Model diagnostic for Stock Synthesis in the assessment of the Indian Ocean swordfish (*Xiphias gladius*).

Hiroki Yokoi and Hirotaka Ijima

yokoih@affrc.go.jp

ijima@affrc.go.jp

National Research Institute of Far Seas Fisheries, Fishery Research Agency,

Shimizu, Shizuoka, Japan

Abstract

We examined the two model diagnostics on the previous stock assessment model. R0 likelihood component profile showed a conflict between CPUE and size composition data. Age-structured production model diagnostic shows the fits to several CPUEs was poor. It is assumed that there are cause for the estimation of selectivity is not good.

Introduction

In recently, study of model diagnostic for Stock Synthesis has been conducted actively (Felipe et al. 2017; Lee et al. 2014; Minte-Vera and Maunder 2016; Minte-Vera et al. 2017; Sharma et al. 2014; Wang et al. 2014). The diagnostic methods that are recognized as particularly useful are RO likelihood component profile and Age-structured production model (ASPM) diagnostic (Maunder and Piner 2015). Therefore, we evaluate the effectiveness of the two diagnostics methods by stock assessment model which is previous swordfish assessment in Indian Ocean. It should be noted that this study is to confirm the effectiveness of the two diagnostics methods for future stock assessment and does not criticize the previous assessment.

Material and Method

Model

Stock Synthesis (SS3) which is one of the integrated stock assessment model was used (Methot 2009; Methot and Wetzel 2013). We used the input file of the base case adopted in the previous swordfish stock assessment (IOTC 2014).

R0 likelihood component profile

In SS3, the virgin biomass (B0) is estimated from the virgin recruitment (R0) using the stock recruitment relationship; that is, R0 determines the scale of the resource amount. The R0 likelihood component profile diagnostic fixing the virgin recruitment at different values and plotting the negative log-likelihood value for each data component against this parameter (Maundur and Piner 2015). If the model is a good, the minima of negative log-likelihood is approximately same R0 value among data components. Different minima among data components indicate possible conflict in the data sources about scale of resource amount. The R0 likelihood component profile does not indicate which data is correct. However, it is assumed that CPUE will indicate correct R0 value because CPUE seems to have greater information on scale of resource amount than other data (Francis 2011).

Age-structured production model (ASPM) diagnostic

This diagnostic consists of comparing the results of ASPM to those from integrated analysis. ASPM is constructed with the selectivity fixed at the values estimated in the base case. If the ASPM cannot explain the CPUE, then either the stock is recruitment driven, resources are not affected by catch because they are many enough, the model is incorrect, or the CPUE is not proportional to abundance (Maunder and Piner 2015). In addition, alternative models of ASPM (i.e. ASPM with recruitment estimated and ASPM with the recruitment estimates set equal to the values from the base case) are also compared to examine the influence of recruitment.

Result and Discussion

R0 likelihood component profile

R0 likelihood component profile showed a conflict between CPUE and size composition data (Figure 1). The log(R0) value of CPUE (green curve) and size composition data (red curve) are about 8.1 and 8.7, respectively. It was suggested that the model had problems with size composition data.

ASPM diagnostic

Fits to Japanese CPUEs, except northwest area, were very poor (Figure 2). Fits to Taiwanese CPUEs were good (Figure 3). However, northeast and southwest area appear to be overfitting (Figure 3b, 3c). Portuguese and Spanish CPUE are similar to Taiwanese and Japanese CPUE, respectively (Figure 4). It is assumed that there are cause for the estimation of selectivity is not good. Certainly, fitting for estimation of size composition data is not good (Figure 5). In order to improve the performance of the model it is necessary to improve the fit of the size configuration data.

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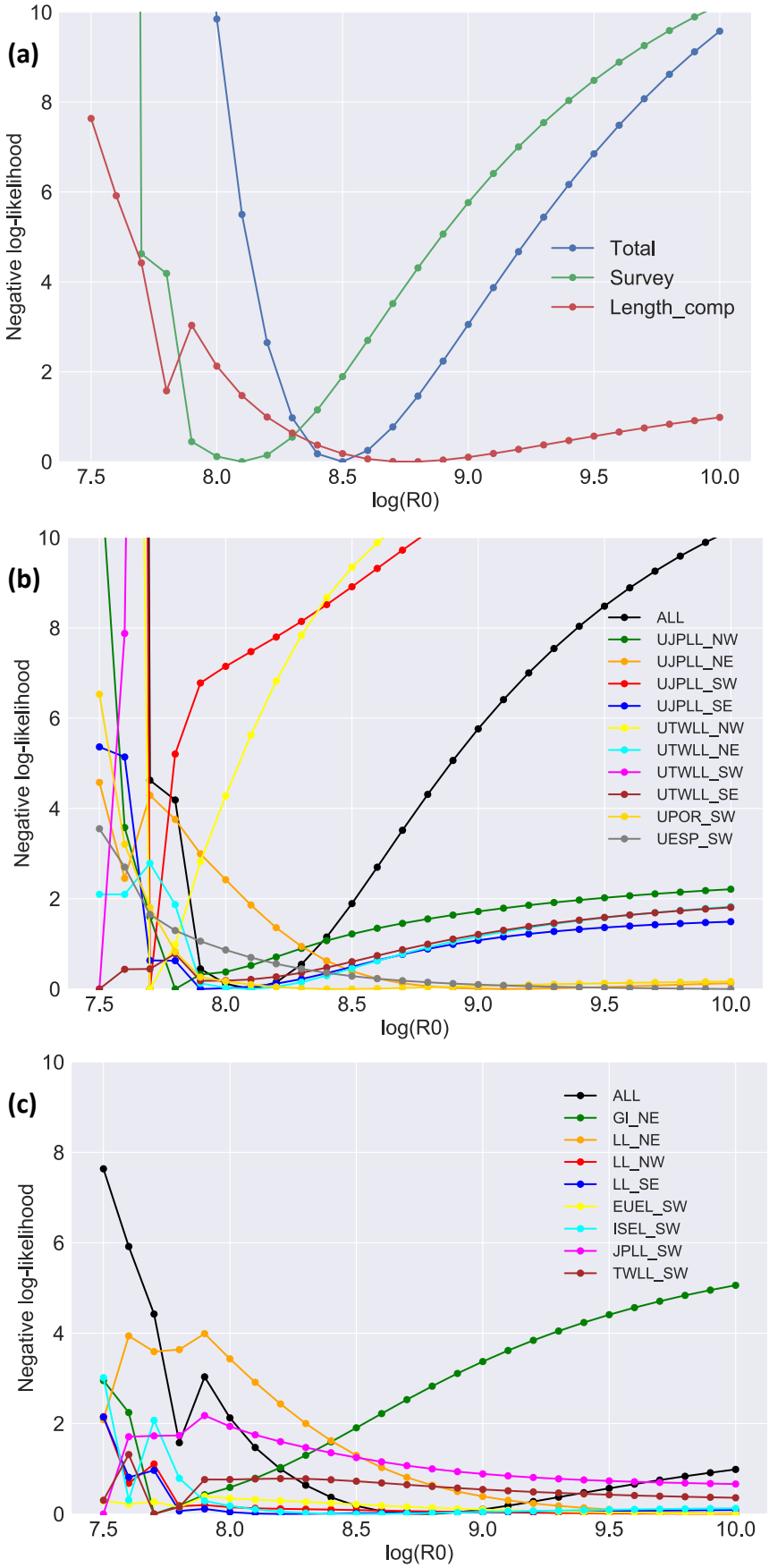

Figure 1. R0 likelihood component profile by Total (a), CPUEs (b), and size composition data (c)

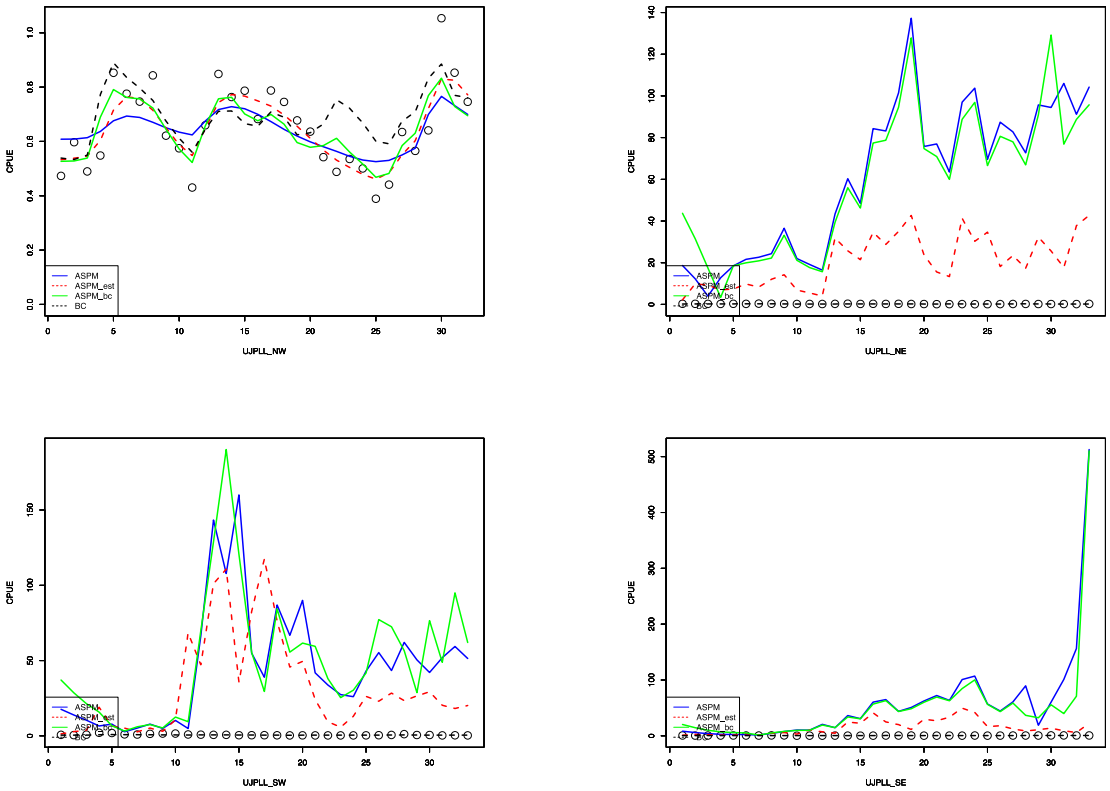

Figure 2. ASPM diagnostic by Japanese CPUEs. Blue line (ASPM), Red dashed line (ASPM with recruitment estimated), Green line (ASPM with the recruitment estimates set equal to the values from the base case), Black dashed line (Base case), (a) North west area, (b) North east area, (c) South west area and (d) South east area

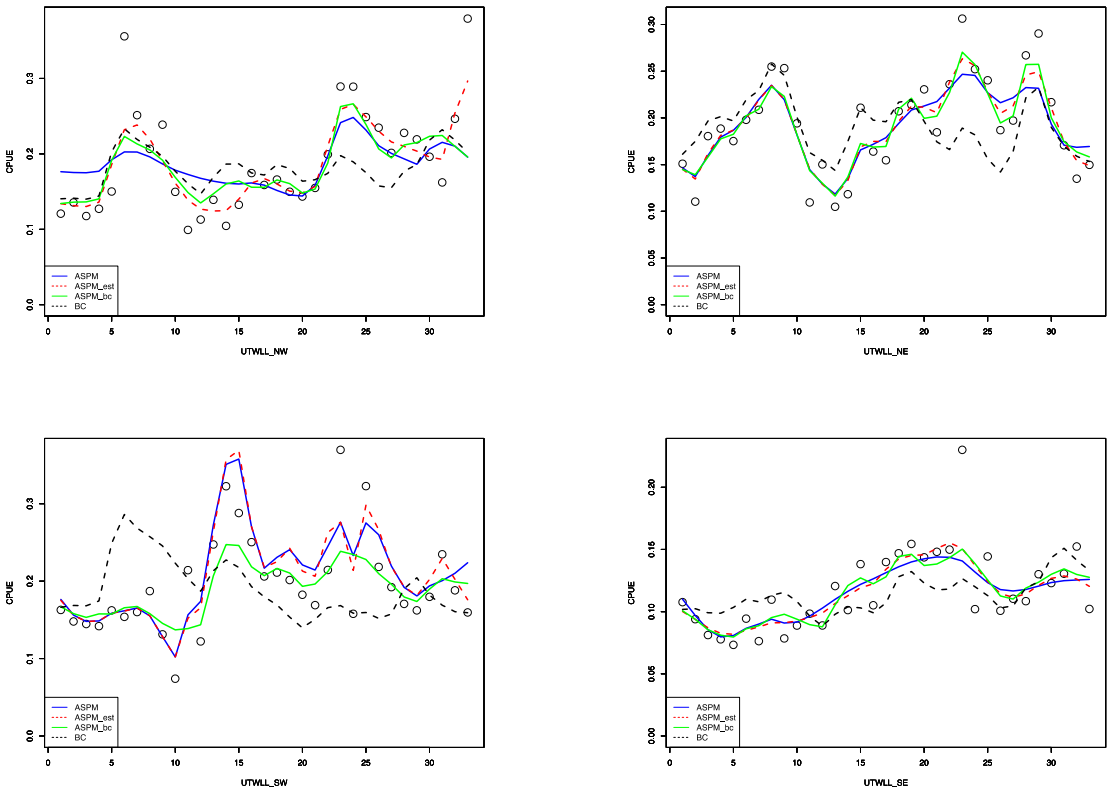

Figure 3. ASPM diagnostic by Taiwanese CPUEs. Blue line (ASPM), Red dashed line (ASPM with recruitment estimated), Green line (ASPM with the recruitment estimates set equal to the values from the base case), Black dashed line (Base case), (a) North west area, (b) North east area, (c) South west area and (d) South east area

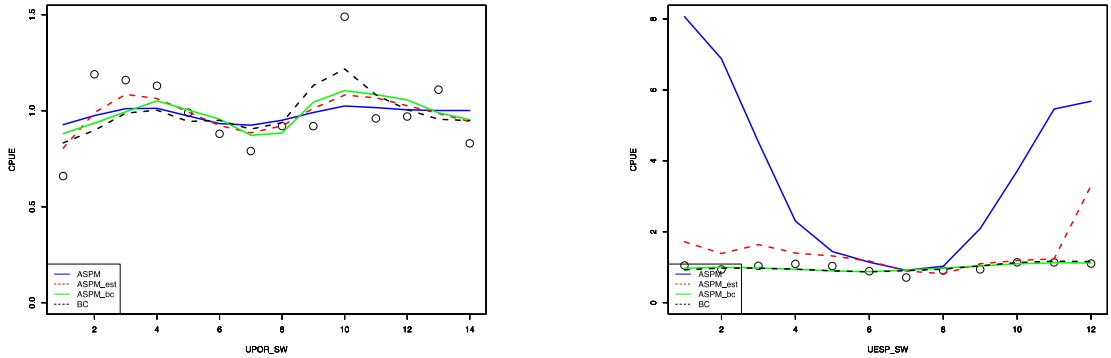

Figure 4. ASPM diagnostic by Portuguese and Spanish CPUEs. Blue line (ASPM), Red dashed line (ASPM with recruitment estimated), Green line (ASPM with the recruitment estimates set equal to the values from the base case), Black dashed line (Base case), (a) Portuguese CPUE, (b) Spanish CPUE

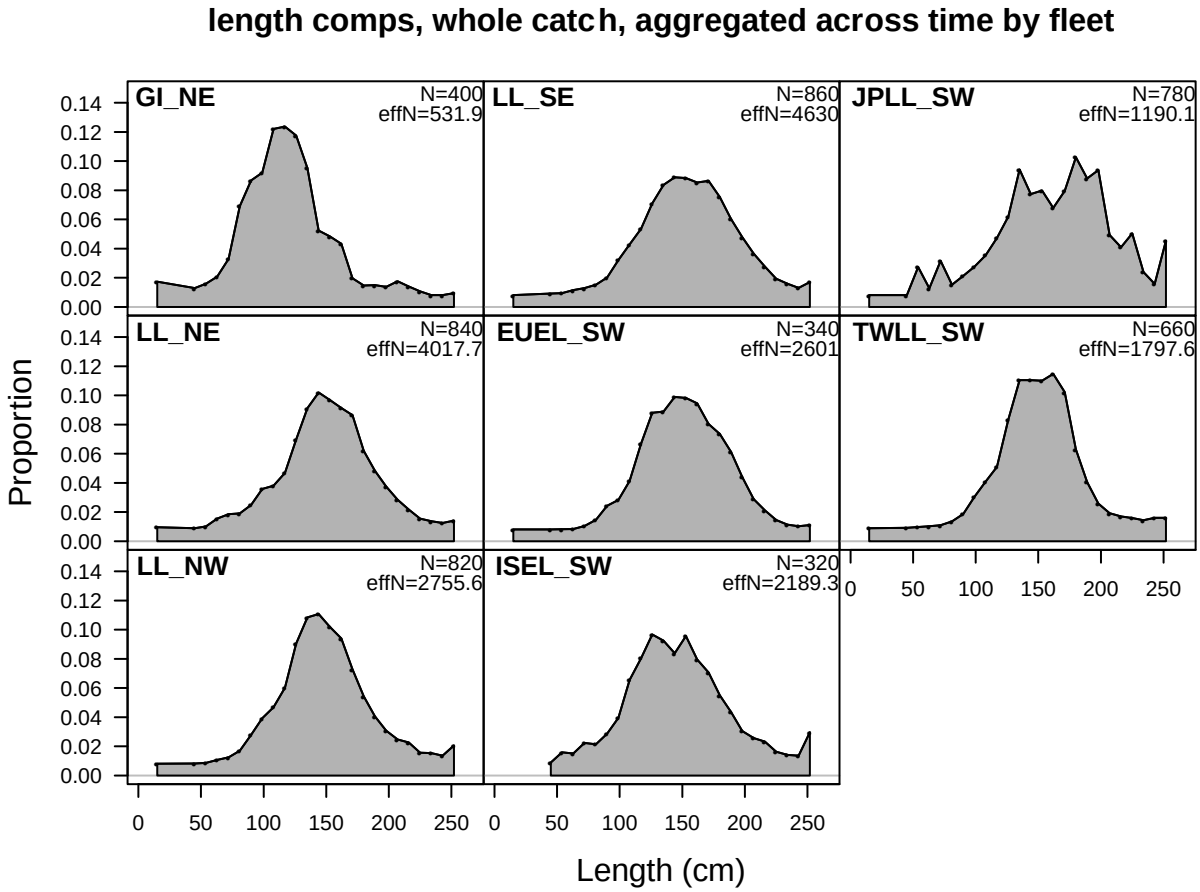

Figure 5. Fit across size composition data