DRAFT: STOCK ASSESSMENT OF BLUE SHARK (*Prionce glauca)* IN THE INDIAN OCEAN

PREPARED BY: IOTC SECRETARIAT[1], 22ND AUGUST, 2015

Abstract

We conduct stock assessments for Indian Ocean blue shark using data poor approaches. We used a catch-based stock reduction analysis method. The method is based on a classical biomass dynamics model, requires only catch history but not fishing effort or CPUE. Known population growth rate will improve the assessment result. In this paper, we assume that the species analysed, in the whole Indian Ocean belong to a single stock and the population size in 1950 is the virgin biomass, and is also equal to their carrying capacities. We use recently updated catch data in the analysis. For blueshark the geometric mean virgin biomass was about 173.3 to 559.7 thousand tonnes, and the intrinsic population growth rate is about 0.245 (0.08-0.73 95% CI). The entire stock can support a MSY of nearly 19.1 thousand tonnes. Catch levels in recent year may have been too high, and likely overfishing is occurring on the stock (Figure 1).

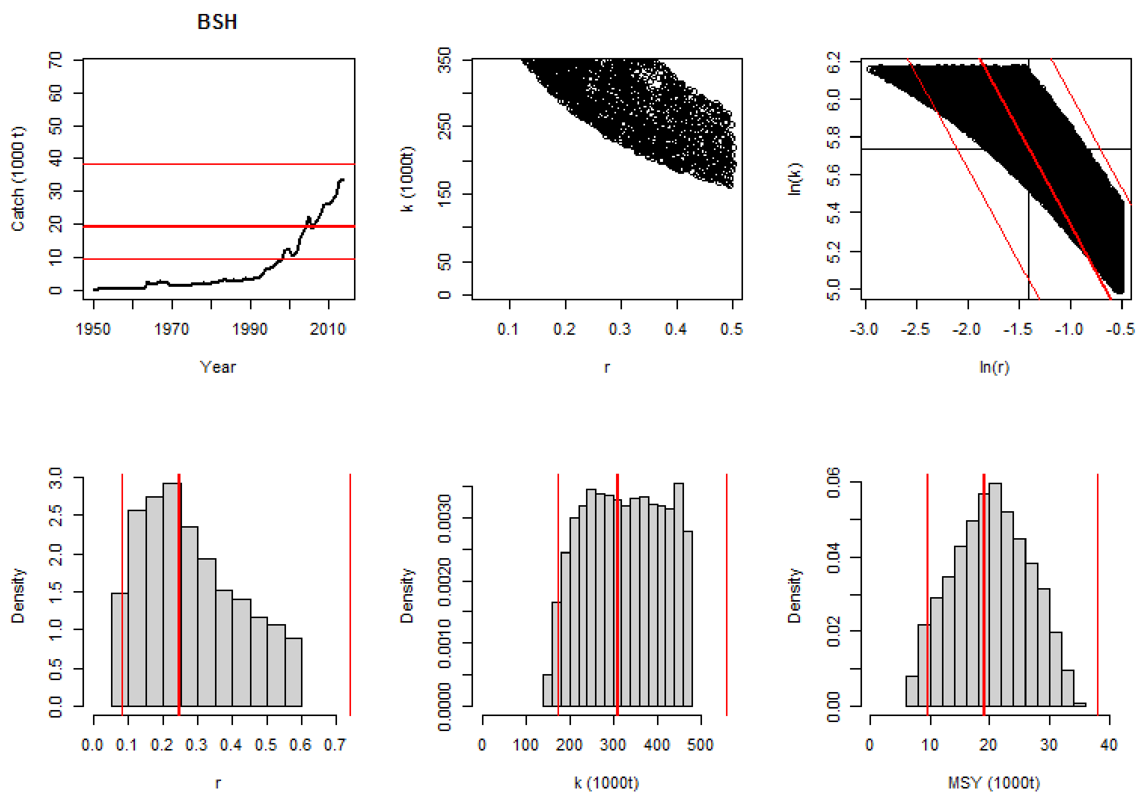

Figure 1: Key parameter using SRA Catch MSY Approach for determining stock status

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Introduction

In standard stock assessments conducted in the IO region, a index of abundance is essential to capture trends in biomass over time. However for Black Marlin and Sailfish in the Indian ocean no such data is available. Methods developed by CSIRO (draft report "Quantitatively defining biological and economic reference points in data poor fisheries" by Zhou et. al. 2013) highlights some methods developed for data poor fisheries using data rich fisheries as a testing platform. The primary method that is of use there is a technique called Stock reduction Analysis (Zhou et. al. 2012,Walters et. al. 2006, Martell and Froese 2012, Kimura and Tagart 1982) making assumptions about initial state of the Biomass, assumptions of what the biomass is at the middle of the time series, and what the biomass depletion levels range for the last year. The technique builds on simple surplus production models (like Shaefer, 1954), that use removal data and some estimate of carrying capacity and k. Ideally, these models should have some measure of the changes in abundance over time, but as shown in Martell and Froese (2012), and Walters et. al. 2006, a narrow range of r-K parameter can be obtained through simulation techniques that maintain the population, so that it neither collapses or exceeds the carrying capacity, K. This is the primary basis of the method developed and used here.

Blue shark (*Pironce glauca)*

Basic Biology and catches

The sharks are oceanic and can be found at depths of 150 m. or more and on coastal reefs. Their distribution can be as varied as estuarine, epipelagic or open ocean, and are vastly abundant in all the worlds oceans.. Marketed fresh, dried or salted, and frozen; meat utilized for consumption, hides for leather and fins for soup (Fishbase, www.fishbase.net).The species is sexually mature at 250 cm long and 4-5 years old. The female gives birth up to 80 young measuring 40 cm long, gestation lasts almost a year (Fishbase, www.fishbase.net). Produces from 4 to 135 young a litter (Fishbase, www.fishbase.net).

Catch data for the species show increasing trends in catches in recent years, and this is primarily attributed to actual reporting of the species being caught in the Indian Ocean. Thus earlier catch stats are underestimates and need to be evaluated with alternative techniques (eg. Clarke et al. 2015) or approaches proposed by Martin (2015),

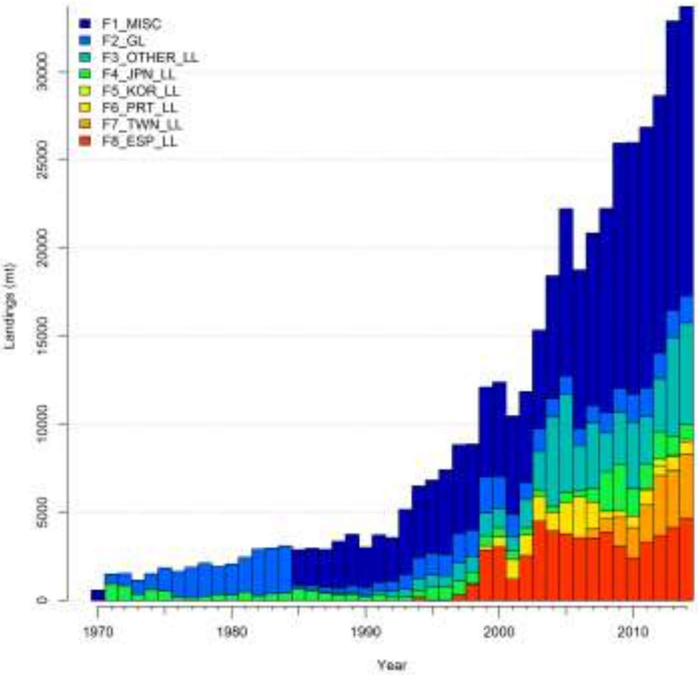

Figure 1L Catch stats on blue shark in the Indian Ocean

Methods

We use a newly developed stock assessment method in this paper. This method is based on catch data and does not require fishing effort or CPUE data. The method involves several steps. It applies a simple population dynamics model, starts with wide prior ranges for the key parameters, and includes the available catch data in the model. Then the model systematically searches through possible parameter spaces and retains feasible parameter values. Mathematically and biologically unfeasible values are excluded from the large pool of data. We progressively derive basic parameters, and carry out stochastic simulations using these base parameters to get biomass trajectories and additional parameters. Finally, we project to future biomass to explore alternative harvest policies.

We use following Graham-Shaefer surplus production model (Shaefer 1954):

$$B_{t+1} = B_t + rB_t\left(1 - \frac{B_t}{B_0}\right) - C_t \qquad (1)$$

Where B_t is biomass in time step *t*, *r* is the population growth rate, B_0 is the virgin biomass equal to carrying capacity K, and C is the known catch.

This simple model has two unknown parameters, r and K. We set reasonably wide prior range, for example, *K* between C_{max} and 500 * C_{max}. We used the approach proposed in Martell and Froese (2012) for “resiliency” estimates that tied to the productivity parameter r (low resiliency levels indicated r between 0.05-0.5, medium resiliency indicated a r between 0.2-1, and high between 0.5-1.5). These were compared to values obtained in the literature and alternative methods.

We run model (1) to find all mathematically feasible *r* values by searching through wide range of Ks for all depletion levels. If the feasible choice of r and k chosen meets the intermediate (0.1 and 1 level of depletion in 1980), and last point depletion levels (the range specified was 0.3-0.7 level of depletion for these billfish stocks) it is kept. The summary of all runs which meet these criteria are then used, and geometric mean values are reported to be the better representation of yield targets (Martell and Froese 2012). Biological parameters, including K, r, MSY, are derived from the retained pool of [r, K] values. The geometric mean values of these are then used to assess the stock dynamics over time and reported using a phase plot.

Results

TBD

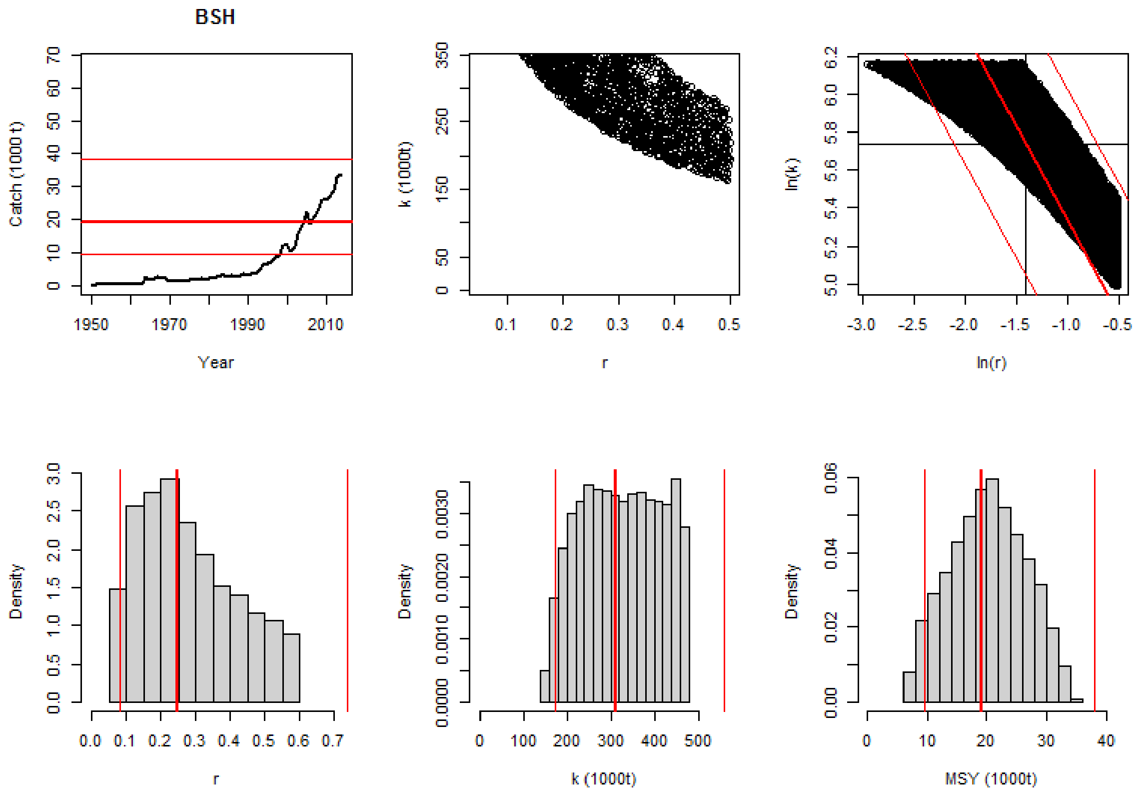

Figure 2: Uncertainty of r and k using SRA approaches and the estimated reference points

Figure 3: Phase plot of SMSY and FMSY Trajectory for Indian ocean Blueshark (TBD)

Table 1 All estimates of possible reference points for blueshark

Table 1: Key parameters associated with the stock reduction analysis for Indian Ocean Sailfish

Parameter	Lower 95% CI	Geometric Mean	Upper 95% CI
r	0.08	0.245	0.13
K	173365	311,504	559713
MSY	9528	19,079	- 38203
B_{MSY}	86682	92,814	279857
B_{2014}/B_{MSY} *	TBD	TBD	TBD
F_{2014}/F_{MSY} *	TBD	TBD	TBD

*Arithmetic Mean not Geometric Mean

Discussion

Thus, while being conservative in nature, this approach could provide some guideline for yield/by-catch levels in these fisheries. Based, on these simplistic models the following could be recommended as target yield levels on the Sailfish species analysed that ***yield should not to exceed 20K Tons for blue shark in the Indian Ocean Region.***

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