Review of existing knowledge on fisheries by-catch in the GFCM area

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What is fishery by-catch?

☞a consistent understanding of by-catch is lacking!

By-catch has largely been determined as the part of the catch which is not targeted…

…. but differing value judgments lead to differing perceptions of what is considered a non-target catch, especially in fisheries where no specific species appear to be targeted.

→"yesterday's by-catch may be tomorrow's target catch"
(Murawski, 1992)

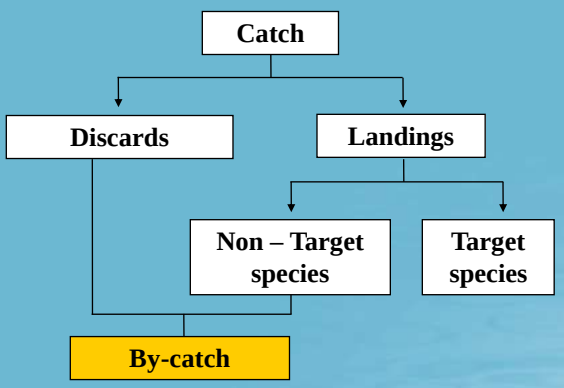
Definitions of by-catch

As Alverson *et al.* (1994) pointed out there are at least three accepted definitions of the word:

- the catch which is retained and sold but which is not the target species for the fishery
- species/sizes/sexes of fish which are discarded
- all non-target fish whether retained and sold or discarded

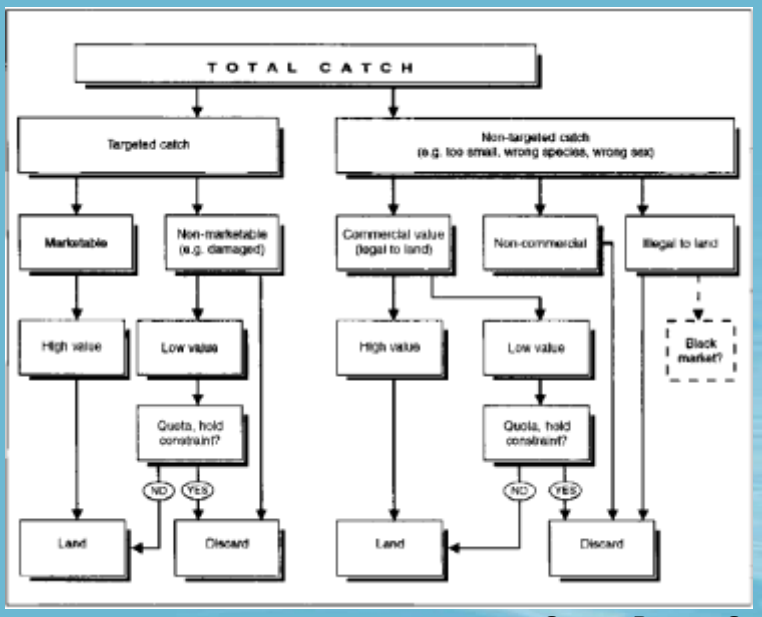
The OECD (1997) define by-catch as “total fishing mortality excluding that accounted directly by the retained catch of target species".

This definition includes organisms which die as a result of interaction with the fishing gear, even if they do not leave the water.



By-catch: **incidental capture of non-target organisms either retained or discarded**

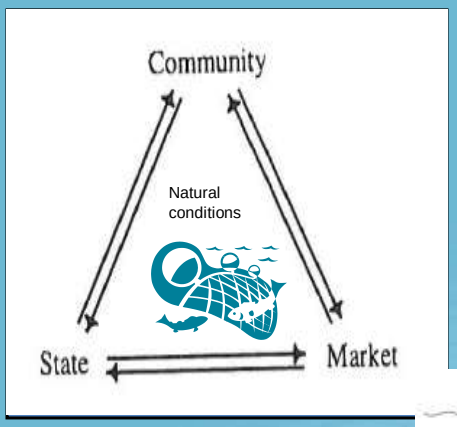
Decision tree for discarding fish at sea

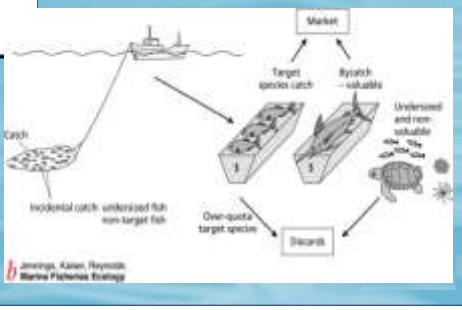


Source: Pascoe, S., 1994
FAO Tech Rep 339.

Natural conditions	Natural condition Conditions for the fishing process	Mixed/single species fishery Natural changes in stock availability Physical and weather conditions
Community	Dominant norms regarding by-catch & discards	General view of by-catch & discard, Institutional knowledge regarding volumes, consequences etc. of the discards
	Identity	The fishers' role in relation to the management system
	Learning	Impacts of fishing activities on the ecosystem Individual and collective initiatives to learn
State	Regulations and measurements	Input/output regulation Technical measures
	Decision rules and procedures	Legitimacy of the fisheries regulation
	Communication structures	Formal and informal forums Communication "climate" - dialogue/position marking
	Control and enforcement	Interpretation of strength of control and enforcement Level of registered non-compliance
Market	Economic incentives	Market prices Market pressure for certain "qualities"
	Strategic investments in technology	- vessels
	Tactical investments in technology	Fishing equipment for tracing, handling and storing

Source: Johnsen & Eliasen, 2011





Summary of all bycatch estimates results

Geographic area of estimates	Bycatch estimates (tonnes)	Estimated total catch (tonnes)	Percentage bycatch of total catch
23 Individual countries	27,453,242	63,291,770	43.4
North-east Atlantic	2,700,000	13,620,000	19.8
Mediterranean and Black Sea	306,000	1,453,000	21.1
Central America and Caribbean	242,000	375,500	64.4
Africa	6,992,000	9,967,000	70.2
Global shark fin	207,000	224,000	92.4
Tuna	605,000	6,300,000	9.6
Total	**38,505,242**	**95,231,270**	**40.4**

Source: Davies *et al*., 2009

Fishery discards

Discards refer to any animal material that is caught during commercial fishing operations that is then subsequently returned to the sea.

They include organisms that are alive as well as those that are dead.

It is estimated that 8% of the fish caught each year are subsequently discarded.

(Source: Kelleher, 2005)

Fishery discards: A waste of resources

It is widely accepted that the dumping of fish at sea is unethical and represents a substantial waste of resources.

There are a number of international statements and agreements, including United Nations (UN) resolutions, that call for states and regional organizations to develop and implement techniques to reduce by-catch and discards (e.g., FAO, 1995; UN, 1996).

UN resolution 57/142, urging action to reduce or eliminate by-catch and fish discards (UN, 2002).

A number of countries have approached **the problem of discarding by banning the practice** through legislation
(also currently considered under the reform of the European Union Common Fisheries Policy)

Article 15
Obligation to land all catches

(a) At the latest from 1 January 2014:

– mackerel, herring, horse mackerel, blue whiting, boarfish, anchovy, argentine, sardinella, capelin;

– bluefin tuna, swordfish, albacore tuna, bigeye tuna, other billfish.

(b) At the latest from 1 January 2015: cod, hake, sole;

(c) At the latest from 1 January 2016: haddock, whiting, megrim, anglerfish, plaice, ling, saithe, pollack, lemon sole, turbot, brill, blue ling, black scabbard, roundnose grenadier, orange roughy, Greenland halibut, tusk, redfish and Mediterranean demersal stocks.

- A study considering a possible discard ban throughout the North Sea for specific commercial species yielded that it could offer substantial benefits.
- Implementation of this policy would be complicated, but the use of real-time area closures, gear modifications, and electronic monitoring systems could help ensure compliance and effectiveness.

Source: Diamond & Beukers-Stewart, 2011)

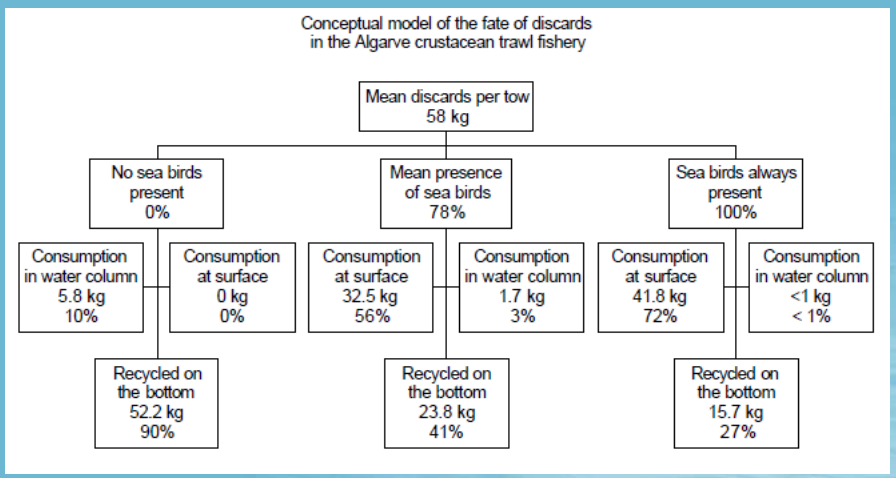
However:
•solutions to by-catch/discards need to be tailored to specific fisheries and may differ between regions of the world.
• solving the discard problem requires not only technical and regulatory instruments, but also arenas and structures that allow and facilitate processes of cultural change.
→ Success will depend on how legitimate and rational the fishers regard the system to be, and whether they see the reasoning behind it.

Source: Johnsen & Eliasen, 2011

Impact of discarding depending on perspective

Perspective	Problem of discards
Fishers	• Reduced future catches due to discard of juveniles or accelerated stock depletion • Increased time and effort in sorting the proportion of catch to be discarded
Policy maker	• Limited information on discarding distorts stock assessment modelling and data analysis, the results of which are used to determine management measures
Society	• Reduce the supply of food potentially available for human consumption, or the manufacture of industrial products • They alter the marine environment by disturbing the ecological balance, affecting both marketable and non-marketable species.

Source: Tingley *et al*., 2000



Source: Castro *et al*., 1999. Study Project No. 96/063.

In GFCM areas by-catch consists of:

(i) undersized specimens of target species
(ii) non-target species of low commercial value
(iii) non-target species of no commercial value

By-catch is defined in relation to the **target species**.

- ✓ In multi-species/multi-gear fisheries, like most of the GFCM area fisheries, target species are not always clearly defined.
- ✓ Decision is often based on the expected value of the catch complex.
- ✓ Most studies in the GFCM area refer to discards which are more clearly defined and measured.

Fishery by-catch & discards in the Mediterranean and Black Sea

- ✓ a crossroad of three continents, where different cultures co-exist: *economic and cultural characteristics regulate needs, demands, species prices and use of marine resources*
- ✓ multi-species/multi-gear nature of the fisheries: *highly varying catches, target species, sorting practices and by-catch/discards composition geographically and among the different fishing gears*
  → Some métiers catch a wide range of species, others can be extremely selective, with most of the catch dominated by one or a few species

Impediments:
- ✓ numerous landing sites create difficulties in recording the relevant information
- ✓ several stocks are shared among countries
- ✓ similar studies cover only a small portion of the total fishing activity

These highlight the need to expand by-catch/discard surveys and standardize practices in order to compare among fisheries and test potential methods / tools for their mitigation

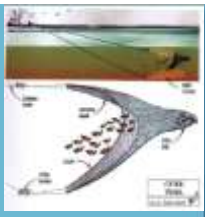
Main reasons for discarding in the Mediterranean multi-species fishery

Explanation of discarding reason	Type of reason
• Fish species, or other marine life-forms, with no commercial value are discarded	Economic
• Catches of legally sized, but low value, species such as sardines and horse mackerel, may be discarded to save space and ice for more valuable target species.	Economic
• Minimum Landing Sizes (MLS) may result in discards of fish below the specified MLS; in some cases poor enforcement results in fish below MLS being landed illegally (instead of being discarded)	Regulatory

Source: Tsimenidis *et al*., 1998.

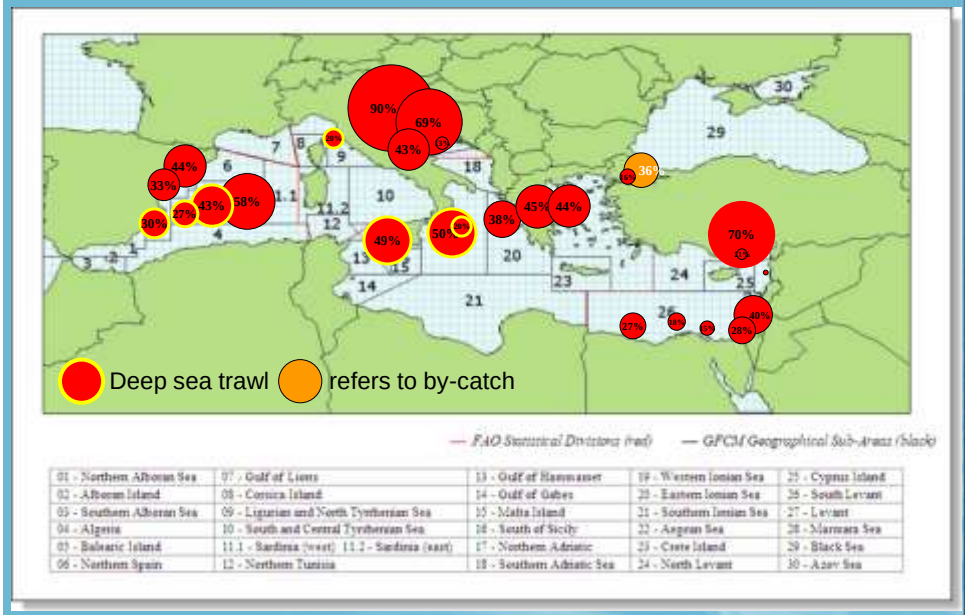
Study Project No. 95/061

Overview of Trawl by-catch in the GFCM area



- ✓ The general absence of clear identification of the target species has led to the study of discards.
- ✓ **Trawling is usually characterized by high discarding ratios** which seems also true for the GFCM area.
- ✓ Kelleher (2005) reports a mean of 45% - 50% for trawl fishery in the Mediterranean and Black Sea with some exceptions (e.g. the Syrian trawl fishery) where discards are negligible.
- ✓ In many cases when target species are clearly defined, by-catch and discards present even higher ratios (e.g. shrimp trawl fishery).
- ✓ The range of discarding ratio highly fluctuates inter-annually, seasonally.
- ✓ Fishing depth, trawl duration and fishing intensity have also been shown to affect discards quantities in the GFCM area.

Trawl by-catch in the GFCM area



Trawl by-catch in the GFCM area

- ✓ These ratios concern the entire catch and can be very different for certain species.
- ✓ Most studies report a high number of species that are always totally discarded, and a high number of by-catch species which are occasionally landed. The species-specific discard ratios vary a lot.
- ✓ For example, concerning elasmobranches, discard ratios are 65.5% and 63.8% in Spanish and Greek trawl fishery respectively.
- ✓ Concerning the target species their discarded fractions are often negligible and comprise undersized or damaged specimens, but in certain cases undersized individuals are also landed

Most common by-catch and discarded species in bottom trawl fisheries in the GFCM area

- ✓ **Undersized or damaged specimens of main commercial species**

  Merluccius merluccius, Parapenaeus longirostris, Aristeus antennatus Helicolenus dactylopterus, Pagellus bogaraveo

- ✓ **Pelagic species**

  Sardina pilchardus, Trachurus trachurus, T. picturatus

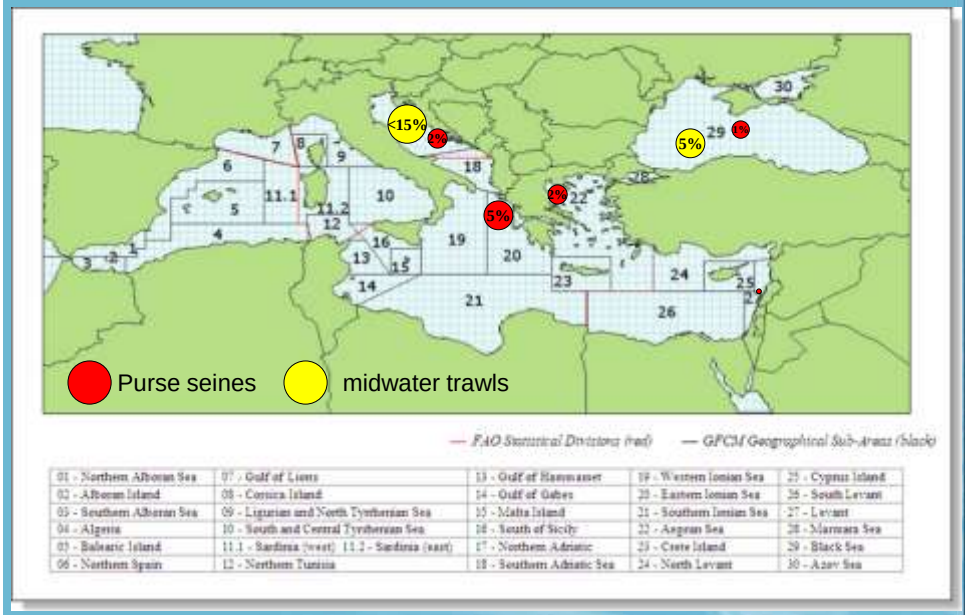
- ✓ **Species with low or no commercial value**

  Illex coindetii, Squilla mantis, Pagellus acarne , Boops boops, Spicara smaris, Diplodus annularis, Phycis blennoides, Galeus melastomus, Scyliorhinus canicula, Lepidotrigla cavillone, Centracanthus cirrus, Argentina sphyraena, Serranus hepatus

Overview of Purse Seine and Mid-water trawl by-catch in the GFCM area

- ✓ **Purse seines targeting small pelagic fish are generally characterized by low by-catch and discarding rates**.
- ✓ Target species in Mediterranean and Black Sea purse seine fisheries usually represent more than 90% of the catch and most of the by-catch largely consists of commercialized species.
- ✓ Discards on total catch ratio was negligible in many areas and was comparable to the weighted global average for purse seines (1.6%).
- ✓ In the Black Sea most by-catch is used for fishmeal.
- ✓ **Discard rates for mid-water trawls were higher** but generally lower compared to bottom trawls.

Purse Seine and Mid-water trawl by-catch in the GFCM area



Most common by-catch and discarded species in mid-water trawl and purse seine fisheries in the GFCM area

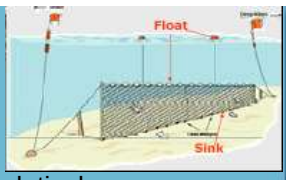
- ✓ **Mid-water Trawls**

  Trachurus mediterraneus, Engraulis encrasicolus, Sardina pilchardus

- ✓ **Purse seines**

  Sardinella aurita, Boops boops, Trachurus trachurus, Spicara smaris

Overview of small scale fishery fleets by-catch in the GFCM area



- ✓ Information on by-catch of the artisanal fishery is relatively scarce.
- ✓ Discards ratios are quite low (less than 10% on average for longlines, trammel and gill nets).
- ✓ In certain cases discards are negligible, but by-catch can be relatively high since low commercial species are also utilized by the fishers for personal consumption or bait.
- ✓ Certain fisheries/métiers present higher discard rates (e.g. trammel nets for cuttlefish, shrimps and common spiny lobster).
- ✓ Low commercial value, damage at sea before retrieval of the gear and bad handling on-board are the main reasons for discarding.

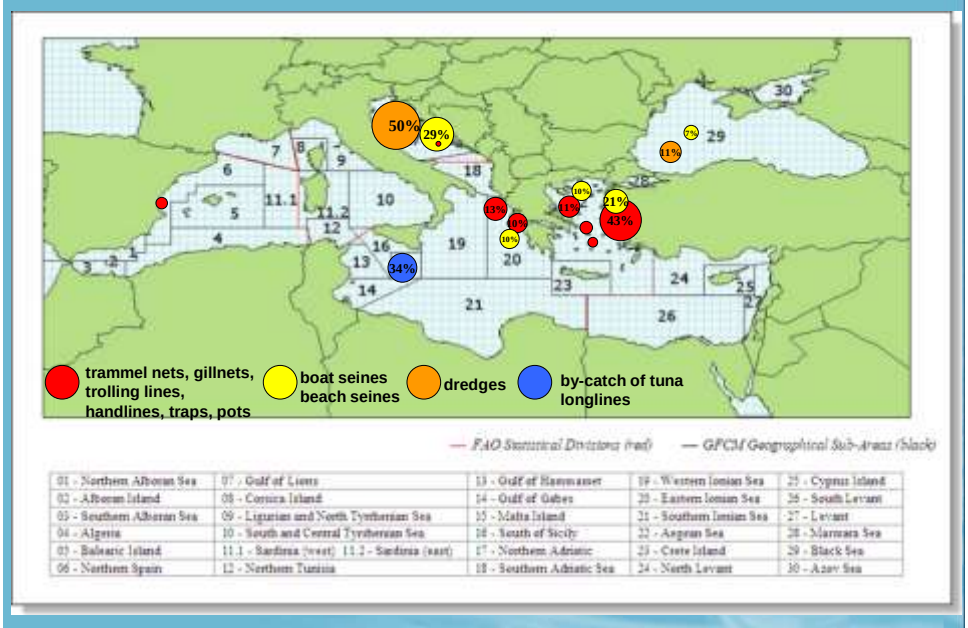
Small scale fishery fleets by-catch in the GFCM area

- ✓ **Discarding ratios and practices differ among métiers.**
- ✓ Need to focus on analysis of different métiers. The small-scale fishing fleet comprises numerous gears and exerts variable fishing practices targeting different species and resulting in different by-catch composition and quantities.
- ✓ Boat seines and coastal encircling nets also present similar discards ratios
- ✓ A higher rate (28.5% by weight) was reported for the Croatian Adriatic boat seines operating over Posidonia meadows (Cetinić et al. 2011). This practice is now banned in the EU countries.
- ✓ Even though discard ratios are low, discarded quantities are quite high since artisanal fisheries are responsible for the bulk of catches in the GFCM area.

Small scale fishery fleets for large pelagics by-catch in the GFCM area

- ✓ Tuna traps in the Mediterranean countries are quite selective and have a low or negligible discard rate.
- ✓ Longlines for tuna and swordfish may have substantial incidental catches of pelagic elasmobranches, which vary in terms of quantities and species composition across the Mediterranean. Their by-catch also includes species of conservation concern and undersized specimens.
- ✓ By-catch of charismatic and vulnerable species (e.g., seabirds, elasmobranches, sea turtles) can be quite high for certain artisanal fisheries.

Small scale fishery and other fleets by-catch in the GFCM area



Most common by-catch and discarded species in small scale fisheries in the GFCM area

- ✓ **gillnets**
  Scorpaena porcus, S. scrofa, Diplodus vulgaris, Diplodus annularis, Sardinella aurita, Serranus cabrilla, Symphodus spp
- ✓ **trammel nets**
  Synodus saurus, Boops boops Diplodus annularis, Sardinella aurita, Diplodus annularis, Pagellus acarne
- ✓ **Beach and boat seines**
  Serranus cabrilla, Chromis chromis, Raja mirelatus, Bothus podas, Crenilabrus tinca, Dasyatis pastinaca, Lepidotrigla cavillone, Raja clavata Serranus scriba
- ✓ **Pelagic longlines**
  Caretta caretta, Xiphius gladius (by-catch), stingrays (*Pteroplatytrygon violacea*), pelagic elasmobranchs
- ✓ **Bottom longlines**
  sharks, rays

Quality of the existing information

- ✓ Several gaps of knowledge in the Mediterranean and Black Sea area.

  → Lack of by-catch studies concerning certain fishing gears and sub-regions, while many of the existing studies cover relatively small temporal and spatial scales.
- ✓ Since the definition of by-catch is related to target species, definition of métiers and their target species is needed to explore by-catch composition and quantities for specific operations.
- ✓ Large amount of the existing information is placed in grey literature, i.e. technical reports, publications of local interest and possibly local databases.

→ Spreading of existing information, standardization of monitoring, cooperation among partners and countries are essential steps for a coherent approach of the by-catch issue in the GFCM area.

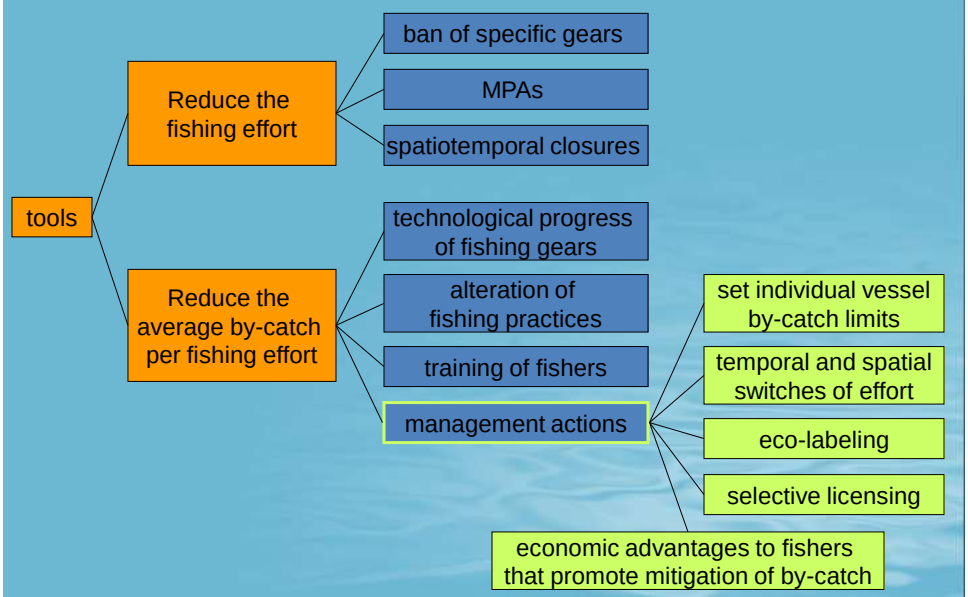
Solutions to mitigate by-catch/discards

Independent of the type of general management system the solutions to avoiding by-catch/discards can be grouped into Technical & Regulatory measures.

- The ***technical measures*** are directed towards gear selectivity, like minimum mesh size, sorting devices, minimum fish size, as well as closure of fishing grounds on a permanent or temporary basis.
- The ***regulatory measures*** deal with ban on discard, mandatory landings, output and effort control through by-catch quotas or shares and monitoring.

☞ Issues of enforcement/control & normative elements of compliance should be considered in all cases.

By-catch mitigation tools



Mitigation tools in the GFCM area

Selectivity improvement: trawls

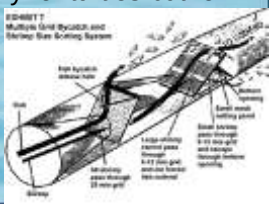
✓Selectivity can be improved by modifying codend characteristics:

- increase mesh size
- change mesh shape: square mesh is more selective than diamond mesh
- use of square mesh escape window
- decrease codend circumference

✓By-catch Reduction Devices (BRD)

- Turtle Excluder Devices (TEDs) seems to be an effective technology for the mitigation of by-catch, not only for turtles but for fish also.
- sorting grids

✓Short haul duration is known to reduce discards rate.



Selectivity improvement: small-scale fisheries

✓ Longlines:

- increase hook size
- modify hook shape

case study: stingray captures in the Strait of Sicily Piovano *et al.* (2010)

i. larger J hooks, resulted in decreased stingray captures,

ii. circle hooks were more effective than J hooks

iii. bait size, within the range of sizes assessed, and use of light attractors did not have significant effects on stingray catch rate

Piovano *et al.* 2010. Biological Conservation 143, 261-264

Selectivity improvement: small-scale fisheries

- ✓ Nets
  - mesh size
  - mesh shape
  - gillnets are generally more selective than trammel nets
  - multifilament nets may be more selective in certain cases
  - rising of the net from the ground may prevent by-catch of benthic species
- ✓ Larger mesh and hook sizes doesn't necessarily mean higher selectivity since catch species composition may change.
- ✓ Intermediate sizes may in certain cases provide adequate size/species selectivity with low or negligible short-term economic losses for fishers

Mitigation tools in the GFCM area

Spatio-temporal closures

- ✓ MPAs are established for the reduction of by-catches, mainly concerning vulnerable and charismatic species.

→ Establishment of MPAs in by-catch hotspots may reduce by-catch quantities.

- ✓ Temporal closures for specific fishing gears also exist and they usually aim to protect juvenile fish and their recruitment (e.g., ban of tuna purse seine fishery from the 1st to the 30th of July for the whole Mediterranean, trawl fishery closes in the Catalan, Adriatic and Greek Seas during summer)

→ The designation of spatio-temporal closures in the GFCM area is not always based on scientific criteria and they often try to satisfy social demands.

Conclusions

- ✓ In general, trawls are characterized by high by-catch and discards rates.
- ✓ Purse seiners and small scale fishery, even though they usually present lower by-catch rates, they may produce large discarded quantities since they are responsible for the bulk of landings in the Mediterranean and Black Seas.
- ✓ Several studies describe promising technical improvements for by-catch mitigation that are or should be taken into account in fisheries management in the GFCM area.
- ✓ Effective technical measures may be gear- and fishery-specific and their application should be tested in different areas.
- ✓ Short and long term economic losses and gains should be explored and counterbalanced before decision making.

Conclusions

- ✓ However, the issue of selective fishing is not that simple since it can affect food-web structure and functioning, decreasing community evenness and species richness.
- ✓ Learning to utilize a wider variety of products already comprised in the catch, should be considered as an option of having a lower impact on the ecosystem.
- ✓ Under the framework of ecosystem based fisheries management clear objectives should be set for decision making on relevant issues.
  - i. disseminate successful technologies more widely and encourage their adoption.
  - ii. comprehensively engage fishers themselves in finding appropriate solutions.
  - iii. consider trade-offs from different approaches by interacting with key stakeholders, and select the best one, developing the appropriate institutional and legislative frameworks.

Thank you for your attention