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Buoy gear – a potential for bycatch reduction in the small-scale swordfish fisheries: a Florida experience and Indian Ocean perspective

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ABSTRACT

A swordfish buoy gear, an innovative fishing practice developed in USA in early 2000s, provide a possibility of direct swordfish targeting yielding high CPUE of target species and very low bycatch levels. Here we present a summary of US experience and discuss potential application of this gear in the Indian Ocean region in the perspective of small-scale fisheries development and bycatch reduction.

Introduction

Heavy exploitation of swordfish in the Atlantic Ocean during 1980s – early 1990s led to an overfished state in both the North Atlantic and South Atlantic stocks (ICCAT, 2009). High levels of juvenile bycatch in certain areas (in particular, the Florida Straits between Florida, Cuba, and the Bahamas) was considered as a major detrimental factor for the stock sustainability. Responding to national and international calls for the conservation, United States NOAA NMFS introduced in 2000-2001 several Regulatory Amendments to the 1999 HMS FMP (Highly Migratory Species Fisheries Management Plan) (NMFS, 2000) applying three time-area closures to U.S. domestic pelagic longline (PLL) fisheries to reduce bycatch of billfish and undersized swordfish: Desoto Canyon in the Gulf of Mexico (Nov. 2000) and Charleston Bump and East Florida Coast off the U.S. Atlantic coast (March 2001). Swordfish buoy gear (SBG) was developed in the United States in 2003 in the Florida Straits to take advantage of the concentration of large swordfish relatively close to shore, and in part as an alternative to (PLL) gear which was banned in the area in 2001. Direct swordfish targeting associated with significant reduction of nominal fishing effort and level of bycatch were principal goals of this invention (Bayse and Kerstetter, 2010).

Gear and fishing practices

Gear. Swordfish buoy gear (SBG) is a modified vertical longline, which is considered as a new type of fishing gear for direct targeting of swordfish. The basic configuration of the buoy gear is very simple: a short section of monofilament mainline equipped with one or two long branchlines rigged with J-hooks (size 9/0). The gear is kept at the surface by at least one large buoy and one auxiliary buoy/ float (bite indicator) (Fig. 1). There are various modifications of gear rigging techniques which commonly vary by boat and captain. Each (often single) hook is baited with dead bait: fish (mackerel, small tuna, or other species) or squid. An electric LED light emitting device ('Electralume®'[1]) or chemical light stick is attached to the branchlines. 'Electralume®' sometimes used as a sinker, but in certain cases an additional lead weight of 20-45 g is also used. The buoys are equipped with strobes, reflective tape, and sometimes with radar reflectors; indicator buoys are commonly also equipped with one or more chemical lightsticks for greater visibility.

Boats. Various boats (mainly small, recreational type vessels) of 5-18 m LOA are used in the Florida Straits area. No mechanisation for fish retrieval/handling is permitted by U.S. regulation, such that fish are hand-lined to the vessel upon capture.

[1] Electralume® Under Water Fishing Lights. Lindgren Pitman. 2615 N.E. 5th Avenue Pompano Beach, Florida 33064 U.S.A. http://www.lindgren-pitman.com/c-4-electralume-battery-powered-fishing-lights.aspx

Gear deployment and fishing tactics. Buoy fishing gear techniques use similar deployment strategies as swordfish-targeting pelagic longline fisheries: gear is deployed after sunset and retrieved several hours prior to sunrise, with specific times varying with season. In case of bite detection, vessel immediately moves to the gear and attempts to retrieve the caught fish. Absent any sign of fish strikes, each buoy is retrieved every 2-3 hours to check bait status. The fishing zone is located off the slope, over water depths deeper than 500 m at the western edge of the Gulf Stream. Buoys are deployed in a straight line at between a 45°-90° angle to the axis of the main current. Setting the gear in a straight line greatly facilitates the later detection of a shift in the gear drifting pattern, which often indicates a fish strike.

Starting in 2006, swordfish buoy fishing gear is officially authorised by U.S. domestic regulation within waters of U.S. jurisdiction. Current regulation allows a maximum 35 buoys (i.e., individual free-floating pieces of gear) per vessel with maximum 2 hooks per buoy in the Gulf of Mexico and along east coast of USA, including those areas closed for pelagic longline fisheries (NOAA, 2011).

The principal advantages of buoy gear, which allows to gain such an exclusive position in US pelagic fisheries are:

- high efficiency (CPUE) in view of very low fishing effort (in terms of nominal hooks),
- extremely low level of bycatch,
- high percentage of live fish at haulback, facilitating live release of non-retained fish,
- high survival rate of released fish,
- low bait consumption, and
- higher ex-vessel fish prices.

Despite the limitations of current regulation, every vessel involved in the Florida Straits buoy gear fishery usually uses much lower fishing effort than permitted, deploying 12-15 buoys per fishing day (night), 12-30 hooks in total (Lerner, 2009 ; Bayse, Kerstetter, 2010; Kerstetter, Moore, 2012).

Buoy gear fleet and catch levels

Buoy fishing gear technique is currently an important part of Florida commercial fisheries. This sector employes 35-40 active vessels by the estimates of D Kerstetter. Official U.S. statistics (NOAA, 2012) reported 50 vessels licensed for this fishery in 2011.

Annual catches of the fleet varies between 65-85 t that yielded during 600 and 700 nightly cruises per year (Fig. 2). Vessels who regularly participate in the buoy gear fishery have an average of one nightly trip per week, dependent on local weather conditions and sea state (i.e., fewer trips occur between December-February, a seasonal period of heavy weather).

Buoy gear is very simple (Fig. 1) and cheap fishing gear, which does not need expensive machinery such mainline spool or hauling machine. In addition, it revived the small-scale Florida fisheries by allowing the small vessels to efficiently target swordfish. Mean swordfish CPUE is 30-50 times higher (depending on index used) than values obtained in pelagic longline fisheries (Fig. 3, 4). In addition the SBG fishery consumes much less bait (15-30 baits per trip) in comparison to traditional pelagic longline (300-2000 baits per set in direct relation with fishing effort). Reported fuel consumption is also much lower than during longline operations (most vessels in the Florida small-scale fishery have outboard engines of 150-300 hp total). It should be noted, however, that overall catch per vessel/trip are vary in relation of fishing success and number of hooks deployed. Catch rates vary between 0 and 10 swordfish per nightly trip (Bayse and Kerstetter, 2010). Average catch per trip is 103.6 kg of landed dressed swordfish (Fig. 5) (NOAA, 2012).

Species composition of catch, bycatch level, environmental effect

Monitored SBG catches included 16 species total (Fig. 6), although swordfish largely dominates the catch (92%); bycatch (non-target catch) represents 8%. Most of non-target species are not retained by the fishery. Swordfish smaller than 120 cm LJFL are released or discarded irrespectively of fish condition (alive, moribund, or dead) in accordance with U.S. domestic fisheries regulations. Non-retained catch (included non-retained swordfish and catch of non-target species (bycatch) represents 38.1% of the total catch. Most of non-retained catch (93%) is released alive and only 7% are dead discards. Fast intervention of fishermen on bite detection allows fast gear retrieval and the release non-desired fish, thereby likely decreasing both capture-associated stress and post-release mortality.

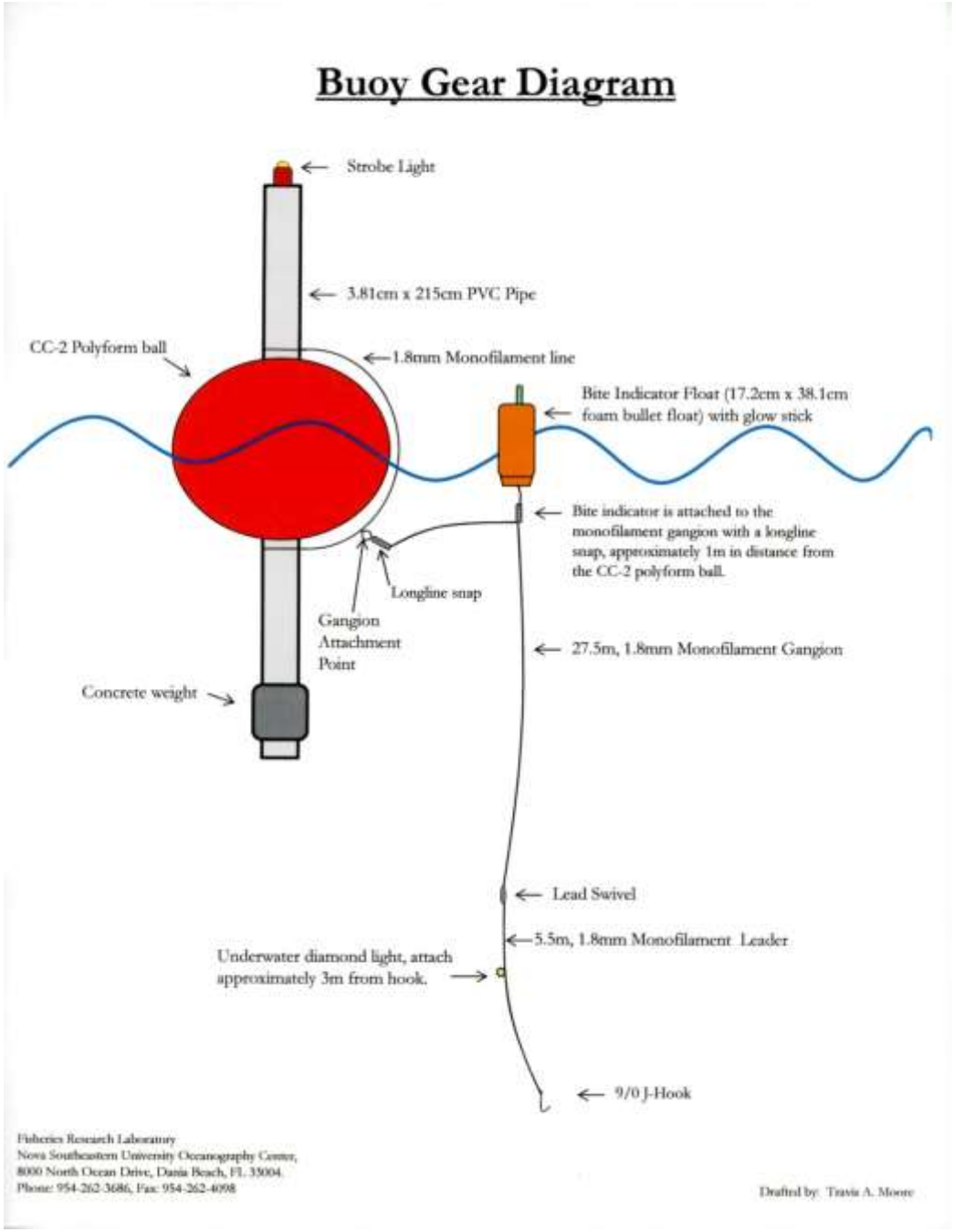

Figure 1. Principal scheme of swordfish buoy fishing gear used in Florida Straits fisheries: supplies and rigging.

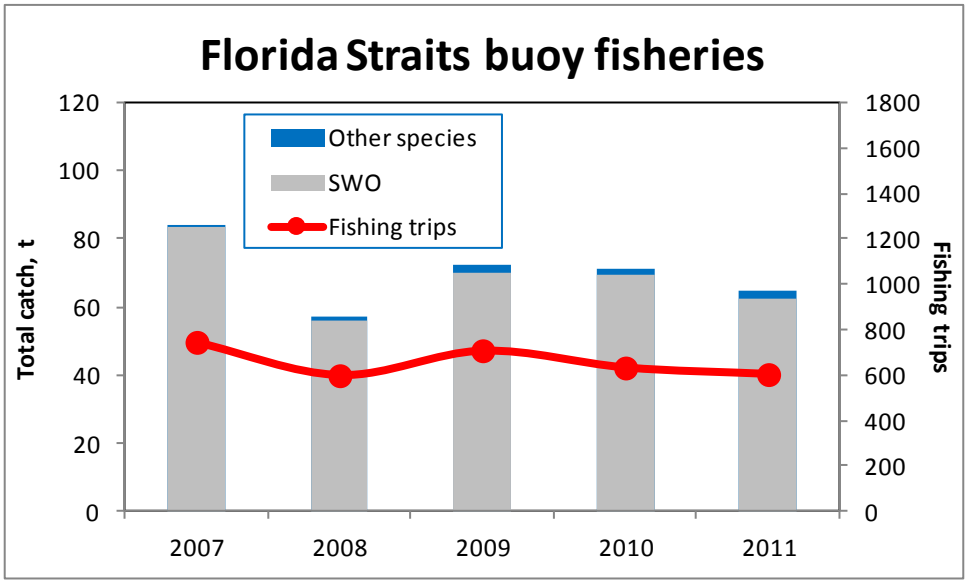

Figure 2. Catch statistics of Florida Straits U.S. swordfish buoy fisheries and annual number of fishing trips reported by buoy fishing fleet (Source: NOAA, 2012).

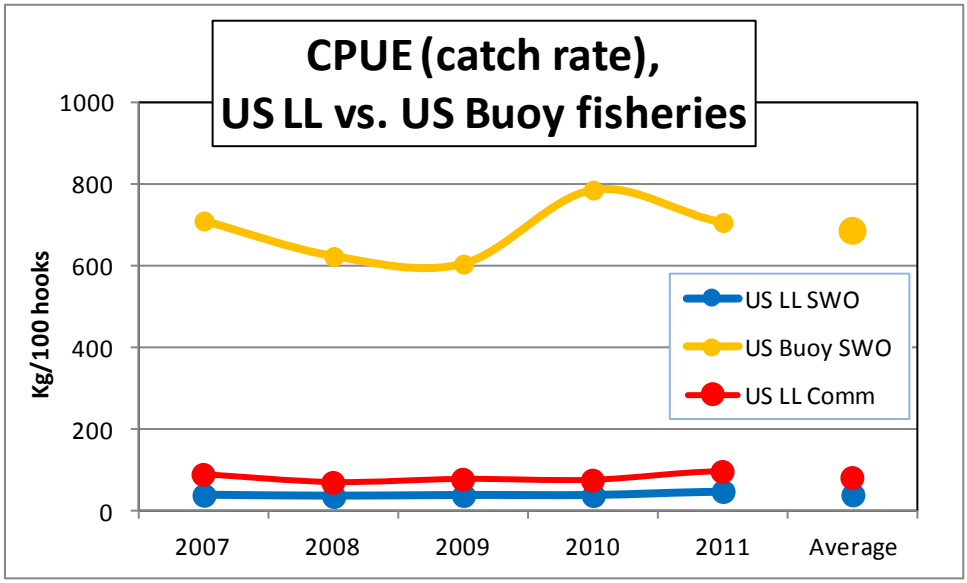

Figure 3. Comparative nominal catch rates (kg/100 hooks) in Atlantic U.S. pelagic longline and Florida Straits swordfish buoy gear fisheries. Catch rates estimated by the authors from reported landing and discards and nominal fishing effort (Source: NOAA, 2012).

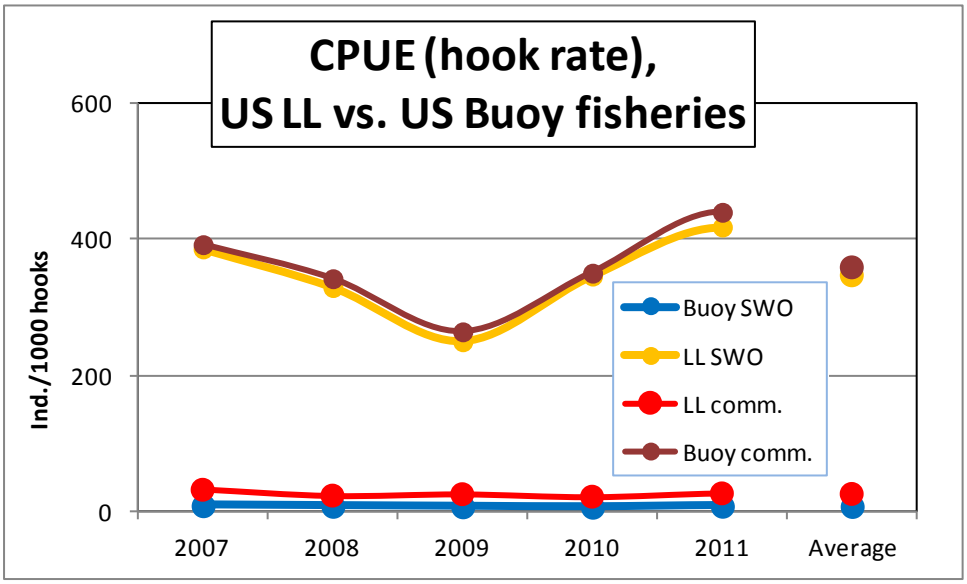

Figure 4. Comparative nominal hook rates (ind./1000 hooks) for swordfish and all commercial species in Atlantic US longline and Florida Straits buoy fisheries. Hook rates estimated by the authors from reported catch and discards and nominal fishing effort (Source: NOAA, 2012).

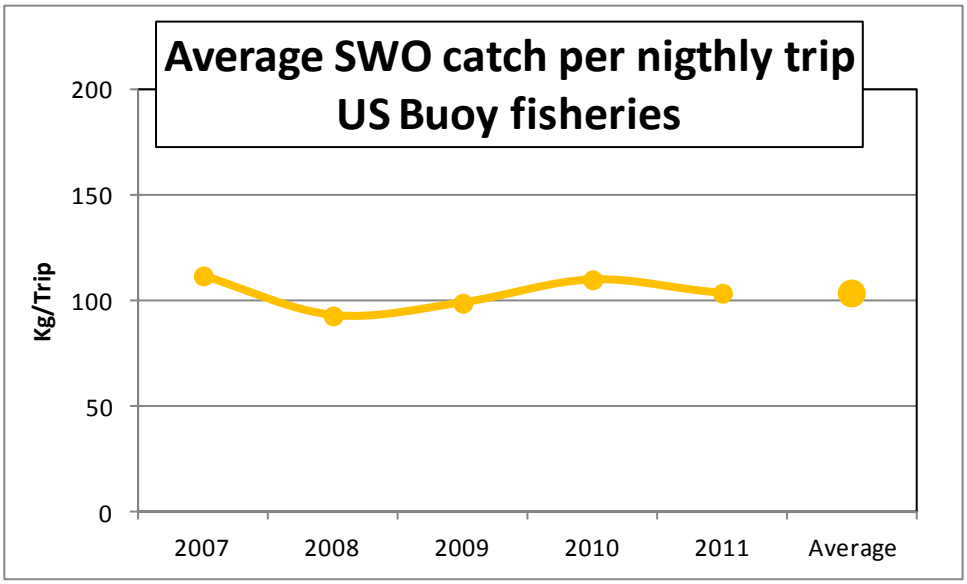

Figure 5. Average catch of swordfish per nightly trip (kg/trip) in Florida Straits buoy fisheries. Estimated by the authors from reported catch and discards and vessel activity statistics (Source: NOAA, 2012).

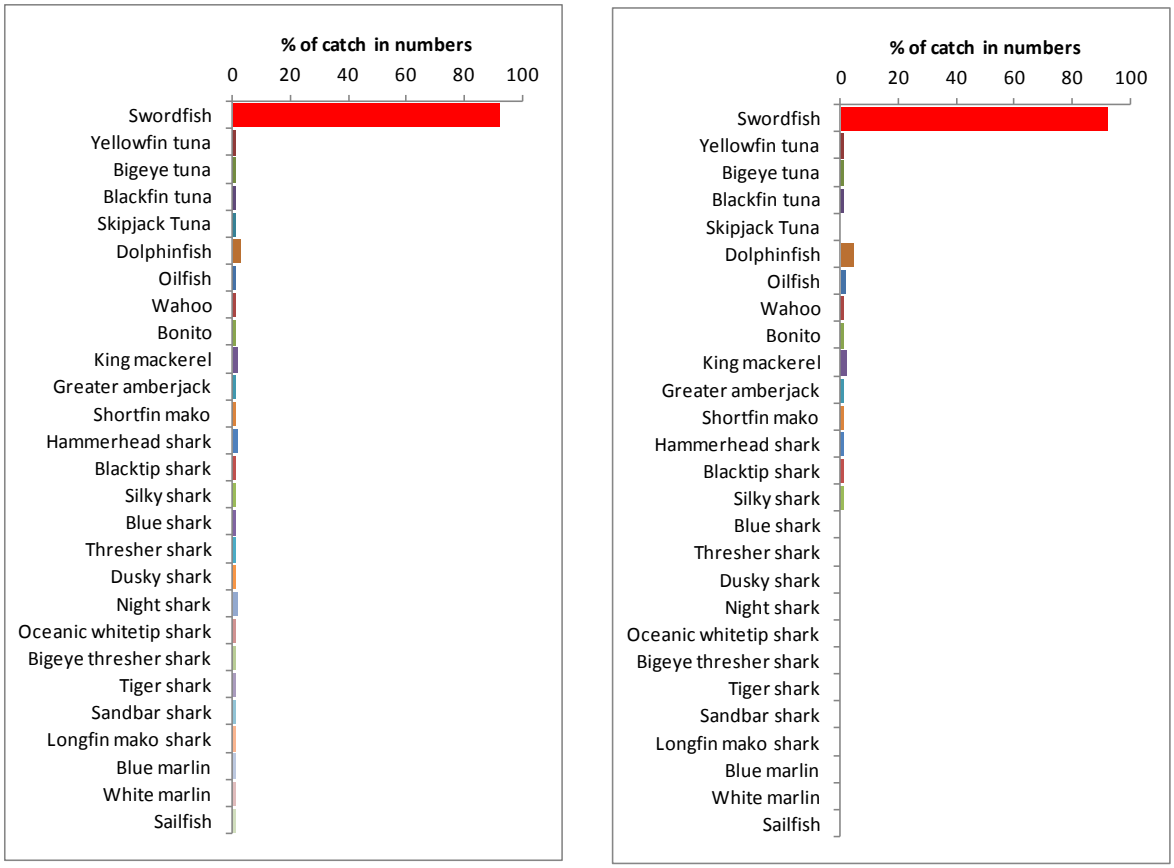

Figure 6. Average catch composition of Florida Straits buoy fisheries in 2007-2011. Left panel: retained catch + released alive + dead discards; right panel: retained catch only (Source: NOAA, 2012).

Low level of bycatch compare to common fishing practice in global longline fisheries (averages on ~20-30% of discards in weight) (Kelleher, 2005) makes the swordfish buoy gear fishery one of the cleanest in catch/bycatch ratio. In this context, the swordfish buoy fishery in the Florida Straits approaches that of purse seine gear tuna fisheries, where average bycatch level is about 3-4% (Romanov, 2002, 2008). While overall level of discards/release in buoy fisheries, equal to 38.1% of total catch is relatively high and comparable with other fisheries: +60% in shrimp trawl fisheries, 20-30% of the catch for tuna longline, dredge and trap/pot fisheries (Kelleher, 2005), the percentage of dead discards is extremely low (NOAA, 2012). PSAT tagging of fish released from this gear demonstrate high survival rate for swordfish (Fenton, 2012), therefore the fishery likely has an overall low ecosystem impact. Recent evaluation of this gear by the Marine Stewardship Council (MSC) resulted in a full certification of this fishery in view of the MSC Principles and Criteria for Sustainable Fishing (Parkes et al., 2013).

Indian Ocean perspective

The simplicity and relatively low cost of investment in swordfish buoy gear materials make it potentially attractive to developing nations of the region. This gear apparently might be used to complement small-scale longline swordfish fisheries, to replace it or to develop new local fisheries. A potential for swordfish stock exploitation apparently exists off many coastal areas in the Indian Ocean with environmental conditions favourable for swordfish:

a. Absence of vertical habitat compression due to oxygen depletion (Fig. 7). Apparently, the waters of the north Arabian Sea and Bay of Bengal, where low oxygen concentration waters are very close to the surface, have no or very limited interest for swordfish fisheries.
b. Zones of strong coastal currents, which exist off the east coast of Africa, Madagascar, and the west coast of Indonesia (Fig. 8).

Low exploitation costs associated with low bait and fuel consumption also makes this gear potentially viable.

Conservation potential and management challenges

Adoption of SBG in local fisheries may provide certain flexibility to the small-scale fleets in view of decrease of bycatch levels and conservation of non-retained species. In particular this gear might be used as a viable alternative of gillnet gear in small-scale fisheries, which often used to target shark or otherwise subjected to relatively high level of mortality among non-retained species. Similarly small longline boats might chose SBG to reduce their bait consumption and decrease catch of non-target species.

One should be aware however that several potential management issues might arise with adoption of the swordfish buoy gear fishing technique:

- Development of additional effort instead of replacement of older fleet, gillnet or longline fleet,
- Catch reporting from small-scale fisheries are usually very poor, which may lead to non-reported fishing mortality and resulting problems with swordfish and other species' stock assessment and management,
- Potential fisheries conflicts:
    - stolen buoy gear,
    - stolen catch,
- Lost gear and environmental pollution with plastic.

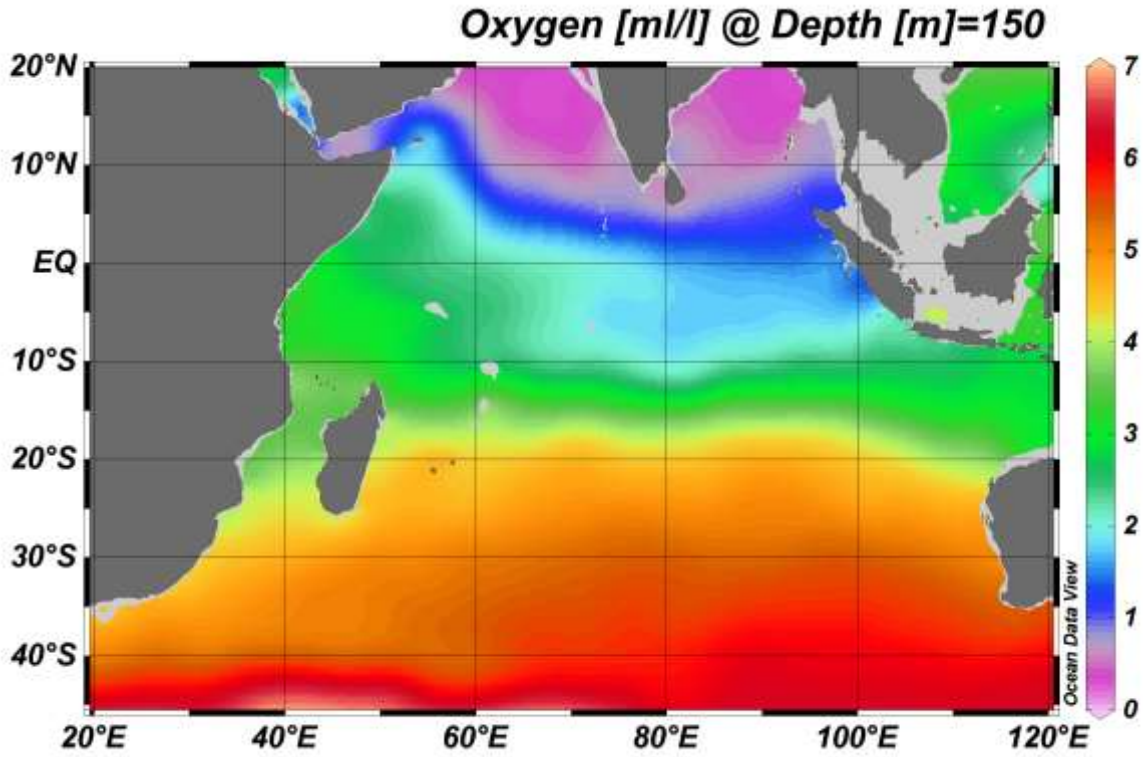

Figure 7. Mean climatic values of dissolved oxygen concentration at the 150 m depth Source: Gouretski and Koltermann, 2004.

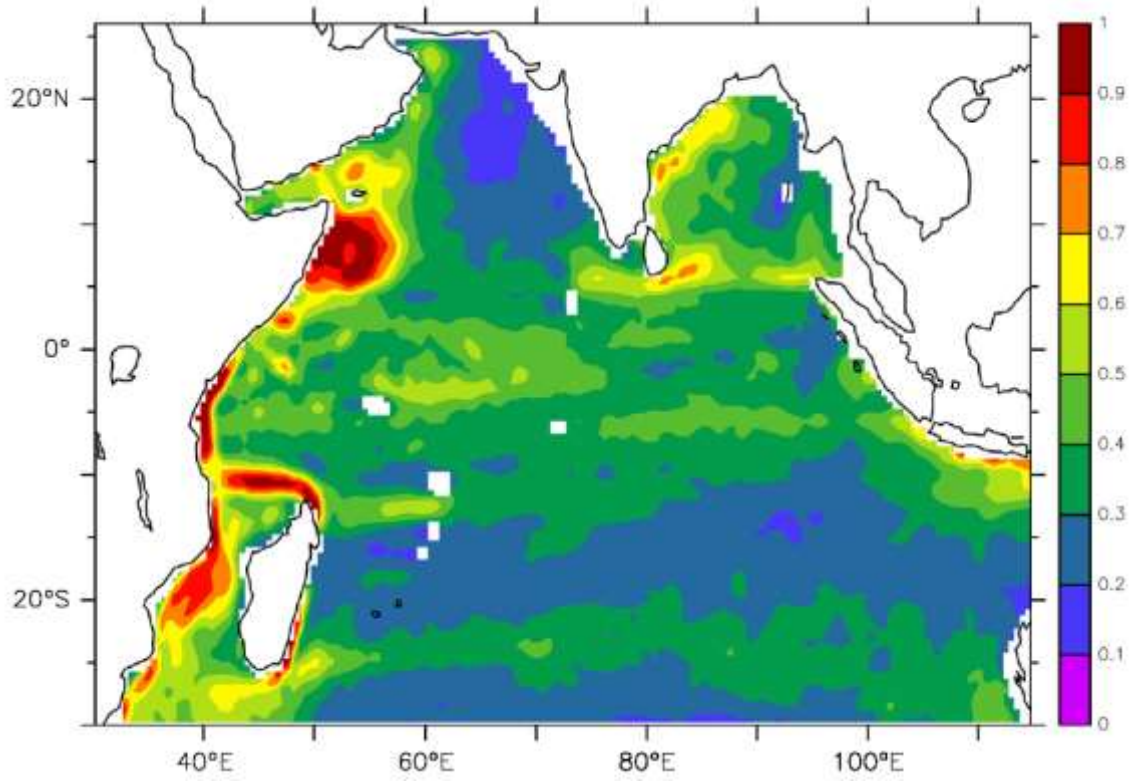

Figure 8. A map of normalized eddy kinetic energy, based on AVISO data (source: McCreary et al., 2013).

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