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Israel: Reconstructed estimates of total fisheries removals in the Mediterranean, 1950–2010

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Over the past six decades, the Food and Agriculture Organization (FAO) has reported fisheries 'landings', not 'total removals' for Israel. Thus, public data do not include all removals, including discards, the recreational fishery, subsistence portions of the catch or Bluefin tuna catches. Moreover, FAO data inadvertently included landings by Gaza fishers in the Gaza Strip during the 1960s and 1970s. We reconstructed total removals for Israel fishing in the Mediterranean Sea using various anchor points from recent studies to account for the missing removals. We estimated total removals at slightly over 255,400 tonnes for 1950-2010, which are nearly 30% higher than the 198,136 t of Israel's reported catch to FAO (after exclusion of data from the Gaza Strip). The major components of unreported removals were discards (over 37,400 t), dominated by the trawl fishery, and recreational removals (over 15,500 t), which account for a large and rapidly growing fishery sector in Israel. In contrast, subsistence catches (just under 4,000 t) are low, which is not unexpected for a developed country. Non-indigenous Indo-Pacific organisms are a large and growing component in the multispecies catch of Mediterranean fishers; however they appear to change species composition and mode of exploitation more than they affect the level of total removals. In the highly oligotrophic, yet fast changing Levantine Sea, the high discarding rates, use of unsustainable fishing methods and under-regulated fisheries (particularly the recreational sector) pose a threat to the integrity of the marine environment and the ecosystem services we expect from it.

Key words: Catch reconstruction, discards, small-scale fisheries, artisanal fisheries, subsistence fisheries, IUU catches

INTRODUCTION

The Levantine Sea in the Southeastern Mediterranean is a warm, salty and highly oligotrophic body of water (HERUT *et al.,* 2000), and this low productivity leads to low fishery yields for the region (CADDY *et al.,* 1996). Oligotrophy in particular plays a key role for the ecosystem along the relatively short Israeli coastline, as damming of the Nile River in the late 1960s halted freshwater floods which used to carry terrigenous nutrients northeast of the delta (TURLEY, 1999; SUARI & BRENNER, 2012). Though modest in overall tonnage, the catch of Israeli fisheries is extremely diverse, as more than 100 different species are marketed. The main target species are sardines (Clupeidae), goatfishes (Mullidae), groupers (Serranidae), breams (Sparidae), lizardfishes (Synodontidae) and jacks (Carangidae), accounting together for the major fisheries target groups in Israel. Another factor which has a decisive effect on Israeli catches is Lessepsian migration - the influx of Red Sea biota into the Mediterranean by way of the Suez Canal (POR, 1978; RILOV & GALIL, 2009). For example, marbled spinefoot *Siganus rivulatus* proliferated along Israel's coast since the 1920s, and in the mid-1950s, the populations of the commercial Indo-Pacific lizardfish *Saurida undosquamis* and goatfish *Upeneus moluccensis* exploded in the Levant. Such events kept occurring at an increasing rate and brought about dramatic shifts in the faunal composition of the ecosystem and the catch (EDELIST *et al.,* 2013). These newly established species have even redirected fishing effort and altered fishing patterns and methods. For example, abundant non-indigenous prawns led to the emergence of a (nocturnal) shallow prawn trawling sector; however, the presence of the venomous striped eel catfish *Plotosus lineatus* in the shallows during daytime often results in these trawlers avoiding shallow waters during the daytime (EDELIST *et al.,* 2012). Furthermore, the voracious silver-cheeked toadfish (*Lagocephalus sceleratus*) forced longliners to use steel instead of nylon cables (see also KALOGIRU, 2013).

Israeli Mediterranean fisheries consist of a small industrial trawl fleet, a small and shrinking artisanal sector of gillnetters, purse seiners, longliners and SCUBA divers, and a considerable and growing recreational fishery (mostly angling, but also spear-fishing).

All fishing in Israel is carried out within approximately 12 nm from shore, except for a small (five vessel) new pelagic longline fleet targeting bluefin tuna farther offshore since 2002. The total fishing grounds thus do not surpass 4,000 km^2, with >99% of the effort concentrated in the shallower 2,000 km^2 (dashed line, Fig.1).

Israel has reported its industrial and artisanal landings to FAO from its independence in 1948 through annual yearbooks compiled by the Department of Fisheries in the Ministry of Agriculture (DoFSY, Department of Fisheries Statistical Yearbooks). One major source of unreported removals is discarding. KELLEHER (2005) has estimated discards in the Black Sea and Mediterranean at a low 4.9%; however DAVIES *et al.* (2009) estimated this figure at a more realistic figure of 21.1%; 85% of which originated from bottom trawling, in which discards were estimated at 45-50%. EDELIST (2013) has found that Israeli trawl discards in recent years are well within the latter range, making the trawl fishery a major source of unreported catch.

The trawl fishery

Whereas bottom trawlers may only account for around 15% of landings in the entire Mediterranean (www.seaaroundus.org/lme/26/5.aspx), in Israel, bottom trawlers have accounted for 20-40% of the reported landings before 1988, 40-50% from 1989 to 2005 and 54-60% after 2006 (1,348 t out of 2,261 t in 2009, EDELIST, 2013.) Such a high proportion of bottom trawl catches may indicate either an exceptionally lucrative trawl fishery, which is not the case in Israel (EDELIST *et al.,* 2011; EDELIST, 2013), or uneven fishing effort by gear type, collapsing inshore and/or purse-seine fisheries and/or an over-subsidized trawl fleet. Bottom trawlers are the only industrial fleet in Israel. SCHEININ (2010) and EDELIST (2013) give very detailed

accounts of the spatio-temporal development of Israeli trawl catch and effort since 1948. They identify several periods of higher fishing intensity along the Israeli coastline (1948-52, 1963-69, 1979-present), versus periods in which the local effort declined because parts of the fleet were fishing in other grounds (1952-1962 – in Turkish waters, 1970-1978 – in northern Sinai Peninsula).

Similarly, from 1958 to 1974, the larger Israeli trawlers would intermittently fish off Massawa, Eritrea, thus lowering the local fishing pressure. The number of trawlers fishing in Israeli waters has shown a general increasing trend, with only a recent decline. From 15 vessels in 1948, it grew to 34 in 1990 (40 vessels if one includes the six shrimp mini-trawlers), thereafter decreasing profitability brought the active fleet down to only 22-24 vessels in the past five years. This renders the cap of 31 trawl license set in 1995 as irrelevant (EDELIST, 2013). The total number of days at sea showed a similar trend and peaked at an annual mean of 6,233 days/year^{-1} during 1997-2001. As fishing became less profitable, it later fell to 4,352 days/year^{-1} during 2006-2010 (EDELIST, 2013). Meanwhile, the mean engine power in the fleet has been steadily increasing, from 146 hp in 1950 to 214 hp in 1990 and then to 305 hp in 2010 (EDELIST, 2013). Israeli trawlers are considered average sized in Mediterranean terms - 15-24 m Length Overall (LOA), 40-200 Gross Register Tonnage (GRT) with 235-450 hp engines. They engage in 1-4 day fishing trips, targeting mainly fish in the daytime and shrimp at night in the shallows (catches of the valuable invasive Kuruma prawn *Marsupenaeus japonicus* have increased substantially since the 1970s).

The fleet is based in the ports of Haifa (Kishon), Jaffa and Ashdod (Fig. 1) and, in recent years, their effort has constricted to the shallow fishing grounds of <100 m depth. In fact, since 2005, grounds deeper than 200 m have been almost un-used due to the decline of deepwater hake stocks, rising deepwater fishing costs and low prices for red shrimp and other deepwater species (EDELIST, 2013).

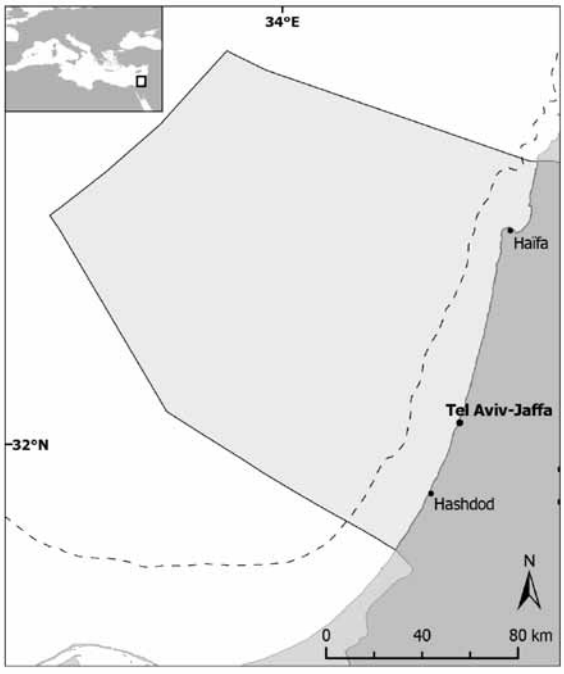

Fig. 1. The Exclusive Economic Zone of Israel (based on default UNCLOS principles; www.seaaroundus.org), as well as the main fishing grounds on the Israeli continental shelf (approximated by the 200 m depth contour, dashed line) and the three main fisheries landing ports. Potential fishing grounds to the west of this area are un-used, except by the small seasonal bluefin tuna fishery. Modified from EDELIST et al., (2011)

The inshore fishery

The Israeli coastal fishing fleet in the Mediterranean increased rapidly from 77 small vessels in 1948 to 212 in 1951, and 317 in 1960, and thereafter consisted of 300-600 licensed vessels. In recent years, ~300 artisanal vessels and ~1,500 fishers are reported in DoFSY. However, less than a third of these fishers support their families by fishing today and nearly two thirds of the vessels are idle (EDELIST, 2013). These small (<7 m) 'Hassacke' or 'Lunge' vessels, normally made of fibreglass-coated wood, are more or less evenly distributed along the Israeli coastline, and are docked at 16 embayments. The majority of this artisanal fleet is comprised of gill and trammel-netters and about a quarter are bottom long liners. Some of the fishers may alternate seasonally or inter-annually between these two static gear methods. Vessel propulsion has changed from oars in the 1950s, to 10-25 hp

engines in the 1960s, to 25-50 hp in the 1970s and 1980s, and then on to the 55-120 hp engines used today. This increase in fishing power has allowed boats to carry and deploy larger gear, but also to cover longer distances. For example, a fisher who once deployed 200-500 m long nets just outside his home port may now travel up to 40 km to look for fish and deploy nets as long as 2 km (EDELIST, 2013). Overall, neither catches (which declined significantly), nor fish prices seemed to be able to compensate for the increase in fuel expenses and overcapacity, and overfishing has become problematic in the last decade (EDELIST, 2013). Total catches are today considerably lower, to a large extent because total days at sea have declined. EDELIST (2013) notes that a mean of 1,235 ± 433 t/year^{-1} were landed by inshore fishers from 1950 to 2003 according to DoFSY. However, the mean catch for 2004-2009 was significantly lower at 845 ± 131 t/year^{-1}, underpinning the inshore artisanal crisis.

The pelagic fishery

In earlier decades, the purse seine fleet in Israel consisted of 28 vessels operating out of Akko, Kishon, Jaffa and Ashdod ports, with Atlantic chub mackerel (*Scomber colias*) and little tunny (*Euthynnus alletteratus*) as significant target species. Only 10 of these vessels are still active today, and most of them fish only sporadically, employing about 50 fishers, some of them alternating between purse-seining and the inshore fishery (EDELIST, 2013). The peak days of purse-seining in Israel were from 1960 to 1975, when mean catches of 1,415 t/year^{-1} were landed by Israeli purse seiners owned by small cooperatives (KIBBUTZIM; EDELIST, 2013). Following construction of the Aswan Dam on the Nile River, the Kibbutzim quit purse seining. The decline of this fishery was accelerated by free trade agreements that Israel signed with Europe, marking the end of state-controlled seining, and enabling the canning industry to rely on imports rather than local production (BEN YEHOYADA, 2005). From 1975 to 1999, annual landings dropped to 1,062 t/year^{-1}, then to 418 t/year^{-1} from 2000 to 2007, and only 130 t/year^{-1} were landed in 2009-2010 (EDELIST, 2013). Thus, in the case of purse-seining, falling catches do not reflect only declining stocks. They stem mostly from effort reduction, due to lack of local markets (almost all of the small pelagic catch is exported to the Gaza Strip today; see also ABUDAYA *et al.,* 2013), driven by low prices for pelagic fishes in Israel, and the reluctance of canning factories to accept local raw material. A recovery in the Egyptian pelagic fishery that coincided with large increases in fertilizer run-off and sewage discharge from the Nile River and the adjacent coast is not paralleled in Israel, as neither the fertilizer (SUARI & BRENNER, 2012) nor the recovery appear to have reached the Israeli coast.

The recreational fishery

There has always been some recreational fishing in Israel; however, catches of this sector were never reported and hardly any information exists about the scale of recreational catch or effort. Only recently has a study of this fishery been launched at Tel-Aviv University (SCHULZ *et al.,* 2011) and it sheds some light on the growing scale of this sector. As the population of Israel quadrupled since 1950, the recreational fishery has also grown considerably. However, most of this growth was during the last decade (SCHULZ *et al.,* 2011), and today more than 70,000 Israelis are estimated to contribute significantly to fish extraction from the sea through their recreational activities. From the earliest days of SCUBA diving, there were spear-fishers searching the coastal waters mainly for high-priced groupers. Although this practice was outlawed by a fishery ordinance in 1956, the regulation was very loosely enforced, and the Department of Fisheries has even allowed some 30 SCUBA fishers to keep practicing it legally, through a special permit. These are counted as artisanal fishers in the present study, but we wish to note here that some illegal, unmonitored SCUBA fishing activity is still taking place. Similarly, beach seining, which was outlawed in 1998, is still common on certain beaches. In the recent decades, spear fishing by free divers (not SCUBA) has increased considerably, and this sector was estimated to

land more groupers than the entire commercial fleet (SCHULZ *et al.,* 2011). Angling has also been a traditional pastime for Israelis, mainly as shore-based rod and line fishing, which provides the majority of recreational landings. This sub-sector has, in the last decade, seen a considerable increase in both popularity and use of improved equipment, mirrored by the recent onset of jig-fishing and trolling from kayaks and yachts. In general, recreational fisheries place a growing fishing pressure on the sensitive, scant rocky habitats and especially on shallow rocky nurseries and spawning grounds (SCHULZ *et al.,* 2011).

MATERIAL AND METHODS

Reported landings

Department of Fisheries Statistical Yearbooks (DoFSY)

We assess the reported landings based on the data reported in the Department of Fisheries Statistical Yearbooks (DoFSY). DoFSY are the only existing long term (time series) account of fishing in Israel, dating back to 1948. They vary in taxonomic resolution from species to phylum level, fail to account for discarded or recreational catch and suffer from the same inherent caveats as most fishery landings data – mainly underreporting and inconsistency in reporting due to differences and variation in personnel, expertise and methodology (HILBORN & WALTERS, 1992). The industrial (trawl) and artisanal landings they report were collected from 1948 to 2010 with notable gaps: for 1988-1996, 1999-2003 and 2008. Fishery catches were either not reported at species or family level, or extrapolated from other yearbooks (each yearbook also contains a table of total annual landings for the preceding decade, which we used to fill gaps). Moreover, the use of local, common and scientific nomenclature generally tended to group several fish species into a single common name for the commercially important species (but also, at times, the same species was assigned different names). In our reconstruction, as a rule of thumb, whenever a value was missing (e.g., for a certain species or year), we extrapolated it linearly from the years prior and following the gaps. In rare cases, we found and fixed discrepancies between DoFSY and FAO, such as the inadvertent omission of 609 t of artisanal catches in 1994, which were missing from the FAO data.

Most of the landings from 1948 to 1984 were sold in an organized collective manner by the Tnuva cooperative (a state-wide agricultural produce marketing cooperative). Until 1984, DoFSY data were derived from reports of the cooperative, as well as through port surveys and, for trawlers, querying the fishers via the Fishery VHF Radio. The cooperative exited the fishery in 1984 and the Fishery VHF Radio was terminated in 2000. Since then, fishing effort data were collected by port surveys and daily landing reports completed by some of the vessels. From 2005-2007 and 2009-2010, students from the University of Haifa carried out the port surveys and in the latter period, taxonomic resolution was improved from 25 to >70 species (reduced to 40 taxa in the final reports).

In the inshore sector, longline and entangling net catches were typically reported together as 'inshore fishery', with purse seining sometimes reported separately. In our present study, however, we consider all of these as 'artisanal'. Inshore fishery data were generally less reliable due to the large number of vessels and landing sites, and the problems associated with elevating sampled catch and effort to fleet level. The number of active artisanal vessels itself was at times erratic, as intermittent regional conflicts altered spatio-temporal fishing patterns.

Finally, discards, as well as pelagic longlining, subsistence and recreational catches were never reported in DoFSY.

Unreported removals

Discards

We base our estimates of discards mainly on the work of EDELIST (2013), who conducted trawl surveys in two periods, which we use as anchor points: a) 324 trawl hauls conducted in 1990-1994 yielded a 28.3% discard rate, and b)

for 2008-2011, this figure increased to 47.2%. There are several likely reasons for the increase in discards observed between the 1990s and the late 2000s: The fleet has moved to shallower waters over this time, where fish assemblages are more diverse and are characterized by smaller species. As gear size and engine power of the fleet increased while mesh size decreased in this period, increasing rates of unwanted by-catch and hence discards were likely. Furthermore, many newly added shallow Lessepsian species are small (e.g., Apogonidae) or venomous/poisonous (e.g., Plotosidae\Tetraodontidae) and are thus discarded, further adding to the increase in discard rate observed For the period 1950-1994, the first rate (28.3%) was applied. Between 1994 and 2008, discards were interpolated by an incremental linear increase from 28.3% to 47.2% and for 2008 to 2010, the second anchor point rate of 47.2% was applied. Taxonomic breakdown to 30 taxa according to the 1990-1994 and 2008-2011 surveys was appropriately assigned to the total annual discards with removal of invasive species prior to their establishment. For the artisanal inshore fisheries, discards were estimated very conservatively at a much lower 3% for the entire period.

Recreational catch

The catch and effort of recreational fishers were never officially reported or evaluated in Israel. Recently, however, SCHULZ *et al.* (2011) conducted extensive in-depth catch and effort surveys for this sector and its sub-sectors. Here, we extrapolated from their survey, conducted during November 2010 to November 2011 along the Israeli Mediterranean coast. Most of the fish in their survey were caught by anglers (81%), a smaller proportion by spear-fishers (14%) and the rest (5%) by other methods such as nets. The estimated catch was 837 t of fish, out of which invasive species contributed 47% of the total biomass. SCHULZ *et al.* (2011) also show the growth in the recreational fishing activity along the Israeli Mediterranean coast, as a function of the median experience (8.5 years) and the average age of the fishers (48.5 years ± 11) (n = 500), suggesting that the recreational fishing effort has doubled during the last 10 years. Therefore, we based the reconstruction on 837 t/year^{-1} for the year 2010 and decreased catch exponentially back to 400 t/year^{-1} in the year 2000. From 2000 back to 1970, total catch was decreased linearly by 10 t/year^{-1} and levelled off at 100 t/year^{-1} in 1970 – which we present here as a very approximate and likely conservative estimate for the 1950-1970 period. Species breakdown was extrapolated for the whole period based on information in SCHULZ *et al.* (2011). Invasive species were omitted from years preceding their dates of establishment in the Mediterranean (e.g., *Sillago sihama* was omitted prior to 1977 and its share in the previous catch was reassigned to 'other species').

Bluefin tuna pelagic longline catch

The Israeli bluefin tuna fishery began in 2000 and by 2003 reached 16 t. However, these catches were generally absent from DoFSY. Prior to this date, tuna and billfish catches were sporadic and probably did not exceed 1 t/year^{-1}. Atlantic bluefin tuna (*Thunnus thynnus*) enter the Mediterranean to spawn in the spring, when Israeli pelagic longliners often catch them with ripe gonads. Other species include mainly swordfish (*Xiphias gladius*), marlins (Istiophoridae), albacore tuna (*Thunnus alalunga*), dolphinfish (*Coryphaena hippurus*) and some yet unstudied bycatch of sensitive pelagic shark populations. The 5-10 vessels in this fishery operate mainly beyond 12 nm offshore, typically deploying 30-50 km of lines per vessel. Data anchor points used here are 5 t/year^{-1} for 2000-2002, 16 t/year^{-1} for 2003-2007 and 20 t/year^{-1} for 2008-2010. Other species (1-4 t/year^{-1}) included swordfish, marlins and albacore.

Subsistence catch

DoFSY routinely state that published landings do not include the fishes taken home to be consumed by fishers and their families or, in the trawling sector, consumed at sea. This 'subsistence' fraction of the catches, which was

never monitored, is thus estimated here at a conservative 2% of the landings, based on personal observation by the senior author while working as a fishery surveyor, as well as interviews with fishers and fishery managers.

RESULTS

Israeli landings reported by FAO on behalf of Israel for the entire 1950-2010 period were 258,816 t, comprising artisanal and industrial landings only (Fig. 2a). However, ~ 60,000 t of these landings are attributable to landings by Gaza fishers along the Gaza Strip during the 1960s and 1970s (Fig. 2a), and were re-assigned to the Gaza Strip (ABUDAYA *et al.,* 2013). Thus, adjusted reported landings of Israel proper were 198,614 t (Fig. 2a). Adding discards (37,469 t), back-calculated recreational estimates (15,687 t), and estimated subsistence sector catches (3,930 t) as derived here to the adjusted reported landings resulted in an estimated total removal of 255,000 t (Fig. 2b). Thus, total catches by Israel's fisheries were 28.9% higher than the adjusted reported landings data would suggest over the 60 year time span covered here.

The artisanal sector (small-scale commercial) accounted for the largest overall catch, with over 127,000 t over the entire time period (of which an estimated 3,700 t were discards), or 50% of total reconstructed catches (Fig. 2a, b). The decline in the artisanal sector began with the commercial collapse of the purse-seine sardine fishery in the late 1970s, which is the most conspicuous trend in the historical species breakdown (Clupeidae, Fig. 3). The industrial sector (large-scale commercial) trawling accounted for slightly over 108,000 t (Fig. 2a, b), but had the largest discards component of 33,700 t. Significantly, the portion of recreational catches have increased substantially over the last decade, and by 2010 (837 t/year^{-1}) recreational catch estimates accounted for 20% of total catches (4,280 t/year^{-1}) being taken by Israel in the Mediterranean (Fig. 2a, b).

Taxonomically, besides the early decline in sardines, goatfishes (Mullidae) have also declined substantially in catches (Fig. 3), mainly

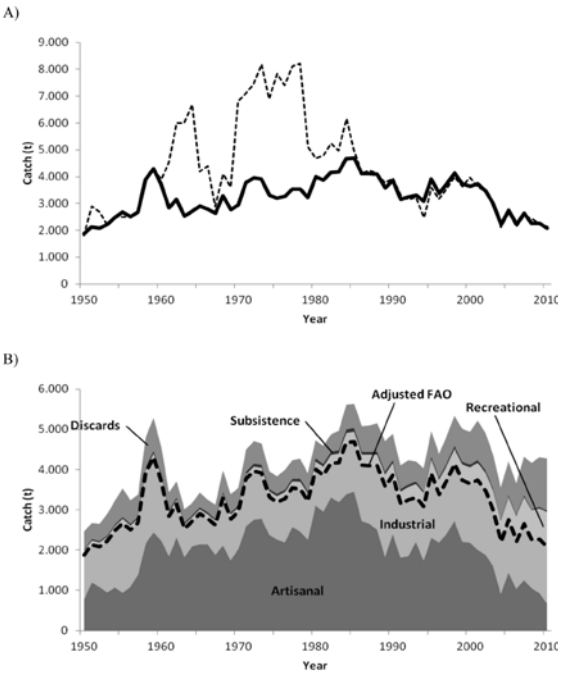

Fig. 2. Fisheries catches in the Israeli Mediterranean for the period 1950–2010; A) Official landings reported by FAO on behalf of Israel (dashed line) versus the Israeli national data (solid line), illustrating the disparity due to landings by Gaza fishers from the Gaza Strip during the earlier decades being miss-assigned to Israel in FAO data. Adjusting for this miss-assignment produces an adjusted reported FAO landings baseline used for the present study. B) Total reconstructed catch by fisheries sector (plus discards), with the adjusted reported FAO landings baseline overlaid as a dashed line

the indigenous *Mullus* spp. (EDELIST, 2013). Furthermore, the non-indigenous species (*Upeneus* spp.) and the non-indigenous lizardfish *Saurida undosquamis* are still a mainstay of the trawl fishery, as is a more recent Lessepsian migrant, the threadfin bream *Nemipterus randalli,* believed to have displaced indigenous breams since its establishment in 2006 (EDELIST, 2013).

The overall catch of carangids and sparids, which in the past was based mainly on the deeper water species, *Trachurus* spp. (Carangidae), bogue *Boops boops* and the common pandora *Pagellus erythrinus* (Sparidae) stayed relatively stable due to a shift to recreational catches of shallow water species, *Diplodus* spp. and epipelagic *Seriola* spp., representing the increasing fishing pressure on the already overexploited

coastal resources. Grouper (Serranidae) catches have also declined (Fig. 3) and they are also caught today mainly by the recreational sector (SCHULZ *et al.,* 2011).

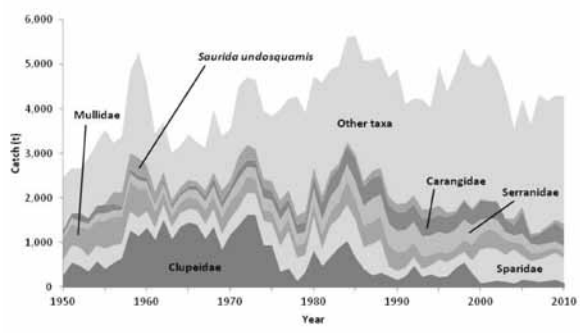

Fig. 3. Total reconstructed catches by major taxonomic components. While the decline of the sardine fishery is evident (Clupeidae), trends for other taxa are less pronounced

DISCUSSION

Overall, the discrepancy of nearly 30% between reported and estimated total catches taken by Israeli fisheries in the Mediterranean between 1950 and 2010 (after adjusting for miss-assigned catches taken by Gaza fishers, ABUDAYA *et al.,* 2013) is equivalent to the under-reporting documented for other developed countries e.g., European countries in the Baltic Sea (ZELLER *et al.,* 2011b), although in some cases the difference can be substantially higher even for developed countries (ZELLER *et al.,* 2011a).

Consistent with other countries is also the fact that the main discrepancy is due to unreported discards, which are generally not included in official statistics by most countries. This omission may be understandable from an historic perspective, in which fisheries data collection was driven by economic and market development purposes (WARD, 2004), and hence emphasis was on marketable landings rather than actual catches (i.e. removals). However, these days this emphasis must change with the accepted and growing emphasis on ecosystem considerations in fisheries and ocean management. Thus, inclusion of all removals in official statistics, including discards, is essential for a comprehensive accounting of human impact on marine ecosystems, and should facilitate improved fisheries management.

Of substantial interest was the finding that recreational fisheries have taken such a significant role in catches in Israel in the last 10 years, accounting for nearly 20% of total catches (or 28% of landings, if one ignores discarding). While recreational fisheries are of increasing importance in many developed countries (COLEMAN *et al.,* 2004; ROSSING *et al.,* 2010; ZELLER *et al.,* 2011b), at present we know of only one case of higher recreational contribution to catches (i.e., The Bahamas, SMITH & ZELLER, 2013). Clearly, this sector requires detailed examination and scrutiny by scientists and focused attention by fisheries managers as well as policy makers in Israel.

Furthermore, the general trend, of an increase in removals until the mid-1980s and subsequent decline of the artisanal sector are hallmarks of fully exploited, and likely overexploited resource.

The acceleration in Lessepsian migration is altering extracted species composition in the Levant (EDELIST *et al.,* 2013). In the recreational sector, SCHULZ *et al.* (2011) now estimate that 32% of the catches are invasive spinefeet (*Siganus* spp.). Other important groups that were not represented in Fig. 3 due to inconsistent or lack of taxonomic breakdown were the main invertebrates – crustaceans and cephalopods. The main crustacean species are the shallow-water invasive Kuruma prawn *Marsupenaeus japonicus* and the swimming crab *Portunus pelagicus*, which have proliferated in the catch in recent decades, and indigenous deep-water red prawns *Aristeomorpha foliacea* and *Aristeus antennatus,* which recently declined in catches. The main cephalopod by far in the catch is the longfin squid *Loligo vulgaris* caught by trawl, with cuttlefish and octopi less prevalent.

In conclusion, the state of knowledge on marine resource use in Israel is not as bad as some might think and certainly does not merit the current lax and seemingly ineffective management, as some stakeholders claim. As Israel still relies more heavily on a destructive (WATLING & NORSE, 1998) industrial bottom trawl

fishery than any other Mediterranean country (EDELIST, 2013), as fish catches in the unregulated recreational sector surpasses artisanal catches, and as fishery management has taken an extremely passive approach in Israel, we urge all stakeholders to strive to exploit resources in a much more sustainable manner, both socio-economically and environmentally.

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Izrael: Rekonstruirane procjene ukupnog izlova u Sredozemnom moru, 1950.–2010.

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SAŽETAK

Tijekom proteklih šest desetljeća, FAO je davao izvješća o ulovu (iskrcajnom ulovu), ali ne i o ukupnom izlovu za Izrael. Stoga, javni podaci ne uključuju sve izlove, uključujući odbačeni ulov, ulov u rekreacijskom ribolovu, ulove u dopunskom ribolovu kao i ulove plavoperajne tune. Štoviše, FAO podaci nehotice uključuju i ulov ribara u pojasu Gaze tijekom 1960-ih i 1970-ih. Rekonstruirani su ukupni izlovi za Izraelski ribolov u Sredozemnom moru, koristeći razna polazišta iz nedavnih studija kako bi se obračunali nedostajući podaci o sveukupnom izlovu. Procijenjen ukupni izlov iznosi nešto više od 255.400 tona za razdoblje od 1950.-2010., koji je gotovo 30% veći od 198.136 t izraelskog prijavljenog ulova prema FAO (nakon odbacivanja podataka iz pojasa Gaze). Glavne komponente neprijavljenih izlova su: odbačeni ulov (preko 37.400 t), u kojem dominira koćarski ribolov, i rekreacijski izlov (preko 15.500 t), koji čini veliki i brzo rastući sektor ribarstva u Izraelu. Nasuprot tome, ulovi u dopunskom ribolovu (nešto manje od 4.000 t) su niski, što i nije neočekivano za razvijene zemlje. Strani organizmi iz Crvenog mora su velika i rastuća komponenta u ulovima mediteranskih ribara, no čini se da će isti promijeniti sastav vrsta kao i način iskorištavanja živih bogatstava znatno više nego što recimo utječu na razini ukupnog izlova. U vrlo oligotrofnom, ali i brzo mijenjajućem Levantskom moru, velike količine odbačenog ulova, postojeća uporaba neodrživih metoda ribolova kao i slabo reguliran ribolov (osobito unutar rekreativnog sektora) predstavljaju prijetnju integritetu morskog ekosustava te ujedno time i onome što možemo očekivati od njega .

Ključne riječi: rekonstrukcija ulova, priobalni ribolov, tradicionalni ribolov, dopunski ribolov, IUU ulovi