**GENERAL FISHERIES COMMISSION
FOR THE MEDITERRANEAN**

**COMMISSION GÉNÉRALE DES PÊCHES
POUR LA MÉDITERRANÉE**

GENERAL FISHERIES COMMISSION FOR THE MEDITERRANEAN
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Strengthening Cooperation in the Black Sea

INTRODUCTION

During its 31st Session, the Commission acknowledged efforts made to strengthen the cooperation with the Black Sea research institutions, particularly through convening the first meeting of the Permanent Working Group on Stock Assessment in collaboration with the Black Sea Economic Cooperation Organization. However, it further encouraged the Scientific Advisory Committee to increase its involvement in the Black Sea area and requested that the Secretariat should explore options for a cooperation project in support of fishery research and management for this sub-region.

In response to this request, the Secretariat has attempted to address the issue, including through the assistance of consultants, and the following related draft documents, which have been produced over the course of the inter-sessional period, are attached for the Commission's perusal:

- Recent experience and future options for fisheries assessment and management in the Black Sea: A GFCM perspective (Caddy, J.)
- List of supplementary relevant Black Sea-related documentation reviewed or compiled by the Secretariat
- GFCM Black Sea programme: preliminary elements for a project framework (Knudsen, S.)
- Objectives and components of a possible GFCM-executed project in the Black Sea

On the basis of the attached documentation, the Secretariat invites the Commission to indicate its intentions with regards to further developing the proposal for a Black Sea project. In the affirmative, a programme of work for the drafting of a project document for this sub-region would need to be drawn up, whilst taking into account that sufficient funding would specifically need to be provided for this purpose.

ATTACHMENT 1

D R A F T

Recent experience and future options for
fisheries assessment and management in the Black Sea:
A GFCM perspective

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Preface

The aim of this paper is to explore a way forward for managing shared and migratory resources of the Black Sea, and to consider how this can be tackled in the GFCM context. Achieving this will need to include a number of basic organizational requirements as well as several innovations, given the significant environmental interactions that have been documented to affect the marine ecosystem of the Black Sea in addition to fishing effort. This paper suggests how the GFCM subregional approach could be adapted to support a closed fisheries management cycle in the Black Sea within a management framework where all parties could participate within their respective mandates and capabilities. (This paper is based on a more extensive summary of historical and useful material resulting from earlier GFCM/FAO involvement in Black Sea Issues).

Contents

1. OVERVIEW OF RECENT CHANGES IN BLACK SEA OCEANOGRAPHY AND ECOLOGY

The dramatic changes in Black Sea fisheries over the last 4 decades cannot be fully understood if we use the classical approach to fisheries assessment followed until recently in north-temperate ocean areas such as the North Atlantic. The radical transformation of the environment and ecosystem of an almost closed inland sea needs to be explicitly taken into account. Any approach to fisheries rehabilitation must be firmly based on an understanding of how environmental factors affect the productivity of a water body, in addition to the effects of uncontrolled fishing pressure.

A number of factors have contributed synergistically to the loss of diversity of fishery resources within the Black Sea since the 1960's (see e.g., Table 1). These have been documented in a series of GFCM Studies and Reviews which constitute the only internationally-available synthesis of events in this sub-region of the GFCM area. Individual influences cannot be easily separated or quantified, but have included:

- excessive nutrient inputs and changes to inflow regimes from rivers
- eutrophication of shelf areas and connected basins with limited flushing capacity
- overfishing
- the truncation of local food webs
- the decimation of some healthy populations of marine mammals, and of other migratory finfish predators
- the introduction of exotic species that have affected both benthic and pelagic biomes.

A number of competing hypotheses have been put forward to explain the breakdown of ecosystem stability: e.g. Christensen and Caddy (1993), Berdnikov et al. (1999), Daskalov (2002) and Daskalov et al. (2007). This last author saw recent events as driven by the much earlier decline in top predators in the system; leading to a trophic cascade which resulted in uncontrolled phytoplankton blooms. Although he acknowledged the role of eutrophication, and its effects on the hypoxia of bottom waters, and hence benthos, macroalgae and demersal finfish as conceptually modelled by Sorokin (1993) and Caddy (1993), these were not explicitly considered. Kideys (2002) and Gucu (2002) also considered the role of overfishing as more important than the *M. leydei* outbreak. Others (e.g. Rass 2001) postulated that the reduction of spring outflows from major rivers was the main factor responsible for the current reduction in range and abundance of migratory pelagic fish. No one hypothesis seems to explain the overall changes that have occurred to this ecosystem in recent decades.

Table 1: The problem of determining the major causes for Black Sea ecosystem change and fishery declines is complex. There is a general lack of agreement between national experts in different scientific specializations as to the main causal factors

Different assumed causes for Black Sea problems. Six are listed below
1) The ECOPATH model assumes an exotic jellyfish impacts the pelagic fish food web.
2) Increased nutrient inputs lead to abnormal phytoplankton blooms.
3) Pollution of incoming rivers affected planktonic productivity in the Black Sea
4) Reproductive success of small pelagics is affected more by environment than spawning stock size
5) A steady state model (ignoring the changing environment) suggests that stock collapse was mostly due to overfishing
6) Elimination of top predators in the 1970s drove a trophic cascade affecting all later events.

Evidently, establishing a single cause for changes in the fishery ecosystem is unlikely, and efforts must be made to simultaneously control a variety of anthropogenic factors; notably, nutrient inputs to the Black Sea, overall fishing capacity and the introduction of exotic species, if resources that have been depleted are to be to protected and restored. Using a broad brush approach and a range of fishery and ecosystem indicators to monitor ecosystem health, seems the appropriate way to go.

Up until the 1930's, the Black Sea was considered a relatively unproductive and low diversity water body (Ivanov and Beverton 1985). 90% by volume of its deeper waters extend below the well-oxygenated surface waters from about 150-200m to the sea floor. These bottom waters are anoxic and saturated with hydrogen sulphide. Evidently this situation prevailed even before mankind began modifying the Black Sea's extensive drainage basin which is some 5 times the area of the sea's surface (see Fig 1). This was the case both prior to the Second World War, and prior to the industrial age and the onset of industrial agriculture that accompanied it. Since then, the Black Sea drainage basin has been the source of a significant proportion of agricultural production from Eastern Europe. Later views on its productivity were modified to take into account recent increases in nutrient inputs from incoming rivers (especially the Danube) as well as nutrients coming from below the oxycline. Clearly this was not just a change in perception, but represented an actual increase in biological productivity. Oceanographic measurements demonstrate this, but the increasing frequency of algal blooms is unequivocal evidence.

It seems clear from these accounts that an overall picture of changes will have to acknowledge multiple factors as important: both fisheries mismanagement and environmental degradation have worked together in introducing imbalances into a naturally productive ecosystem. Ivanov and Beverton (1985) illustrated the effects of eutrophication on primary productivity graphically, in terms of its effect on small planktivorous fishes; showing that both landings and biomasses of sprat, a key pelagic species, had begun to show marked upward trends by the early 1980s. Such a synchrony would not have been possible if fisheries production had remained stable: an increase in yield would have been accompanied by a decline in remaining

biomass if due to an increase in fishing effort on a resource with stable productivity. The fact that we cannot assume a stable productivity for this water body complicates the use of simple fisheries models which make this assumption. This is the main motive for basing further monitoring on a wider range of fisheries and ecosystem indicators.

The alarming trends in the oceanography of the Black Sea over recent decades have been widely documented, but this brief description takes into account GFCM (1993) and the summary by Balkas et al. (1990) and the later review by Volovik (2004). The Balkas et al.(1990) report noted that the original view of this sea as oligotrophic or nutrient-limited has changed, such that estimates of primary productivity made in 1990 were comparable with those from a fertile sea, the Baltic. The most productive areas are the NW and NE (including the Sea of Azov) under the influence of incoming rivers, and the sea as a whole has much higher levels of dissolved organics than the world oceans. Modern techniques of oceanography, including satellite observation systems (e.g. NATO 1997) have improved our knowledge of the oceanography of the Sea, and there is an extensive network of national and international bodies concerned with environmental quality.
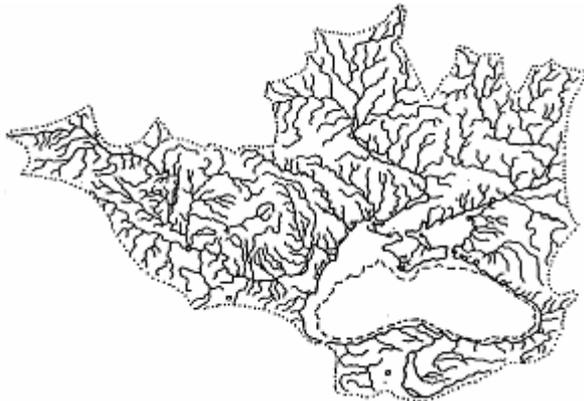

Fig 1: The Black Sea, its shelf areas (dashed line) and its catchment basin and rivers.

The role of the Danube is predominant with respect to inputs of fresh water (53%), solid materials (55%) and nutrients to the Black Sea, and clearly, maintaining the quality of the marine environment is closely tied to the water quality of Danube inflows. One consequence of the fact that the catchment area is some 6 times greater than the surface of the Black Sea is that eutrophication of the Sea has occurred progressively since at least 1960. This process has been marked by phosphorus levels which increased 5 times as much, and similar changes for nitrogen and organics. In consequence, nutrients have long ceased to be a constraint on phytoplankton production, and seasonal phytoplankton blooms and red tides leading to heavy deposition of organic material, has resulted in hypoxia of lower shelf waters, at least seasonally in the western and north-western Black Sea. Given that the exchange of Black Sea waters with the Mediterranean is estimated to take 480-600 years (Kolarov MS), the urgency of maintaining high standards of water quality for incoming waters is evident.

Dense blooms of nanoplankton and the zooplanktonic species *Noctiluca*, which is of little value for fish food, have also resulted. Mee (1992) estimated that some 60,000 t of phosphorus (more than inputs to the North Sea or Baltic), and 340,000 t of inorganic nitrogen (more than from the Rhine to the North Sea), enter the Black Sea annually from the Danube. Among the specific effects of this huge nutrient input on fisheries has been the reduction of light penetration due to suspended material and algal cells, rendering shallow the euphotic zone and thus eliminating beds of *Phyllophora* and other macrophytes which previously oxygenated bottom waters. Mee (1992) reported that a single anoxic event in 1991 off the

Romanian coast eliminated 50% of the remaining benthic fish, while 95% of the NW shelf of the Black Sea is now prone to hypoxia and hydrogen sulphide-rich water. In consequence, large areas of the near bottom habitat in this area are now unsuitable for the large beds of filtering species such as blue mussels which formerly played a key role in water cleansing (Sorokin 1993). Exotic species adapted to low oxygen conditions have flourished in some areas, such as the exotic clam *Mya arenaria,* and the demersal/pelagic ratio of fishery production has been driven to low levels (Caddy 1993; de Leiva Moreno et al. 2000), and many oligotrophic species have been eliminated. A generally diffused opinion suggests that the effects of national controls on phosphate detergents, and the reduction in fertilizer use in agriculture under market economies, may have improved somewhat the ecological condition of marine environments, but little evidence of the introduction of cooperative fisheries management is evident. If this is true, there is the possibility however, that without effective controls on water quality of inflowing waters, nutrient loading may increase again as the economies of Eastern Europe recover.

High zooplankton production has been another consequence of eutrophication. This in turn has favoured jelly predators. Balkas et al. (1990) noted that the jellyfish *Aurelia aurita* in 1959-1962 made up a biomass of 93,000-1.6 million tons, but by 1978 was present at a biomass estimated at 300-450 million tons. Pollution, dams, and other hydraulic modifications to the Danube and other large incoming rivers further to the north (the Dniester, Don and Kuban) have affected the maintenance of a diverse fauna of anadromous species. Reduced water inflows, especially in northern areas, has converted the Azov Sea from a shallow sea with important freshwater fish resources, to one dominated mainly by marine species**.** Wild native stocks of highly valuable sturgeon species have been seriously affected by interruptions to their migration routes, and in some cases populations are now largely sustained by hatchery operations.

Pollutants mentioned by Balkas et al. (1990) included domestic and industrial waste and oil residues from the heavy shipping traffic. Mine wastes, heavy metals, pesticides and industrial effluents, were reported to be directly discharged into the Black Sea or its inflowing rivers without pre-treatment. Some evidence was cited by Balkas (1990) and Mee (1992) of radioactive fall out from the Chernobyl nuclear power plant incident in 1986 entering the Black Sea. A detailed commentary on the issues raised by Black Sea pollution was provided by Mee (1992), whose account provided an environmental focus for international action on improving water quality in the Black Sea.

Pollutants entering from outside the Black Sea in the underflow from the Bosphorus with its coastal population of over 9 million persons (in Istanbul) were also referred to by Mee (1992) as forming a potential barrier to incoming migratory species that previously played a key role in the Black Sea.

The increase in nutrient runoff over the last half century or so was made more critical by the very low flushing rate of this sea to the Mediterranean through the Bosphorus and Sea of Marmara. The Black Sea was already oxygen-depleted close to bottom prior to human-induced runoff of nutrients from its drainage basin. In addition to nutrient runoff, the introduction of *Mnemiopsis (M. leidyi)* into the Black Sea and its subsequent impacts on the ecosystem merit specific mention. The effects of this event on the ecosystem have now been described in an extensive literature, (e.g. Volovik 2004), much of which is also summarized in GESAMP (1997). However the subsequent history after 2000, involving an exotic controlling species also introduced to the basin, apparently after 1997, has not been well documented in

the scientific literature in English and can only be mentioned here from anecdotal evidence. From the GESAMP report, prior to 1988, the dominant jelly predator on plankton (but apparently not extensively on fish larvae) was *Aurelia aurita*. Although *M. leidyi* was introduced into the Black Sea at some imprecise date in the early 1980's according to Shiganova (1998), probably from ship ballast water, it only 'bloomed' to high population levels in the Azov Sea in 1988 (Volovik et al. 1993 – Fig 2), but by 1989-90, its biomass in the Black Sea was estimated to be around 900,000t; dropping to lower levels in 1991, and spreading eastwards. By 1993, the biomass in the eastern Black Sea was still more than three times higher in the western than in the eastern Black Sea (Mutlu et al. 1994). No data seems available on current levels of summer biomass.
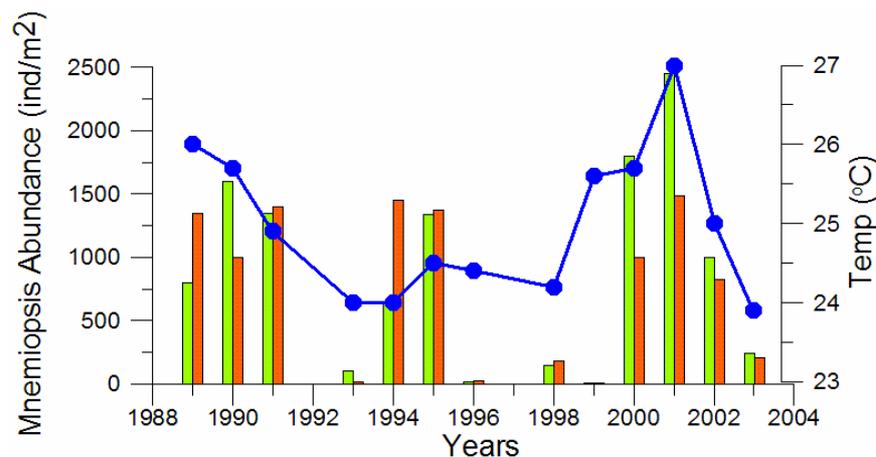

Figure 2. Interannual variation of *Mnemiopsis* abundance in the eastern Black Sea offshore waters (green bars) and inshore waters (red bars) during August of 1989-2003 period, and August surface water temperature (blue dots). The data were taken from Shiganova et al. (2004).

Thus, although the Prodanov et al. (1997) report confirmed the effect of the *Mnemiopsis* outbreak from their last 2 years of data (1991 - 92), the only comment made on the anchovy collapse was that it was due to 'negative natural and anthropogenic impacts due to the *Mnemiopsis* outburst and anchovy overfishing in particular'. One general observation that can be made in retrospect on the analyses of both Ivanov and Beverton (1984) and Prodanov et al. (1997) therefore, is that they are largely basing their analyses on 'pre-*Mnemiopsis*' conditions in the Black Sea. To what extent these analyses now reflect the potential productivity of a Black Sea is not yet clear; given that since 2000 the pelagic ecosystem now has several new jelly predators, and its main predatory species (marine mammals and migratory pelagics) have been significantly reduced in abundance.

In the GESAMP (1997) report, GFCM (1993) is quoted as recommending immediate attention be paid to the outbreak; that a Task Force, Strategy and Action Plan be drawn up, and a list of possible control organisms considered. It was stressed that the consensus of all Black Sea riparian countries should be sought before any control agents were released into the sea. This proposal was directed to GEF to be included in its Program of Environmental Management and Protection of the Black Sea. A range of control agents was considered by GESAMP(1997), and it was concluded that another ctenophore, *Beroe spp* would be ideal in many respects since it is a specific predator on *M. leidyi* in its natural habitat in the west Atlantic, and is reported not to be a predator on fish larvae or copepods. However, there were fears that it may not be able to exist in the lower salinity waters of the Black Sea. An earlier

study of trophic flows in the Black Sea food web (Christensen and Caddy 1993) had examined the potential effect on Black Sea food webs of introducing successively *M. leidyi* and *Beroe spp*, and had concluded that while the first species would result in a decline in pelagic fish productivity, this would be somewhat counteracted by also introducing the second species. No decision was made internationally to introduce this species into the Black Sea, so it is perhaps remarkable that two species of *Beroe* (*B. cucumis* and *B. ovata*) were reported to have been introduced 'accidentally' in the late 1990s (Zaitsev 1998). This last-cited author is quoted in Zaitsev and Osturk (2001) as having suggested that the introduction of *Beroe spp* may have been in part responsible for the subsequent decline in blooms of *M. leidyi* and increases in fish catches. Fig 3 shows dramatic changes in the abundance of bottom plants and demersal fishes and in phytoplankton abundance in the period 1960-2002: in all probability as a cumulative effect of overfishing, environmental degradation and the addition of an exotic planktonic predator, *M. leidyi*.
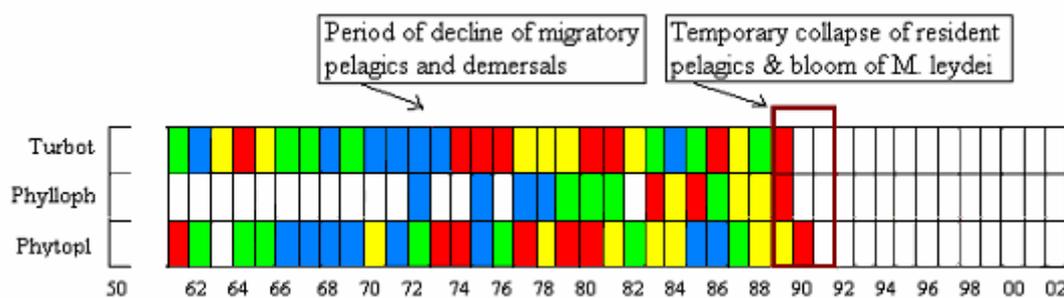

Fig 3. Showing the general correspondence over time in <u>Phyllophora</u> abundance and turbot catches (red = low abundance: blue = high) as indicators of declining health of demersal habitats, and the inverse trend in phytoplankton abundance (in this case, red = high primary production).

This section of the report draws particularly on the paper by Prodanov et al. (1997), whose analyses mainly extend up until 1992.

2. CHANGES IN BLACK SEA FISHERIES

2.1. Stocks and catches

In the late 1970's, estimates of the biomass of anchovy were of the order of 0.4 – 1.5 million tons, and the overall mortality rate Z for anchovy cited by Ivanov and Beverton (1985), presumably also for the late 1970's, ranged from Z = 1.0 – 1.5: which is a fairly high range. By 1980 however, Ivanov and Beverton (1985) commented with some misgivings, on the nearly doubling of the anchovy catch to 400,000t, due to the recent increase in Turkish fleet capacity. One reasonable deduction from this however, is that such a rapid doubling of pelagic production would not have been possible if the productivity of the Black Sea had not also increased. Also there seems little evidence that the collapse of the anchovy stock in 1988-90 was solely due to overfishing, though the high exploitation rate certainly reduced the biomass of zooplankton-feeding fish. The decline in planktivorous fish, together with increased planktonic production from high nutrient inflows, may together have led to a high abundance of zooplankton. This would have supported a bloom of relatively unselective jelly

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predators. It must be said however, that this is only one possible interpretation of the sequence of events.

The Straits connecting the Black Sea to the Mediterranean are in Turkish waters and include the Canakkale Strait, the Sea of Marmara and the Bosphorus. These have traditionally been rich fishing grounds, and play a key role as spawning areas for some of the migratory predators (mackerels, bluefish and bonito), which enter the Black Sea seasonally (Ivanov and Beverton 1985), and in prior to the *Mnemiopsis* outbreak were ecologically dominant predators in Black Sea food chains. Ivanov and Beverton (1985) and Prodanov et al. (1997) documented the serious declines in numbers of these highly migratory scombrid stocks which seasonally enter the northern Black Sea. Since 1968, (mackerel) and since around 1971 (bluefish and bonito), are now rarely recorded in the northern parts of the Black Sea, whereas the maps in Ivanov and Beverton show them to have migrated throughout the whole Black Sea in the 1970's and earlier. Although in reduced numbers, these species still enter the southern Black Sea. It merits specific investigation to determine whether the key factor affecting their reduced migration routes are environmental deterioration of the western and north-western Black Sea under the influence of Danube inflows, a decline in water quality in the straits, ecological change in the Sea of Marmara hampering spawning, or simply overfishing. This last explanation seems less likely as the only cause of declines, given that recent catches of the same species of scombrids in the Aegean and Marmara Seas appear to have remained relatively high (Prodanov et al. 1997). The possibility that the decline in migratory pelagics has had a consequent positive impact on small pelagic production has been suggested as one of several competing hypotheses (Table 1) which suggest mechanisms for the slow rise of native pelagic production until the mid 1980's, its rapid decline in the late 1980's, and the apparent partial recovery of pelagic production following the diminution of *Mnemiopsis* abundance subsequent to the introduction of its predator *Beroe* spp. It seems likely that all of the factors in Table 1 had some influence on fishery productivity and should be closely monitored.

Table 2. Commercial species considered by Black Sea scientists to be shared resources, whose exploitation should be regulated cooperatively.

Species	Characteristic
Engraulis encrasicolus (Anchovy)	Endemic
Trachurus m. ponticus (Black Sea horse mackerel)	Endemic
Sprattus sprattus phalericus (Black Sea sprat)	Endemic
Merlangius m. euxinus (Whiting)	Endemic
Squalus acanthias (Piked dogfish)	Endemic
Psetta maeotica (Black Sea turbot)	Endemic
Mullus barbatus ponticus (Black Sea striped mullet)	Endemic
Liza aurata (Golden grey mullet)	Endemic
Mugil cephalus (Flathead grey mullet)	Endemic
Rapana thomasiana (Rapana whelk)	Introduced from the Pacific
Sarda sarda (Atlantic bonito)	Migratory
Scomber spp (Mackerels)	Migratory
Alosa caspia (Caspian shad)	Anadromous
Pomatomus saltator (Bluefish)	Migratory

Ozturk et al. (2002) described some of the ecological and fishery problems emerging in fisheries of the Istanbul Strait, notably frequent shipping collisions between fishing vessels and tankers, and mass mortalities of bluefish, mullets and sea bream due to consequent oil

spills. Without further investigation, domestic waste output from the large population of the bordering city of Istanbul cannot be discounted as a possible negative factor (Mee 1992).

The Danube is critical to fisheries for at least 4 species of sturgeon These have shown drastic declines in landings, especially those spawning in the Danube and caught in Romanian waters. Landings dropped from 680 t at the end of the 19th Century to 83 t in 1976-79. (Prodanov et al. 1997), while landings of the shad (*Alosa kesserli pontica*) have shown significant increases. Pollution of incoming rivers, loss of feeding grounds, destruction of spawning habitat and barrier to migration all appear to be important factors for sturgeon, while genetic contamination from hatchery fish cannot be discounted.

The consequences of the large blooms of *Mnemiopsis* on the pelagic fishery at the time were dramatic: Turkish catches in the Black Sea and Sea of Marmara (formerly merged in Turkish fishery statistics reported by FAO) were reported to have fallen from almost half a million tons in 1988, to 264,00 tons in 1989, and to be at around 70-80,000 tons in 1991. In Romania, the sprat catch fell from some 11-15,000 t in the early 1980s to around 700 tons in 1991. A similar situation was reported for Bulgaria. Hydroacoustic studies offshore in 1991 found no evidence for young-of-the-year.

TRENDS IN BLACK SEA FISHERIES LANDINGS

CATEGORY/SPECIES	Baseline trend (before 1989)	Trend in in "Collapse yrs": 1989-92	Trend in 92-2002	Trend over Last 5 yr
Resident pelagic species Anchovy (*Engraulis*)	+ +	-	+	+ +
Horse mackerel (*Trachurus*)	+ +	- -	-	+
Sprat (*Sprattus*)	+ +	- -	+ +	-
MIGRANTS				
Mackerel (*S. scombrus*)	-	+	+	-
Chub mackerel (*S. japonicus*)	+ +	- -	-	-
Bluefish (*Pomatomus*)	+ +	-	+	+ +
Bonito (*Sarda*)		+	+	- -
DEMERSAL				
Turbot (*Psetta*)	-	-	+	+ +
Whiting (*Merlangius*)	+ +	- -	-	-
Spiny dogfish (*Squalus*)	+	- -	-	+
Mullets (*Mullus*)	-	+ +		- -
Mugilidae		++	-	- -
Gobies	+	- -	+	- -
Rapana	N/A	N/A	+	- -
(+ve/-ve)*100	267	44	160	55

Fig 4: An indirect idea of the health of an ecosystem can be obtained from trend analysis, even if landings are the only data available (Data here are for years up to 2002). Here high landings are in blue, and progressively declining levels of landings in green, yellow and red. + means a positive trend and – a declining trend in the short period shown. In this traffic light figure, the trends for 14 key species show similar trends. A collapse occurred for many species in 1989-92, and although there was some recovery subsequently, it was not sustained for all species; (From Caddy et al. 2004).

It should be noted that by 2005, bonito catches in Turkish waters had recovered, and further updating of the traffic light plot in Fig 4 would be useful.

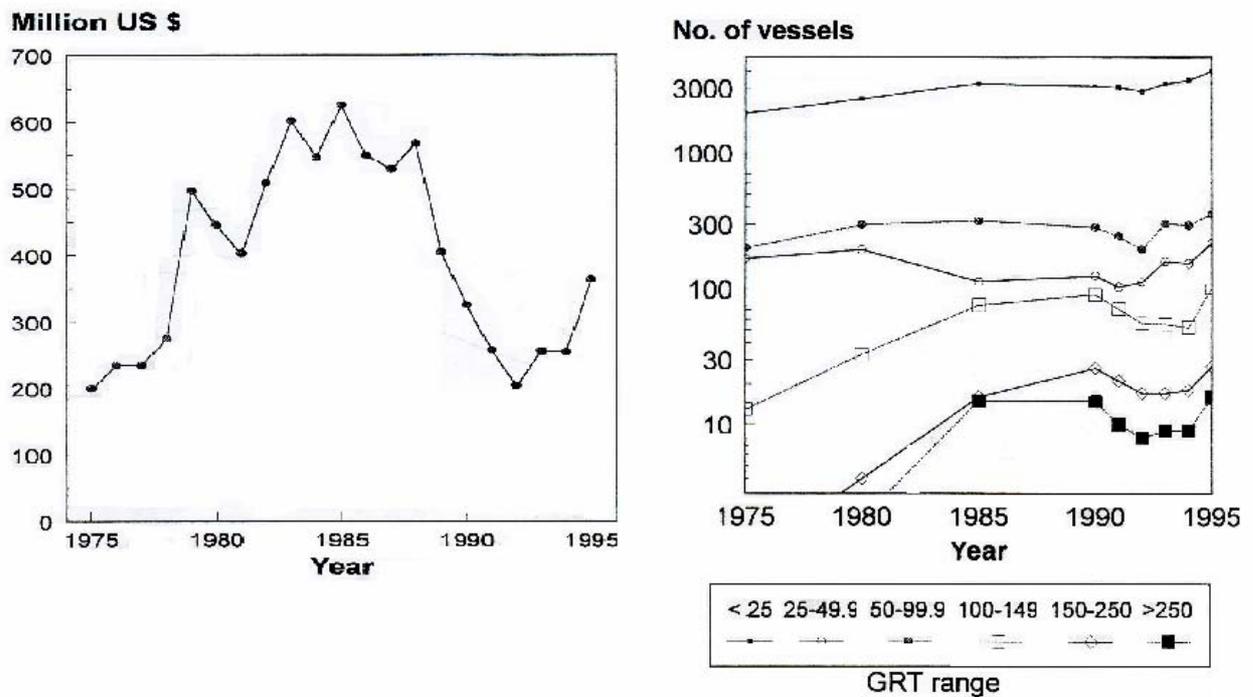## 2.2. Changing structure of Black Sea fishing fleets

Fig 5. Changes in overall landed value and number of vessels operating in Black Sea fisheries; 1975-95. (UNEP sources).

Fig 5 shows the significant changes in fleet size that occurred between 1975-1995. In the 1970s-80s, fleet capacity, fishing effort, and landings, were not then, and are not now, restrained by any international agreement (Balkas et al.1990). Major new investments in fleets and processing facilities were being made leading to overcapitalization, but an up-to-date review of current actively operating fleets is not available. However, it seems that the growth in number of large Turkish fishing vessels abated during the 1990s and 2000s, but fishing capacity continued to increase as a result of the construction (or enlargement of) steadily larger purse seiners and the investment in more powerful engines and state of the art electronic fishing equipment (Knudsen 2008). Thus, growth in fishing capacity has exceeded growth in number of vessels, at least in Turkey. In effect, the Turkish Black Sea fishery has rapidly modernized to become the dominant Black Sea fleet (Knudsen 2003). Turkish landings overtook those of the (then) Soviet Union fleet by 1979. It is evident from Fig 2, that the dramatic decline in pelagic landings over the late 1980's had no significant impact in reducing the fleet capacity in operation (See Knudsen 1997 for reasons for the resilience of the Turkish fleet during the early 1990s crisis years). During and prior to the same period, the ageing fleets of the 'Joint Commission' or 'Varna Commission' countries (Bulgaria, Romania and the Soviet Union) who had signed the 'Convention on Fishing in the Black Sea' in 1959, were suffering from a lack of funds for fleet renewal. The collapse of the Soviet Union and changes in international relations, state policies and economy resulted in overall structural change in the fisheries of Bulgaria (Marciniak and Jentoft 1992), Romania, Ukraine and Russia (Knudsen and Toje 2008) and Georgia (FAO 2006). The introduction of a market

economy, the withdrawal of state support and economic decline resulted in weak demand. A lack of funds for investment and replacement of obsolete equipment in the harvesting and processing sectors - together with a critical resource situation, seriously weakened the fishing fleets of these countries; investment in the Turkish fleet went forward. The socio-economic turmoil resulting from the transition to private ownership in countries where formerly the means of production were owned by the government has evidently not been an easy one (for details, see Toje and Knudsen 2006, Knudsen and Toje 2008) - and the resulting breakdown of the Black Sea fishing fleets by nation (Table 3) shows the overwhelming numerical domination by the Turkish fleet as one result of the uneven availability of funds for investment in national fisheries.

Number of vessels by fishing method in 1995

Type of Vessel	COUNTRY						Total (ex Tur.)	Grand Total
	Tur	Bul	Rom	Ukr	Rus	Geo		
Single-purpose fishing vessels								
Trawler	148	12	9	1	3	6	31	179
Purse seiner	201					22	22	223
Gill netter	2572					8	8	2580
Trap setter				24			24	24
Longliner (P)	56	2				8	10	66
Longliner (A)	750						0	750
Multi-purpose fishing vessels								
Trawler/Seiner	217			65	23		88	305
Gillnetter/Dredger	324			59			59	383
Total fishing vessels	4268	14	9	149	26	44	242	4510
Non-fishing vessels								
Fish carrier	118			14		2	16	134
Factory vessel				4			4	4
Fish farm tender	16						0	16
Research vessel		1					1	1
Total all vessels	4402	15	9	167	26	46	263	4665

NOTES: P = Professional fishing
A = Amateur fishing

Table 3. A breakdown of fleet composition by nationality in 1995.

3. REGIONAL COOPERATION

Modelling the ensemble of ecosystem changes that have taken place over the last 25 years would be difficult. Hence in preparing the 1996 Black Sea Transboundary Diagnostic Analysis (TDA 1996), an indicator-based approach based on the environmental requirements of specific species as indicators of habitat quality and exploitation stress was suggested, thus incorporating both fisheries and environmental time series. Even where resource declines

have been documented, it has been largely impossible to take action on these due in part to ecosystem changes, but also to an incomplete regulatory framework. There is a lack of agreement on national sharing of those fisheries resources that extend throughout potentially exclusive economic zones over the whole basin. In part, this has been a consequence of the serious political and socio-economic divisions of the past, but also the more recent divisions and redrawing of boundaries that have created new riparian countries over recent decades. Although recent data are not generally available, it seems that despite national declarations and some bilateral discussions, the drawing of boundaries for definitive national Exclusive Economic Zones (EEZs) that are accepted by all parties is not yet fully agreed. This is unfortunate, since a start could then be made in deciding on allocations based on the distribution of resources in relation to maritime boundaries. Such an approach (e.g., for the Caribbean Sea - Mahon 1987) has been successful, and can be later modified by bilateral or multilateral accords on mutual access, such as has been achieved in other areas such as the Baltic and North Seas.

3.1. Status of scientific investigations on Black Sea ecosystems and fish stocks

The main initiatives for regional cooperation relevant to fisheries so far, have been in the area of fisheries research, especially in documenting ecosystem and fishery changes. A substantial published literature exists on a variety of subjects related to fisheries. Probably a much larger literature also exists in national languages which is not easily available to international experts: hence this report will be based largely on a limited number of documentary sources, and will focus mainly on issues where the GFCM has played an active role.

Even here however, new information on indicators listed in the 1996 TDA is not easily obtained, but is required for a coordinated review of the recent situation. Most resource reviews referred to in this study, both from GFCM and elsewhere, seem to depend on data series which end at or around 2002, or even earlier. Socio-economic upheavals over the last 1-2 decades in countries which formerly had planned economies, have reduced the necessary funding for research vessels, in-port samplings and other research activities (Toje and Knudsen 2006, Knudsen and Toje 2008). Turkish data collection has also been erratic over the same period, resulting in the lack of reliable time series data on stocks. It would seem urgent therefore to address this issue explicitly by identifying time series that have been interrupted, and to establish a list of current survey activities, and the priorities for continuing time series of importance for resource evaluation. Identifying what the costs would be of resuming surveys that may have been interrupted, and bringing all survey activities under a common heading with standard reporting procedures and transparency of data, are top priorities for implementation, once the necessary funding is restored.

The GFCM Studies and Reviews issue of Ivanov and Beverton (1985) gave a useful summary of events in the fisheries ecosystem until the early 1980's, and was supplemented by GFCM (1993). GFCM Studies and Reviews by Caddy and Griffiths (1990) and Zaitsev (1993) added details on events up to, and just after, the first *Mnemiopsis* blooms in 1990. Prodanov et al. (1997) in the later GFCM Study and Review # 68, carried the story forward until the late 1990s. Since then, reviews by the Turkish Marine Research Foundation (Zaitsev and Ozturk 2001) and by Volovik (2004) have brought the story closer to the present, but the latest data point included in these reviews seems to be 2002, so that we are not in a position here to discuss events over the last half decade.

The Second Technical Consultation on Stock Assessment in the Black Sea in February 1993 (GFCM 1993) provided the first opportunity for a meeting of all Black Sea riparian countries on fisheries resources. After reviewing the status of key resources, the meeting launched the first international alarm on the impacts on pelagic fish stocks and economic returns from the fishery of the *M. leidy*i invasion, and began the search for remedial measures. The need for shared stock management, harmonized fishery regulations, an international agreement on fisheries, a common data base, and a control on fleet capacity were all issues raised for the first time. Socio-economic considerations were also discussed. Elements of importance for insertion in a Black Sea project aimed at restoration of fishery ecosystems were described, and have been incorporated as objectives into all subsequent activities. Little has changed over the subsequent 14 years to radically change the relevance of these conclusions, although as noted, their implementation has been lacking in the more fundamental institutional requirements for a managed fishery on shared stocks, or multilateral controls on fishing capacity.

That the report by Prodanov et al. (1997) did not include much data after 1992, may stem from the recent shortage of financial resources for the research institutes in the North and West of the Black Sea. In particular, a decline in the financial resources available for maintaining the standard research surveys carried out in the 1970's and earlier, may be of particular importance. Such a break in fisheries time series at around 2002 is also evident in the reports of the workshop in Sile, Turkey in 2003 (Ozturk and Karakulak 2003).

The above comment on the break in information series also applies to a significant extent to the later reports from Caddy (2004) and Caddy et al. (2004), which largely drew on the data base in Prodanov et al. (1997). These reports recognized the lack of some recent fishery time series, and tried to develop an alternative approach to monitoring that is less dependent on single species assessments which are difficult to update if the original survey schedules and consequent time series of data have been interrupted.

As a general comment, the high level and high quality of fisheries analyses in the 1970's-80's which is evident especially from Ivanov and Beverton (1985), but also to a large extent from the Prodanov et al. (1997) report, mainly stem from the research activities by Varna Convention countries, supported by their then well-organized and well-funded research vessel surveys. The type of assessments they reported are objectively little different in methods and quality from those reported in the North Atlantic literature of the time. Most of the important Black Sea species had been assessed by the 1980's: a statement that still cannot be made for most Mediterranean areas! Although intensive assessment work began somewhat later in Turkey, there is now a well-trained group of fisheries scientists there also. It cannot therefore be claimed that any shortfall in fisheries management in the Black Sea region is due to a lack of technical expertise in assessment methodologies, although as noted, it is likely that time series of data essential for comparison with earlier assessments may have been interrupted in some cases. However, the work of the experts could be better organized and coordinated both within the countries (institutionally too dispersed in Turkey) and between the Black Sea countries. We would have to look elsewhere however to understand why cooperative fisheries management mechanisms have been slow to emerge in the Black Sea area.

To some extent we are restricted in relation to recent events to what can be deduced from fisheries statistics, but a degree of recovery of at least the pelagic resources is evident from the landing series. However, the new TDA stresses that although catches of some species have partially recovered, their structure has changed dramatically. Catches of some species

(e.g. horse mackerel and many demersal species continue to decrease, and distribution patterns have often changed in relation to national waters. A limited view of recent events within the Black Sea Environmental Commission of relevance to fisheries emerged from a joint meeting of GFCM/SAC/SCSA and the BSC equivalent bodies (AG FOMLR/PWGAM) in November 2005; (Annex XI). From this it emerged that in 2005, joint hydro-acoustic surveys for anchovy were still at an early stage of planning, and that age composition data for this species suitable for Virtual Population Analysis (VPA) exist for 1967-1994, but not subsequently, although earlier historical data may be supplemented by a resumption of data collection in 2005.

Note however, that these research and survey activities, as for those on turbot, while carried out by some individual countries, are not yet regularly coordinated. Research, survey and assessment activities involving all Black Sea nations are still at an early stage.

Different types of fish population analysis have been carried out for Black Sea fisheries since the early 20th Century, and since at least the 1960's, a rather high level of competence has existed in the Black Sea area in the field of conventional single species stock assessment. It must be questioned however, to what extent single species assessment methods will be sufficient for management of Black Sea resources without specific reference to environmental forcing functions, and the significant changes in system productivity and characteristics already noted. Still more important, administrators should not lose sight of the importance of ensuring continuity of time series of resource information as a basis for scientific management. Scientists in the region must also be aware of changes in approaches to resource monitoring underway in other areas of the world, particularly in response to non-equilibrium situations such as those typical of ecosystems in transition such as the Black Sea ecosystem.

3.2. Development of regional institutional structures for addressing Black Sea environmental problems and fishery issues.

Apart from the problems of analysing complex changes in the ecosystem, (which could be effectively tackled by scientists if a forum for exchanging data and performing joint analyses were available), the main problem appears to be the lack of a forum for negotiating common management measures and deciding how to implement them. In the past, several Commissions have received successive incomplete mandates for managing fisheries in the Black Sea basin. The 1959 Varna Convention coordinated fisheries by former communist countries (but not Turkey) until an effective cessation of activities in 1993. Several countries (Bulgaria, Romania and Turkey) have been member States of the General Fisheries Commission for the Mediterranean (GFCM), and recently have been joined by Georgia, but Russia and Ukraine are still only observer States at GFCM.

Beginning in the 1990's, the 2-part GEF-funded Black Sea Environmental Programme (BSEP) provided logistic support for the signing of the Bucharest Convention. A Secretariat was established in Istanbul for the work of a Commission on the Protection of the Black Sea against Pollution (BSC), whose main objective is to improve environmental quality in the Black Sea. The intention originally was that a separate Black Sea Fisheries Commission would be negotiated to manage work on shared fishery resources. Negotiations on the form and responsibilities of such a Fisheries Commission have apparently occurred sporadically over more than a decade, without any agreed resolution to date. Presumably as an interim measure, the Black Sea Commission has taken over responsibility for managing fisheries in the Black Sea, and uses the Activity Centre approach pioneered by the GEF project. The fisheries centre in Costantza, Romania, has been given wide responsibilities for coordination.

Despite the good work of this centre, the necessary structure, management agreements and mechanisms required for a working fisheries Commission remain to be established.

The background document to the proposed GEF programme: "Reversing the process of environmental degradation and unsustainable use of natural resources of the Black Sea (and Azov)" noted that the 1959 Varna Convention was *"More focussed on data gathering rather than regulation, and had little or no impact on stock management..."* Another study (Toje and Knudsen 2006) suggests that the stock assessments carried out were used by the Varna Commission for resource management. Nonetheless, since one fishing nation, Turkey, was not a member, even though at the time Turkish catches were much smaller than now, it is difficult to see this Commission as a fisheries management body for the whole Black Sea. In reality, the situation has not changed radically today, with respect to active management of shared resources. Written in the early 1990s, the GEF project document noted that *"It will be vital to resolve the issue of a single Commission with strong links to the GEF project and eventually to the Black Sea Action Plan, if environmental management is to be successfully achieved"*. Somewhat optimistically (in light of the lack of implementation of an active Fisheries Commission over the last decade), it continued: *"Those involved in the fisheries industry would eventually benefit from sustainable catch quotas, though a contraction in the present scale of fishing would call for the investigation of alternative employment in some cases"*. The total cost of inaction resulting from overinvestment and overexploitation was roughly estimated at the time as $240 million annually, and for inaction on environmental issues, in excess of $1 billion or higher. There seems no reason to suppose that the annual losses due to inaction on these key issues are any smaller nowadays. The document continued by noting: *"As the Bucharest Convention does not address fisheries, action is being taken to develop a single new Fisheries Convention for the Black Sea with the assistance of FAO, which will provide a policy framework for implementing the proposed programme"*. It was noted that: *"FAO will organize a meeting on Black Sea fisheries in the spring of 1993. The important issue of integrating fisheries into the Black Sea programme and the work of the Black Sea single Commission will then be addressed to ensure a holistic approach"*. Although this GFCM meeting was held (GFCM 1993), concrete management action from an agreement between the Parties was not forthcoming. Again optimistically, the document noted that *"If the fish stocks are to recover at all, a 3-5 year moratorium on fisheries may now be necessary"*. While this may be a drastic solution to the evident needs for stock recovery programmes, no basis for a common restraint on the fishing effort applied will be possible in absence of an explicit agreement.

In the 1990's, Exclusive Economic Zones were proclaimed by Black Sea countries, but as noted, the definition of a common regulatory framework for the shared, anadromous and highly migratory species that cross or lie across these EEZ boundaries remains in abeyance, or at least has not yet been translated into a common regulatory framework. Although fisheries have been on the agenda of meetings of the BSC for some time, no major controls on catches, capacity or allocations were adopted in the absence of an agreement on a specific fisheries Commission. At its thirteenth meeting in November 2005, the BSC received the mandate to manage fisheries as an additional responsibility to its main task of restoring environmental quality. At the same time, the GFCM has three Black Sea Member countries; two of which are now members of the European Community, and others which are in some stage of discussion with a view to possible future membership. Under its new autonomous structure, the GFCM is now better able than in the past to offer fisheries management capabilities using the subregional approach that has been successfully applied in other areas

of the Greater Mediterranean (See Annex V which discusses the structure and functions of the GFCM and its relevance to Black Sea fisheries management).

While significant progress has been made to date in setting up cooperative mechanisms for tackling the problems caused by nutrient runoff to the Black Sea, progress with implementing cooperative management of Black Sea fishery resources appears to be close to a standstill, as far as concerns recommendations for practical implementation made over the last decade. With respect to the priorities for research and management, those established in the 1996 TDA and others still appear valid, and have been on the books for over a decade, in some cases without implementation.

The past (and to a large extent the present) problems of fishery management for Mediterranean fisheries, have been political diversity and and the need to coordinate cooperative fisheries management between the 24 States and political entities surrounding the Mediterranean and Black Seas. Currently fisheries for resources other than large pelagic fish which are dealt with by the International Commission for Conservation of Atlantic Tunas (ICCAT), are managed by one of the oldest fisheries Commissions globally; the General Fisheries Commission for the Mediterranean. GFCM's jurisdiction has not substantially changed since before negotiation of the Law of the Sea, and includes responsibilities for management of all resources in international waters outside territorial seas, other than for the larger tunas; but it has not played an active management role in the Black Sea, other than providing experts and institutional memory. But if we consider other active management commissions such as NAFO and ICES, we must conclude that no Commission so far is managing shared resources of the Black Sea using the conventional tools of internationally-agreed quotas and/or access/effort controls. GFCM has also played a secondary role for member States fishing tunas which are not members of ICCAT, but in this case, a very active tuna commission, ICCAT, plays the lead role. Since 1999 GFCM has moved from being a largely FAO-funded Commission, to a self-funded body, and has begun to act as a forum where countries agree on binding fishery resolutions. Its current structure and functions can be reviewed on the GFCM web site (www.gfcm.org).

The dramatic events undergone by the Black Sea ecosystem and fisheries have been documented in GFCM Studies and Reviews, Numbers 60, 63, 64 and 68, and relevant issues for management of fisheries in the greater Mediterranean area are reviewed in Studies and Reviews 70, 80 and 83. From these accounts it is clear that GFCM has played an important supporting role in the Black Sea, and will continue to do so, as well as assisting its local member States.

Many issues need to be resolved before an operating fisheries Commission can become fully effective, and the GFCM can provide a special forum for discussing these issues and attempting to resolve them. At the same time, while these issues are being debated in separate sessions outside the regular meetings of the Commission, the parties concerned, without prejudice to their long term negotiating positions, should make attempts to arrive at workable management regimes for at least a few key resources initially. This will allow the urgent need for conservation measures to make progress, and will provide all parties with experience in using a common management framework. It may be hypothesized that deciding on national shares from a common resource, and national shares of a Black Sea fishing fleet, have been the major impediment, especially since national shares of the common resources have changed drastically over the last 20-30 years.

If basic sharing arrangements continue to remain in abeyance, there is a risk of resource collapse, and the long term economic damage that has already occurred to fisheries for some resources will spread more widely.

At least five issues must be resolved in order to allow a Commission to operate actively in support of sustainable resources. This is most likely to flow naturally from an agreement on boundaries to national EEZs in the Black Sea. Obviously there is room for a wide range of collaborative mechanisms, but some common elements are likely to be:

> 1) An agreement on the boundaries of national EEZs.
> 2) A timetable should be established over a period during which national fleet capacities and national species harvests will have to be agreed to for shared stocks. If access of fleets is confined to the agreed national waters, landings and fleet sizes should gradually converge on values that more closely resemble the long term relative productivities of each national zone.
> 3) A licensing system should ideally be established that records all vessels fishing specific resources or gears whatever the flag of operation, and a Black Sea data base inaugurated registering all vessels licensed to fish. Countries should agree on common procedures for inspection and reporting of catches and infringements of established regulations.
> 4) Regulations on access to national zones by harvesters may need to be tightened up, and bilateral or multilateral reciprocal access agreements drawn up (such as are used in the Baltic Sea), in order to allow access of national fleets to other EEZs if this can be agreed to.
> 5) To facilitate the transition to an actively managed fishery, one strategy may be to agree on joint exploitation companies between relevant national fishing industries, to ensure efficient processing and equitable distribution of resources.

It is assumed that, as occurred with COPEMED for the Western Mediterranean, ADRIAMED for the Adriatic, and other subregional fisheries support projects that have subsequently been set up, that a subregional 'BLACKMED' project could be established to provide institutional support and funding to a specific Fisheries Commission and its activities.

3.3. Legal aspects of developing regional cooperation for Black Sea fishery management

The negotiation of a fisheries Commission for the Black Sea had been underway intermittently for close to a decade after the effective termination of Varna Commission activities, guided by an earlier draft prepared by international consultants. It is not clear why these preceding negotiations were unsuccessful, but it may be supposed that the considerable contrast between the past performance of the fisheries of some coastal States and their recent performance under the widely differing economic situations that now prevail nationally, was in part responsible. As noted on www.grid.unep.ch/bsein/tda/files/3b1x.htm, "…the current distribution of benefits by coastal country does not well reflect the territorial distribution of resources". Nonetheless, the 6th meeting of the Council of Foreign Ministers of the Black Sea Economic Cooperation (of) Member States in April 2002 suggested resumption of the search for an accord, and assigned overall coordination for the preparation of a (new?) draft of a Convention on fisheries to the BSC, and this in turn was apparently delegated to AG FOMLR for action. The difficulty in arriving at appropriate shares in both the resource base and fleet capacities, given that these have changed dramatically over the last few decades, will

eventually have to be overcome however, or all parties will suffer economically from resource declines.

It may be that agreement on national zones will allow realism to prevail, initially perhaps in the absence of access by national fleets to other national zones without specific bilateral negotiations. It is recommended to consider the approach to problems of mutual access to resources, and exchange of fishing rights in respective zones, followed by the Baltic Sea Fisheries Commission, once national zones have been established.

Significant progress has been made in setting up cooperative mechanisms for defining and attempting to reverse declines in environmental conditions in the Black Sea, but progress in developing and actually applying cooperative management measures to shared and migratory stocks appear to be close to a standstill. There is no public account of the factors which have delayed bringing a fisheries Convention agreed to be all parties, to a successful conclusion after more than a decade of negotiation. The obstacles to a comprehensive fisheries agreement can perhaps be addressed in three stages:

    a) Agreement on the maritime boundaries of national EEZs
    b) Agreements on sustainable yields for the key resources (Table 2) or on recovery plans
    to restore these resources to their former productivity.
    c) National allocations from the sustainable harvest levels agreed to under b), or on
    national shares of sustainable levels of fishing effort.

a) Agreements on national maritime boundaries?
While considerable progress seems to have been made on maritime boundaries, there are still disagreements to resolve bilaterally. According to the BSC, "for the most part EEZ delimitation has been established for the Black Sea with some pockets remaining to be determined. There is currently a delimitation case before the International Court of Justice between Ukraine and Romania on this matter". Hopefully, independent arbitration will resolve this issue promptly. Under these circumstances, a relatively rapid resolution should be possible, and would open the way to more rapid progress with items b) and c).

b) Agreements on sustainable yields for resources?
Although studies to date (e.g., GFCM Studies and Reviews and elsewhere) have provided some indications of potential yields, the issue is more complicated than in many areas of the world's oceans. As noted, the collapse of stocks documented over recent decades makes earlier assessments of species productivities from the 1970's-80's of doubtful value unless the resources in question have recovered. As such, MSY values determined from historical data may only be of theoretical interest until updated information is collectively analysed , and requires more recent joint assessments to be carried out. This certainly can be achieved if cooperative research survey activities can be carried out.

c) Agreeing on national catch or capacity allocations from sustainable harvests?
An approach to allocation that is usually aimed for where EEZs have been established, is that the relative size of national allocations should come to reflect the relative productivities of resources in each national zone over time. Assuming that an overall MSY of current relevance is difficult to determine in the absence of cooperative research and assessment, if national fishing efforts were restricted to national EEZs, the ratio of landings from each country over time would presumably approximate to the appropriate national shares from an overall quota of landings for the species in question, or at least, the relative productivities of national zones

would provide one starting point for negotiation, and the historical record of landings another. As has been noted, the actual shares of common resources at this point in time are not equitable with respect to the relative productivity of national zones: Turkey with the most modern fleet now takes the largest share, judged also by the relative sizes of national zones. Neither however was their share equitable in the 1970's, when fleets from Varna country signatories were harvesting the major share of common resources. As such, negotiating shares based on relative historical production alone is unlikely to reflect the relative size or productivity of national zones. Investment strategies in fisheries to date in the Black Sea have tended to reflect the economic resources currently available for investment in harvesting capacity in each country, in a situation where no international controls on effort or catch allocations have existed, (and still do not exist). In future, it may be more practical, easier to enforce, and more conducive to positive economic returns to all parties, to decide long-term targets for national fleet capacities that can be supported by their respective EEZs, as modified by any bilateral or multilateral agreements that have been agreed to.

In other regions (e.g. the Caribbean – Mahon 1987), the approach followed in these circumstances was to hold a workshop in which the distribution patterns of resources, seasonally and annually, were superimposed on the agreed EEZ boundaries. A weighted seasonal sum of national biomass shares over time within each national zone might thus be obtained, however imprecisely, as a starting point for negotiation.

There are of course serious drawbacks to this procedure in a situation where a progressive eutrophication of the northern and western Black Sea has changed the distribution of resources over time. Conditions in the southern and eastern Black Sea and around the entry point close to the Bosphorus, have remained less affected by environmental degradation, being more distant from large river outflows. Presumably the national shares of resources could have been roughly calculated in the 1970's-80's from the maps in Ivanov and Beverton (1985) using GIS procedures. This is no longer the case however, since the resource distribution patterns have changed since the 1970's and early 1980s. For several species, the northern limits of distribution are now more southerly (e.g., some pelagic fishes) as a result of declines in water quality, especially within the area of influence of nutrient inflows from rivers to the west and north. De facto considerations such as the relative fishery productivities of national zones will prevail if national fisheries are confined to national zones.

This paper cannot go into specifics on issues of shared resource management which are discussed elsewhere in more detail (see Gulland 1980, Munro 1987,'93, Caddy 1996,'98). However, the assumption that resources will be divided strictly in terms of their distribution patterns is not always reflected in studies of resource sharing procedures in other areas, even though calculating shares using geographic/seasonal criteria provides a point of departure for negotiation. Fisheries are economic activities, and if a 'first party' has an overriding socio-economic need for the resource and is prepared to make what has been called a 'side payment' (Munro, MS). A 'side payment' may be formulated either in monetary terms or other concessions of value to the other party or parties, allowing th first party to increase its share. In other words, fisheries are not the only economic activity in the Black Sea, and achieving some other economic objective may have a national priority, and could be used in negotiations to compensate for the smaller share of a particular fisheries resource within national waters.

One point made by Caddy (1996) is that resource negotiations can be divided into resolving those issues that can be quantified from biological and survey data (such as determining the

seasonally weighted proportion of a stock occurring in a national sea area), and those socio-economic questions that relate to the weightings that parties may wish to give to the first component in the light of their economic, dietary or other priorities. A higher weighting may also be considered relevant, where (for example) the stock spawns or passes time in nursery areas within national waters, so that economic resources may have to be expended to protect nursery areas or other critical habitats within national waters from alternative economic activities. The situation is not simple, nonetheless its resolution is a pressing one if effective fisheries management of shared resources is to go ahead. Where negotiations are not successful, presenting national cases before international arbitration may be the way to go.

For the Black Sea, a number of independent attempts have been made to develop one or other of the necessary components of a cooperative management framework, but so far, a coordinated system is not yet in place. Until this is achieved, individual attempts at cooperative management of the resources are effectively doomed to failure. It is for this reason that a generalized management cycle is described below, modelled upon those implemented elsewhere, before attempting to see what building blocks need to be put in place to realize such a fisheries management cycle in the Black Sea.

4. SUGGESTIONS FOR A BLACK SEA FISHERIES MANAGEMENT CYCLE

There are many methods of defining the operation of a fisheries management cycle, depending on the resources, geographical context, political systems of the parties concerned, and their regulatory frameworks. No definitive judgement is made here as to the 'best' mix of components in such a common management system. It is obviously essential, above all other considerations, that a cycle of activities be agreed to and implemented in a continuous fashion by all parties concerned. Such a cycle of activities, to be effective, requires a common management framework and plan, and some agreement on national shares of common resources. Working procedures will have to be built on a joint agreement on acceptable management procedures, and national shares of resources will need to be negotiated before, or in parallel with, the implementation of such an integrated management framework.

Recent experience and future options for fisheries assessment and management in the Black Sea: A GFCM perspective
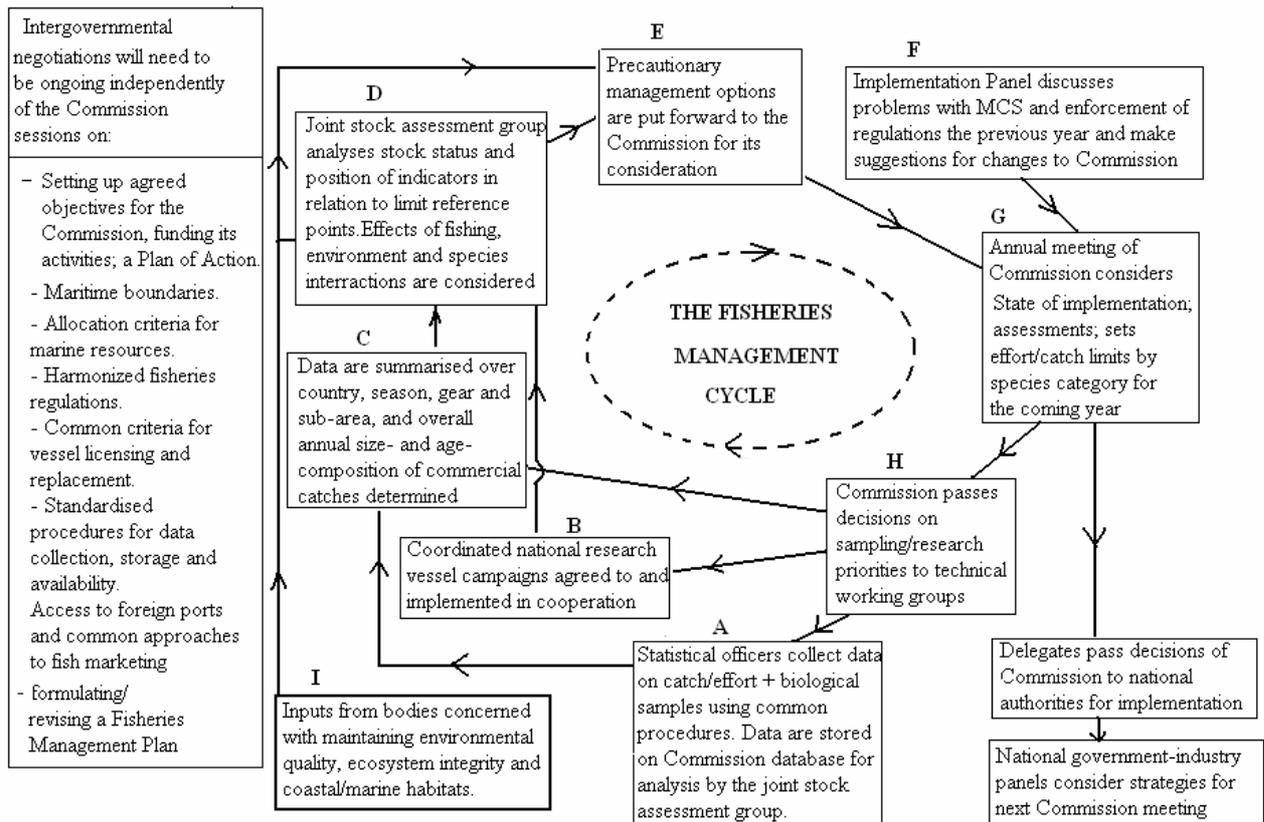

Fig 6. (Left): The intergovernmental negotiations that will have to occur outside Commission annual meetings in order that the necessary agreements will be in place for smooth annual functioning of the Commission. (Right) A description of annual events within a closed fisheries management cycle. (Note: The role of Non- Governmental Organizations interested in fisheries are not specifically mentioned in the figure, but will obviously play a large role in determining national policies)

Excellent progress has been made in defining some management problems, but the Black Sea fisheries community has not succeeded in implementing cooperative activities under all of the above headings, or in 'closing the circle' by putting together a working management cycle. Experience with fisheries management world wide shows that in order to successfully manage the renewable resources of a marine area, compliance of all parties harvesting common resources to a common framework is needed, and their agreement on common objectives is required. The parties should agree on compatible, effective and cost-effective regulations, on the allocation of resources, and on details of implementation of a common fisheries management regime outside national territorial waters. These details should be spelled out explicitly in a management plan, which should be upgraded at intervals of 5-10 years. The plan should spell out standard data gathering requirements, and the control and surveillance procedures that should apply. Common research vessel survey and stock assessment operations and their timing, and research priorities in support of fisheries management will also have to be agreed to. These activities should be reported on in an uninterrupted annual cycle of meetings between the parties concerned, including permanent working parties of national experts, panels on special issues, and commissions made up of accredited government representatives. The annual cycle of activities will need to be coordinated by international staff with experience in fisheries management issues in the Mediterranean and Black Seas.

It is suggested that the best way forward to build the foundation of a Black Sea fisheries management cycle would be to ensure closer cooperation between BSC and GFCM. Active cooperative management of shared resources is now possible, as evident from recent meetings and reports on the GFCM web site (www.fao.org/fi/body/gfcm/gfcm.asp).

In conclusion, this paper has also made the point that the two Commissions with an interest in Black Sea fisheries environment and resources do not in fact have conflicting roles, given their particular areas of specialization. Both have an interest in environmental quality and resource management; the BSC mainly addressing a constituency of national Ministries of Environment; the GFCM mainly addressing Ministries of Fisheries or their national equivalents from a wide range of coastal countries. Making better use of the specializations in each case will provide a more directed and effective response. It is suggested that discussions on a more explicit mode of cooperation would be to the benefit of the fisheries sector in the Black Sea.

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ATTACHMENT 2

List of supplementary relevant Black Sea-related documentation reviewed or compiled by the Secretariat

- **The Trans-Boundary Diagnostic Analysis (TBDA) for the Black Sea developed 1993-6;**

- **The 2006 revised TBDA**

- **The Strategic Action Plan for the Rehabilitation and Protection of the Black Sea.**

- **Excerpts from the draft Project Document for the second phase of the UNDP-GEF Black Sea Ecosystems Recovery Project, October 2004 (BSERP).**

- **Other projects and funded activities in the Black Sea.**

- **The Advisory Group on Fisheries and Other Marine Living Resources (AG FOMLR).**

- **Structure and functions of the GFCM and its relevance to Black Sea fisheries management**

- **Proposals relevant to fisheries considered in Phase 2 of the BSERP**

- **A summary of key points in Anon (1996): 'Strategic Action Plan for the Rehabilitation and Protection of the Black Sea'.**

- **Impacts of the transition from planned economies on national activities in support of fisheries.**

- **The closed fisheries management 'cycle': its purpose and components.**

- **Agreements reached within the BSERP on actions that need to be taken in developing indicators for selected commercial species and habitat/environmental indicators.**

- **Establishing a logical framework for using indicators for fishery monitoring and management.**

- **Summary of conclusions from a joint meeting between assessment scientists of the Mediterranean and Black Seas; Istanbul, 14-18 Nov, 2005.**

- **Decisions made at the Thirteenth Meeting of the Commission on the Protection of the Black Sea Against Pollution.**

- **Potential use of a Fisheries Control Law.**

- **Conservation of sturgeons and marine mammal populations.**

ATTACHMENT 3

DRAFT

GFCM Black Sea programme:
preliminary elements for a project framework

Ståle Knudsen

February 2008

ABBREVIATIONS:

AG FOMLR	- Advisory Group on the Environmental Aspects of the Management of Fisheries and other Marine Living Resources
BSIS	- Black Sea Information System
BSC	- The Commission on the Protection of the Black Sea Against Pollution
BSEP	- Black Sea Environmental Programme
BSERP	- Black Sea Environmental Recovery Project
CFP	- Common Fisheries Policy
DG Fish	- Directorate-General for Fisheries and Maritime Affairs (EC)
EC	- European Commission
EFF	- European Fisheries Fund
GFCM	- General Fisheries Commission for the Mediterranean
ICES	- International Council for the Exploration of the Sea
ITQ	- Individual Transferable Quotas
LBD	- Legally Binding Document
BS-SAP	- Strategic Action Plan for the Rehabilitation and Protection of the Black Sea
TAC	- Total Allowable Catch
TDA	- Black Sea Transboundary Diagnostic Analysis
VMS	- Vessel Monitoring System

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1. INTRODUCTION

The dissolution of the Soviet Union made it possible to establish an environmental convention signed by all Black Sea countries (Bucharest Convention) and establish a Commission (Black Sea Commission - BSC) to address the urgent environmental problems of the Black Sea. Although fisheries has been on the agenda from the beginning and a legally binding document concerning regional cooperation about fisheries management has been negotiated for a decade, no binding agreement has been reached. With the accession of Bulgaria and Romania to EU in January 2007, new dimensions and dynamics have been incorporated into the process. The Black Sea waters of these countries have become EU waters and the EC is seeking institutional mechanisms for wielding EU policies in the region.

In this context, the General Fisheries Commission for the Mediterranean (GFCM), with the Black Sea as part of its Convention Waters, naturally assumes its responsibility in facilitating the process of fostering scientific, human capital and international cooperation that will be necessary to develop responsible fishery management in the Black Sea. This short report presents a general review on the knowledge of the state of Black Sea fisheries resources and management and seeks to identify the priorities and essential elements to promote sustainable fisheries in the region.

The state of the Black Sea environment and fish stocks have been comprehensively addressed in several recent reports (TDA 2007, Caddy 2008, SOEBS 2008) and this report will therefore not dwell much on these issues beyond outlining the main conclusions of those reports. After a short survey of the current status of knowledge and regional cooperation, this report identifies challenges for cooperative responsible management of Black Sea fisheries. Following up on this survey, an outline of a possible GFCM Black Sea fisheries project in close cooperation with the BSC is outlined.

The methodology used to produce this document includes, in addition to the author's own knowledge of the Black Sea fisheries, a thorough review of Caddy 2008, desk study of relevant scientific literature and reports, and consultation of project or institution web sites. Knowledge and perspectives were also gathered from some individuals involved in the sector, including from the Executive Director of the BSC.

2. CURRENT STATUS OF BLACK SEA ENVIRONMENT, FISHERIES AND INSTITUTIONS

2.1. State of the Black Sea environment

The Black Sea has since the 1960s undergone dramatic and perhaps non-reversible environmental changes. There is at present no overall agreement among scientists about the reasons for and dynamics of the shifts in the Black Sea ecosystem since the 1960s. Caddy (2008) identifies several different approaches which all to a certain extent seek to give primacy to one causal factor. In some models, fisheries has constituted a major pressure on the state of the environment – including dwindling stocks and changed trophic structure among target species, while other models stress the importance of other pressures, primarily eutrophication and the introduction of alien species. However, as noted by Caddy (2008), the

upheavals in the Black Sea ecology are probably best understood as a complex interaction of qualitatively very different pressures, the most important being:

- eutrophication
- overfishing
- alien species
- removal of top predators, trophic cascade
- climatic variations

The Black Sea ecosystem has seen some recovery over the last 10-15 years, due to reduced nutrient inflow and the introduction of a natural predator (*Beroe ovata*) of the invasive comb jelly *Mnemniopsis leidyi* which disrupted the Black Sea ecosystem during the late 1980s and early 1990s. There are signs of increased biodiversity, hypoxis occurenses have decreased on the north-western shelf, and stocks of anchovy and sprat are to some extent recovering. However, recovery is non-linear, with different opportunistic and invasive species dominating now the benthic and pelagic realms. The system is characterized by ecological instability, manifested in, for example, sustained significant stock decline of most of the large pelagic fishes. The benthic system is under high pressure from fishing and the predating effect of the invasive top predator the Japanese sea snail *Rapana venosa*.

Fisheries has been one of the drivers for the changes, but has also been dramatically affected by changes caused by other variables. This also means that the cause and effect role of fisheries remains unclear or unresolved. Anyhow, it is impossible to understand the state of the fish stocks of the Black Sea without taking into consideration the changing complexity of the Black Sea ecosystem. The Black Sea illustrates very clearly the futility of managing fisheries as if it was isolated from the wider dynamic ecosystems of which the fish stocks are important parts.

2.2. Fish stocks

Assessments of Black Sea fish stocks have been irregular, and in most cases one has to rely on catch data to gain information on status of stocks. Stocks of apex predators in the pelagic system, many of them migratory, started to decline several decades ago. Stocks of short lived pelagic fishes (anchovy, sprat, horse mackerel) collapsed in the late 1980s and early 1990s. Anchovy and sprat stocks have partly recovered since the mid 1990s, while horse mackerel stock remains depleted. Stocks of important benthic species such as turbot, red mullet and whiting have continued to decrease, and stocks of several sturgeon species are threatened. In the benthic system the bluefish has shown some recovery, while the bonito stocks vary dramatically (with record catches in 2005). Stocks of commercially important invasive species, such as pacific mullet and especially sea snail, have increased. To summarize, stocks of some small pelagics (and occasionally bonito) are in good shape, while stocks of most other commercial species are low and decreasing.

2.3. Fisheries

There exists no comprehensive overview of the fisheries sector in the Black Sea. It seems evident, however, that there are considerable differences between the various Black Sea countries in fleet composition and organization of the fisheries. The combined effect of resource crisis, and changed conditions for fisheries in the former Soviet States have resulted in a dramatic shift in the relative importance of the fishing fleets of the various Black Sea

countries. Turkey has emerged as the most important fishery nation in the Black Sea. Turkish fisheries were just as adversely affected by the resource crisis as the fisheries in the northern Black Sea, but for various reasons they were more resilient during the crisis years (see Knudsen 1997).

The composition of Black Sea fish stocks and fish catches differs from the Mediterranean. In the Black Sea the short-lived pelagic species biomass is much higher than in the Mediterranean. Therefore, purse seiners play a much more important role, especially in the Turkish Black Sea fisheries. Fisheries constitute an economically very important sector in some regions of the Black Sea, such as the eastern Black Sea region of Turkey and in Crimea. A large share of the Turkish anchovy and sprat catches is processed in the close to 20 fish meal and oil factories along the coast. The fishery sector is, however, heterogeneous, with important trawler fleets as well as various multi-purpose and artisanal fishing being of importance in most countries.

Although no estimates exist, and would be difficult to produce, for what sustainable fishing capacity for the Black sea would be, there seems to be consensus among experts as well as among actors within the sector that there is overcapacity in Black Sea fisheries, especially on the Turkish side. Despite a levelling off in the growth in number of Turkish purse seiners, their total catch capacity has continued to increase due to investments in longer boats, more powerful engines, and improved electronic equipment. There are signs that Ukrainian and Russian fisheries sectors are now slightly increasing their catch capacity again. Some fishing practices, such as dredging for the Japanese sea snail (*Rapana*) and the use of bottom trawl, is believed to have harmful impacts on demersal habitats. Finally, many of the most important commercial species, such as anchovy, sprat, turbot and bonito, are shared among several or all Black Sea countries, and there is widespread conflict over cross border fishing activities, occasionally resulting in aggression and death of fishers.

2.4. Science and statistics

Fisheries science, including research on the Black Sea, had a long and strong tradition in the Soviet Union. For various reasons, this tradition was weakened during the 1990s. Turkish fishery related science is much younger, with most of the institutions established since the 1980s. In Turkey, fishery science appears to be quite dispersed. The 1990s saw the opportunity for researchers across the Black Sea region to communicate and cooperate better than before, resulting e.g. in the important GFCM report *Environmental Management of Fish Resources in the Black Sea* (Prodanov et al. 1997). However, lack of resources and variable competence in a common language has resulted in the cooperation not having full effect.

Social and economic aspects of Black Sea fisheries have received very little academic attention, and Black Sea fisheries hardly figure in the international scene of social science of fisheries. There is close to no indigenous socio-economic research on fisheries in the Black Sea.

Shifts and constraints in funding and administration of science have resulted in irregular gathering of data. Moreover, for administrative purposes different standards and categories are used in different countries, resulting in inconsistencies between data sets collected by scientists from different Black Sea countries. The BSC has set up the Black Sea Information System (BSIS) which also contains fisheries-related information.

2.5. Fishery management and regional cooperation

Fisheries management has very different traditions in the various Black Sea countries, with some tradition for applying TACs and vessel quotas in the states that were formerly united in the Soviet Union. Turkey uses a range of different regulatory mechanisms, but does not favour TACs/quotas in the Black Sea. Except for some bilateral agreements (e.g. between Georgia, Turkey and Ukraine about anchovy fishing in Georgian waters) there is no overall agreement about regional management of Black Sea fish stocks.

A draft text on a fisheries convention has circulated and been negotiated since at least 1996, and there have been articulated ambitions to set up a regional fisheries commission. It seems that at present, the most likely way forward now to agree on a legally binding document on Black Sea fisheries is to sign a protocol to the Bucharest Convention. This way, Black Sea fishery policy will be thoroughly embedded in an institutional structure that takes the larger environmental view on Black Sea fisheries into consideration. Recently there has been some progress on the Legally Binding Document (LBD). According to the *Black Sea Ecosystem Recovery Project EXIT STRATEGY*, "the text of the LBD has been approved by BSC at the 13th meeting in November 2005........The process of approval has run into a jurisdictional difficulty in that the two countries, Bulgaria and Romania, which are both contracting parties and Member States of the EU can no longer individually address this issue since jurisdiction lies with the European Union (BSERP 2007: 13)".

2.6. EU accession and the Common Fishery Policy

The citation above points to a recent development with important implications for Black Sea fisheries and fishery management. EU Common Fishery Policy (CFP) has now extended into the Black Sea (in 2008 for the first time EU TACs for sprat and turbot on Bulgarian and Romanian waters were set) and resulted in many issues relevant for a potential GFCM project already being addressed and brought into a standardized format (CFP) in Bulgaria, Romania and (partly) Turkey. In Romania and Bulgaria the transfer to CFP has seemingly met with little problems: these countries have basically accepted and met all requirements for joining the CFP and are now eligible for support from the European Fisheries Fund (EFF). Although Turkey cannot take advantage of EFF support, EU twinning projects and technical assistance has addressed a range of important issues:

- Training of field staff
- Restructuring of administrative institutional composition
- Fisheries Information System and statistics (port offices, vessel monitoring system and information centre)
- Legal issues – new fishery law waiting to be ratified by parliament
- Fishery management plans for 10 major species
- Management advice in favour of TACs
- Vessel registration
- Subsidies and support
- Producer organizations
- Common organisation of the market, market/quality standards

The process of aligning Turkish fisheries policies with the CFP is considerably delayed relative to benchmark dates set in twinning contracts, but is making some significant progress at the level of technical infrastructure (e.g. Port Offices, VMS). The most significant reduction in fishing capacity is expected to result from structural aid for decommissioning, which will most likely only be available with membership (Knudsen et al. 2007).

Table 1. OVERVIEW OF INSTITUTIONS, CONVENTIONS AND RESEARCH PROJECTS THAT FOCUS ON BLACK SEA ENVIRONMENT AND FISHERIES

Organization/institution, agreement, or project	Date(s)	Funding	Fisheries management-related objectives or products	Further information
(Bucharest) Convention on the Protection of the Black Sea against Pollution	1992, ratified 1994		Fisheries briefly mentioned (Article XIII); Protection of the marine living resources; Convention protocols signed for some issues, but not for fisheries.	http://www.blacksea-commission.org/main.htm
The Commission on the Protection of the Black Sea Against Pollution (BSC) - Permanent Secretariat	1993 2000	Black Sea Governments, GEF, EC	- No staff responsible for fisheries at Secretariat; - Fisheries Activity Centre at Constanza; - Advisory Group on Fisheries and other Marine Living Resources (AG FOMLR); - Black Sea Information System (BSIS). (includes some data series on catches and vessels, but is not comprehensive).	http://www.blacksea-commission.org/
Black Sea Environmental Programme (BSEP)	1993 - 1996	UNDP-GEF and others	Responsible for TDA 1996 and BS-SAP. Close cooperation with the BSC secretariat	http://www.blackseaweb.net/general/mascprog.htm#02
Black Sea Transboundary Diagnostic Analysis (TDA 1996)	1996	GEF-UNDP	A systematic scientific analysis of the root causes of environmental degradation in the Black Sea. Formed the scientific grounding for BS-SAP.	http://www.grid.unep.ch/bsein/tda/main.htm
Strategic Action Plan for the Rehabilitation and Protection of the Black Sea (BS-SAP)	1996, amended 2002	GEF-UNDP, EU	Plan for rehabilitation of Black Sea, signed by ministers from all Black Sea countries. Stipulated the formation of Advisory Boards (including AG FOMLR). New TDA (2007) will form the basis for a new BS Strategic Action Plan.	http://www.blacksea-commission.org/OfficialDocuments/BSSAP_iframe.htm

Black Sea Ecosystem Recovery Project (BSERP)	2002 - 2008	UNDP-GEF US$10 million	One of the main objectives of the BSERP is to assist countries to find ways to keep the amount of nitrogen and phosphorus entering the Black Sea below the levels observed in 1997. Close cooperation with the BSC secretariat Responsible for TDA 2007	http://www.bserp.org/
IASON - International Action for Sustainability of the Mediterranean and Black Sea Environment	2005-2006	EU FP6	To distil the collected scientific knowledge regarding the Mediterranean and the Black Sea as a system of interconnected basins. To identify policies and intervention tools on the coastal and marine environment.	http://www.iasonnet.gr/
Black Sea Transboundary Diagnostic Analysis (TDA 2007)	2007	GEF-UNDP	Objective, non-negotiated analysis, using best available verified scientific information to examine the state of the Black Sea environment and the root causes for its degradation. Interest in the basis for updated BS-SAP	http://www.bserp.org/Text/Activities/BS_TDA/index.htm
State of the Environment report	2008	BSC and BSERP	Preparation organized by the BSC Secretariat. A more 'scientific' text than the TDA.	Not yet published.
Black Sea SCENE	12/2005 – 11/2008	EU FP6	To establish a Black Sea Scientific Network and develop Black Sea environmental virtual data and information infrastructure.	http://www.blackseascene.net/content.asp?pageid=1
SESAME	11/2006 - 10/2010	EU FP6	Aims to evaluate and predict changes in the Mediterranean and Black Seas ecosystems and in their ability to provide key goods and services. Case studies in North Western and North Eastern Black Sea	http://www.sesame-ip.eu/

For other completed Black Sea environmental programmes and projects, see the Black Sea Web (http://www.blackseaweb.net/general/enviprog.htm).

NB! No regional scale projects or institutions that focus solely on Black Sea fisheries (except GFCM).

3. CHALLENGES FOR SUSTAINABLE/RESPONSIBLE MANAGEMENT OF BLACK SEA FISHERIES

Important challenges, issues or 'unknowns', that somehow will have to be addressed in the process towards a more sustainable Black Sea fishery management system, are identified below. The character of some of these issues makes it difficult to address them directly through a GFCM Black Sea project, and it is therefore outside the scope of this paper to provide recommendations on those issues. However, it can be expected that a successful project could have a positive effect on, for example, international cooperation.

3.1. Fisheries Management related issues

Overcapacity
Overcapacity is itself a driver for overfishing and ways should be sought to cut capacity, even before a coordinated Black Sea fisheries management policy is operational.

Ecosystem approach
The recent environmental history of the Black Sea, with its many dramatic shifts and changes, means that sound fisheries management must be thoroughly addressed. It should be acknowledged that embedding fishery management in an ecosystem approach is no easy task. Although the current development of 10 management plans in Turkey each focus on an individual species, the organization of the fishery science in the Black Sea is not structured along conventional single species research. Advantage should be taken of this to organizationally embed both fisheries science and management structures in organizational structures that can facilitate ecosystem based management.

Introduced species: management and policy dilemma
Introduced alien species have contributed significantly to the shifts in the Black Sea ecosystem. However, some invasive species, such as the sea snail *Rapana* and Pacific mullet, have become commercially important. This raises a tricky management dilemma: should such species be managed as a threat to the ecosystem and therefore eradicated or contained, or should they be seen as resources to be managed 'sustainably'. Turkish management of the *Rapana*, for instance, have focused on it being a resource and restrict *Rapana* harvesting during their summer spawning season. On the other hand, invasives like this are generally considered a threat to biodiversity.

Effects on habitats
Fishing practices such as bottom trawling and dredging (for sea snails) are believed to harm demersal habitats (i.e. not only on target stocks) and management to a certain extent take this into consideration. However, few studies have actually tried to ascertain the extent to which such fishing practices are harmful in the Black Sea context.

Illegal, Unreported and Unregulated (IUU) Fishing
A panel of experts from different Black Sea countries considers illegal fishing and destructive harvesting techniques to constitute the largest threat to marine living resources of the Black Sea (Shlyakhov and Daskalov 2008). For instance, dredging for sea-snail in Turkey is most intense when its fishery is illegal (during summer) (Knudsen and Zengin 2006). However,

very little is known about the character and extent of illegal, unreported and unregulated fishing in the Black Sea. There exist no studies of this issue in the Black Sea context. If management is to be based upon careful considerations of stocks, landings, catch capacity etc., this uncertainty is obviously a major obstacle.

What kind of management and regulation is appropriate for the Black Sea?
Which measures would work in the short term and in the long run to develop sustainable, ecosystem based management of Black Sea fisheries. There is no easy answer to this, and it will remain one of the major challenges for the foreseeable future. Changes are clearly needed, but it is <u>not</u> obvious that all changes should be towards a uniform management regime. Indeed, different property regimes and regulatory mechanisms may be developed for different fisheries, provinces and nations. Individual transferable quotas, marine protected areas, gear and season restrictions, local customary control of near shore fishing territories (for which there is tradition and current practice in the region) may all be suitable management tools. Fisheries management systems cannot be "paste-and-copied" – they must be developed to suit the particular conditions, including socio-economic ones, of the various Black Sea countries.

What is the de facto *character of current management systems?*
While the main contours of formal structures of the Black Sea countries' fishery management systems are largely known, the actual on the ground implementation of the management, such as regulation and control activities, is less transparent. Moreover, with the current adoption of the CFP in Bulgaria, Romania and partly in Turkey, together with constant reform of fishery administrations and the down-grading of fishery management to lower institutional levels in Ukraine and Russia (Knudsen and Toje 2008), fishery management systems of Black Sea countries currently experience significant changes.

3.2. Science related issues

Interface science - management
How tightly knit should fisheries science be to fishery management? When the research institutions are poorly funded and equipped, dependency on the fishery management administrations, national or, potentially, regional, can undermine the independent role of science. It may therefore be important to establish and nurture regional network of scientists (a Black Sea Fishery Science Association?) independently of how Black Sea fishery management develops. Effective integration with international science would also help ensure the independency of Black Sea fishery science. This raises the issues of both organisational structure and funding of regional scientific cooperation.

Language
Although many of the leading scientists in the region, and certainly an increasing number of the younger scientists, communicate easily in English, insufficient command of a common language clearly inhibits scientific communication. During conferences, results are presented, but assumptions and implications sometimes not explored to the extent that one might wish with an audience with such high scientific competence. This issue can most effectively be addressed in parallel with the issue of better integration with international science.

Internationalisation
Insufficient funding and language competence have also restrained participation in the international scientific community beyond the Black Sea region. During the last decade a very

competent new generation of young fishery researchers from most Black Sea countries have entered the scene. However, fishery research in the Black Sea region remains sparsely equipped and funded in comparison to, for example, Western Europe, and the number of Black Sea scientists working on fishery and environmental issues who make their mark internationally is limited.

Statistics

Irregular funding and changing policies has resulted in there being a very serious lack of time series data for many important variables relevant to fisheries management (Caddy 2008). Furthermore, although the BSIS can become the seed of a Black Sea Fisheries Information system, it is not yet comprehensive enough and sufficiently populated to constitute a sound management tool in Black Sea fisheries. Although agreed upon rules exist together with methods for regular reporting of data to BSIS, these are not properly observed. Thus, there is still a long way to go before a fully operational centralized or coordinated data gathering system is in place. Even within the countries themselves centralized data gathering systems are not always operational or reliable for core categories relevant to fisheries, such as fleet registers. Also, the categories used are generally very broad, there is no registration of vessel movements, and methods for gathering data on fleets, fishermen and catches are often not satisfactory.

Thus, there is not only lack of time series data, but catch data are probably not very reliable, and total catches probably exceed reported catches. One should consider how one could proceed with cooperative management even in the case when, for example, time series data on stocks and catch are incomplete/inaccurate and vessel information systems/statistics of the various countries are not consistent.

Continuity

Lack of reliable time series data is one of the major issues addressed by the EU twinning project and technical assistance to Turkish fisheries. The importance of this issue is now increasingly acknowledged, but both training and equipment must still be developed. It will require further inquiries to ascertain the situation in the other Black Sea countries and assess what it will take to build the capacity to undertake regular data gathering activities. Lack of research vessels and resources for operating them is one important issue in this context. For instance, during the 1990s many of the research vessels of the former Soviet Unions were sold, some to operate as fishing boats (Knudsen and Toje 2008). It is most likely outside the scope of GFCM to contribute to large infrastructure projects such as construction of research vessels. That will remain the responsibility of individual countries. However, GFCM in close cooperation with BSC, may have a role in helping coordinate and support cruises, facilitate training of young researchers, and in general bring its expertise to bear in fostering regional integration of data gathering activities.

Social science

The lack of experience with socio-economic studies of fisheries within the Black Sea region is a serious impediment to development of sustainable fisheries. There is an increasing awareness worldwide that social and economic issues must be better included in fishery management policy, as managing fisheries is about managing people rather than managing fish. Fisheries management often implies political choices with important social repercussions. Social science might be able to identify how stakeholders can be legitimately involved and thereby contribute to the robustness of management and compliance with regulation. Finally, information and knowledge at this level constitutes a precondition or basis

for methodologies and categories to be used in fisheries information systems. There is considerable variation, in social and economic dimensions of fisheries within the Black Sea region. This is a challenge for designing a uniform method and database of fisheries as well as for involvement of fishers in the management process.

Unlike natural sciences working on the Black Sea, the study objects of socio-economic research of Black Sea fisheries vary between the countries. There are immense differences between, the way fisheries are organized in the riparian countries (e.g. family based organisation of fishing companies being much more important in Turkey than in Ukraine and Russia). Thus, it is important that socio-economic studies of fisheries embed the fisheries within their particular social and historical contexts, and the fishery sociology should be conducted by researchers with research expertise in the individual countries. This is best done by social scientists working in social science departments or institutes, while simultaneously ensuring that the research stays in close contact with international fishery sociology, anthropology or economy. It would clearly be an advantage if social science fishery research was concentrated in one institution in each country, and some continuity over time was secured.

3.3. Social issues

Social equity
The societies in which Black Sea fishers are embedded, are generally very different from each other. Inequality, poverty, low educational level etc. are important aspects of these societies. Social justice between the countries may be one important concern (Caddy 2008), but fishery management also impinges on social equity issues within the countries. The potential introduction of ITQs in Turkey, e.g., could lead to increased social differences. In some places, such as Samsun in Turkey (Knudsen and Zengin 2006) poverty is one reason for increased fishing pressure.

Involving stakeholders
There is currently very little involvement of non-governmental stakeholders in the fishery management process in the Black Sea countries. While there are good reasons to wish more involvement of fishers and other stakeholders, caution should be taken in having naive expectations concerning an immediate potential for NGO activity, co-management, and fisher/citizen participation in fisheries management in the Black Sea. Although various kinds of fishers organisations do exist in the Black Sea countries (Toje and Knudsen 2006, Knudsen in press), there is generally a lack of representative, legitimate and influential fishers' organisation. This issue should be an important item in a survey of institutional frameworks of Black Sea fishery management.

Marketing, distribution and consumption
Few surveys of these aspects of Black Sea fisheries exist (but see Elliot 1996, Knudsen 2006, Knudsen and Toje 2008). Marketing and distribution has undergone dramatic changes and experienced major challenges in the previous Soviet states with the disintegration of the state supported system of production, processing and distribution. New private actors are now gradually recreating the effective structures through vertical integration (Knudsen and Toje 2008). The fish market sector in Turkey, Bulgaria and Romania has been comprehensively addressed by the EU-alignment process (hygiene, fair competition, registration and control).

While the Black Sea fisheries may experience challenges of economic efficiency, quality standards etc., related to distribution and marketing, these issues may be of second priority for a Black Sea fisheries project. The major issue in the short term, is perhaps the large sector of Turkish fish meal and oil processing factories which makes economically viable very large catches of small pelagics within a very short time span.

3.4. Funding

BSERP *Exit Strategy* is sober reading: "The member countries must now decide how to continue the positive progress of the BSERP BSC joint activities. The current situation is not sustainable in that the organizational and programme mandate given to the BSC cannot be achieved with the existing resource base, in fact it cannot be maintained at even a minimal level" (BSERP 2007:17).

Securing funding for coordinated scientific and managerial activities at Black Sea level is thus a very urgent matter. Funding for cooperative activities should be sought through a variety of mechanisms and donors, as well as contributions from individual governments.

EU support to the Turkish fishery sector reform amounted to more than 6 million EURO for the period 2005-2006 (Knudsen, Pelczarski and Brown 2007), but has now been phased out. Bulgaria and Romania now benefit from EC support and are bound to implement a co-financed annual fisheries scientific data collection programme (EC Regulation 1639/2001). Nevertheless, considering the global Black Sea scenario, the fishing capacity and production of Bulgaria and, in particular Romania, remain relatively low and the impact on Black Sea ecosystem and fisheries resources is trivial; thus, efforts to expand the support to a region-wide scale are vital in order to secure regional cooperative responsible fisheries management and to guarantee the sustainable exploitation of living marine resources in the Black Sea.

4. PROPOSAL FOR A GFCM SUPPORTED 'BLACKFISH' PROJECT

In the light of all of the above, there appear to be strong scientific and institutional reasons for integrating a possible GFCM executed project in the Black Sea with options for close collaboration with other initiatives such as the Advisory Group on the Management of Fisheries and other Marine Living Resources (AG FOMLR) of the BSC.

The very particular challenges in the Black Sea region mean that many years of coordinated effort is necessary to build the required network of human competence, science, fishery information and institutional structures within the region to facilitate sustainable Black Sea fisheries management. Thus, one should not expect that science, management, and funding are up and running independently in the region at the end of a project cycle of e.g. 5 years. The project should secure continuity in scientific cooperation and data gathering irrespective of progress in the formulation of a common management regime. The initial project might be for a period of 5 years, but the overall strategy towards which it should be aimed, should have a longer time frame (10-15 years).

4.1. Strategy and elements for a Project

It could be wise to consider devising a strategy with two strands, to support and facilitate coordinated and sustainable fisheries management:

- Short term initiatives to reduce fishing effort, secure continuity and strengthening in current scientific cooperation and data collection activities.
- Long term development of capacities, institutions and procedures.

A GFCM executed Black Sea fisheries project ('BLACKFISH') could be organized in close collaboration with BSC, as illustrated in Figure 1. The project would need to be directed by a expert conversant with the region, its fisheries and environment. It would not be a purely 'technical' post, since the challenges facing the project is as much of an institutional character as is of a scientific and technical nature.

The scientific work of BLACKFISH could be organized in different work packages (WPs) distinguished from each other by focus and partly scientific discipline. There should be ToRs for each of these groups which would be expected to have regular workshop and deliver advise to the Scientific Advisory Committee (SAC) of the GFCM and other relevant scientific bodies in the region. For training purposes young scientists should be encouraged to participate alongside senior representatives. In addition to the scientific activity organized around the regional framework, scientific activities of the project should also be based on guidelines and priorities emanating from the subsidiary bodies of the SAC, as well as to take on board experiences gained from other FAO-GFCM sub-regional projects (COPEMED, ADRIAMED, MEDSUDMED). Cooperation with the EASTMED project, which should start imminently, should also be encouraged.

The WPs should be instructed to focus particularly on issues like:

- introduced species (all WPs)
- effects on habitat of harmful fishing practices (abrasion etc.) (WP 1)
- IUU (WPs 2,3 and 4)
- character of current management system, survey of management tool options (WPs 3 and 4)
- regional stock assessments (WP 1)

When an issue involes more than one WP, there should be workshops and outputs that includes all of the WPs. When it comes to social science of Black Sea fisheries (group 4), it could better be developed through to the involvement of one social science research institution in each of the fishery nations of the Black Sea.

One of the tasks of BLACKFISFH that would require most day-to day manpower would be the development of a Fisheries Information system. The existing fisheries information system BSIS could be used as a basis, but recent information systems and data collection methodologies successfully developed by other FAO-GFCM projects should be used as models.

National inputs to the project could be administered through the AG FOMLR structure and together with appointed National Focal Points.
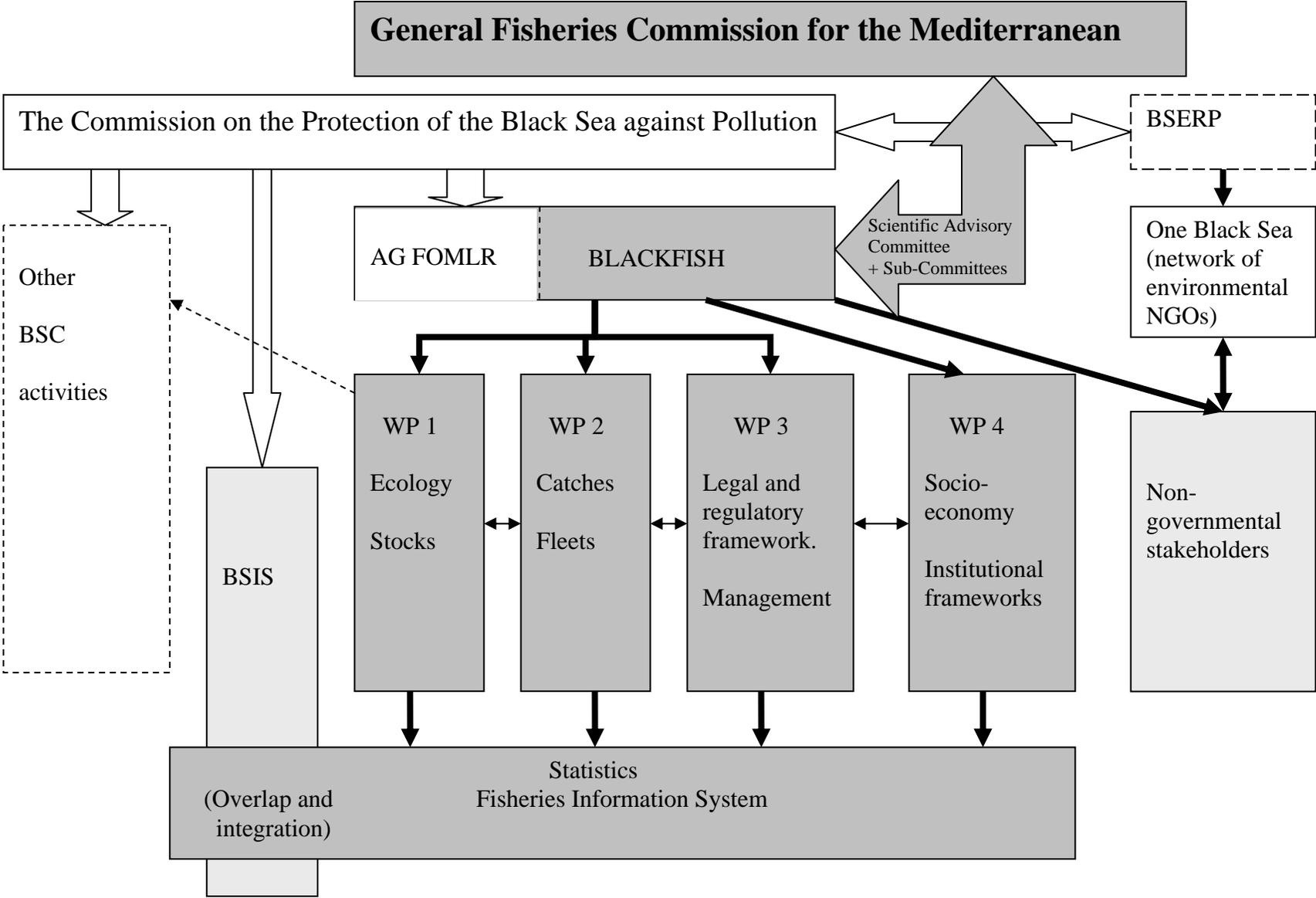
General Fisheries Commission for the Mediterranean

The Commission on the Protection of the Black Sea against Pollution

BSERP

Other

BSC

activities

AG FOMLR

BLACKFISH

Scientific Advisory Committee + Sub-Committees

One Black Sea (network of environmental NGOs)

BSIS

WP 1

Ecology

Stocks

WP 2

Catches

Fleets

WP 3

Legal and regulatory framework.

Management

WP 4

Socio-economy

Institutional frameworks

Non-governmental stakeholders

(Overlap and integration)

Statistics
Fisheries Information System

Figure 1. DRAFT INSTITUTIONAL STRUCTURE OF POTENTIAL 'BLACKFISH' PROJECT

4.2. Envisaged staff and budget

The project would be expected to run over a period of five years and would be managed by purposely recruited project staff, on both a full-time and part-time basis, as well as a number of consultants for ad hoc tasks. These may include: 1 project coordinator, 1 fisheries statistician, 1 programmer, 1 administrative clerk and 7 part-time experts. The budget would of course be more outreaching than merely covering staff salaries and would need to cover aspects such as field activities, training, meeting / workshop expenses, publications and travel. Based on the experiences in executing other FAO-GFCM regional projects, a reasonable budget estimate for such a project would be $5 million over a five-year period.

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ATTACHMENT 4

**Objectives and components of a possible
GFCM-executed project in the Black Sea**

1. Foster cooperation among fishery scientists and stakeholders from Black Sea coastal states in the fields of fisheries science, socio-economics and management within the framework of an Ecosystem Approach to Fisheries.

2. Promote technology transfer among countries and support capacity building in, inter alia, monitoring and assessment of fisheries resources, bio-economic modelling, fishing gear technology, catch assessment surveys and statistics and Information Technology tools for fisheries science.

3. Develop a multidisciplinary database and regional information system to act as a repository of all available data and information, as well as to serve as a tool to identify gaps in knowledge, perform analyses and produce outputs useful for scientists and managers alike.

4. Conduct joint data collection schemes including surveys to promote standardisation methodologies, complete information deficiencies and calibrate national systems, as appropriate.

5. Promote discussion among scientists, decision makers and stakeholders, through, inter alia, workshops and symposia, on strategy options for fisheries management in the region focussing, in particular, on the integration of ecosystem considerations, bio-economic indicators and reference points, as well as on artisanal fisheries.

6. Cooperate with other initiatives of Black Sea scientific bodies, national entities and international projects, in order to achieve coordinated results and maximise the benefits for the future of the Black Sea environment and sustainable exploitation of Black Sea living marine resources.

7. Support the attendance of Black Sea national scientists in international fisheries scientific fora, together with those of related disciplines, and encourage their effective participation in activities of the GFCM Scientific Advisory Committee and those of other regional scientific bodies.

8. Promote the presentation and publication of knowledge and results emanating from the Project's activities in international conferences, seminars, scientific meetings of the GFCM and other relevant meetings, contributing to the advisory processes required for the implementation of responsible fisheries management in the Black Sea.