine fisheries in the north, fishers feel they need newer and larger fishing vessels to have the capabilities to fish offshore (Diran 2009). At present, the average length of the 269 registered fishing vessels is 8 m, which is only a suitable for inshore waters. Since the north has traditionally lacked investment and development, it lags behind international standards in regards to hygiene, marketing and conservation (Çiçek 2011a). Many fishers have negative interactions with some species that get captured in fishing nets, such as the endangered Mediterranean monk seal (*Monachus monachus*), dolphins and sea turtles. In addition, the silver-cheeked toadfish invasion has clearly caused substantial concerns amongst fishers, as these fish often damage nets, are difficult to remove, and consume other species caught in nets.

Recreational spear-fishers with and without the use of scuba, and longline fishers have been known to catch more fish than registered small-scale commercial fishers, yet these catches are often unreported (B.A. Çiçek, pers. obs.). Generally, the most valuable species are caught (i.e., groupers) and then marketed illegally. Some recreational fishers use a jigging technique to fish from the shore, and sometimes catch copious amounts of fish, i.e., one recreational fisher in March of 2012 caught approximately 400 kg of grouper in one day (B.A. Çiçek, pers. obs.).

All registered recreational and small-scale fishers in the north receive fuel subsidies from the government to the amount of U.S. $102 (183 Turkish Lira, TL) per month, for each popular fishing month, from February to October (I. Salihoglu, pers. comm.). This fuel subsidy is fixed per registered vessel and commenced in 2009. Some locals register more than one vessel to receive additional fuel

subsidies although only one vessel is used, many of which have non-fisheries related full-time income. These government fuel subsidies superficially encourage the over-exploitation of the marine resources. Normally, the increasing global cost of fuel would inhibit a good portion of fishers from fishing, thus encouraging natural resource conservation (Sumaila *et al.* 2010). Restructuring the subsidies to instead enhance monitoring, control and surveillance would greatly improve fisheries management. Perhaps training and paying some fishers to monitor stocks or to collect data would be beneficial for the sector, so that jobs are not lost. Having a registered fishing boat also allows the general public to receive bank credit to help buy boats, radars, fish finders, etc., thus further increasing fishing capacity, i.e., one person received bank credit to buy a vessel and a GPS, even though this person was already a full-time government employee (B.A. Çiçek, pers. obs.). Since reported fisheries catches likely represent only around one fifth of what is actually removed from the seas of north Cyprus, the 'unreported' fishing component is high and should be addressed. Future attempts to increase the credibility of the reported data will enhance fisheries managers with decision-making regarding the marine stocks.

All sizes of driftnets targeting large pelagic fish, such as tuna and swordfish, were banned in all ICCAT member countries in 2003[23] and all Mediterranean States in 2005 by the General Fisheries Commission for the Mediterranean (GFCM)[24], yet a handful of fishers are still using driftnets in the north (B.A. Çiçek, pers. obs.). Driftnets are highly unselective in their catches, catching high proportions of non-target species such as sharks, rays, dolphins, turtles and seabirds, most of which are discarded.

It is praiseworthy that large-scale fishing practices (i.e., bottom trawling and purse seining) have been banned as those practices benefit very few people and have massive ecological and monetary costs associated with them (Pauly 2006). There are some recent successful developments in the north

[23] http://wwf.panda.org/?9954/Long-awaited-total-driftnet-ban-in-the-Mediterranean-a-major-victory
[24] http://www.ciesm.org/news/policy/0303.htm

regarding marine conservation strategies. Fish markets created in 2012 will exclude the need for middle(sales)men and leave fishers with approximately 80% higher profits (B.A. Çiçek, pers. obs.). An 'Artificial Reef' project is also a step forward which involves the small-scale sector in local conservation efforts.

SOUTH

There is currently a Fishing Effort Adjustment Plan[25] (FEAP) which was crafted by the Department of Fisheries and Marine Research (DFMR), the governmental body in charge of conducting fisheries research and data collection continues according to the relevant EU regulation. (Anon 2010b). The FEAP aims to reduce inshore fishing effort for all sectors to alleviate pressure exerted on coastal stocks, and to adjust the fishing fleet in accordance with the sustainability of the stocks. The FEAP is funded by the European Fisheries Fund in compliance with the Common Fisheries Policy. To adjust fishing effort, the following measures are currently being implemented: the decommissioning of vessels, using selective fishing gear and methods, increasing the allowable net mesh size, reducing the number of fishing licenses, reducing the types of allowable fishing gear, creating areas protected from fishing disturbances, and imposing tighter controls (Anon 2010b). The Department of Fisheries and Marine Research (DFMR) was contacted during the writing of this report but unfortunately was not willing to share any information which was not already publicly available.

Discards from the large pelagic longline fishery were stated not to be significant since they do not include commercially valuable species (European Union 2007). However, they were shown to include ocean sunfish, loggerhead turtles (which are endangered) and many rays. A species may have no commercial value; but it does not imply that it has no ecological value.

[25] The FEAP is funded by the European Fisheries Fund in compliance with the Common Fisheries Policy.

Fishing in countries belonging to the European Union is managed under the Common Fisheries Policy (CFP). The CFP aims to have a thriving and sustainable European fishing industry; However, the European Commission has blamed the CFP for failing to meet its objectives and admits that fish stocks have collapsed in its presence (Wakefield 2011). The European Parliament is presently working on reforming the Common Fisheries Policy, to reduce unwanted by-catches and gradually eliminate discards; Priority will be given to processes which initially avoid unwanted catches by encouraging selective fishing techniques, rather than simply 'managing' the discards[26]', which seems more difficult to put into practice for mixed-species fisheries compared with single-species fisheries. This gradual elimination of discards would require an in-depth reform of each EU member states' control and surveillance management sectors[24]. Two decades of stock assessment data in the south have defined the status of most commercial fish stocks as 'poor'. All five commercially-assessed stocks in 2010 (picarel, bogue, striped red mullet, red mullet and common pandora) were "overexploited with high fishing mortality and low abundance" (DFMR 2011). The issue is being dealt with by the restriction of effort, which has already begun. More specifically, from 2010 to 2013, two of the four demersal trawlers operating in inshore waters have retired with the help of public financing (Anon 2010b) and 12 multi-purpose vessels were retired in 2010, representing 36% of the multi-purpose fleets' total tonnage. The small-scale sector is to reduce its number of licenses by 30% over the four years, and the multi-purpose fleet is to be reduced by 15%. Great care should be taken that vessel decommissioning is not anticipated by fishers, or else capacity may dramatically increase by 'trickling' back into the fishery (Clark *et al.* 2004).

Other conservation strategies Cyprus is implementing include an increase of minimum mesh size from 32mm to 36 mm for both small-scale and multi-purpose vessels which deploy bottom gill nets and

[26] http://www.europarl.europa.eu/sides/getDoc.do?pubRef=-//EP//TEXT+TA+P7-TA-2012-0336+0+DOC+XML+V0//EN

trammel nets (Anon 2010b) with fishers compensated for their initial reduction in catches by receiving lump sum monetary payments. The expectation is that with termination of the four inshore bottom trawlers along with the increase in mesh size for the small-scale sector, a corresponding 20% increase in biomass of the four well-assessed demersal species could occur (Anon 2010b).

Alignment with "EU Acquis"

In November 2004, the Republic of Cyprus was acquiesced into the European Union and thus their fisheries management plans were aligned with EU's objectives. The EU's Mediterranean Regulation was adopted by the EU in 2006, operational as of 2010, and applied to the 7 EU member countries which border the Mediterranean: Spain, France, Italy, Slovenia, Greece, Cyprus and Malta[27]. The entire island is considered part of the European Union; however, since the Republic of Cyprus (south) does not have control of the northern portion of the island, EU legislation is suspended in the north[28]. If a solution to the "Cyprus Problem" is found, this suspension will be lifted. Turkish Cypriots are regarded as EU citizens even though they reside in areas outside of governmental jurisdiction[31].

The EU requires that the minimum depth required for the use of bottom trawl gear be 50 m (DFMR 2007). This limit previously proved difficult to monitor, but a Vessel Monitoring System (VMS) was initiated for the south. One deviation from the Mediterranean Regulation in Cyprus is that trawlers are allowed to operate between 0.7 and 1.5 n. m. from the coast, which is still deeper than the 50 m limit due to a narrow and steep nature of the continental shelf (DFMR 2007). The implementation of the European Commission Data Collection Regulation is expected to improve scientific knowledge of key commercial stocks (DFMR 2007).

[27]http://www.eubusiness.com/topics/fisheries/mediterranean.806/
[28]http://www.mof.gov.cy/mof/customs/customs.nsf/All/05AEEF243C9BFC8BC22572BF002D0A28?OpenDocument

Cyprus is one of the first European countries to enlist aid in combatting illegal fishing. The Cyprus government has paid close to £1 m (US$ 1.33 million) to provide a GPS-based fisheries management system to the Department of Fisheries and Marine Research, to monitor the activity of 500 licensed small fishing boats <15 m operating in Cypriot waters, so that unlicensed vessels fishing in the area can be more easily detected[29], but unfortunately there were legal hurdles and this is not yet operational.

CONCLUSION

This study has highlighted some of the differences and commonalities with regards to the fisheries of Cyprus' two entities, and presented a continuous time-series of total fisheries extractions for the entire island of Cyprus, as well as its two components. It is become apparent that both north and south have become increasingly proactive in marine resource conservation, and may indeed be shifting towards more sustainable fishing methods.

Total catches on the island of Cyprus between 1950-2010 were 2.6 times higher than the reported data suggested. Both north and south have been proactive in marine resource conservation and are shifting away from unsustainable industrial fishing methods.

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[29] http://www.cybit.co.uk/News/Cybit-Win-Vessel-Tracking-Contract-With-Cyprus-Dep.aspx

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Table 1. Locally reported small-scale catches (t) and estimated total catches for the north of Cyprus, as presented by the Dept. of Animal Husbandry (2000-2010).

Year	Locally reported small-scale catches (t)	Estimated total catches by Dept. of Animal of Husbandry (t)
2000	-	450-500
2001	-	400-450
2002	-	450
2003	-	400
2004	130	400-450
2005	165	400
2006	162	400
2007	186	400

Table 2. Taxa allocation for 1950-1962 to disaggregate 'marine fishes nei' amounts (averaged from 1970-1974 reported FAO landings).

Taxa	%
Bogue	0.21
Groupers, seabasses nei	0.16
Red mullet	0.13
Porgies, seabreams nei	0.11
Common pandora	0.08
Octopuses, etc. nei	0.08
Misc. marine fish	0.07
Common dentex	0.05
Sharks, rays, skates, etc. nei	0.05
Red porgy	0.03
Greater amberjack	0.02

Table 3. North: Data on recreational fisheries (2007-2010), Provided by the Department of Animal Husbandry.

Year	2007	2008	2009	2010
Recreational fishing boats	207	227	242	281
Recreational fishing licenses	205	217	220	263
Recreational additional fishers	138	146	157	221
Recreational angler	205	217	220	263
Spearfishing licenses	306	384	208	368

Table 4. North: taxa allocation for recreational catches, 1950-2010.

Species	% Weight
Dentex dentex	0.30
Epinephelus marginatus	0.25
Mycteroperca rubra	0.20
Sarda sarda	0.15
Seriola dumerili	0.06
Lichia amia	0.04

Table 5. Taxonomic allocation of discards in the north (1950-2010, large-scale and artisanal) and south (1950-1973, artisanal).

Taxon	%
Batoidea	0.20
Muraena helena	0.20
Selachimorpha	0.20
Spicara maena[a]	0.20
Anguilla anguilla	0.05
Coris julis	0.04
Thalassamo pavo	0.04
Scorpaena scrofa	0.03
Macroramphosus scolopax	0.01
Euechinoidea	0.01
Asteroidea	0.01
Dardanus megistos	0.01

Table 6. North: baitfish composition, 1950-2010.

Taxon	%
Diplodus annularis	0.22
Sardinella maderensis	0.02
Serranus cabrilla	0.12
Serranus scriba	0.14
Octopus vulgaris	0.10
Eledone spp.	0.10
Sepia officinalis	0.10
Illex coindetii	0.10
Loligo sp.	0.10

Table 7. Discards of the invasive silver-cheek toadfish in north and south (t).

Year	North	South
2003	13	104
2004	28	257
2005	75	521
2006	78	820
2007	112	1195
2008	146	1195
2009	149	831
2010	150	840

Table 8. North: Discard allocation per fishing group (See text)

Group	% of total catch	Discard allocation %
1	0.12	49
2	0.31	58
3	0.46	65
4	0.12	65

Table 9. Discard allocation for the artisanal sector in the south, 1974-2010.

Taxon	%
Spicara smaris	0.29
Pagellus erythrinus	0.16
Dasyatidae	0.20
Mola mola	0.12
Alopias spp.	0.05
Murex scolopax	0.03
Boops boops	0.01
Mullus barbatus	0.01
Mullus surmuletus	0.01
Serranus cabrilla	0.02
Bolinus brandaris	0.05
Echinoidea	0.03
Maja squinado	0.02

[a] From 2001-2010, *Spicara smaris* catch contributions were decreased to allow for some discards to be allocated to *Sargocentron* rubrum, a 'newer' lessepsian migrant.

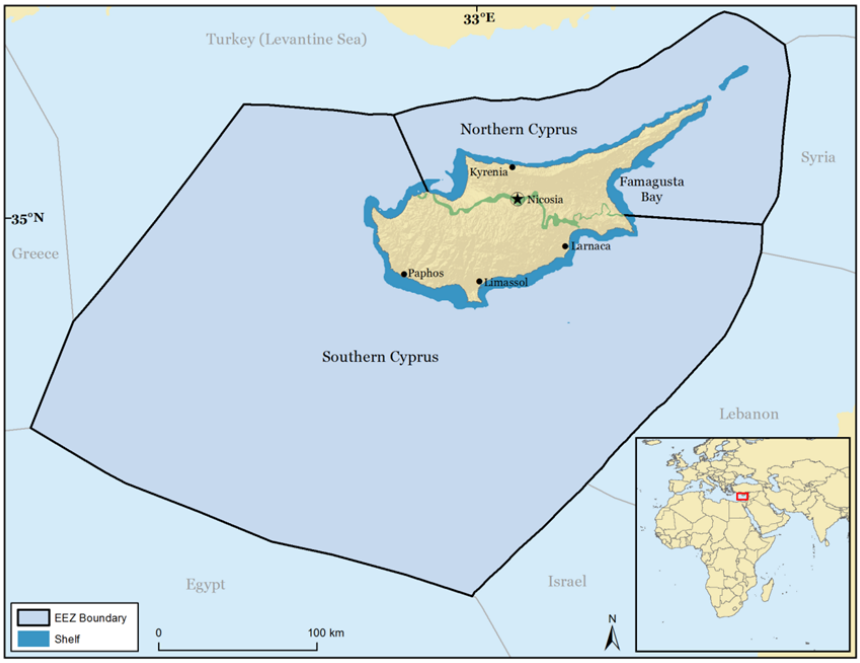

Figure 1. The island of Cyprus, showing the 'Green Line' which divides the north and the south, the capital city (Nicosia), prominent fishing ports, and the Exclusive Economic Zones (EEZ) in the north and south as theoretically assumed by the *Sea Around Us* project based on a basic, non-binding interpretation of fundamental UNCLOS principles.

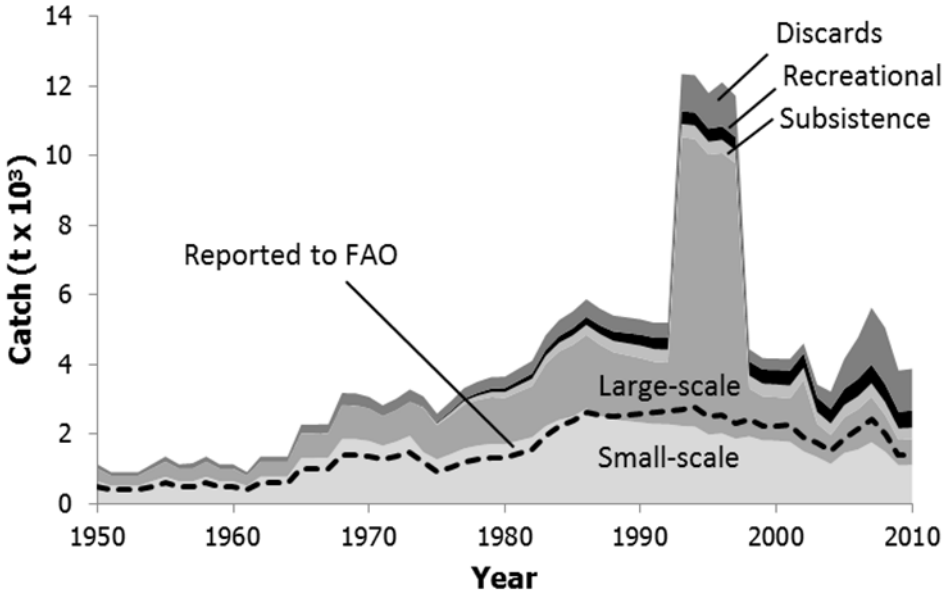

Figure 2. United Cyprus: Total reconstructed catch by sector, 1950-2010.

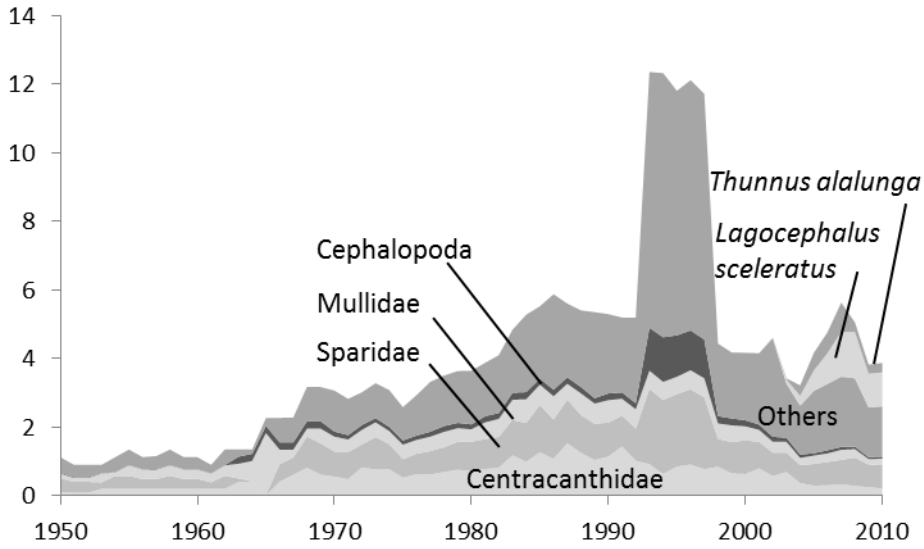

Figure 3. United Cyprus: Total reconstructed catch by taxa, 1950-2010, the 'Others' grouping contains 56 taxa.

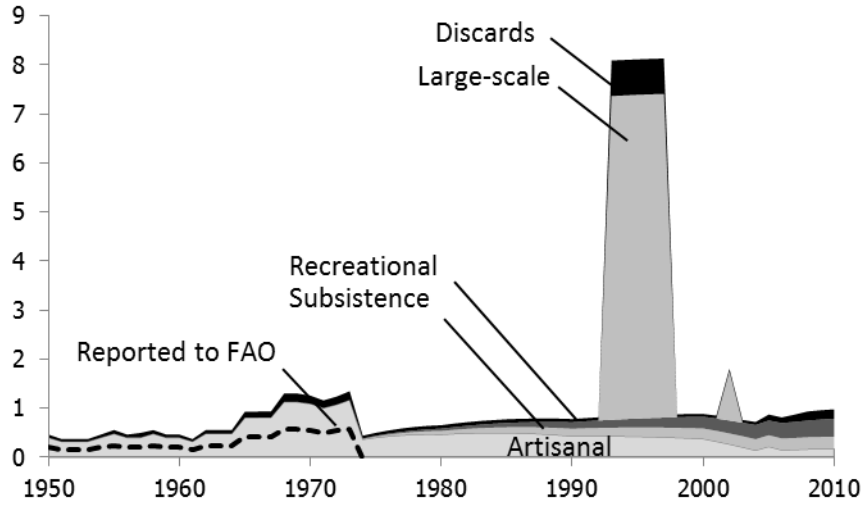

Figure 4. North Cyprus: Total reconstructed catch by sector, 1950-2010.

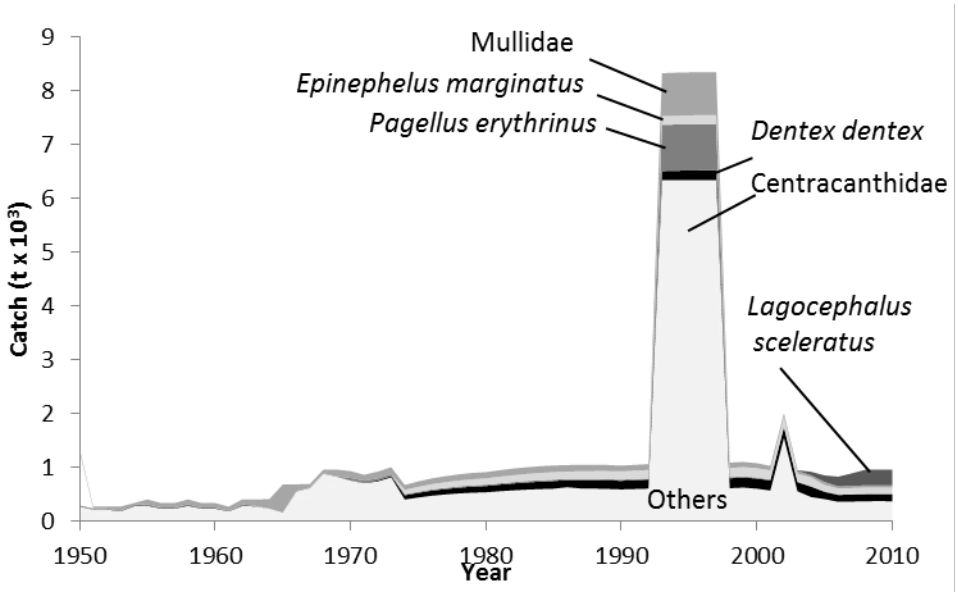

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Figure 5. North Cyprus: Total reconstructed catch by taxa, 1950-2010, the 'Others' grouping contains 40 taxa.

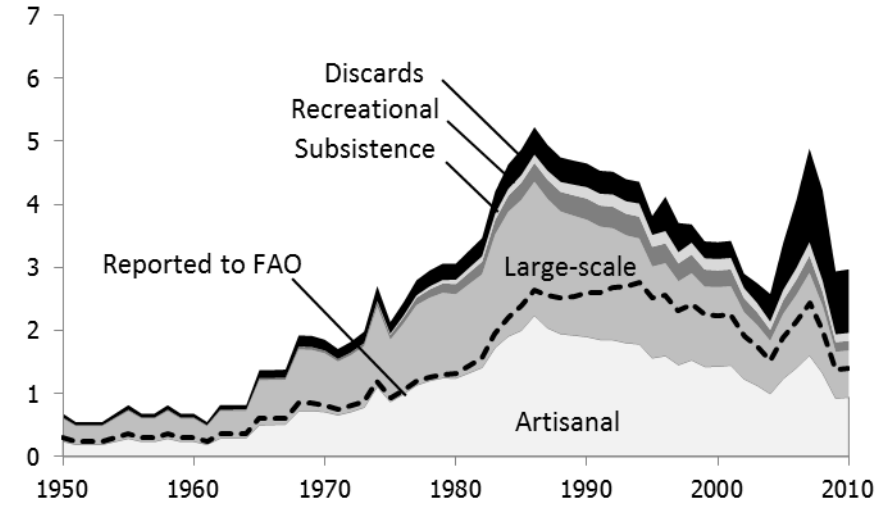

Figure 6. South Cyprus: Total reconstructed catch by sector, 1950-2010.

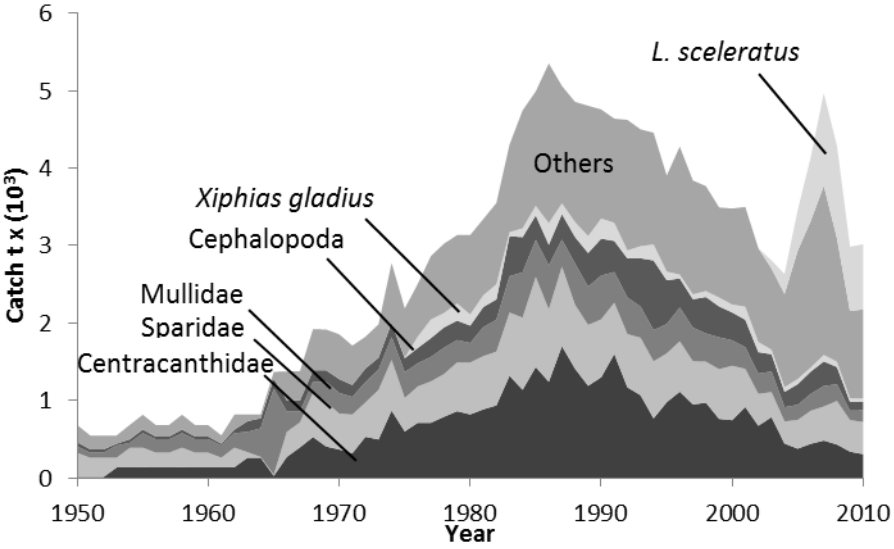

Figure 7. South Cyprus: Total reconstructed catch by taxa, 1950-2010, the 'Others' grouping contains 51 taxa.

Appendix Table A1. United Cyprus: total reconstructed catch (t) by sector, 1950-2010.

Year	Reported FAO	Large-scale	Small-scale	Subsistence	Recreational	Discards	Total Reconstructed
1950	500	360	640	30	1	122	1,153
1951	400	288	512	25	1	97	924
1952	400	288	512	25	1	97	924
1953	405	288	513	25	1	98	926
1954	508	361	641	30	1	123	1,156
1955	605	432	769	35	1	145	1,382
1956	505	360	641	30	2	122	1,154
1957	505	360	641	30	2	156	1,188
1958	603	432	768	35	2	145	1,382
1959	503	360	640	30	2	122	1,154
1960	503	360	640	30	2	120	1,152
1961	403	288	512	25	2	100	927
1962	603	429	771	35	2	146	1,383
1963	605	427	774	35	2	146	1,383
1964	610	424	778	35	2	146	1,385
1965	1,019	707	1,308	55	2	247	2,319
1966	1,014	704	1,315	55	2	248	2,324
1967	1,022	703	1,327	55	2	249	2,336
1968	1,425	972	1,854	75	2	348	3,251
1969	1,419	964	1,856	75	2	347	3,243
1970	1,376	926	1,802	72	2	336	3,139
1971	1,268	847	1,665	67	2	309	2,890
1972	1,348	898	1,784	71	2	330	3,085
1973	1,467	971	1,949	77	2	359	3,358
1974	1,190	1,270	1,477	89	16	293	3,145
1975	927	984	1,272	100	31	245	2,633
1976	1,055	1,118	1,422	130	46	275	2,992
1977	1,197	1,269	1,585	161	62	308	3,385
1978	1,260	1,314	1,670	187	78	322	3,570
1979	1,298	1,347	1,718	211	95	330	3,702
1980	1,321	1,331	1,710	234	112	327	3,715
1981	1,439	1,406	1,808	262	130	345	3,951
1982	1,563	1,477	1,904	289	148	363	4,182
1983	1,956	1,792	2,227	329	167	427	4,942
1984	2,216	1,972	2,408	362	187	463	5,391
1985	2,392	2,069	2,499	390	206	482	5,646
1986	2,657	2,119	2,733	421	227	510	6,010
1987	2,553	2,046	2,524	435	248	481	5,733
1988	2,508	1,938	2,418	450	269	459	5,534
1989	2,545	1,893	2,378	469	291	450	5,482
1990	2,587	1,853	2,334	488	314	440	5,428
1991	2,604	1,791	2,289	494	327	430	5,331
1992	2,679	1,769	2,284	508	345	427	5,333
1993	2,696	8,305	2,236	514	359	1,075	12,489
1994	2,765	8,271	2,216	526	377	1,070	12,459
1995	2,508	8,049	1,988	497	372	1,025	11,931
1996	2,550	8,065	2,018	506	388	1,267	12,244
1997	2,312	7,923	1,867	479	383	1,185	11,837
1998	2,420	1,375	1,933	495	405	351	4,560
1999	2,244	1,267	1,818	476	405	328	4,294
2000	2,235	1,254	1,808	478	418	325	4,284
2001	2,245	1,251	1,775	482	434	330	4,272
2002	1,908	2,057	1,501	444	420	281	4,703
2003	1,740	958	1,337	426	420	369	3,511
2004	1,528	837	1,139	404	417	502	3,299
2005	1,889	1,027	1,456	447	462	868	4,262

2006	2,138	1,156	1,557	477	498	1,190	4,879
2007	2,431	1,306	1,764	512	539	1,635	5,757
2008	1,991	1,065	1,493	463	516	1,619	5,157
2009	1,390	736	1,098	397	478	1,187	3,896
2010	1,403	740	1,113	400	495	1,199	3,946

Appendix Table A2. United Cyprus: total reconstructed catch (t) my major taxa or family, 1950-2010, the 'Others' grouping contains 56 taxa.

Year	Centracanthidae	Sparidae	Mullidae	Cephalopoda	*L. sceleratus*	*Thunnus alalunga*	Others
1950	116	375	139	26	-	-	497
1951	93	301	111	21	-	-	398
1952	93	301	111	21	-	-	398
1953	207	180	253	5	-	-	281
1954	208	356	106	7	-	-	479
1955	210	357	306	8	-	-	501
1956	208	269	280	7	-	-	390
1957	208	269	280	15	-	-	416
1958	210	357	306	7	-	-	502
1959	208	269	280	6	-	-	391
1960	208	269	280	6	-	-	389
1961	207	180	253	5	-	-	282
1962	210	357	306	7	-	-	503
1963	410	95	427	207	-	-	244
1964	410	9	601	207	-	-	158
1965	17	13	1,801	212	-	-	276
1966	417	510	427	212	-	-	758
1967	617	510	228	212	-	-	769
1968	824	924	228	217	-	-	1,058
1969	624	924	428	217	-	-	1,050
1970	563	770	435	148	-	-	1,223
1971	489	830	373	125	-	-	1,073
1972	830	641	427	140	-	-	1,047
1973	770	915	429	121	-	-	1,123
1974	780	656	380	121	-	-	1,208
1975	532	487	427	122	-	-	1,065
1976	634	537	400	126	-	-	1,295
1977	626	595	421	144	-	-	1,599
1978	698	647	448	167	-	-	1,610
1979	766	708	397	153	-	-	1,678
1980	726	736	362	144	-	-	1,747
1981	785	778	485	181	-	-	1,722
1982	829	817	524	171	-	-	1,841
1983	1,183	947	580	206	-	-	2,026
1984	996	1,059	694	208	-	-	2,434
1985	1,276	1,262	591	178	-	-	2,339
1986	1,081	1,048	676	190	-	-	3,015
1987	1,535	1,184	459	188	-	-	2,367
1988	1,258	968	632	187	-	-	2,489
1989	1,043	930	592	157	-	-	2,760
1990	1,150	872	655	193	-	-	2,558
1991	1,443	779	491	185	-	-	2,433
1992	1,026	829	565	176	-	-	2,737
1993	930	2,076	527	1,253	-	-	7,703

1994	642	2,032	528	1,299	-	-	7,958
1995	854	2,006	503	1,209	-	-	7,359
1996	917	2,036	555	1,158	-	-	7,578
1997	780	1,970	552	1,131	-	-	7,404
1998	851	694	450	214	-	-	2,351
1999	655	805	492	201	-	-	2,141
2000	640	892	409	178	-	7	2,158
2001	806	658	349	154	-	-	2,305
2002	583	1,076	318	148	-	30	2,548
2003	696	468	309	119	117	59	1,743
2004	376	415	212	100	284	350	1,562
2005	300	524	242	69	595	572	1,959
2006	310	563	247	92	898	686	2,083
2007	337	588	294	82	1,306	955	2,194
2008	293	710	248	69	1,340	370	2,126
2009	253	567	158	57	980	351	1,531
2010	220	575	189	59	990	371	1,543

Appendix Table A3. North Cyprus: total reconstructed catch (t) by sector, 1950-2010.

Year	Reported	Large-scale	Small-scale	Recreational	Subsistence	Discards	Total reconstructed
1950	200	-	400	1	12	60	473
1951	160	-	320	1	10	48	378
1952	160	-	320	1	10	48	378
1953	160	-	320	1	10	48	379
1954	200	-	401	1	12	60	473
1955	240	-	480	1	14	72	567
1956	200	-	400	1	12	60	473
1957	200	-	400	1	12	93	506
1958	240	-	480	1	14	72	567
1959	200	-	400	1	12	60	473
1960	200	-	400	1	12	60	473
1961	160	-	320	1	10	48	379
1962	240	-	480	1	14	72	567
1963	240	-	480	1	14	72	567
1964	240	-	481	1	14	72	567
1965	403	-	806	1	22	121	949
1966	404	-	808	1	22	121	951
1967	406	-	812	1	22	122	956
1968	565	-	1131	1	30	170	1,331
1969	564	-	1128	1	30	169	1,328
1970	546	-	1091	1	29	164	1,285
1971	503	-	1005	1	27	151	1,183
1972	536	-	1073	1	28	161	1,263
1973	584	-	1168	1	31	175	1,375
1974	-	-	366	7	12	55	440
1975	-	-	402	13	23	60	498
1976	-	-	431	19	33	65	548
1977	-	-	452	26	43	68	589
1978	-	-	464	33	52	70	620
1979	-	-	469	40	62	70	641
1980	-	-	466	47	71	70	654
1981	-	-	481	55	80	72	688
1982	-	-	491	63	89	74	716
1983	-	-	497	71	97	75	740
1984	-	-	500	79	106	75	759
1985	-	-	498	87	114	75	774
1986	-	-	493	96	122	74	785
1987	-	-	483	105	130	73	790
1988	-	-	470	114	137	70	791
1989	-	-	453	123	144	68	788
1990	-	-	431	132	151	65	779
1991	-	-	433	142	158	65	798
1992	-	-	433	152	165	65	815
1993	-	6,600	432	162	171	725	8,090
1994	-	6,600	429	173	177	724	8,103
1995	-	6,600	424	183	183	724	8,114
1996	-	6,600	418	194	189	723	8,124
1997	-	6,600	410	205	194	722	8,131
1998	-	-	401	216	200	60	877
1999	-	-	390	228	205	58	881

2000	-	-	378	239	210	57	883
2001	-	-	325	251	214	60	850
2002	-	1,000	268	264	219	52	1,802
2003	-	-	207	276	223	56	761
2004	-	-	142	289	227	62	719
2005	-	-	218	301	230	121	872
2006	-	-	150	314	234	114	812
2007	-	-	157	328	237	150	871
2008	-	-	168	341	240	186	935
2009	-	-	172	355	243	190	959
2010	-	-	172	369	246	191	978

Appendix Table A4. North Cyprus: total reconstructed catch (t) my major taxa or family, 1950-2010. The 'Others' grouping includes 41 taxa or families.

Year	Centracanthidae	Sparidae	Mullidae	Epinephelus	Siganidae	*Lagocephalus sceleratus*	Others
1950	119	115	62	42	1	-	135
1951	95	92	49	33	1	-	109
1952	95	92	49	33	1	-	109
1953	88	76	104	27	1	-	83
1954	90	150	43	54	1	-	135
1955	92	151	125	54	1	-	145
1956	90	114	114	41	1	-	113
1957	90	114	114	41	1	-	146
1958	92	151	125	54	1	-	144
1959	90	114	114	41	1	-	113
1960	90	114	114	41	1	-	113
1961	88	76	104	27	1	-	83
1962	92	151	125	54	1	-	144
1963	174	42	175	14	1	-	162
1964	174	6	246	1	1	-	140
1965	16	10	738	1	1	-	183
1966	180	210	175	14	1	-	372
1967	262	210	93	14	1	-	377
1968	351	377	93	14	1	-	496
1969	269	377	175	14	1	-	493
1970	243	304	178	13	1	-	546
1971	212	325	152	17	1	-	476
1972	353	268	174	59	18	-	391
1973	329	396	175	55	24	-	396
1974	7	87	91	55	23	-	176
1975	8	98	101	64	29	-	198
1976	9	107	108	72	35	-	217
1977	9	114	113	78	40	-	234
1978	9	119	116	84	45	-	246
1979	9	123	117	88	50	-	254
1980	9	124	117	91	54	-	260
1981	10	130	120	97	59	-	272
1982	10	135	123	102	64	-	283
1983	10	138	124	107	69	-	292

1984	10	141	125	111	73	-	299
1985	10	143	125	114	77	-	305
1986	10	144	123	117	81	-	309
1987	10	144	121	119	85	-	311
1988	9	144	117	121	89	-	310
1989	9	142	113	122	92	-	310
1990	9	139	108	123	95	-	306
1991	9	142	108	127	100	-	313
1992	9	144	108	130	104	-	320
1993	1,969	1,466	801	134	108	-	3,612
1994	1,969	1,468	800	137	112	-	3,616
1995	1,969	1,469	799	140	116	-	3,621
1996	1,969	1,470	797	143	120	-	3,624
1997	1,968	1,471	796	145	124	-	3,627
1998	8	151	100	148	128	-	341
1999	8	151	97	150	132	-	343
2000	8	150	94	152	136	-	344
2001	7	141	81	148	137	-	336
2002	5	130	67	144	134	-	1,322
2003	4	119	52	139	133	13	302
2004	3	107	35	133	131	28	282
2005	4	126	55	148	136	75	328
2006	3	113	37	142	134	78	305
2007	3	117	39	146	135	112	319
2008	3	122	42	151	136	146	334
2009	3	125	43	156	137	149	346
2010	4	128	44	160	138	150	355

Appendix Table A5. South Cyprus: Total reconstructed catch (t) by sector, 1950-2010.

Year	Reported FAO	Large-scale	Small-scale	Subsistence	Recreational	Discards	Total Reconstructed
1950	300	360	240	18	1	62	680
1951	240	288	192	15	1	49	545
1952	240	288	192	15	1	49	545
1953	240	288	192	15	1	51	547
1954	300	361	240	18	1	63	683
1955	360	432	288	21	1	73	815
1956	300	360	240	18	1	62	681
1957	300	360	240	18	1	63	682
1958	360	432	288	21	1	73	815
1959	300	360	240	18	1	62	681
1960	300	360	240	18	1	60	680
1961	240	288	192	15	1	52	548
1962	360	429	291	21	1	74	816
1963	360	427	294	21	1	74	816
1964	361	424	297	21	1	74	817
1965	604	707	502	33	1	127	1,370
1966	606	704	508	33	1	127	1,373
1967	609	703	515	33	1	128	1,380
1968	848	972	724	45	1	178	1,920
1969	846	964	728	45	1	178	1,916

1970	819	926	711	43	1	172	1,854
1971	754	847	660	40	1	158	1,707
1972	804	898	711	43	1	169	1,822
1973	876	971	781	46	1	184	1,983
1974	1,190	1,270	1,111	76	10	238	2,705
1975	927	984	870	77	18	185	2,135
1976	1,054	1,118	991	98	27	211	2,444
1977	1,201	1,269	1,133	119	36	240	2,796
1978	1,260	1,314	1,205	135	45	252	2,951
1979	1,298	1,347	1,249	150	55	260	3,060
1980	1,321	1,331	1,244	163	65	258	3,061
1981	1,439	1,406	1,327	182	75	273	3,263
1982	1,563	1,477	1,413	200	86	289	3,466
1983	1,956	1,792	1,730	231	97	352	4,202
1984	2,217	1,972	1,909	256	108	388	4,632
1985	2,394	2,069	2,001	276	119	407	4,872
1986	2,642	2,119	2,240	299	131	436	5,225
1987	2,554	2,046	2,041	305	143	409	4,943
1988	2,507	1,938	1,948	313	156	389	4,743
1989	2,546	1,893	1,926	325	168	382	4,694
1990	2,590	1,853	1,902	337	181	376	4,649
1991	2,605	1,791	1,856	336	185	365	4,533
1992	2,681	1,769	1,851	343	193	362	4,518
1993	2,699	1,705	1,804	343	197	351	4,400
1994	2,766	1,671	1,787	349	205	346	4,357
1995	2,511	1,449	1,564	314	188	301	3,817
1996	2,554	1,465	1,600	317	194	545	4,120
1997	2,316	1,323	1,456	285	178	463	3,706
1998	2,423	1,375	1,532	296	189	291	3,683
1999	2,245	1,267	1,428	272	177	269	3,413
2000	2,237	1,254	1,431	268	179	268	3,401
2001	2,251	1,251	1,450	268	182	270	3,422
2002	1,909	1,057	1,233	225	157	229	2,901
2003	1,741	958	1,130	204	145	313	2,750
2004	1,529	837	998	177	128	440	2,581
2005	1,888	1,027	1,238	217	161	747	3,391
2006	2,136	1,156	1,407	243	184	1,076	4,067
2007	2,428	1,306	1,608	274	211	1,485	4,886
2008	1,992	1,065	1,325	223	175	1,434	4,223
2009	1,386	736	926	154	123	997	2,937
2010	1,401	740	941	154	126	1,008	2,970

Appendix Table A6. South Cyprus: total reconstructed catch (t) my major taxa or family, 1950-2010. The 'Others' grouping includes 51 taxa or families.

Year	*Centracanthidae*	Sparidae	Mullidae	*Cephalopoda*	*Lagocephalus sceleratus*	*Xiphias gladius*	Others
1950	12	311	81	55	-	-	221
1951	10	249	65	44	-	-	178
1952	10	249	65	44	-	-	178
1953	133	128	156	24	-	-	106
1954	135	250	65	46	-	-	186
1955	138	252	188	47	-	-	191
1956	135	190	172	36	-	-	149
1957	135	190	172	36	-	-	150
1958	138	252	188	46	-	-	191
1959	135	190	172	35	-	-	149
1960	135	190	172	35	-	-	147
1961	133	128	156	24	-	-	107
1962	138	252	188	46	-	-	192
1963	261	70	262	139	-	-	84
1964	261	10	369	129	-	-	48
1965	25	16	1108	133	-	-	87
1966	271	322	263	143	-	-	373
1967	394	322	140	143	-	-	380
1968	527	575	140	147	-	-	531
1969	404	574	263	147	-	-	527
1970	366	464	268	178	-	-	579
1971	319	498	229	154	-	-	508
1972	530	444	262	177	-	-	409
1973	495	641	263	153	-	-	431
1974	869	654	295	185	-	2	769
1975	599	431	334	180	-	10	633
1976	711	469	299	197	-	148	681
1977	712	534	316	243	-	242	820
1978	789	552	340	263	-	187	894
1979	861	631	287	252	-	221	883
1980	819	671	252	224	-	144	1025
1981	885	687	375	259	-	152	984
1982	935	694	412	262	-	196	1049
1983	1318	817	468	518	-	52	1131
1984	1137	933	585	454	-	113	1523
1985	1431	1162	480	317	-	124	1476
1986	1240	934	570	267	-	278	2062
1987	1701	1027	348	330	-	139	1516
1988	1411	826	531	343	-	194	1551
1989	1188	786	495	434	-	219	1683
1990	1299	748	566	477	-	260	1409
1991	1600	663	396	400	-	235	1345
1992	1169	687	473	506	-	102	1685
1993	1067	743	401	624	-	157	1509
1994	767	737	403	900	-	207	1443
1995	976	630	379	566	-	111	1241
1996	1113	650	435	376	-	50	1653
1997	947	559	434	366	-	64	1470
1998	971	529	364	473	-	76	1355
1999	761	642	411	399	-	115	1163
2000	744	704	328	360	-	103	1241
2001	915	492	279	355	-	169	1287
2002	672	413	261	278	-	130	1212
2003	784	323	268	223	120	59	1049
2004	443	286	184	198	324	61	1203
2005	376	371	195	268	716	66	1657
2006	440	426	219	288	1220	54	1892

2007	482	439	265	318	1911	84	2185
2008	430	563	215	223	1912	70	1594
2009	338	408	120	115	1330	48	1124
2010	306	415	151	111	1344	40	1153

Appendix Table A7. List of Cypriot fish by English name, scientific name, Cypriot name, and Turkish name found in Cypriot waters (Source: Authors of this report).

English name	Scientific name	Cypriot name	Turkish name
Albacore tuna	*Thunnus alalunga*	-	-
Angel shark	*Squatina squatina*	Kyrós	Keler
Anglerfish	*Uranoscopus scaber*	Lychnos	Kurbaga
Annular seabream	*Diplodus annularis*	Sparos	İsparoz (ispari)
Atlantic bonito	*Sarda sarda*	Palamida	Palamut (torik)
Atlantic horse mackerel	*Trachurus trachurus*	Safridi	Istravrit (kraça)
Atlantic mackerel	*Scomber scombrus*	Scumbrí	Uskumru
Axillary seabream	*Pagellus acarne*	Fatsoukli	Kırma Mercan
Big-scale sand smelt	*Atherina boyeri*	Atherina	Gümüş (çumuka)
Black goby	*Gobius niger*	-	-
Blackmouth catshark	*Galeus melastomus*	-	-
Black seabream	*Spondyliosoma cantharus*	Scáthari	Sarigöz
Blackspot seabream	*Pagellus bogaraveo*	-	-
Blotched picarel	*Spicara maena*	Menoulla	İzmarit
Blue butterfish	*Stromateus fiatola*	Stira	-
Blue jack mackerel	*Trachurus picturatus*	-	-
Blue shark	*Prionace glauca*	Cancharías	Pamuk
Bogue	*Boops boops*	Voppa	Kupez (kupa)
Blue-spotted cornetfish	*Fistularia commersonii*	-	-
Brown meagre	*Sciaena umbra*	Siakos	Işkine
Brushtooth lizardfish	*Saurida undosquamis*	-	-
Bull ray	*Pteromylaeus bovinus*	Actopsaro	Kulaklifolya
Chub mackerel	*Scomber japonicus*	Collíos (Koliós)	Kolyoz
Comber	*Serranus cabrilla*	Channos	Asıl hani
Corb	*Umbrina cirrosa*	Milokopi	Kötex
Common dentex	*Dentex dentex*	Synagrida	Sinağrit
Common guitarfish	*Rhinobatos rhinobatos*	Violopsaro	Iğnelikeler
Common pandora	*Pagellus erythrinus*	Lythrini	Kırma mercan
Common stingray	*Dasyatis pastinaca*	-	Vatoz
Common torpedo	*Torpedo torpedo*	Electryko	Uyuşturan
Common two-banded seabream	*Diplodus vulgaris*	Haratzida	Karagöz
Devil fish	*Mobula mobular*	Selachi kephaloptero	-
Dogfish	Squaliformes	Skyllos	
Dusky grouper	*Epinephelus marginatus*	Orfos	Orfoz
Dusky spinefoot	*Siganus luridus*	-	Sokan
European anchovy	*Engraulis encrasicolus*	Gávros	Hamsi
European barracuda	*Sphyraena sphyraena*	Sphyrna	İskarmoz (baraküda)
European conger	*Conger conger*	Mougri	Miğri
European eel	*Anguilla anguilla*	Chéli	Yilan
European hake	*Merluccius merluccius*	Backaliaros	Berlam
European pilchard	*Sardina pilchartus*	Sardella	Saradalya (çiroz)
European seabass	*Dicentrarchus labrax*	Lavraki	Levrek
Flying gurnard	*Dactylopterus volitans*	Chelidonopsaro	Uçan

Foureyed sole	*Microchirus ocellatus*	Glóssa	Dil
Four-spot megrim	Lepidorhombus	-	-
Frigate mackerel	*Auxis thazard thazard*	Kopáni	Gobene
Garfish	*Belone belone*	Velonida	Zargana
Gilt-head seabream	*Sparus aurata*	Tsipoura (Çipura)	Çipura
Golden picarel	*Spicara flexuosa*	Tseroulla	-
Greater amberjack	*Seriola dumerili*	Mineri	Avci (sarikuyruk)
Greater pipefish	*Syngnathus acus*	Sacerápha	Deniz ignesi
Greater weever	*Trachinus draco*	Drákena	Trakonya
Grey gurnard	*Eutrigla gurnardus*	Capóni	Benekli kirlangiç
Grey mullet	Mugilidae	Kefalos	Kefal
Grey triggerfish	*Balistes capriscus*	Gourounópsaro	Çütre
Groupers	Epinephelus	Vlachos	Orfoz
Gulper shark	*Centrophorus granulosus*	-	-
John Dory	*Zeus faber*	Chrystópsaro	Dülger
Largescaled scorpionfish	*Scorpaena scrofa*	-	-
Leerfish	*Lichia amia*	-	Akya
Lesser weever	*Echiichthys vipera*	Drákena	Varsam
Little tunny	*Euthynnus alletteratus*	Palamida (karvòuni)	Yazili orkinoz
Lizardfish	*Synodus saurus*	Skarmos	Zurna
Longspine snipefish	*Macroramphosus scolopax*	-	-
Long-snouted seahorse	*Hippocampus guttulatus*	Alogakí	Deniz aygiri
Madeiran sardinella	*Sardinella madirensis*	-	-
Marbled spinefoot	*Siganus rivilatus*	-	-
Mediterranean horse mackerel	*Trachurus mediterraneus*	Safridi	Istavrit (karagöz)
Mediterranean moray	*Muraena helena*	Smérna	Merina
Monkfish	*Lophius piscatorius*	-	-
Mottled grouper	*Mycteroperca rubra*	-	-
Ocean sunfish	*Mola mola*	Fegarópsaro	Pervane
Ornate wrasse	*Thalassamo pavo*	-	-
Painted comber	*Serranus scriba*	Perka	Asıl hani
Parrotfish	*Sparisoma cretense*	Skaros	Iskaroz
Picarel	*Spicara smaris*	Marida	Smarida (Izmarit)
Piper gurnard	*Trigla lyra*	Capóni	Mazak
Porbeagle shark	*Lamna nasus*	Cancharías	Dikburun karkarias
Rainbow trout	*Oncorhynchus mykiss*	Pestrofa	-
Rays and skates	*Rajiformes*	Vati	Vatoz
Red mullet	*Mullus barbatus barbatus*	Stryllia	Barbunya
Red porgy	*Pagrus pagrus*	Fangri	Fangri (Mercan)
Redcoat squirrelfish	*Sargocenton rubrum*	Rossos	Hindistan
Round sardinella	*Sardinella aurita*	Sardella	Gümüş
Saddled seabream	*Oblada melanura*	Melana	Melanurya
Salema	*Sarpa salpa*	Salpa	Sarpa (çitari)
Sardinellas	*Sardinella spp.*	Sardella	Gümüş (çumuka)
Scorpionfish	*Scorpaena spp.*	Scorpios	İskorpit
Sharks and dogfishes	*Squaliformes*	Skyllos	Köpek baliği
Sharksucker	*Remora remora*	Collisópsaro	Vantuz
Sheepshead	*Archosargus probatocephalus*	Mytáki	Sivriburun karagöz
Silver-cheeked toadfish	*Lagocephalus sceleratus*	-	-
Small-spotted catshark	*Scyliorhinus canicula*	Skyláki	Mahmuzlu camgöz
Smooth hammerhead	*Sphyrna zygaena*	Pateritza	Cekiç
Spotted flounder	*Citharus linguatula*	Glossa	Dil
Starry ray	*Raja asterias*	-	-

Streaked weever	*Trachinus radiatus*	Drákena	Çarpan
Striped sea bream	*Lithognathus mormyrus*	Mourmoura	Çizgili mercan
Surmullet	*Mullus surmuletus*	Barbouni	Tekir
Swordfish	*Xiphias gladius*	Xifias	Kiliç
Thresher shark	*Alopias vulpinus*	Alepóu	Sapan
Twaite shad	*Alosa fallax*	Fríssa	Tirsi
White grouper	*Epinephelus aeneus*	Sphyrida	Lahoz
White seabream	*Diplodus sargus sargus*	Sorgos	Karagöz
Whiting	*Merlangius merlangus*	Prosphygák	Mezgit

Appendix Table A9. List of Cypriot invertebrates by English name, scientific name, Cypriot name, and Turkish name found in Cypriot waters.

English name	**Scientific name**	**Cypriot name**	**Turkish name**
Banded-dye murex	*Hexaplex trunculus*	-	-
Common octopus	*Octopus vulgaris*	Octopus	Ahtapot
Common spiny lobster	*Palinurus vulgaris*	Astakos	Böcek
Cuttlefish	*Sepia officinalis*	Soupia	Mürekkep
Deepwater rose shrimp	*Parapenaeus longirostris*	Garida	Pembe karides
European flying squid	*Todorodes sagittatus*	Kalamari	Kalemerya
European lobster	*Homarus gammarus*	-	İstakoz
Four-horned spider crab	*Pisa tetraodon*	-	-
Great Mediterranean scallop	*Pecten jacobaeus*	-	Tarak
Hermit crab	*Dardanus calidus*	-	-
Mantis shrimp	*Squilla mantis*	-	Böcek yiyen
Mediterranean hermit crab	*Paguristes eremita*	-	-
Mediterranean locust lobster	*Scyllarides latus*	Karavida	-
Mediterranean mussel	*Mytilus galloprovincialis*	-	Kara midye
Pencil sea urchin	*Cidaris cidaris*	-	-
Purple-dye murex	*Bolinus brandaris*	-	-
Shrimps	*Penaeidae*	Garides	Karides
Spider crab	*Maja crispata*	-	-
Spiny lobster	*Palinurus vulgaris*	Astakos	Böcek
Squid	*Loligo vulgaris*	Kalamari	Kalemerya
Swimming crab	*Portunidae*	Karkinos	Çalpara
Turban snail	*Bolma rugosa*	-	Deniz salyangozu