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Correcting mis - and under-reported marine fisheries catches for the Gaza Strip: 1950-2010

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Total marine fisheries catches were estimated for the Gaza Strip from 1950-2010 by reconstructing past catches and accounting comprehensively for all fisheries sectors and components. Landings data are reported by the Food and Agriculture Organization of the United Nations (FAO) separately for the Gaza Strip since 1995 and represent the official records. These only cover the larger-scale commercial sector. Prior to 1995, FAO landings data for Gaza were reported as Israel's landings data. Here, these miss-assigned landings were rectified by re-allocating these data to Gaza. Thus, the reported baseline (i.e., a portion of FAO landings data reported for Israel and those reported for Gaza) totalled 97,920 t over the 1950-2010 time period. In contrast, reconstructed total catches for Gaza were estimated at over 227,000 t, which translates to 2.3 times the reported baseline. The majority of unreported catches were from the small-scale commercial (i.e. artisanal) and non-commercial sector (i.e. subsistence) with artisanal catches representing 96.5% of the total small-scale catch.

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

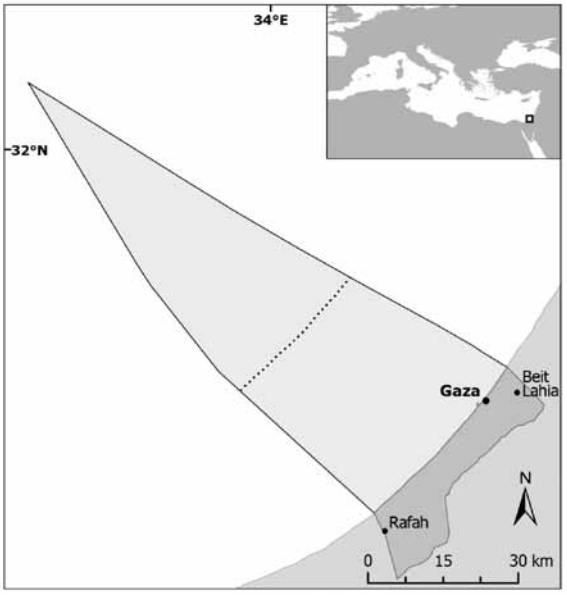
INTRODUCTION

The Gaza Strip is a narrow stretch of land lying along the south-western portion of the Palestinian coastal plains located between longitudes 34° 2' - 34° 25' East and latitudes 31° 16' - 31° 45' North (Fig. 1). It has a land area of 365 km^2 and extends along the south eastern Mediterranean coast. The Sinai Desert is located to the south, the Negev Desert to the east, Israel to the north and the Mediterranean Sea to the west (MOPIC, 1996). The Gaza Strip is divided into five administrative areas: North Gaza, Gaza, Middle, Khan Younis and Rafah governorates.

The Gaza Strip is considered one of the most densely populated places in the world, with more than 1.65 million residents (PCBS, 2012). This population is concentrated in four cities, a few villages, and eight refugee camps.

The marine component of the Gaza Strip is regionally recognised as the area along the coast that stretches up to 20 nautical miles (nm) offshore (Fig. 1, dotted line). Not all of these waters can be used for fishing. The marine area has been divided into three distinct Maritime Activity Zones, named K, L and M. Zones K

and M are border buffer zones, zone K between Gaza and Israel (20 nm offshore and 1.5 nm wide) and Zone M between Gaza and Egypt (20 nm offshore and 1 nm wide). Navigation is restricted within these zones. Zone L extends 20 nm offshore and is open to fishing by fishers from the Gaza Strip according to the 1994-1995 Oslo agreement. However, as Israel has resisted implementation of this agreement, fishing was further limited to within 12 nm, reducing the total fishing area to about 660 km^2 (MELON, 2011).



Figs.1. Map of the Gaza Strip, its 20 nm marine restriction area (dashed line) and its theoretical 200 nm Exclusive Economic Zone (solid lines)

Since the second Intifada (in 2001), Israel's government has been progressively restricting Gaza fishers' access to the sea. Thus, in 2006, the fishing zone was further reduced to 6 nm. Following the Israeli operation "Cast Lead" (2008-2009), Israel banned Gaza fishers from operating beyond a distance of 3 nm from shore, thereby preventing them from accessing 85% of the maritime area they are entitled to according to the 1994 Gaza-Jericho Agreement (MELON, 2011). Occasionally, this leads to conflicts between Gaza fishers and the Israeli military (AKRAM & RUDOREN, 2012). On the other hand, the spatial restriction (if comprehensively enforced) may have served as an involuntary marine reserve (i.e. no-take zone) for fish stocks beyond 3 or 6 nm.

Currently, there are around 2,500 fishers in the Gaza Strip and a further 2,500 people working in affiliation with the fishing industry (MELON, 2011). When Israel began restricting access to fishing areas, there were approximately 10,000 fishers. Including fishing industry workers and families, it is estimated that the total population affected by the buffer zone restrictions was around 65,000 (UNOCHA, 2010). Moreover, the increased restrictions have substantially reduced both the quantity and quality of fisheries catch. Thus, nearly 90 percent of fishers are now considered either poor (with a monthly income of between US$ 100 and US$ 190) or very poor (earning less than US$ 100 per month), which constitutes a sharp increase from 2008 when 50% of fishers fell into these categories (ICRC, 2010).

The coastal and marine environment of the Gaza Strip is facing large and serious threats. The small Gaza Strip contains a rapidly growing human population, and the limited land resources, the physical isolation of the area and the underdeveloped environmental management systems have caused serious problems. These problems relate to pollution of the coastal zone and seawater, deterioration of natural resources and natural habitats, and diminishing fish populations. The fisheries and tourist sectors, as well as the domestic agricultural sectors are directly affected by these impacts.

Fishing fleet

The latest survey of the fishing fleet (MENA, 2001) indicates that there are over 700 vessels and 2,500 fishers involved in fishing activities (Table 1). An un-motorised hasaka is a small vessel (about 3 m) with a closed deck that is handled with oars by fishers standing on the deck. The motorised hasaka is a relatively small vessel, with a length of 5.5–6.5 m. A flouka is also a small vessel without deck and has a length of 5 - 8 m. Shanshula hasaka are slightly larger at about 7.5 m in length. Trawlers are larger vessels, between 16-27 m long.

Table 1. Number and types of vessels, value of each vessel type and the total value of the fishing fleet by region. Total number of fishers using each vessel type is also shown

Type of vessel	Vessel length (m)	Gaza	Deir el-Balah	Khan Younis	Rafah	Total no.	Vessel value (US $)	Total value (US $)
Flouka	5-8	92	3	37	26	158	2,000	316,000
Hasaka (un-motorised)	3	86	8	3	-	97	1,000	97,000
Motorised *hasaka*	5.5-6.5	198	46	44	33	321	6,000	1,926,000
Shanshula hasaka	7.5	39	19	4	11	73	6,000	438,000
Shanshula boat	7.5	36	-	11	8	55	40,000	2,200,000
Trawler	16-27	15	-	-	-	15	100,000	1,500,000
TOTAL Vessels		466	76	99	78	719	n/a	6,477,000
Number of Fishers		1,370	327	532	276	2,505	-	-

Fishing methods and gears

Many fishing methods and gears used in the Gaza Strip have been used traditionally for many decades (Table 2). However, since the 1960s there have been many changes to fishing gears, techniques and vessels, and many traditional gears are now banned (Table 3).

Table 2. Fishing gears currently used by the fishers of the Gaza Strip (MENA, 2001)

Fishing gear English name (local name)	History of use	Type of catch	Total No.
Fish Trawler (*Gar*)	After 1971	Benthic & epibenthic	15
Shrimp (Trawler)	After 1971	Shrimp	15
Purse seine nets (*Shanshula*)	After 1964	Pelagic & epipelagic	238
short seine			*56*[a]
long seine			*120*[a]
devil seine			*62*[a]
Beach seine net (*Garafah*)	Before 1948	Benthic & Pelagic	7
Fixed drift net (*Zeda, Boshlalah*)	Before 1948	Benthic, pelagic & epipelagic	75
Drift net (*Maltash*)	Before 1948	Sardines & flying fish	200
Shrimp Trammel net (*Monofil*)	After 1967	Shrimp	40-50
Fish Trammel net (*Monofil*)	Before 1948	Benthic & epibenthic	600-1000
Hand cast net (*Shabaka*)	Before 1948	Mullet	200-250
Hook and line (*Sharak*)	Before 1948	Benthic & epibenthic	138-172

[a] subset of total purse seine nets

Table 3. Traditional fishing gears previously used in Gaza but currently banned

Fishing gear		Type of catch	Year of ban
English name	Local name		
Floating trammel net	Edit Al Bosse	Mullets	1948
Large hooks	El Helb	Large sharks	1948
Surrounding net or Lampara	Edit Al Lux	Pelagic	1965
Shark gillnets	El Mada	Sharks	1967
Gillnet	El Boshlalah	Drums, meagres	1967
Shallow water gillnets	El Qata	Drums, meagres	1967
Scoop baskets	SalitEl Sonnar	Assisted in line fishing	1967
Beach seine net	Garafah	Coastal fishes	2000

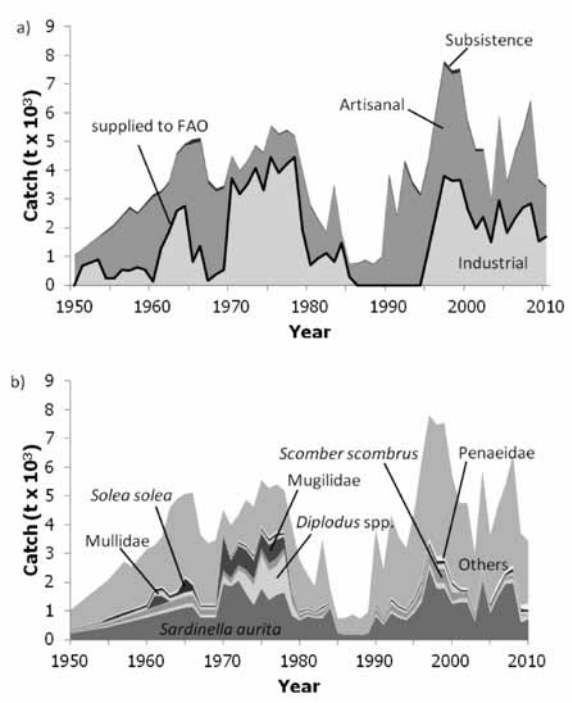


Fig.2. Gaza Strip fisheries data, showing a) Total reconstructed catches for the Gaza Strip, showing both the landings data of the large-scale commercial (i.e., industrial) sector as reported to FAO on behalf of Gaza (1995-2010) and via Israel (1950-1994), as well as the unreported small-scale sector catches (artisanal and subsistence) as reconstructed in the present study; and b) total reconstructed catch by major taxa, with 'others' representing 23 individually reported taxa and a miscellaneous marine fishes group

Bottom trawlers: Two types of bottom trawlers are used, a) fish trawlers which catch demersal and benthic fish; and b) shrimp trawlers, which fish nocturnally for shrimp. Semi-pelagic and mid-water trawlers are not used by fishers in the Gaza Strip. Trawlers fish continuously and land their catch once a day in the morning, when they also re-supply and change crews.

Surrounding nets: Two main types of surrounding nets are used, a) beach purse seine, which is known as Jarafah, pulled by fishers on the beach; and b) off-shore purse seine, which are known as Shanshula. This type of purse seine is used at different depths to catch pelagic and epipelagic fish, such as flying fish and sardines. Lights are used to attract fishes.

Drift nets: Two types of drift nets are used, a) drift nets with a large mesh size (Zida, 30-50 mm), which catch tuna at different depths; and b) drift nets with a small mesh size (Maltash, 10-20 mm), to catch sardines.

Gillnets: Two types of gill nets are used, a) Quta, with a length of about 20-30 m and deployed without a boat to catch shallow water coastal fishes; and b) Bushlela, which is similar to the quta, but longer and used in deeper water. Both gillnets are fixed at both ends by anchors or stones.

Trammel nets: A trammel net is a three-layered gillnet with an inner net that has a small mesh size (10-44 mm) and two outer nets that have a larger mesh size (240 mm). Fish will swim through the outer net into the inner net and get trapped. One type of trammel net is used to catch demersal fish. A similar type is also used to catch shrimp. Combinations of gill nets and trammel nets are not used in the Gaza Strip.

Hand cast nets: A type of net with a central line and without pockets, which is used by fishers mainly to catch mullet in shallow coastal waters.

Hook and line of different sizes are known as Sharak, which are used to catch groupers and other demersal and benthic species, using bait. Floating or hanging lines are not used by Gaza Strip fishers.

Non-technical gears, such as bottles, are also used by fishers and non-fishers. Plastic bottles with a lateral cut are used to attract very small fish (fry) near the beach by swimmers. This includes juveniles of many species of fish found during the spawning season near the beach. The sand steenbras (*Lithognathus mormyrus*), for example, is particularly threatened by this method of fishing. Rod-fishing is also practiced by many people along the beach.

Overfishing

There are serious concerns about overfishing of pelagic and demersal fish in the waters of the Gaza Strip. In the Gaza marine zone there is a high density of fishers and there is evidence of catches of undersized and juvenile fish. In addition, there seems a significant problem of discarding, but detailed figures are not known. The large trawlers catch demersal fish, and this

gear is the biggest threat to the marine resources of the Gaza Strip.

However, even in the shallow coastal zone, fish species are under severe pressure. Fishers use beach shanshula (purse seine fishing) to catch small, juvenile fish, which cannot grow to adult reproductive size. Another method used in shallow waters is catching fry (very small fish) using plastic bottles. This also affects many species of fish usually found during the spawning season near the beach.

Based on the complexity of the situation and the available data for catches, it is not possible to state with certainty what level of overfishing is occurring. In order to assess this problem, the fish populations and fishing effort in the greater surroundings of the Gaza coastal zone would have to be analysed, i.e., requiring analyses at the scale of stocks. At present, there are no detailed data or accurate estimates available of the sustainable yield of these fisheries. There are also no data on fish production within the Gaza marine zone. In studies conducted by the Marine Institute International (MENA, 1999), fishers in three fishing communities raised concerns that too much fishing effort was imposed on the fish populations. The potential "no-take" marine reserve effect of the spatial restriction enforced by Israel can also not be examined.

Fishing port

A new Gaza fishing port that is planned south of Gaza City may have significant impacts on coastal erosion and beach stability. On the other hand, the port may provide rocky substrate and shelter as an environment for juvenile fish. However, this would require that the waters in the fishing port be kept clean and free of waste and oil spills (highly doubtful for any port development), and fishing not be allowed in or near the fishing port (questionable given existing enforcement problems).

Population

The Palestinian Central Bureau of Statistics (PCBS) conducted the last national population census for Palestine in 1997. At that time, the total population for Palestine (Gaza Strip and the West Bank) was 2.9 million (PCBS, 2000). The population in the Gaza Strip has reached approximately 1.6 million people in 2010, with an annual growth rate of 3.9%. The average population density in the Gaza Strip is over 4,300 persons/km^{-2}, while in the refugee camps of the Gaza Governorates it is substantially higher, ranging from 29,000 to 100,000 persons/km^{-2}. This plays a critical role in the planning and management of water and sanitation resources impacting coastal environments. The economic situation in the Gaza Strip is directly affected by the political situation. Israeli procedures like closures, prohibition of export and import from and to the Gaza Strip are significant factors that have resulted in a decreasing trend of *per capita* income. The Gross Domestic Product (GDP) had dropped to US$ 600 per capita by 2002 and it is expected to be much lower at present due to the continuous instability of the political situation (PCBS, 2001). This significantly impacts fishing activities and fishing effort, with beach-based fishing likely growing in significance for subsistence and alternative livelihood purposes.

MATERIAL AND METHODS

Reported marine landings data were obtained from FAO FishStat for Gaza, but include only landings from 1995-2010. Prior to 1995, landings for the Gaza Strip appear to have been included in Israel's landings data, as is noted in the 1995 FAO Yearbook notes (FAO, 1995). Thus, in order to derive the complete reported baseline of FAO landings by Gaza fishers in the Gaza Strip from 1950-2010, the Gaza portion of Israel's FAO data had to be determined and extracted from Israel's FAO data first. This was accomplished in coordination with the Israeli scientific team conducting Israel's catch reconstruction (EDELIST *et al.,* 2013), and involved comparing Israel's FAO landings dataset with Israel's national reported data time series. The difference between these datasets was deemed to be Gaza's reported landings for the 1950-1995 time period. This derived data time series was combined with the FAO data for Gaza (1995-

Table 4. Data sources used for the reconstruction of marine fisheries catches of the Gaza Strip

Type of Data	Time period	Source
Fish catch	1967-2010	Ministry of Agriculture (General Directorate of Fisheries) and Palestinian Fishers Syndicate. Details per species are available.
Marine landings	1950-1994	Through subtraction of national Israel data from FAO Israel data
Marine landings	1995-2010	FAO data for Gaza
Number of fishers	1968-2010	Palestinian Fishers Syndicate and Ministry of Agriculture (General Directorate of Fisheries)
Population	1950-2012	Palestinian Central Bureau of Statistics

2010) to derive an adjusted reported landings baseline.

Separately, Gaza's catches were estimated using Gaza national data from the General Directorate of Fisheries in the Ministry of Agriculture for the 1967-2010 time period (Table 4). For earlier time periods, number of fishers and catch rates per fisher were utilised (Table 4). Annual fisher numbers were obtained from the General Directorate of Fisheries for 1968-2010 and for some years from 1950-1967. The catch rate per fisher was estimated based on the average number of fishers for 1968-1970 and the catch for the same period. For 1955 and 1965, the number of fishers as a fraction of the total population was used to derive a complete time series of fishers from 1950-1967, assuming a linear relationship between number of fishers and population between 1950 and 1967. Then, the derived average catch rate was applied to the number of fishers to derive catch estimates for the 1950-1967 period.

Here, it was assumed that the FAO data represent only the large-scale, commercial sector. Other sectors, such as the small-scale artisanal and subsistence sector, are not monitored and/or accounted for in the official records. The difference between the reconstructed estimate and the adjusted FAO reported landings baseline was therefore considered unreported small-scale catches. The small-scale fisheries (artisanal and subsistence) largely represent the near-shore fisheries of the Gaza Strip, which play an important role, both culturally as well as a source of domestic food and income security. Yet, these fisheries often remain under-reported in statistics in many countries (ZELLER *et al.,* 2007a; ZELLER *et al.,* 2007b). In general, most of the people engaging in near-shore fishing sell the majority of their catches along the coast and on the roads close to the coast, rather than retaining this catch for self-consumption. Thus, for the purposes of this work, only 3.5% of the reconstructed small-scale sector catch was deemed subsistence (i.e., small-scale, non-commercial for self- and family-consumption), while the remaining 96.5% of unreported catch was treated as artisanal (i.e., small-scale, commercial). The small-scale sector mainly catches the following taxa: *Sardinella aurita* (round sardinella), Mugilidae (e.g., grey mullets), Portunidae (swim crabs), *Sphyraena sphyraena* (European barracuda) and Synodontidae (Lizardfishes).

RESULTS

The reported adjusted landings baseline for Gaza, as provided by the FAO presents approximately 98,000 t for the 1950-2010 time period (Fig. 2a). This reported baseline was derived from non-Israeli landings reported to FAO by Israel (1950-1994) plus landings reported to FAO on behalf of the Gaza Strip (1995-2010). In contrast, the separately and independently derived total reconstructed catch for the 1950-2010 time period was estimated to be slightly over 227,000 t (Fig. 2a). Thus, the total reconstructed catches were 2.3 times higher than the

adjusted landings data reported on behalf of Gaza by FAO. The time series showed a similar trend over time with considerable annual variation. The total reconstructed catch was disaggregated, using the adjusted reported baseline, into reported and unreported components by taxa, as well as by sector (large-scale, artisanal and subsistence). The FAO data were assumed to represent only the large-scale (i.e., industrial) sector, whereas the unreported components were taken as representing the two small-scale sectors (Fig. 2a). Artisanal catches totalled over 124,000 t from 1950-2010, while the subsistence sector amounted to over 4,500 t over the same period. Total catches were dominated by round sardinella (*Sardinalla aurita*), Atlantic mackerel (*Scomber scombrus*), grey and red mullets (Mugilidae and Mullidae, respectively), common sole (*Solea solea*), and shrimp (Penaeidae; Fig. 2b). The remaining catch consisted of 23 individual taxa and a miscellaneous marine fishes group.

DISCUSSION

Total reconstructed catches for the Gaza strip were 2.3 times higher than the adjusted reported landings data over the 1950-2010 time period. The main reason for the substantial difference between these two estimates is that the data reported to FAO likely do not account for artisanal and subsistence catches. This is supported by the fact that official data collection in the Gaza Strip does not monitor, estimate or report these sectors. National data provided by the Palestinian Ministry of Agriculture are the only available official data.

The considerable inter-annual fluctuations and variations in catch are also noteworthy. These temporal trends have been strongly influenced by the political conditions in the Gaza Strip over time. Seven distinct stages can be identified:

1) The first stage was before the 1978 Camp David Accord, when the average catch was estimated at around 4,000 t/year^{-1}. During that period, the fishing area included both the waters off the Gaza Strip and the Sinai coast (now part of Egypt), i.e., a total area of over 75,000 km^2. Overall, the time series also shows a generally increasing trend from 1950 to the late 1970s (Fig. 2);
2) The second stage was after 1978, when the catch dropped to approximately 1,200 t/year^{-1} (Fig. 2). This period was marked by the withdrawal of Israel from the Sinai Peninsula, with the result that Gaza fishers were no longer allowed to fish off the coast of the Egyptian owned Sinai;
3) The third stage was between 1985 and 1989, when total production declined severely to the lowest levels of only 700 t/year^{-1} in 1985 (Fig. 2). This was due to several factors, including the establishment of Israeli settlements throughout the Gaza Strip, the uprising (Intifada), as well as the military restrictions imposing limited fishing zones;
4) The fourth stage was between 1990 and 1992, when total catches started to increase again, reaching 2000-3000 t/year^{-1} (Fig. 2). This may be the result of the previous reduction in fishing, allowing some fish populations to partially recover. In addition, it may be driven by improvements in fishing gears and the increase in the number of fishers, both resulting in increasing nominal as well as real effort (WATSON *et al.,* 2012);
5) The fifth stage started in 1994 after the Oslo agreement, when the total catch declined again. This decline may be due to the Israeli military restrictions resulting in reductions of the permitted fishing area from 20 nm to 12 nm ;
6) The sixth stage was between 1996 and 1999. This stage is marked by increasing catches, which may be due to better reporting by the Fisheries Department, the use of new fishing gears such as the hasaka shanshula, the use of new equipment such as sonar, and the improvement of fishing techniques, initiated by and supervised through international programs under co-operation of the Ministry of Agriculture; and
7) The seventh stage is the most recent time period since 2000, after the second uprising (Intifada), which shows ongoing declines of

fish catches due to increased Israeli fishing restrictions limiting fishing to only 3 nm off-shore.

Strategies for fisheries improvements

The issue of how best to manage littoral resource for artisanal fisheries is widely examined and studied in the Mediterranean basin, including closed areas and co-management options (MATIĆ-SKOKO *et al.,* 2011a; MATIĆ-SKOKO *et al.,* 2011b; STAGLIČIĆ *et al.,* 2011). There are numerous strategies that could be employed to address threats to the marine environment, and fisheries in particular. These strategies may be cross-sectored and may relate to structural measures as well as non-structural measures. This may also contain actions that have already been identified previously by different organizations. These possible strategies are briefly presented as they relate to fisheries.

1. Expansion of Gaza Fishing Zone.
   Over the past ten years, the Israeli military has gradually increased the restrictions on access to the fishing areas along the Gaza Strip coast. Since early 2009, Gaza fishers have been largely prevented from accessing the waters beyond 3 nm from shore. Thus, Gaza fishers are now prevented from accessing around 85% of the maritime areas they are entitled to access according to the Oslo agreements. The 3 nm limit enforced by the Israeli military prohibits Gaza fishers from catching sardines, which are usually found 5-8 nm offshore. The sardine market used to represent the main element of the Gaza fishery. However, this restriction has resulted in increasing imports of sardines from Israel (see EDELIST *et al.,* 2013). The potential catch lost as a result of access restrictions is estimated at approximately 7,000 t, with a related income loss of around $US 26.5 million over a period of five years (UNOCHA, 2010). On the other hand, the spatial restriction enforced on Gaza fishers may have served as a de-facto no-take marine reserve, and thus may have the potential to enhance longer term stock status and stock productivity. Very serious considerations should be given by Palestinian authorities on retaining and enforcing large-scale closures (e.g., 20-30% of all fishing areas and habitats) should the Israeli enforced restriction change at some time in the future. Obviously, this requires monitoring and enforcement capacities, something the Gaza Strip is lacking, especially for off-shore waters. Thus, identification and protection (permanent closures) of juvenile fish habitats in near-shore waters may benefit Gaza fisheries more readily, as such coastal and near-shore closures are more readily monitored and enforced.
2. Seasonal closure.
   Many countries around the Mediterranean (e.g., Egypt) control the fishing season which usually closes in summer (July and August). Seasonal closures can also be introduced in the Gaza Strip, and are relatively easily enforceable if they apply to all fishing sectors. However, often seasonal closures alone have a poor track record, as annual fishing mortality remains high. Furthermore, the implication is that fishers, and especially trawler crews, will be out of work for a period of two months. A possibility is to create other seasonal work for fishers, or to pay them for not fishing for a two month period as a subsidy for creating more sustainable fisheries. A Gaza fisher earns about $10 per day, in total there are 15 trawlers with a crew of 12 per vessel. For a period of 60 days, the total annual cost for such an approach would be $108,000, for the trawler fleet alone. Applying this to the entire population of fishers (around 2,500) would increase this cost to $1.5 million, assuming each fisher earns $10 per day and fishes seven days per week. Additional costs would include write-off of investments, maintenance and other costs.
3. Replace the bottom-trawlers with pelagic trawlers.
   Another possibility is to use the trawlers to catch small pelagic fish, such as sardines. This species is a migratory fish and is not so much dependent on local conditions and habitats as the demersal and benthic species. However, this strategy is conditional on strategy 1 (see above).

4. Prohibit the catch of undersized fish.
   At present, there is no law enacted and enforced with regards to the catch of undersized fish. There is a law from 1937 that proclaims a certain minimum legal size, but it is not enforced and likely not even known to most fishers. The Fisheries Department has therefore prepared a new law, the Fisheries Law for the State of Palestine, which is currently being reviewed and examined by the Ministry of Justice. Unfortunately, size regulations are very difficult to enforce and monitor, making this measure less likely to succeed.
5. Regulate fishing gear (mesh size).
   At present, nets that are used have very small mesh sizes. Using these nets leads to the catch of small, juvenile fish and also to a relatively large by-catch that may not be used and hence may be discarded. Specific data on the quantity of discards is not known at present. The new Fisheries Law will issue regulations on mesh-sizes, but it is not yet implemented. Unfortunately, mesh-size regulations are difficult to enforce and monitor, making this measure less likely to succeed.
6. Reduce local fishing pressure through other methods.
   A possibility is to promote deeper water fishing (this would require lifting the current spatial restrictions, see strategy 1) or to deploy new fishing methods, like floating lines or a combination of trammel nets and drift nets. However, fishers, fisheries managers and policy makers need to be aware of the negative side-effects. Other techniques may be useful in decreasing the number of fishers and effort, but more efficient fishing may lead to further deterioration of fish populations.
7. Implement a quota system for Maximum Sustainable Yield.
   At present, knowledge on maximum sustainable yield of the commercial fish species is lacking. For some species, it is obvious that the maximum yield has already been exceeded, other species, such as sardines, seem to support the high exploitation currently applied each year. Firstly, the maximum sustainable yields for the most important commercial fish species would have to be defined. This implies that stock sizes and growth rates have to be assessed. Secondly, quotas may be defined to ensure that fish stocks are not depleted. However, as is the case elsewhere, quota application requires massive investments in and costs for monitoring and enforcement. For some species, especially migratory fish, this means that the stock assessment needs international cooperation between a large number of neighbouring countries, such as Libya, Egypt, Israel, Lebanon, Cyrpus and Turkey. While this strategy is theoretically the best, in practical terms this does not seem achievable at present.
8. Monitor fish catches.
   The statistics for 36 groups of species are monitored by the Fishery Department, but only for the large-scale commercial fisheries. However, as shown here, this accounts for only part of actual total fisheries catches. As illustrated in the present study, artisanal and subsistence catches represent a sizeable amount of the actual total catches (see Fig. 2). Thus, it is important to obtain as much information as possible within the severe resource constraints operating in the Gaza Strip. Random, stratified sampling of small-scale fishers' catch (even if not annually), combined with Gaza-wide extrapolations and interpolations for non-sampled years, followed by incorporation into annual reported statistics could assist in maximizing knowledge and data return for resources being invested in monitoring (see ZELLER *et al.,* 2007a). Regular sampling is also recommended to determine fish size, weight, sex, species and other information.

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REFERENCES

AKRAM, F. & J. RUDOREN. 2012. Israel Seizes 2 Gaza Boats Near New Offshore Limit. The New York Times, New York, Published November 29, http://www.nytimes.com/2012/11/29/world/middleeast/israel-seizes-gaza-fishing-boats-near-offshore-limit.html?ref=fishingcommercial&_r=0 [accessed Februray 21, 2012]. A14, New York edition pp.

EDELIST, D., A. SCHEININ, O. SONIN, J. SHAPIRO, P. SALAMEH, G. RILOV, Y. BENAYAHU, D. SCHULZ & D. ZELLER. 2013. Israel: Reconstructed estimates of total fisheries removals in the Mediterranean, 1950-2010. Acta Adriat., 54(2): 253-264.

FAO. 1995. FAO yearbook of fishery statistics: catches and landings.Vol. 80, Rome.

ICRC. 2010. Gaza Closure: Not Another Year. International Committee of the Red Cross, Geneva; http://www.icrc.org/eng/resources/documents/update/palestine-update-140610.htm [accessed Februray 2013].Accessed March 27, 2011].

MATIĆ-SKOKO, S., N. STAGLIČIĆ, M. KRALJEVIĆ, A. PALLAORO, P. TUTMAN, B. DRAGIČEVIĆ, R. GRGIČEVIĆ & J. DULČIĆ. 2011a. Croatian artisanal fisheries and the state of it's littoral resources on the doorstep of entering the EU: effectiveness of conventional management and perspectives for the future. Acta Adriat. 52(1): 87-100.

MATIĆ-SKOKO, S., N. STAGLIČIĆ, A. PALLAORO, M. KRALJEVIĆ, J. DULČIĆ, P. TUTMAN & B. DRAGIČEVIĆ. 2011b. Effectiveness of conventional management in Mediterranean type artisanal fisheries. Est. Coast. Shelf Sci., 91(2): 314-324.

MELON, M. 2011. Shifting paradigms: report on Israel's enforcement of the Buffer Zone in the Gaza Strip. Al-Haq and Palestinian National Authority, Ramallah (Palestine). 25 pp.

MENA. 1999. Palestinian environmental strategy. Ministry of Environmental Affairs (MENA), Palestinian National Authority, Gaza City (Palestine). 94 pp.

MENA. 2001. Gaza coastal and marine environmental protection and management action plan. Ministry of Environmental Affairs (MENA), Palestinian National Authority, Gaza City (Palestine). 112 pp.

MOPIC. 1996. Coastal Zone Plan, regional plans for Gaza and West Bank governorates. Palestinian National Authority, Ministry of Planning and International Cooperation, Directorate for Urban and Rural Planning, Gaza City (Palestine). 65 pp.

PCBS. 2000. Population, Housing and Establishments Census. Palestinian Central Bureau of Statistics, Ramallah (Palestine). 25 pp.

PCBS. 2001. Population in the Palestinian Territory, 1997-2025. Palestinian Central Bureau of Statistics, Ramallah (Palestine). 19 pp.

PCBS. 2012. Population, Housing and Establishments Census. Palestinian Central Bureau of Statistics, Ramallah (Palestine). 85 pp.

STAGLIČIĆ, N., S. MATIĆ-SKOKO, A. PALLAORO, R. GRGIČEVIĆ, M. KRALJEVIĆ, P. TUTMAN, B. DRAGIČEVIĆ & J. DULČIĆ. 2011. Long-term trends in the structure of eastern Adriatic littoral fish assemblages: Consequences for fisheries management. Est. Coast. Shelf Sci., 94(3): 263-271.

UNOCHA. 2010. Between the Fence and a Hard Place: The humanitarian impact of Israeli-imposed restrictions on access to land and sea in the Gaza Strip. Special Focus (August 2010), United Nations Office for the Coordination of Humanitarian Affairs - occupied

Palestinian territory (UNOCHA). 36 pp.

WATSON, R., W. W. L. CHEUNG, J. ANTICAMARA, R. U. SUMAILA, D. ZELLER & D. PAULY. 2012. Global marine yield halved as fishing intensity redoubles. Fish Fish. DOI: 10.1111/j.1467-2979.2012.00483.x.

ZELLER, D., S. BOOTH, G. DAVIS & D. PAULY. 2007a. Re-estimation of small-scale fishery catches for U.S. flag-associated island areas in the western Pacific: the last 50 years. Fish. Bull., 105(2): 266-277.

ZELLER, D., S. BOOTH & D. PAULY. 2007b. Fisheries Contribution to the Gross Domestic Product: Underestimating Small-scale Fisheries in the Pacific. Mar. Resour. Econ., 21: 355-374.

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Ispravljanje neprijavljenih i nepotpunih ulova u morskom ribarstvu za područje Gaza pojasa: 1950-2010

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SAŽETAK

U ovom radu je procijenjen ukupni morski ulov u pojasu Gaze od 1950. do 2010. godine rekonstrukcijom prošlih ulova te sveobuhvatnim obračunom svih sektora i komponenti ribarstva.

Podatke o ukupnom ulovu, koji ujedno predstavljaju službenu evidenciju, objavio je FAO odvojeno za Pojas Gaze započevši od 1995. godine. Ti podaci se odnose samo na komercijalni sektor. Prije 1995. godine FAO podaci za pojas Gaze bili su smatrani izvješćem o ukupnom ulovu Izraela. Ovim propustom dodijeljeni podaci o ukupnom ulovu su ispravljeni ponovnim dodjeljivanjem tih podataka za pojas Gaze. Prijavljeni početni ukupni ulov (tj. dio FAO podataka prijavljenih za Izrael i onima prijavljenim za Gazu) iznosio je 97.920 t tijekom razdoblja 1950.-2010. godine. Nasuprot tome, rekonstruirani ukupni ulov za Gazu je procijenjen na više od 227.000 tona, što iznosi 2,3 puta više od prehtodno prijavljenog početnog ulova. Većina neprijavljenog ulova dolazi iz komercijalnog priobalnog ribolova (tj. tradicionalnog ribolova), te iz nekomercijalnog sektora (tj. dopunskog ribolova) koji sa tradicionalnim ulovom predstavlja 96,5% od ukupnog ulova u priobalnom ribolovu.

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