ISMAR

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La Tartaruga marina in Adriatico: Tutela e conservazione di una specie a rischio di estinzione

Riduzione delle catture accidentali della tartaruga marina nella pesca al traino

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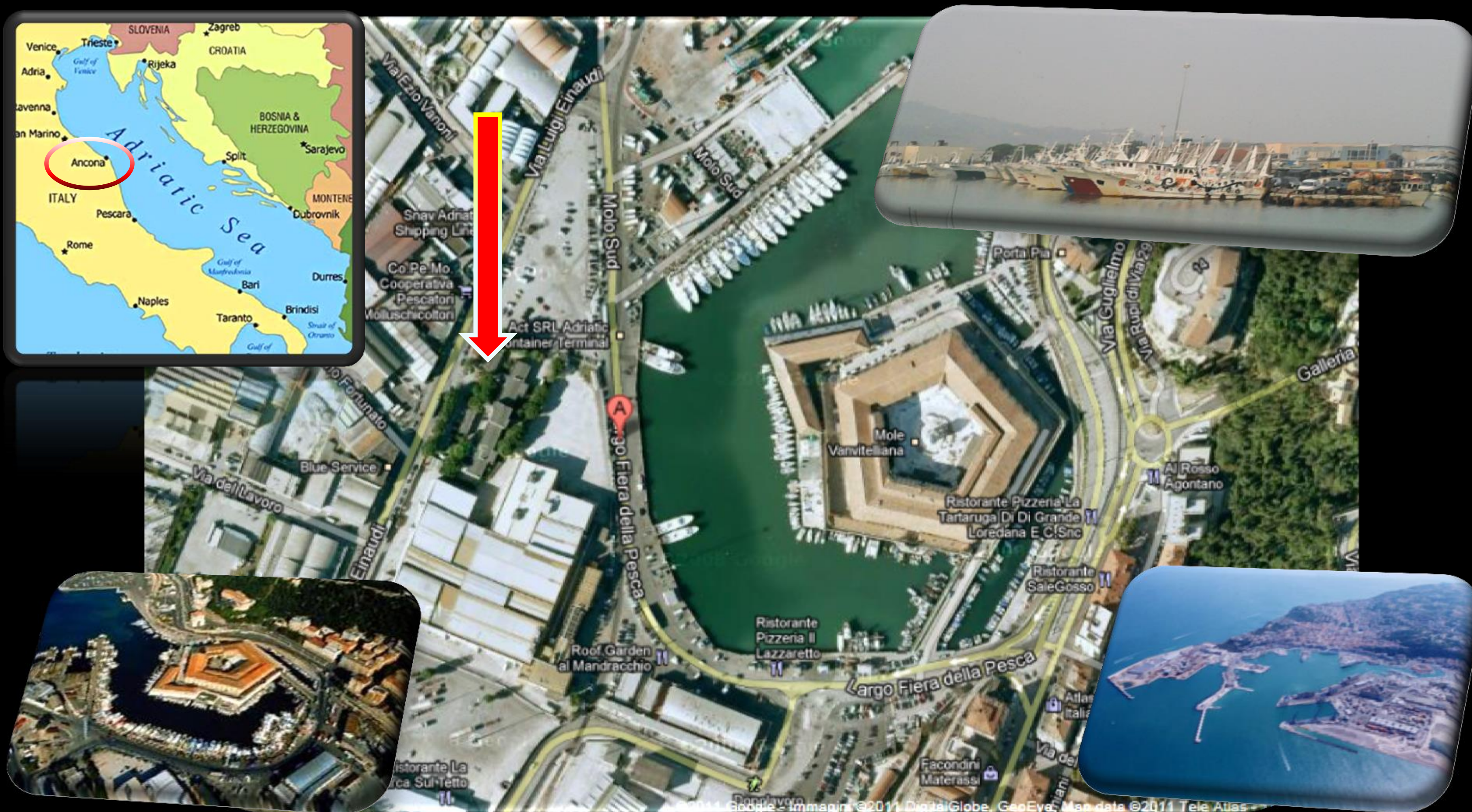


INSTITUTE ORGANISATION

- Fishing Technology
- Applied Electronics
- Marine Fishery Biology
- Fish Population Dynamics
- Fishing Vessels Technology
- Oceanography
- Mariculture and Artificial Reefs
- Administration

Main Research Activities

Fisheries Technology Field

MYGEARS	*“Technical specifications of Mediterranean trawl gears”*
MARTE+	*“MAre, Ruralità e TErra – Sottoprogetto SD, Componente 3: Innovazione nei processi produttivi della pesca, Regione Liguria”*
BENTHIS	*“Benthic ecosystem fisheries Impact Study”*

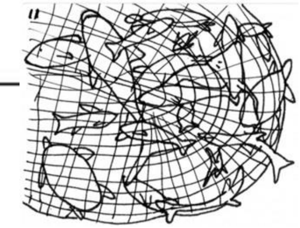
Fisheries Biology

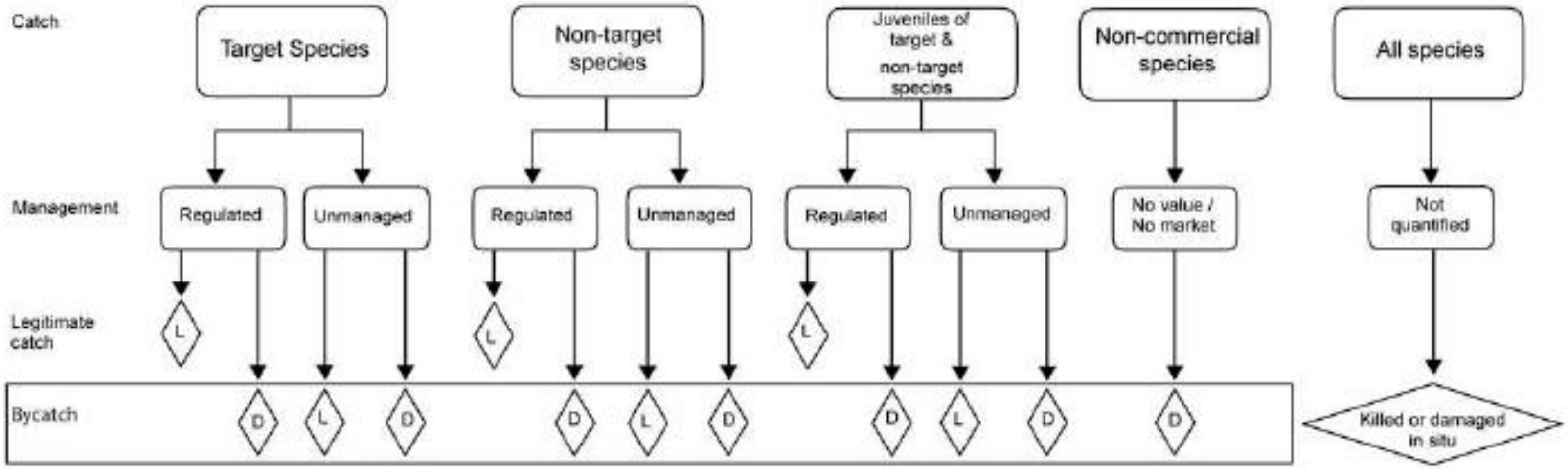
CLAM ASSESSMENT	*“Valutazione della risorsa vongola”*
BYCATCH V	*“Valutazione delle catture accidentali di specie protette nella pesca al traino pelagica”*

Fisheries Management

MAREMED	*“Pilot Project on Transferable Fishing Concessions (TFC)”*
ECOFISHMAN	*“Ecosystem-based Responsive Fisheries Management in Europe”*

What is Bycatch in Mediterranean?





The term "bycatch" is usually used for fish caught unintentionally in a fishery while intending to catch other fish. Starting from the bycatch definition of Hall (1996), which is "*all non-target fish whether retained and sold or discarded*", in the multispecies <u>Mediterranean fisheries</u>, more precise information is needed (Sala et al. 2011).

The source of the problem is mainly in the description of "<u>target" species</u>. Very often undersized individuals (e.g. below the MLS) or juveniles are illegal but marketed and therefore targeted and in some cases they are the main target (Sala et al. 2011).

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Why and how to reduce bycatch?

Why to reduce bycatch?

- Trawl and processing efficiency
- Product quality and marketing opportunities
- Food security
- Protecting the marine environment

How to reduce bycatch?

- trawls with a low headline height to minimise fish catches,
- ground chain arrangements that reduce the amount of seabed animals, rocks and debris taken,
- avoidance of fishing grounds where bycatch is known to be high, including grounds where coral, sponges and rocks are present,
- using mesh sizes big enough to allow some small animals to escape, and
- using TEDs and BRDs.

To successfully reduce bycatch fishermen must be part of the research process. A key to the successful involvement of fishermen is to explore how they may benefit from reducing bycatch.

Bycatch and … protected species

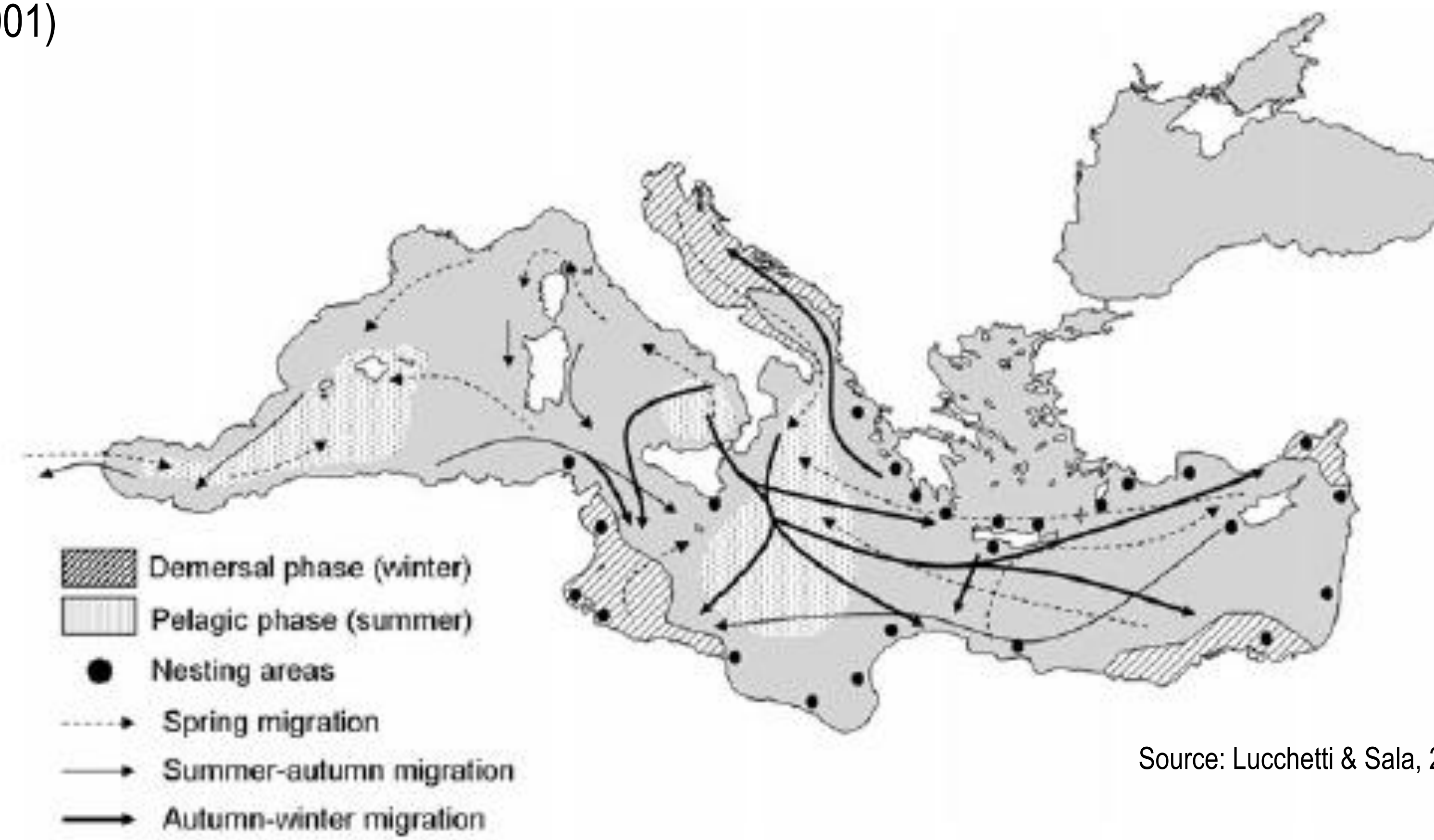
By-catch during fishing operations is one of the main sources of anthropogenic mortality in protected species and species of conservation concern worldwide.

For some species or populations this represents a significant conservation threat.

Not all forms of fishing gear have the same impact, and the threat represented by a given type of fishing gear may depend on how that gear is used (Fortuna et al. 2010).

Mediterranean loggerhead sea turtles

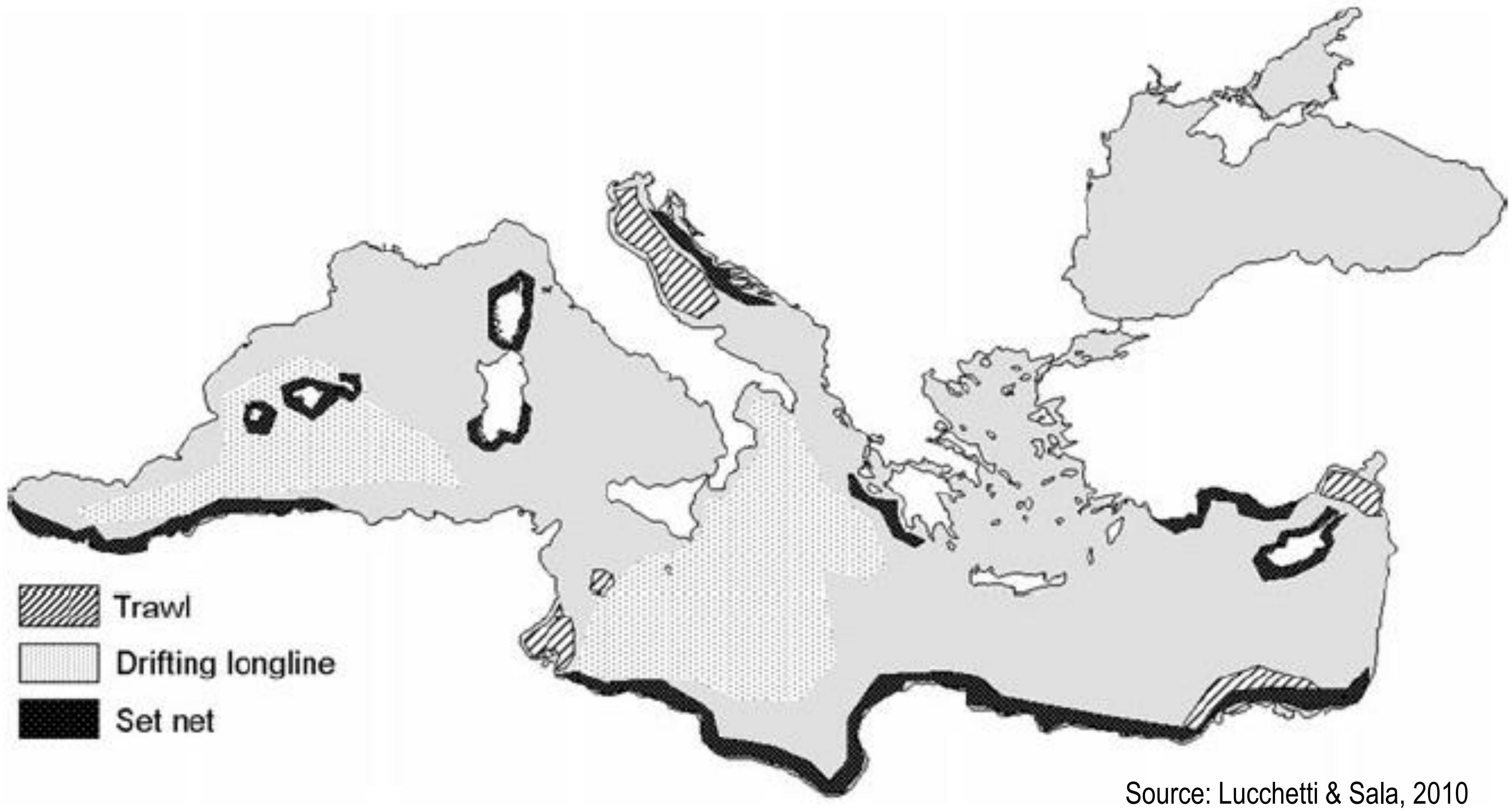
Three main ecological phases characterize the life of loggerhead sea turtle: the pelagic phase, when loggerheads feed on pelagic preys; the demersal phase, when they swim close to the bottom to eat benthic species; and finally an intermediate neritic phase, when loggerheads shift from pelagic–oceanic to benthic–neritic foraging habitats (Tomas et al. 2001)



Source: Lucchetti & Sala, 2010

Bycatch and … Mediterranean sea turtles

Drifting longlines and bottom trawls have the greatest impact on Mediterranean turtle populations, respectively in pelagic and demersal phase, while passive nets (gillnets and trammel nets) seem to be responsible for the highest direct mortality, due to drowning.



Source: Lucchetti & Sala, 2010

Bycatch and … Mediterranean sea turtles

Only two bottom trawl studies are available from the Mediterranean. Turtle excluder devices have been tested with promising results in Turkey and Italy, even if the loss of large fish should be carefully investigated. For set nets no practical solutions are available at this time (Lucchetti & Sala, 2010).

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From scientific literature (1/2)...

Gear type	Area	Catch/year	Direct mortality	Reference
Drifting longline	Entire Mediterranean	50,000	0–4% (40% potential)	Casale 2008
	Entire Mediterranean	60,000–80,000	Potential mortality 17–42%	Lewison et al. 2004; NMFS 2001
	Western-central Mediterranean	35,000		Panou et al. 1992
	Spain	22,000–35,000	0.36–7.7% (20–30% potential)	Aguilar et al. 1995; Tudela 2000, Carreras et al. 2004
	(Balearic Islands: 15,000–18,000; Aguilar et al. 1995; Camiñas 1988; Camiñas et al. 2001; Mayol et al. 1988)			
	Spain		0.54–4.24%	Camiñas et al. 2006a, b
	South Sicily (Italy)	2,148	>30% potential	Casale et al. 2007a,b
	Lampedusa Island (Italy)	245		Casale et al. 2007a
	Ionian Sea (Italy)	1,084–4,447	0% (potential mortality high)	Deflorio et al. 2005
	Ionian Sea (Greece)	280–3,181		Panou et al. 1999; SGRST-SGFEN 2005
	Aegean and South Ionian seas (Greece)	1,145–5,474		Kapantagakis and Lioudakis 2006
	Cephalonia (Greece)	50		Panou et al. 1992
	Malta	1,500–2,500		Gramentz 1989
	Cyprus	2,000		Godley et al. 1998
	Morocco	3,000		Laurent 1990
	Algeria	250–300		Laurent 1990, Camiñas 2004
	Tunisia	486–4,000	0% (9.1% potential)	Echwikhi et al. 2006; Salter 1995; Demetropoulos 1998; Jribi et al. 2008
Bottom trawl	Entire Mediterranean	30,000	5% (20–25% potential)	Casale et al. 2004; Casale 2008; Laurent et al. 1996; Lazar and Tvrtkovic 1995; Oruç 2001
	Italy	8,000	14% (57% potential)	Casale et al. 2004, 2007a
	Lampedusa Island (Italy)	4,056		Casale et al. 2007a
	North Adriatic (Italy)	4,273	9.4% (43.8% potential)	Casale et al. 2004
	France		3.3–3.7%	Laurent 1991; Delaugerre 1987
	Croatia	2,500	Low	Lazar and Tvrtkovic 1995
	Thracian Sea	0–418		Margaritoulis et al. 2001
	Ionian Sea (Greece)	0–448		Margaritoulis et al. 2001
	Tunisia (whole continetal shelf)	14,000		Jribi and Bradai 2008
	Gulf of Gabes (Tunisia)	2,500–5,500	3.3%	Bradai 1992; Jribi et al. 2004
	Egypt	2,269–high	1–10%	Nada and Casale 2008; Laurent et al. 1996
	Turkey	High	1.6% (13% potential)	Oruç (2001); Oruç et al. 1996

Source: Lucchetti & Sala, 2010

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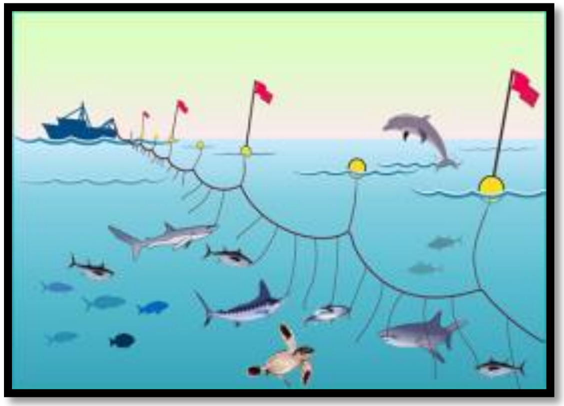
From scientific literature (2/2)...

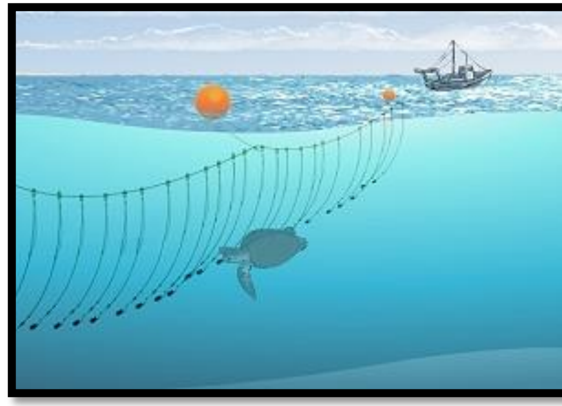
Gear type	Area	Catch/year	Direct mortality	Reference
Drift nets	Italy	16,000	20–30%	De Metrio and Megalofonou 1988
	Ligurian and Tyrrhenian Sea (Italy)	Low		Di Natale 1995
	Spain	117–354	3.3%	Aguilar et al. 1995
	Spain	236		Silvani et al. 1999
Bottom longline	Entire Mediterranean	35,000	Potential mortality 40%	Casale 2008
	Lampedusa Island	257		Casale et al. 2007a
	Tunisia	733–2,000	0.53–12.5% (33% potential)	Echwikhi et al. 2006; Jribi et al. 2008; Bradai 1993
	Egypt	2,218		Nada and Casale 2008
Fixed nets	Entire Mediterranean	30,000	>50% (60% potential)	Casale 2008
	Balearic Islands (Spain)	209	50–100%	Carreras et al. 2004
	Corsica (France)	Low	93.3–75%	Laurent 1996; Delaugerre 1987
	France	10–100–low	50–100%	Laurent 1991
	Italy		50%	Argano et al. 1992
	Slovenia-Croatia	657–4,038	50–73%	Lazar et al. 2006
	Cyprus	500	10%	Godley et al. 1998
	Tunisia	920–2,000	5%	Bradai 1993
	Egypt	754		Nada and Casale 2008
	Turkey	1,328	10%	Godley et al. 1998
Pelagic pair trawl	North Adriatic	1,550		GFCM-SAC 2008
	Turkey	High (5 trawlers catch around 100 loggerheads)	Oruç (2001)	
Purse seine	Egypt	37		Nada and Casale 2008
Small scale fishery fixed nets, purse seines, bottom and surface longlines etc.	Tunisia	5,000		Bradai 1995

Source: Lucchetti & Sala, 2010

Longline and Mediterranean sea turtles

Most of the experiments available for the Mediterranean are focused on drifting longline (Lucchetti & Sala, 2010).





PARAMETER	FROM	TO	EFFECT
Hooke size	Smaller	Larger	+
Hooke shape			?
Bait types			+
Depth setting	Pelagic	Bottom	?

Sea turtles and … our research projects

2007

TARTANET *A NETWORK FOR THE CONSERVATION OF SEA TURTLES IN ITALY* (LIFE 04 NAT/IT/000187)

2010 – pres.

BYCATCH *VALUTAZIONE DELLE CATTURE ACCIDENTALI DI SPECIE PROTETTE NELLA PESCA AL TRAINO PELAGICA*

2013

..A NEW LIFE PROJECT ???

Bottom trawl and mitigation measures

TARTANET Project

TED EXPERIENCES …

- Good results in non-Mediterranean fisheries (Usa, Australia)
- NO EXPERIENCE in the Mediterranean sea: some authors (Casale, 2004) believe that…

  "*TEDs available at present are probably not a realistic solution for reducing turtle bycatch in the Mediterranean, because they are designed for the shrimp trawl fishery and they would exclude the larger commercial specimens too*".

OUR GOALS

- Projecting and testing different type of TED

DIFFERENT MATERIALS

DIFFERENT DESIGN

In order to implement TEDs effectively, there is a need to show that they can **minimize the loss of target species** *while also* **providing benefits to fishermen.**

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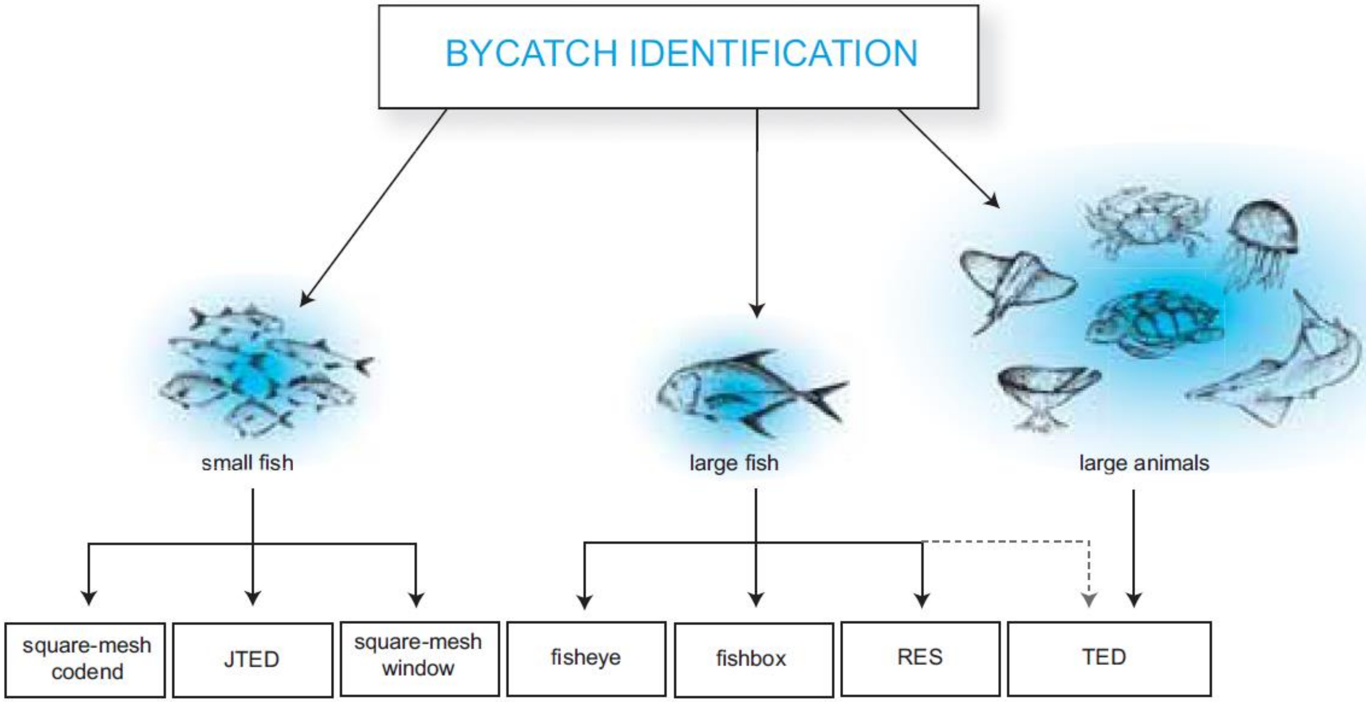
Choosing and testing a TED or BRD?

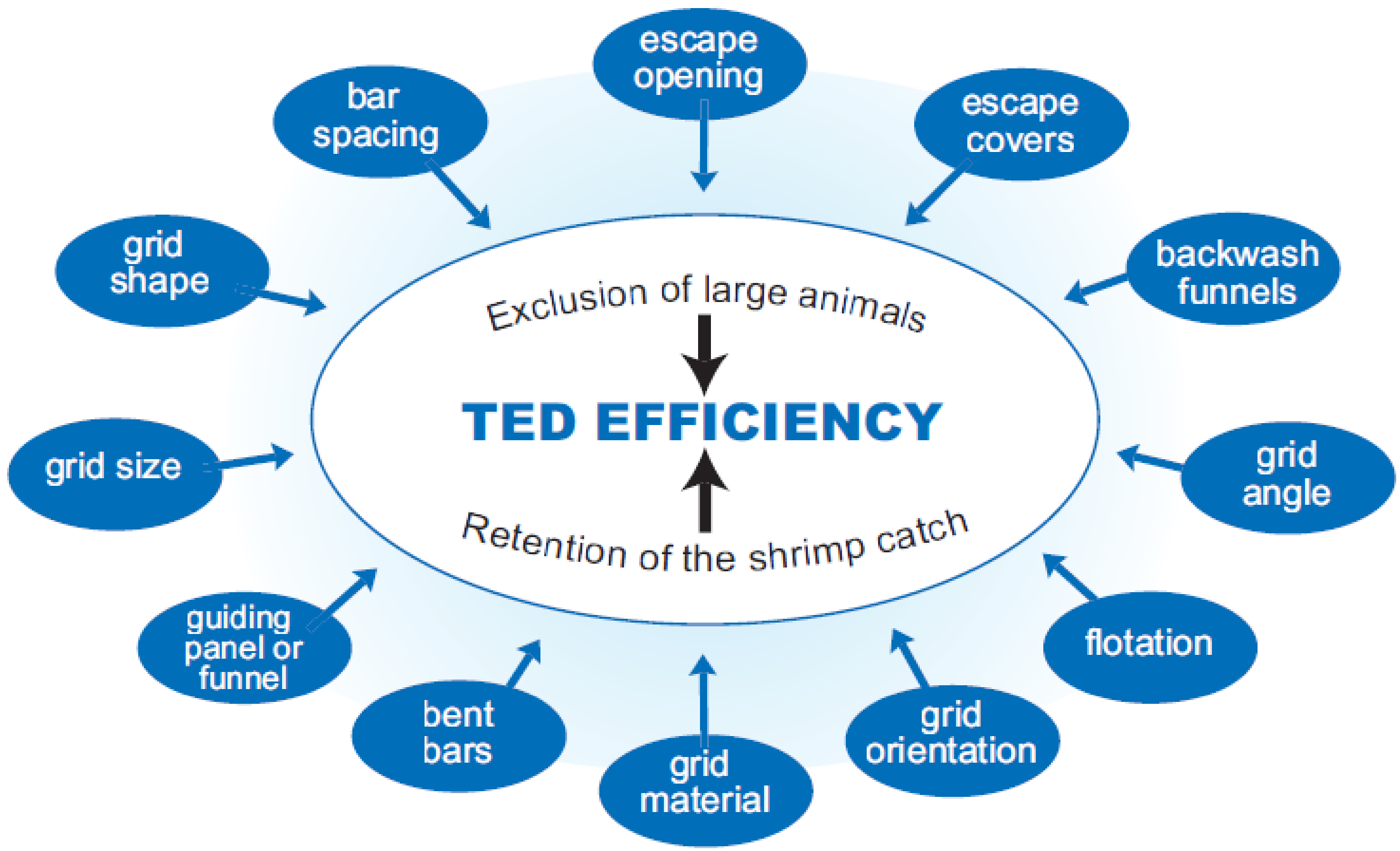


In this study, we projected and tested at sea a typical *Supershooter* and three new types of low-cost TEDs with different designs and materials, incorporating aspects of both US and Australian TEDs as well as design features to improve handling and maintaining catch rates.

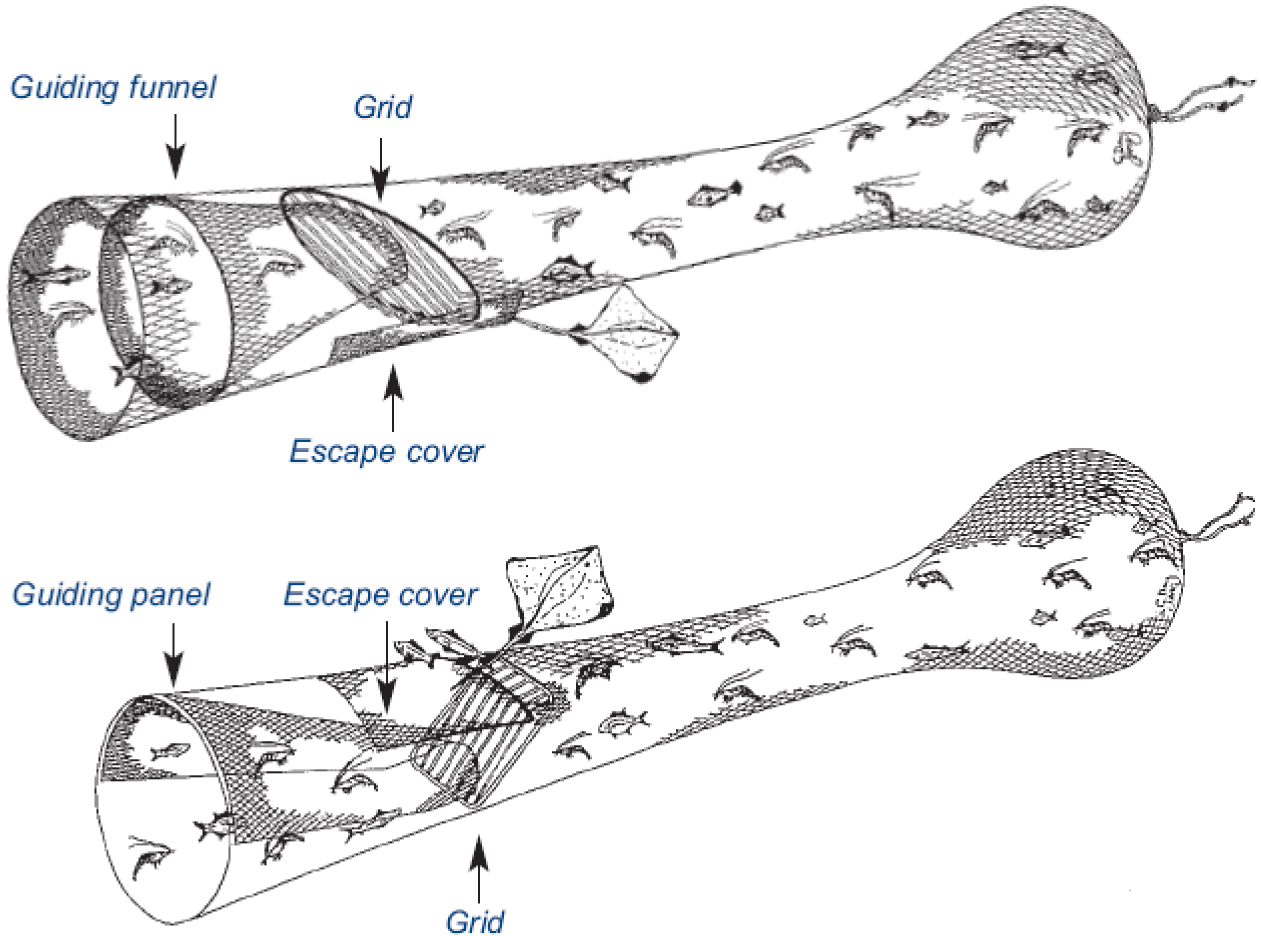
Optimizing TED Performance

A well-designed and maintained TED should ensure that large animals and objects are rapidly excluded from the trawl and fish loss is minimal or nonexistent. This is influenced by the design, construction and rigging of the various TED components.

The various design and construction parameters that influence TED performance and efficiency.



Principal TED designs



The various components typically incorporated into the design of a downward-excluding TED (top) and an upward-excluding TED (bottom).

RV *"G. Dallaporta"* used during the Adriatic sea trials

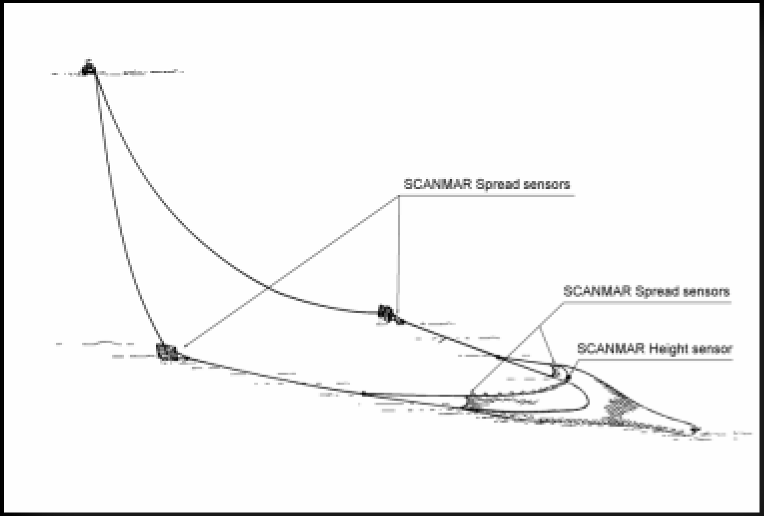
Technical characteristics: 810 kW at 1650 rpm, L_{OA} 35.30 m and Gross Tonnage of 285 GT

The ship was launched in May 2001 and was specifically designed for conducting research on marine biology, oceanography and fishing gear technology.

Engineering tests at sea

Measured vessel parameters:

1. Vessel speed relative to the sea bed measured by Atlas Doppler log
2. Warp loads
3. Revolution
4. Shaft torque
5. Shaft power
6. Fuel consumption of the main vessel engine



Scanmar sensors mounted on the gear:

7. Horizontal door spread
8. Door Pitch and roll angles
9. Horizontal Net Opening
10. Vertical Net Opening and Clearence
11. Depth, Temperature, Pitch and Roll at the headline centre
12. Trawl speed sensor (longitudinal, transversal speeds)

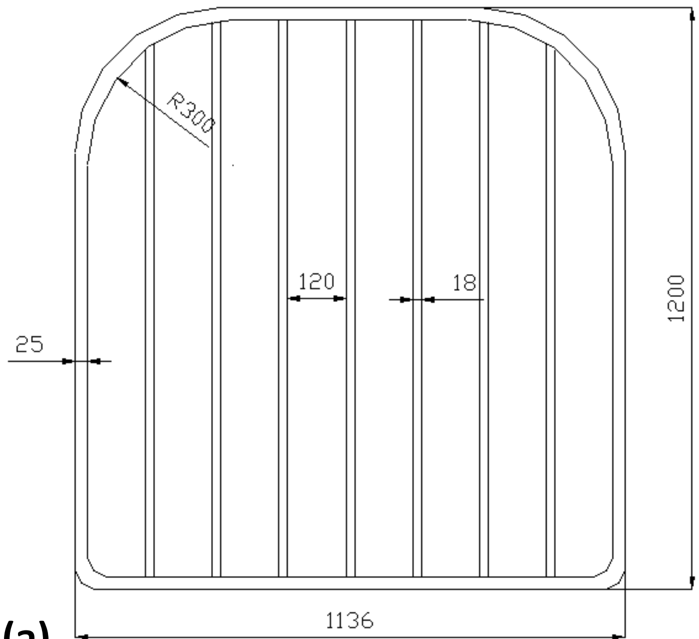
Underwater Micrel sensors:

13. Tensions exerted by the warp and by the backstrops at the attachment points of the door
14. Tensions ahead of the Net wing tips

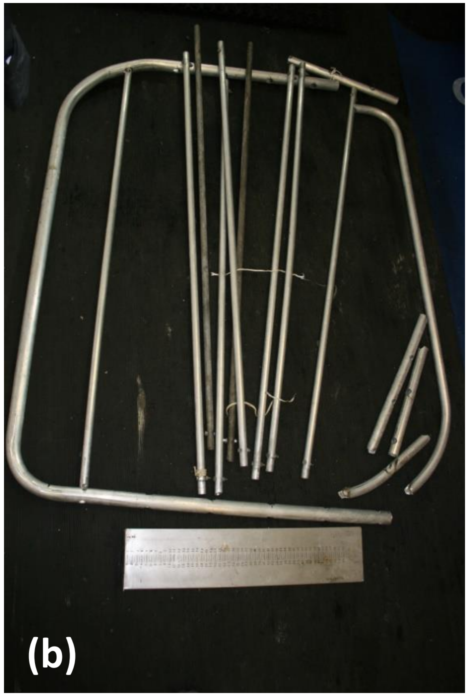
DST StarOddi *(Data Storage Tag)*:

15. Pitch, Roll, Depth, Temperature *(mounted on the door)*

TED specifications and design details: TED1



(a)


(b)

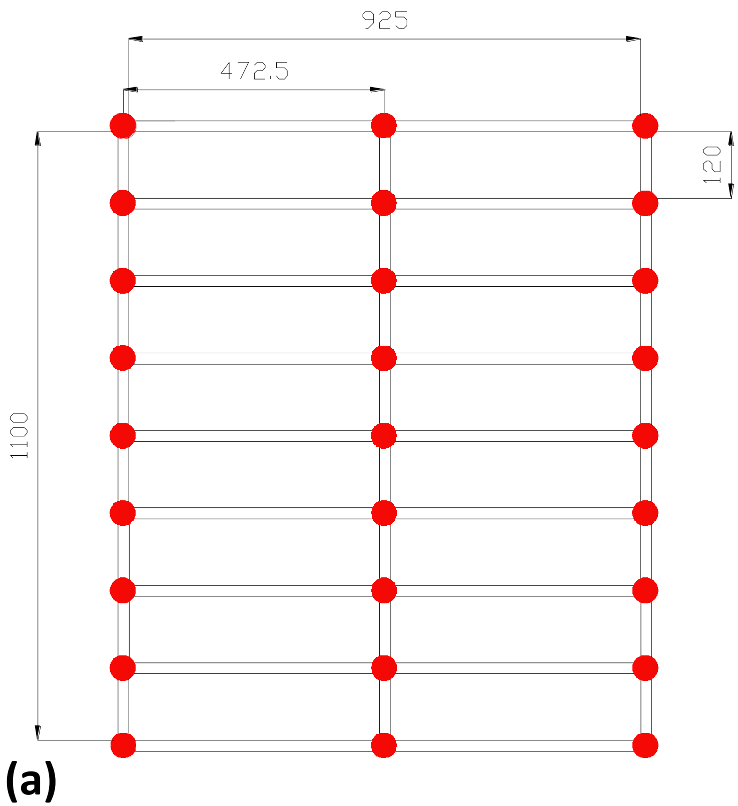

(c)

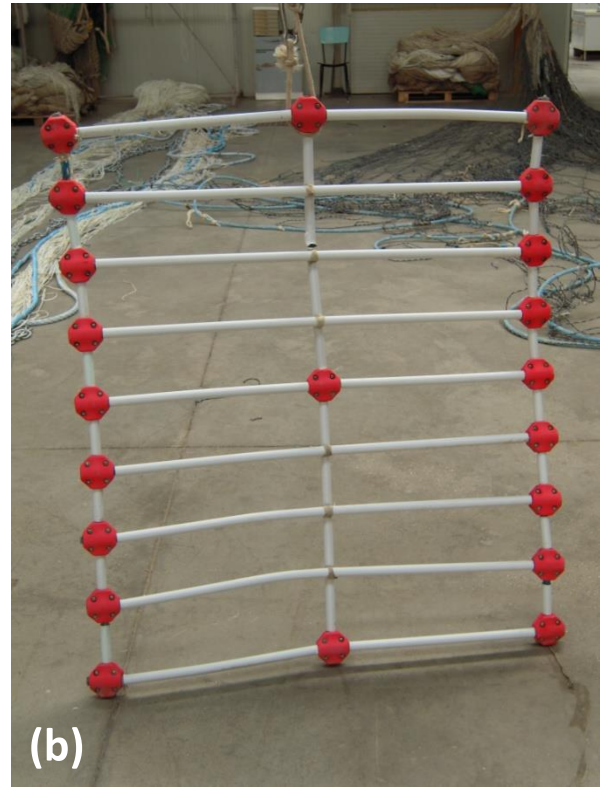
(a) Dimensions in [mm] of the first aluminium Turtle Excluder Devices (TED1). The bars were removable with the aim of adjusting the space between bars;

(b) TED1 broken down because of the large quantity of debris;

(c) which was not discharged out the exit hole and getting trapped in the TED causing an obstruction and then its rupture.

TED specifications and design details: TED2

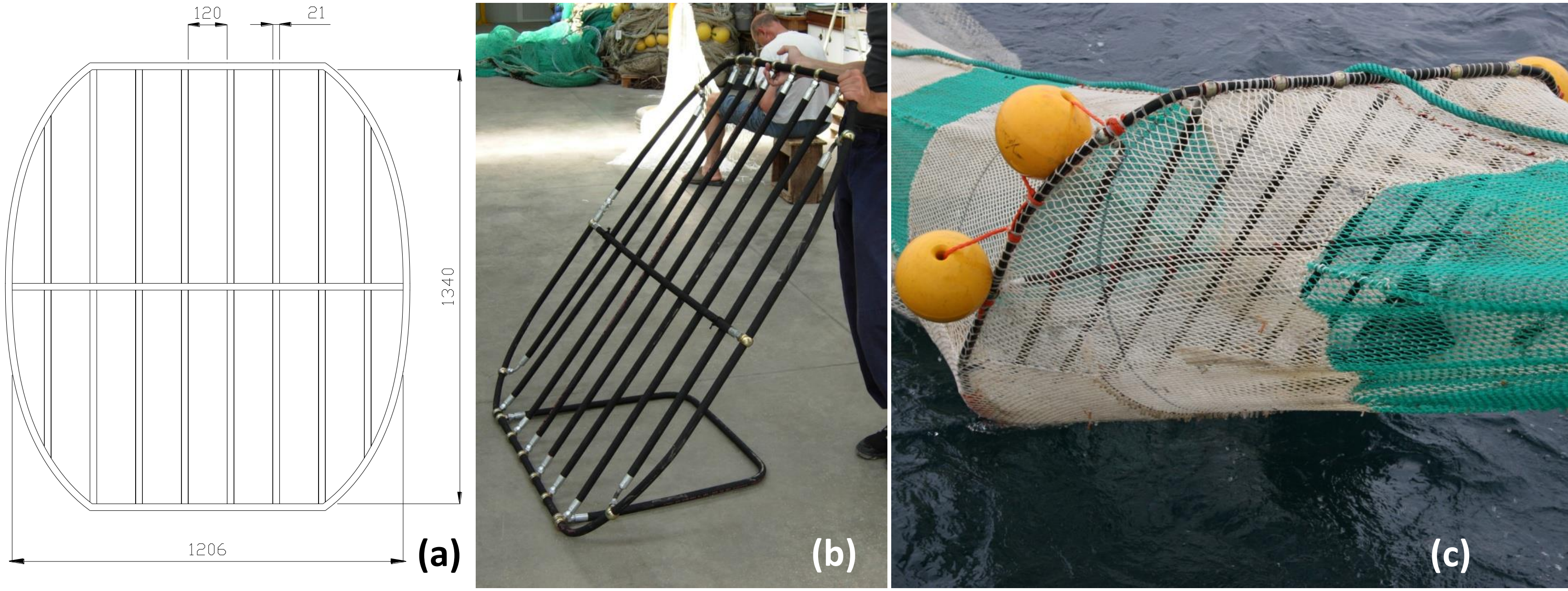




(a) Dimensions in [mm] of the second Turtle Excluder Devices (TED2)

(b) TED2 is a flexible grid made of mixed cable (steel inside and polyethylene outside). This grid was projected with the aim of making the TED position able to adjust depending on the net movements during tow.

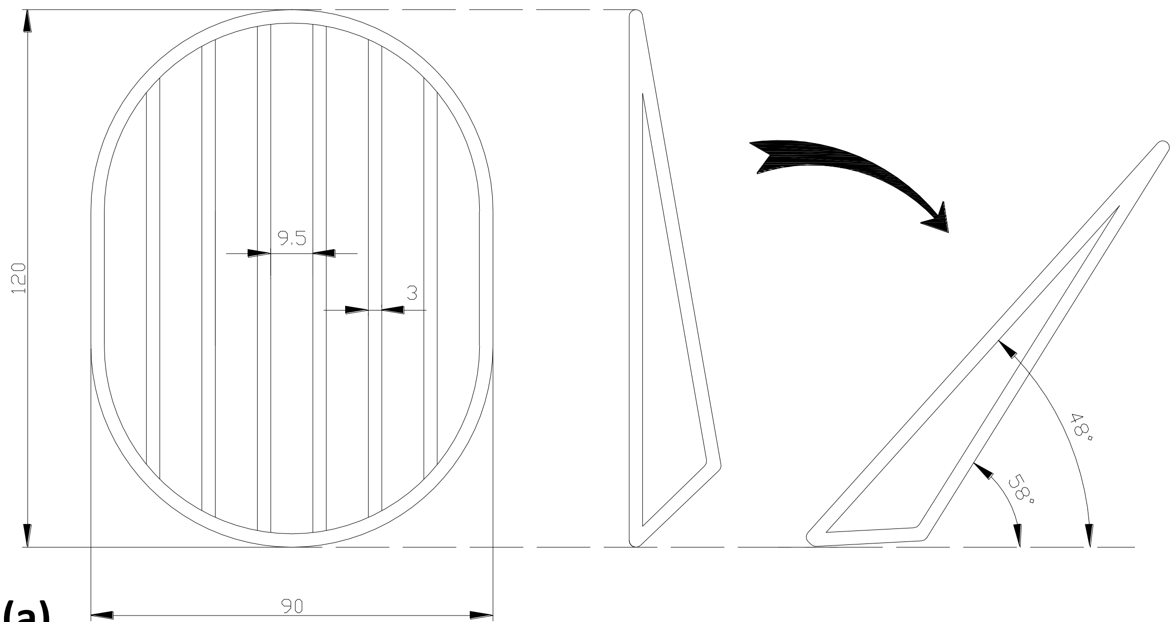
TED specifications and design details: TED3



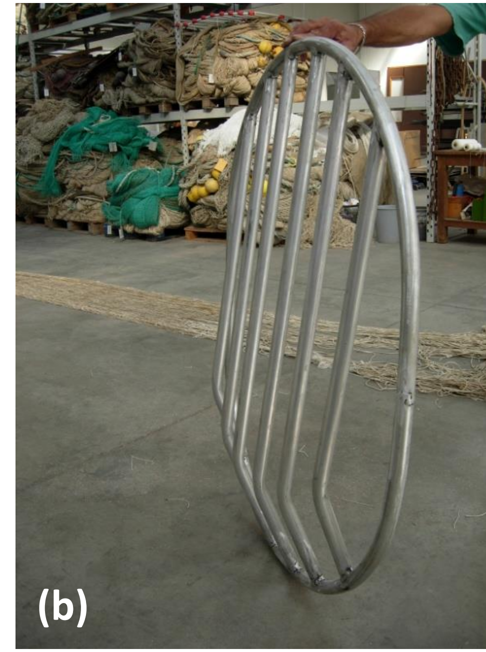
(a) Dimensions in [mm] of the third Turtle Excluder Devices (TED3);

(b) and (c) TED3 is a semi-rigid and resistant grid, made of steel and rubber with the aim of combining the flexibility of rubber and the resistance of steel.

TED specifications and design details: TED4 *(Supershooter)*



(a)

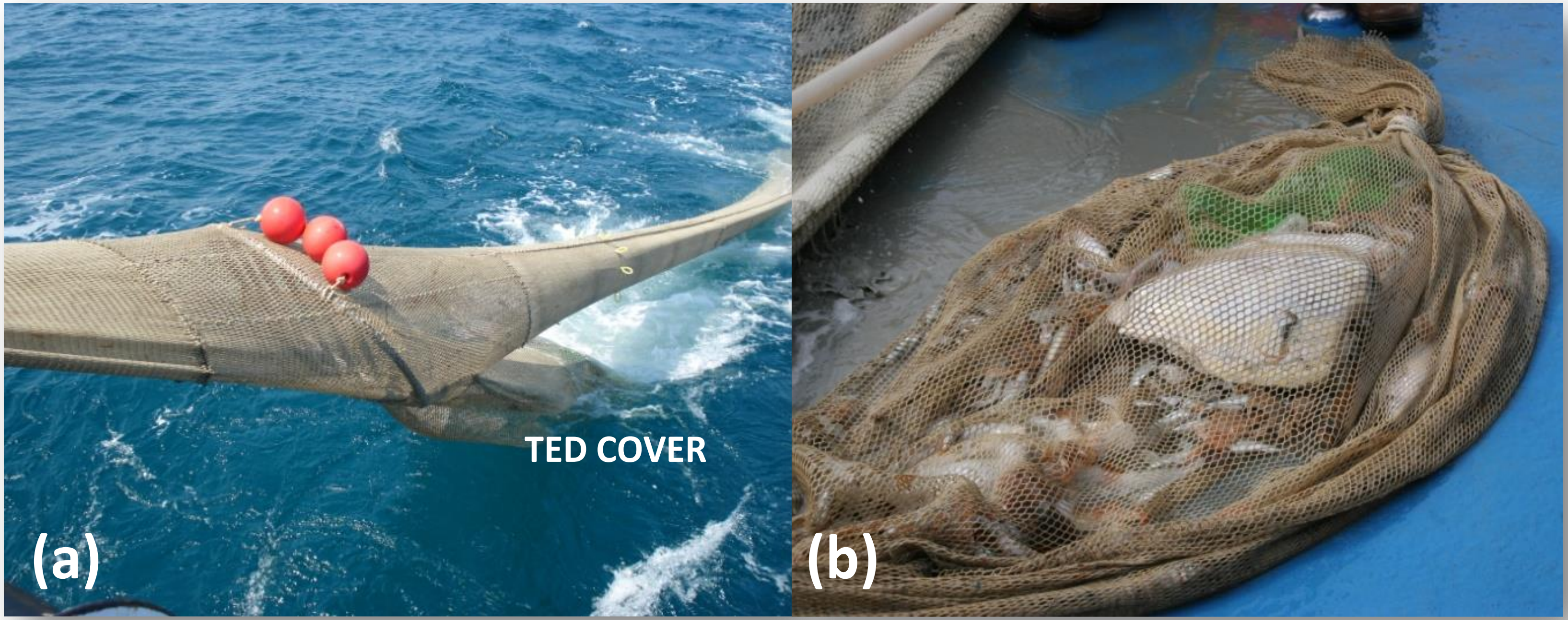


(b)

(a) Dimensions [mm] of the fourth Turtle Excluder Devices (TED4, Supershooter);

(b) TED4 is a classic aluminium Supershooter grid commonly used in several countries in prawn fisheries. By considering complex fishing composition (crustaceans, molluscs and fishes together), we kept the space between reflector bars larger than the standard models.

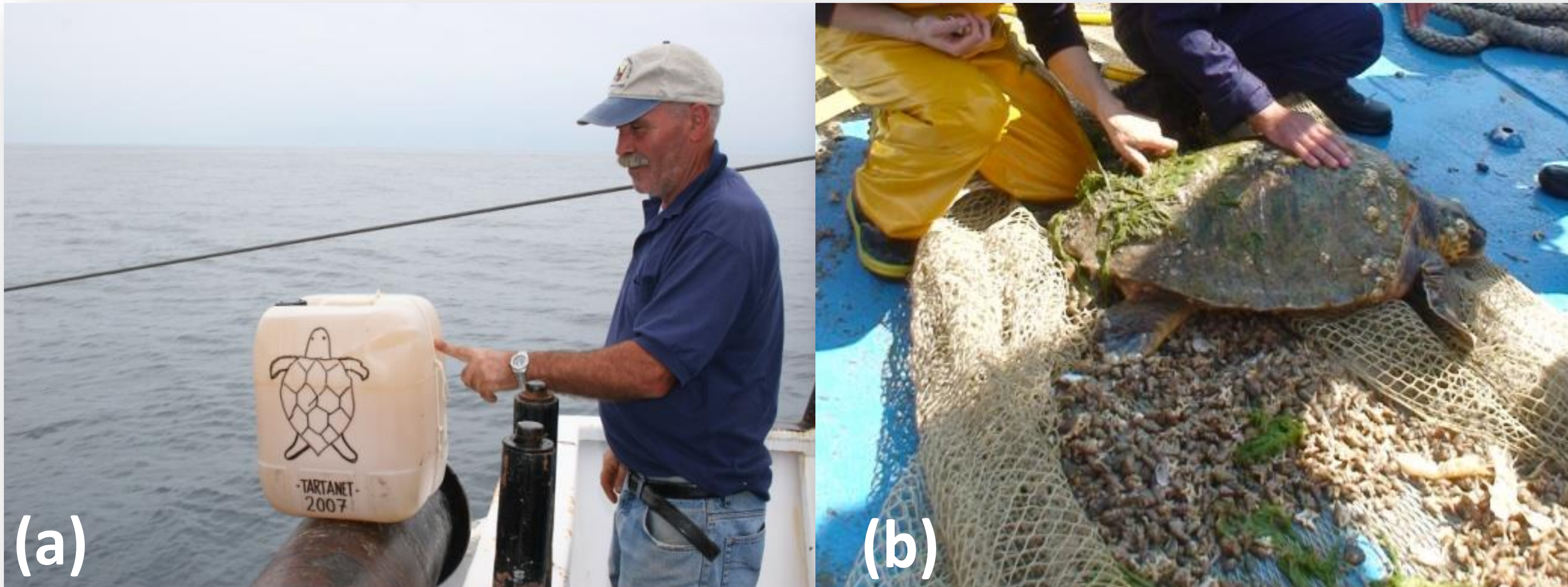
TED specifications and design details (TED Cover)



(a) Supershooter (TED4) during the hauling operations with a particular of the TED cover;

(b) catch of the TED cover containing a carapace of a died turtle excluded by the *Supershooter*.

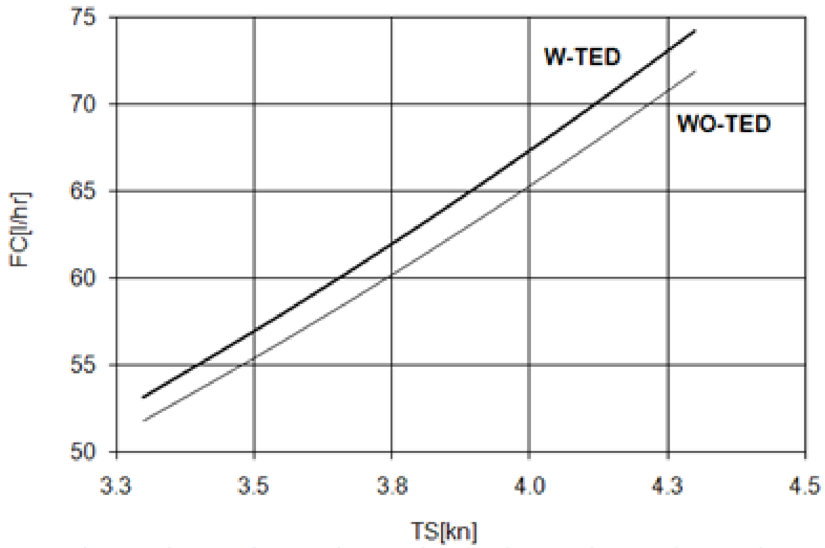
Preliminary simulations and turtle exclusion performance

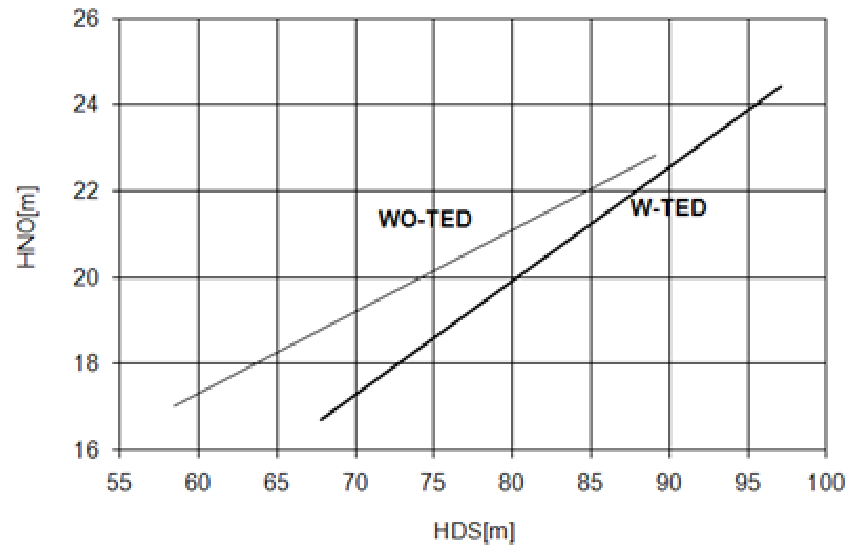


(a) Preliminary simulations with plastic containers (40x40 cm) released by the vessel stern during the tows in order to reveal if they are successfully excluded through the TED escape gap;

(b) loggerhead turtle (*C. caretta*) excluded by TED4 and found in the TED cover.

Will a TED increase codend drag?





- Fuel consumption (FC[l/hr]) and horizontal net opening (HNO[m]) in relation with towing speed (TS[kn]) and horizontal door spread (HDS[m]) respectively.
- The overall effect of the TED on codend drag has been quantified. The addition of a TED to a codend is unlikely to have any noticeable impact on codend drag and it should not make the trawl more difficult to tow through the water.
- A mean increment in the fuel consumption of 1.86 $l \cdot hr^{-1}$ was noted in the TED-equipped net but it was not statistically significant.

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Analysis of the catch rates

		RET		DIS		DEB
TED2	*Control*	20.72		27.56		6.36
	Test	13.25		11.21		5.20
	FPOW	**0.642**		**0.443**		**0.825**
TED3	*Control*	20.16		27.04		11.56
	Test	17.29		20.92		2.18
	FPOW	**0.865**		**0.778**		**0.623**
TED4	*Control*	20.02		22.45		1.92
	Test	19.50		3.95		0.19
	FPOW	**0.975**		**0.415**		**0.514**
Anova	*Sig. P*	*0.000*	**	*0.003*	**	*0.431*
HS	**1**	**TED2**		**TED2,4**		**TED2,3,4**
	2	**TED3,4**		**TED3**		

The <u>fishing power (FPOW)</u> of each TED-equipped-net (test) relative to a control (codend+TED cover) was calculated for each catch category: RET=retained, DIS=discards, DEB=antrophic debris, as the ratio between the <u>mean catch (kg·tow^{-1})</u> of the test and control. Balanced one-way analysis of variance (ANOVA) and Tukey's Post-hoc tests were conducted for each category on log-transformed data of FPOW with TED-type as factor. Means for groups in <u>homogeneous subsets (HS)</u> are displayed.

Discussion and conclusions (1/2)

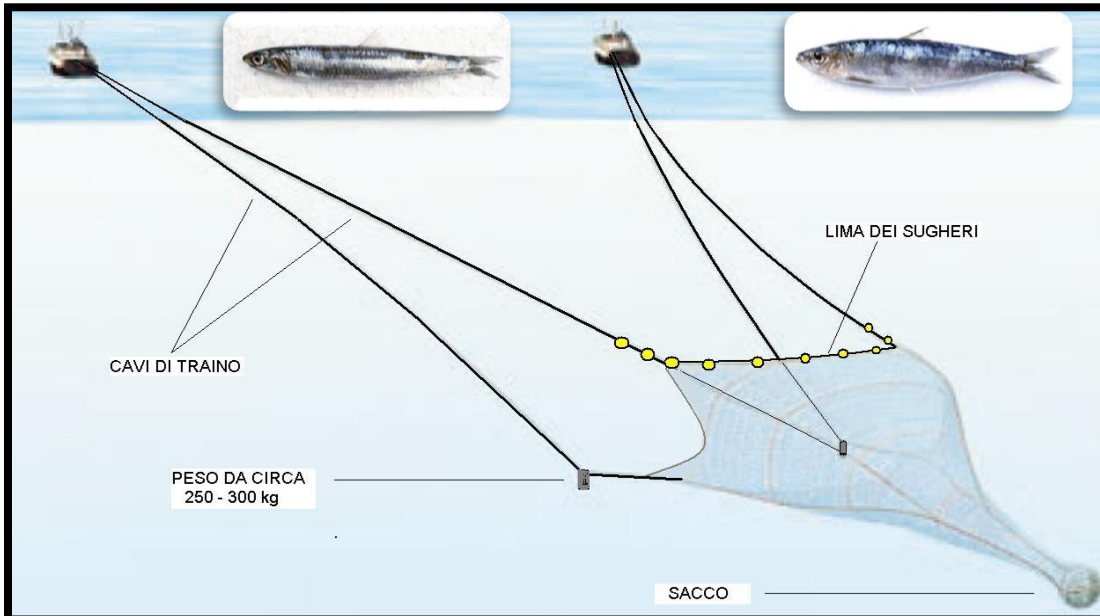
1. **TEDs demonstrated to reduce debris and therefore increase also fish quality. This also would imply reduction of additional sorting operations on board.**
2. **Among the four TEDs tested both the semi-rigid TED (TED3) and the *Supershooter* (TED4) performed in accordance with the design objectives: total discards were reduced, large rays and turtles were not retained and commercial catches were not significantly reduced.**
3. **Both the TED3 and the *Supershooter* were easy to operate and did not require changes to normal fishing operations. The light weight of the *Supershooter* ensured that the safety of the crew on the work deck was not compromised.**
4. **No noticeably increase in drag or twisting of the codend was detected in the trawl fitted with the TEDs.**
5. **We have shown that the *Supershooter* releases mainly smaller-size hake (below 16 cm) by a significant amount and we therefore believe that it has potential utility as a technical tool for use within the Mediterranean management programme.**

Discussion and conclusions (2/2)

6. **In order to effectively implement TEDs, there is a need to minimize the loss of target species meanwhile providing benefits to fishermen: innovations can be easily accepted by professional fishermen only if the economic losses are negligible.**
7. **TEDs produced fewer discards compared to the standard commercial trawls. The discard rate (by weight) was for many species 30-60% lower. The Council Regulation (EC) No 1967/2006, concerning management measures for the sustainable exploitation of fishery resources in the Mediterranean, claimed for the emerging policy of discard reduction in waters under the jurisdiction of the European Union (Lucchetti and Sala 2010; Sala et al. 2007, 2008; Sala and Lucchetti 2010), therefore TEDs may have some broader value in this context.**

Pelagic trawl and TED

BYCATCH Project



NO EXPERIENCE in pelagic trawl fisheries…

Pelagic trawl and turtles (1/2)

Summary of monthly bycacth data by region (Fortuna et al. 2010)

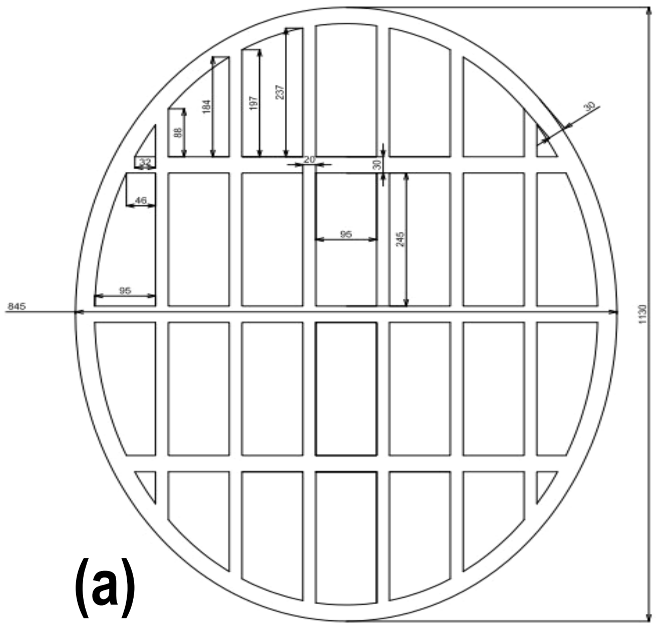
Region Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
North Adriatic Sea												
Sea turtles by-catch rate	0.0	0.005	0.0	0.0	0.025	0.006	0.032	0.049	0.053	0.037	0.025	0.063
Elasmobranch by-catch rate	0.212	0.283	0.109	0.270	0.264	0.356	0.822	0.195	0.435	0.211	0.343	0.384
Veneto												
Fishing trips	19	13	6	13	20	15	33	4	40	54	46	24
Hauls	71	52	19	65	122	88	200	26	223	270	227	78
Cetacean catches							1*				1	
Sea turtles catches					2(1†)	1	4		2	1	2	1
Sea turtles by-catch rate	0.0	0.0	0.0	0.0	0.016	0.011	0.020	0.0	0.009	0.004	0.009	0.013
Elasmobranch catches	45	39	6	27	50	57	239	7	93	64	91	54
Elasmobranch by-catch rate	0.634	0.750	0.316	0.415	0.410	0.648	1.195	0.269	0.417	0.237	0.401	0.692
Emilia Romagna												
Fishing trips	40	34	30	23	26	23	38	3	49	51	32	31
Hauls	151	135	110	87	79	92	143	15	170	214	137	112
Cetacean catches										1*		
Sea turtles catches		1			3		7(2†)	2	19(1†)	17(2†)	7(1*)	11
Sea turtles by-catch rate	0.0	0.007	0.0	0.0	0.038	0.0	0.049	0.133	0.112	0.079	0.051	0.098
Elasmobranch catches	2	14	8	14	3	7	43	1	78	38	34	19
Elasmobranch by-catch rate	0.013	0.104	0.073	0.161	0.038	0.076	0.301	0.067	0.459	0.178	0.248	0.170
Abruzzo/Puglia = Central Adriatic Sea												
Fishing trips	11	10	12	6	4	4	3	–	6	8	5	8
Hauls	38	33	41	25	16	15	8	–	15	21	20	20
Cetacean catches								–				
Sea turtles catches								–				
Sea turtles by-catch rate	0.0	0.0	0.0	0.0	0.0	0.0	0.0	–	0.0	0.0	0.0	0.0
Elasmobranch catches	1	1		4		1	1	–				
Elasmobranch by-catch rate	0.026	0.030	0.0	0.16	0.0	0.067	0.125	–	0.0	0.0	0.0	0.0

Pelagic trawl and turtles (2/2)

Annual by-catch estimates: Northern Adriatic Sea and all pair trawlers fishery (Fortuna et al. 2010)

	Total hauls	Observed hauls	Total by-catch	By-catch rate	Annual estimate	CV	95% CI
North Adriatic Fishing Effort							
Loggerhead turtle (captured)	78,010	2899	80	0.0276	863	0.15	817–891
Loggerhead turtle (dead)	78,010	2899	1	0.0003	–	–	2–27
Loggerhead turtle (comatose)	78,010	2899	6	0.0021	65	0.39	46–79
Bottlenose dolphins	78,010	2899	2	0.0007	–	–	9–37
Rays	78,010	2899	504	0.1739	5436	0.08	5360–5482
Pteromylaeus bovinus	78,010	2899	143	0.0493	1542	0.18	1434–1611
Sharks	78,010	2899	502	0.1732	5415	0.15	5124–5595
Alopias vulpinus	78,010	2899	13	0.0045	140	0.23	124–151
Squalus acanthias	78,010	2899	372	0.1284	4012	0.20	3654–4242
Mustelus mustelus	78,010	2899	80	0.0276	863	0.15	818–891
Total Fishing Effort							
Loggerhead turtle (captured)	148,205	3147	80	0.0254	1510	0.15	1426–1562
Loggerhead turtle (dead)	148,205	3147	1	0.0003	–	–	4–50
Loggerhead turtle (comatose)	148,205	3147	6	0.0019	113	0.40	79–140
Bottlenose dolphins	148,205	3147	2	0.0006	–	–	15–66
Rays	148,205	3147	509	0.1617	9607	0.08	9467–9691
Pteromylaeus bovinus	148,205	3147	143	0.0454	2699	0.18	2500–2825
Sharks	148,205	3147	505	0.1605	9531	0.16	9001–9861
Alopias vulpinus	148,205	3147	13	0.0041	245	0.29	202–276
Squalus acanthias	148,205	3147	374	0.1188	7059	0.20	6403–7480
Mustelus mustelus	148,205	3147	80	0.0254	1510	0.15	1427–1561

FLEX Grid



(a) Technical characteristics of the sorting grid (Bycatch Reducer Device Mod. FLEX-GRID) tested on board commercial fishing vessels

(b) Detail of the grid tested and mounted on a section of extension piece. In the lower part is visible the collection bag (CB) used to collect the species and the material deflected out-off the grid.

Sea Trials

- No turtles caught
- No increase in drag forces and fuel consumption
- No good performance of the grid (Orientation Angle comprised 60°-90°)
- Bad performance of the fishing gear
- Loss of important quantity of catch

FURTHER SEA TRIALS ARE NEEDED

In July new test, without CB, just using a camera

Some turtle caught…

E. Notti, Bycatch III

Some turtle caught…

E. Notti, Bycatch III

31/05/2013, Senigallia (AN)

Some turtle caught…

E. Notti, Bycatch III

Some turtle caught…

Some turtle caught…

Some turtle caught…

Some turtle caught…

M. Virgili, Bycatch IV

31/05/2013, Senigallia (AN)

Some turtle caught…

Some turtle caught…

G. Buglioni, Campagna RITMARE, 2013

Some turtle caught…

G. Buglioni, Campagna RITMARE, 2013

31/05/2013, Senigallia (AN)

Some turtle caught…

G. Buglioni, Campagna RITMARE, 2013

31/05/2013, Senigallia (AN)

31 Maggio 2013
La Tartaruga marina in Adriatico:
Tutela e conservazione di una specie a rischio di estinzione

Riduzione delle catture accidentali della tartaruga marina nella pesca al traino

Massimo Virgili

Consiglio Nazionale delle Ricerche (CNR) – Istituto di Scienze Marine (ISMAR), Ancona (Italy)

NATIONAL RESEARCH COUNCIL – INSTITUTE OF MARINE SCIENCES (ISMAR), ANCONA (ITALY)

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