Preliminary study on CPUE standardization of albacore tuna caught by Korean tuna longline fishery in the Indian Ocean, 1977-2017

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Abstract

In this study we standardized CPUE of albacore tuna caught by Korean tuna longline fishery in the Indian Ocean using Generalized Linear Models (GLM) with operational data. The data used for the GLMs were catch (number), effort (number of hooks), number of hooks between floats (HBF), fishing location (5° cell), and vessel identifier by year, quarter, and region. We applied cluster analysis to address concerns about the changes of target species through time which can affect CPUE indices. The CPUE was standardized using lognormal constant and delta lognormal approaches, considering with vessel effects and without vessel effects, and the main indices was estimates from delta lognormal approach.

Introduction

Albacore tuna is one of major important commercial species of Korean tuna longline fishery in the Indian Ocean. Albacore tuna catch had considerably increased from the mid-1960s and peaked at about 10 thousand tons in 1974, but sharply decreased to below 100 tons thereafter. After 2009 it increased and showed over 600 tons in 2013 and 2014, but again decreased in 2016 (Lee et al. 2019).

In this study, CPUE (catch per unit effort) standardization of albacore tuna caught by Korean tuna longline fishery in the Indian Ocean (1977-2017) was conducted using the approaches developed by the collaborative study on tropical and temperate tunas CPUE from multiple Indian Ocean longline fleets to assess the proxy of the abundance index.

Data and Method

In this study, set by set data were used for albacore tuna CPUE standardization, which complied from captain onboard and contained catch (number of fishes), effort (number of hooks) and HBF (number of hooks between floats) by year, month and area from 1977 to 2017. Data preparation and analysis were carried out using the approaches described by Hoyle et al. (2015, 2016).

The region definition for albacore tuna CPUE is based on the regional structure (regA4) that is divided into 4 regions (2 subtropical areas and 2 temperate areas) (Fig. 1).

We clustered all data for each area using the approach applied by Hoyle et al. (2015, 2016). For this analysis we aggregated the data by vessel-month, and calculated proportional species composition by dividing the catch in numbers of each species by those numbers of all species in the vessel-month. The data were transformed by centering and scaling, to reduce the dominance of species with higher average catches. And we clustered the data using the hierarchical Ward hclust method and using the kmeans method.

For CPUE standardization, two approaches, lognormal constant and delta lognormal were used, considering with vessel effects and without vessel effects. We selected the estimates from the delta lognormal as the main indices.

Results and Discussion

The standardized CPUE in the western subtropical region (R1) sharply decreased from the early 1980s to the early 1990s, after that showed at low level with a fluctuation, and has increased since the 2010s (Fig. 2). In the eastern subtropical region (R2), it showed the similar trend with those of R2 but had no information on albacore tuna after the mid-2000s (Fig. 3). In the western temperate region (R3), it showed an increasing trend since the mid-2000 until the mid-2010s but decreased thereafter (Fig. 4). In the eastern temperate region (R4), after 2010 it showed a high level with a big fluctuation, but there was a few information on albacore tuna before 2010 (Fig. 5).

References

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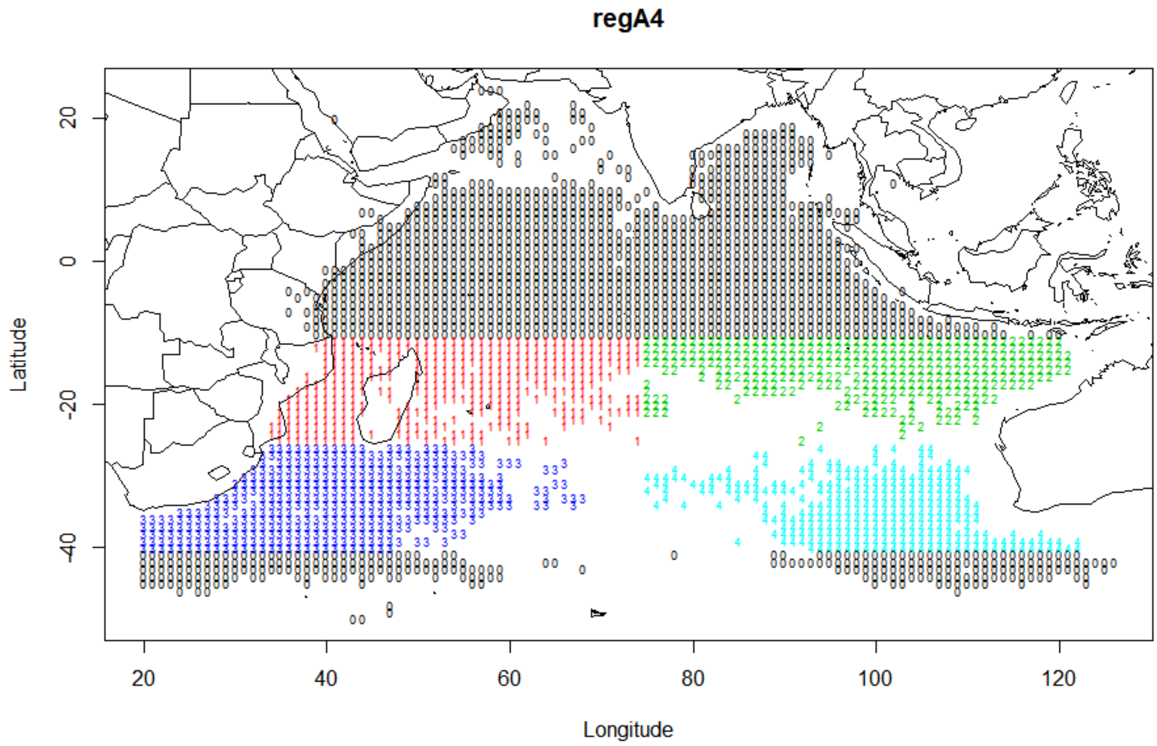

Fig. 1. Maps of the regional structures used to estimate albacore tuna CPUE indices.

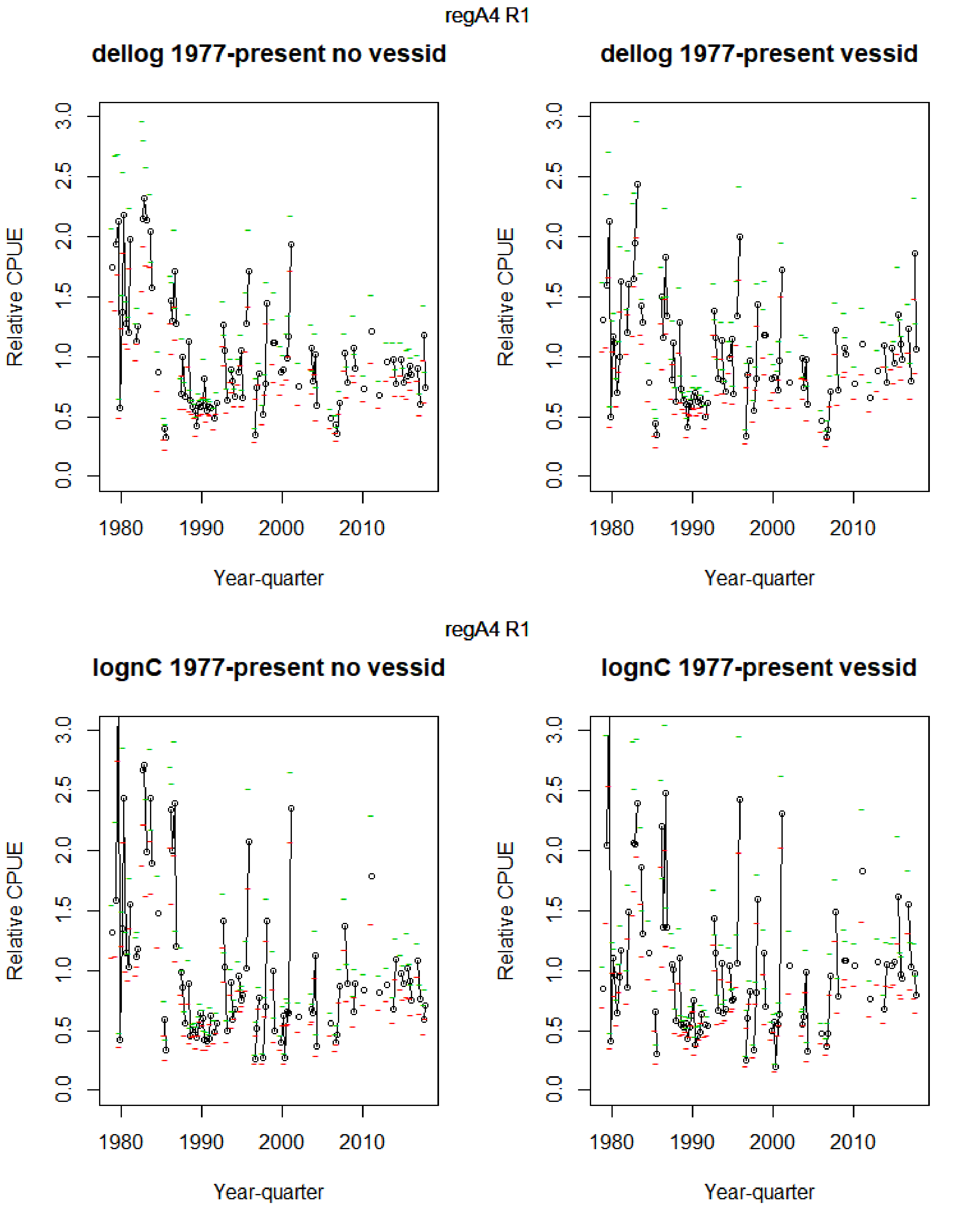

Fig. 2. Quarterly CPUE series for albacore tuna region 1 (western subtropical, regA4_R1). The plots show indices from delta lognormal (upper) and lognormal constant (lower) without and with vessel effects.

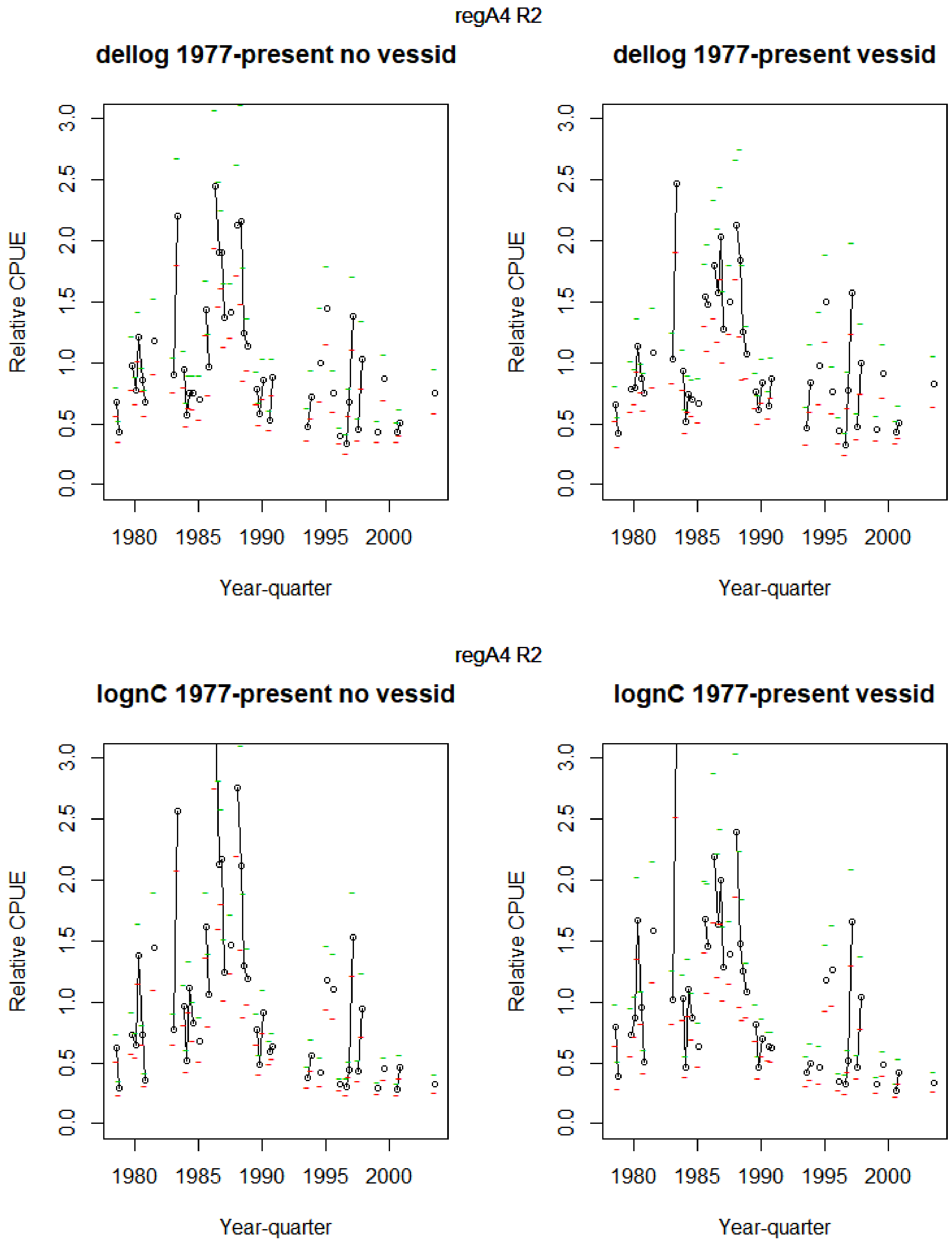

Fig. 3. Quarterly CPUE series for albacore tuna region 2 (eastern subtropical, regA4_R2). The plots show indices from delta lognormal (upper) and lognormal constant (lower) without and with vessel effects.

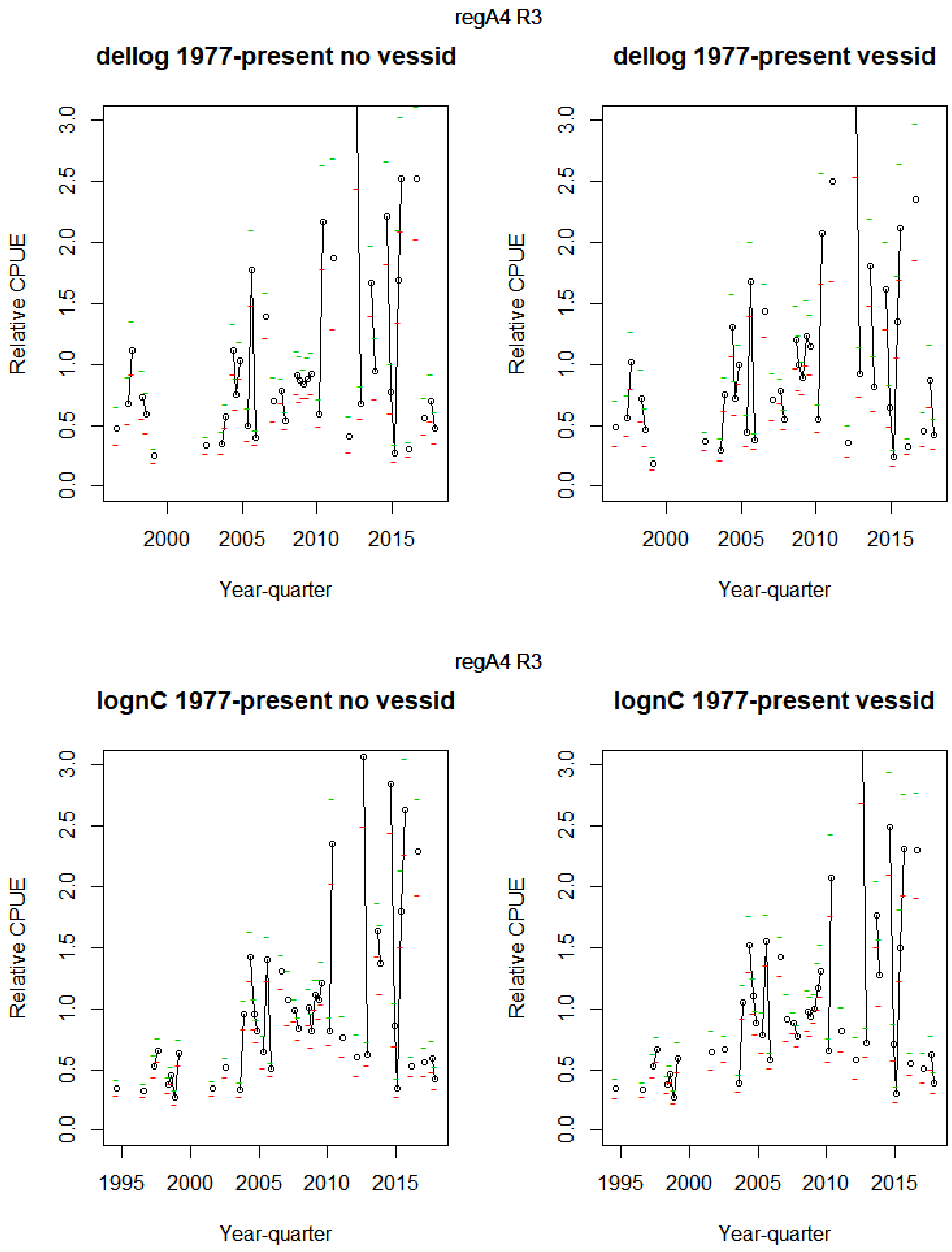

Fig. 4. Quarterly CPUE series for albacore tuna region 3 (western temperate, regA4_R3). The plots show indices from delta lognormal (upper) and lognormal constant (lower) without and with vessel effects.

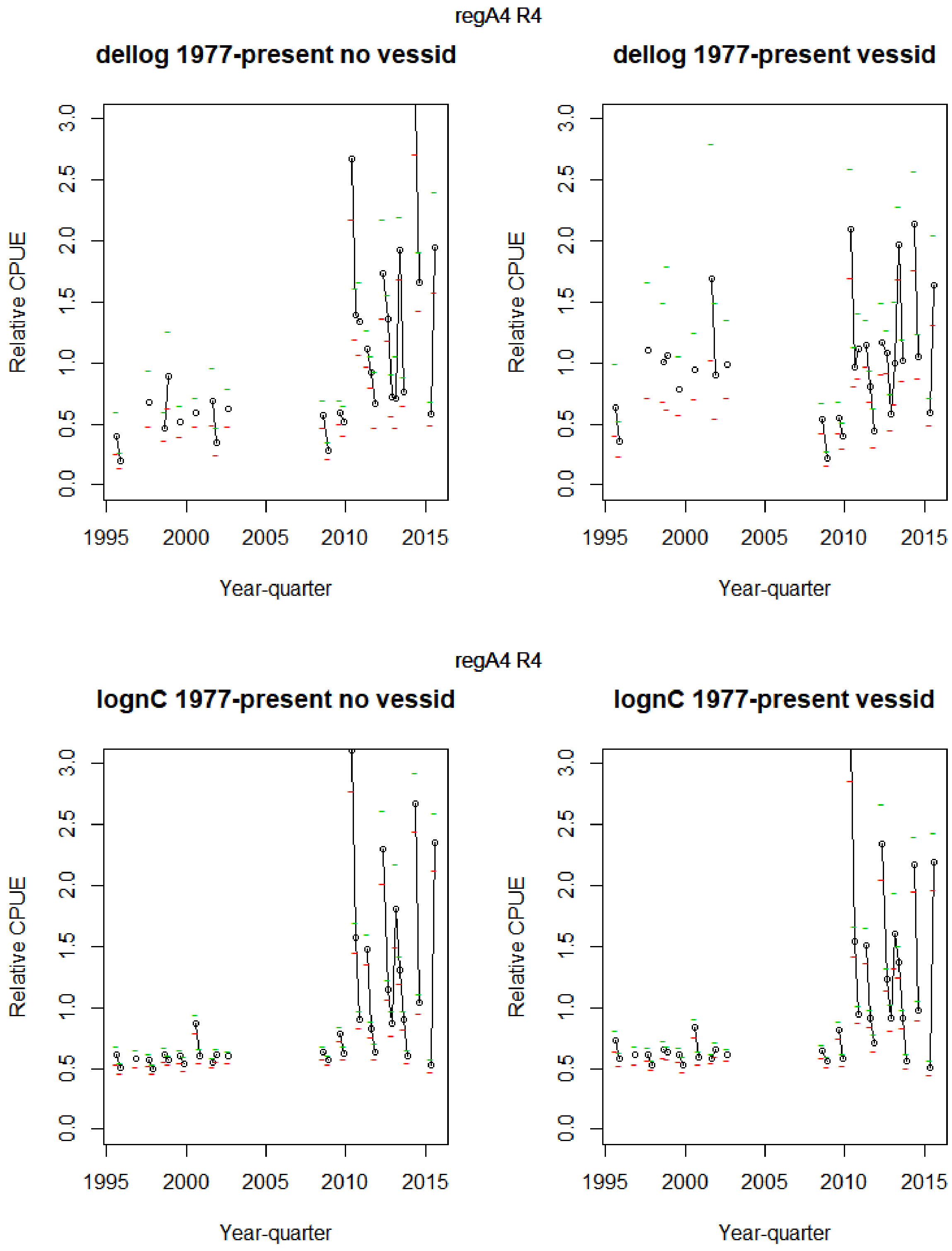

Fig. 5. Quarterly CPUE series for albacore tuna region 4 (eastern temperate, regA4_R4). The plots show indices from delta lognormal (upper) and lognormal constant (lower) without and with vessel effects.

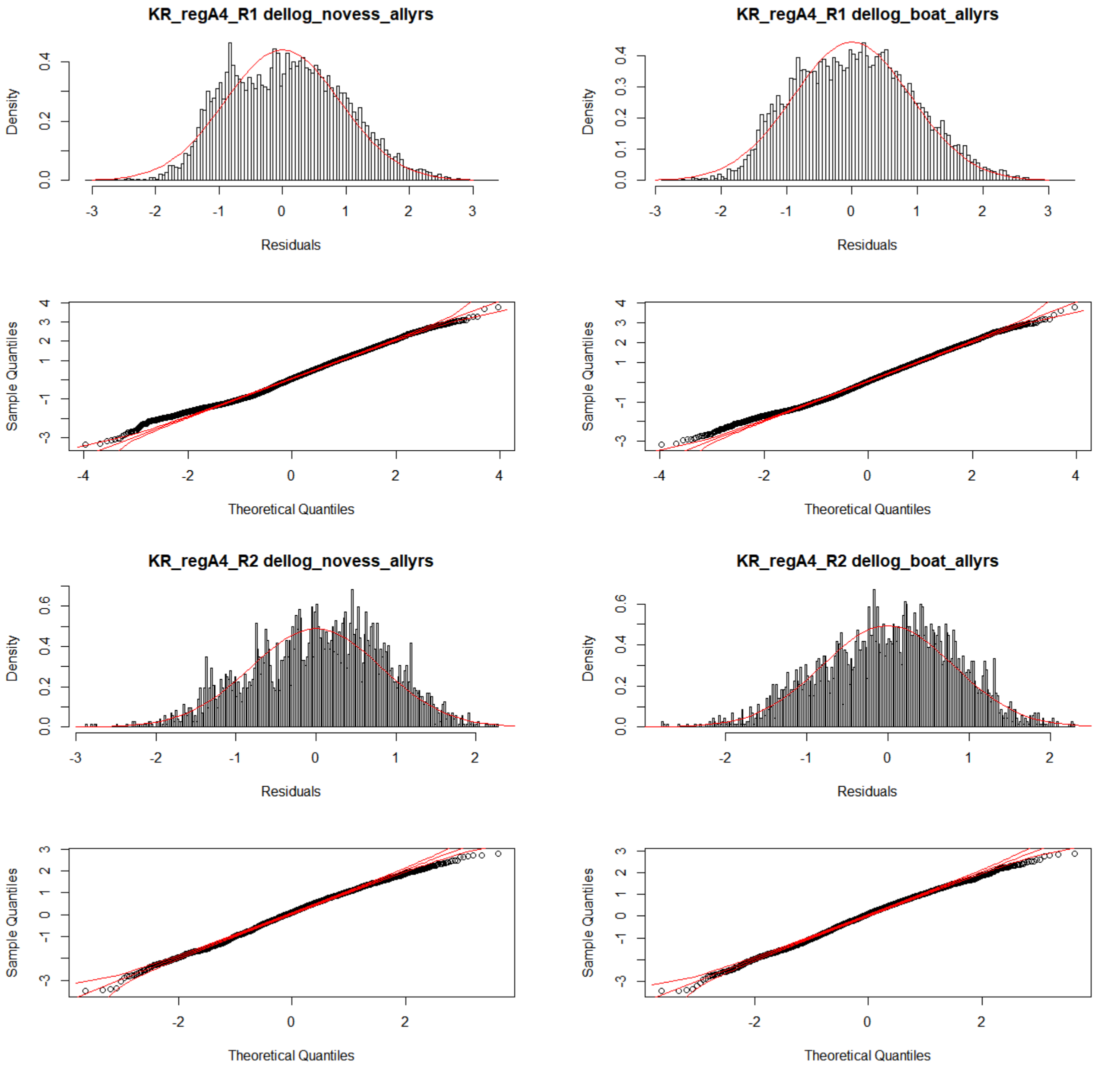

Fig. 6. Diagnostic plots for albacore tuna models in each region (R) of structure 4 (regA4) without (left) and with (right) vessel effects.

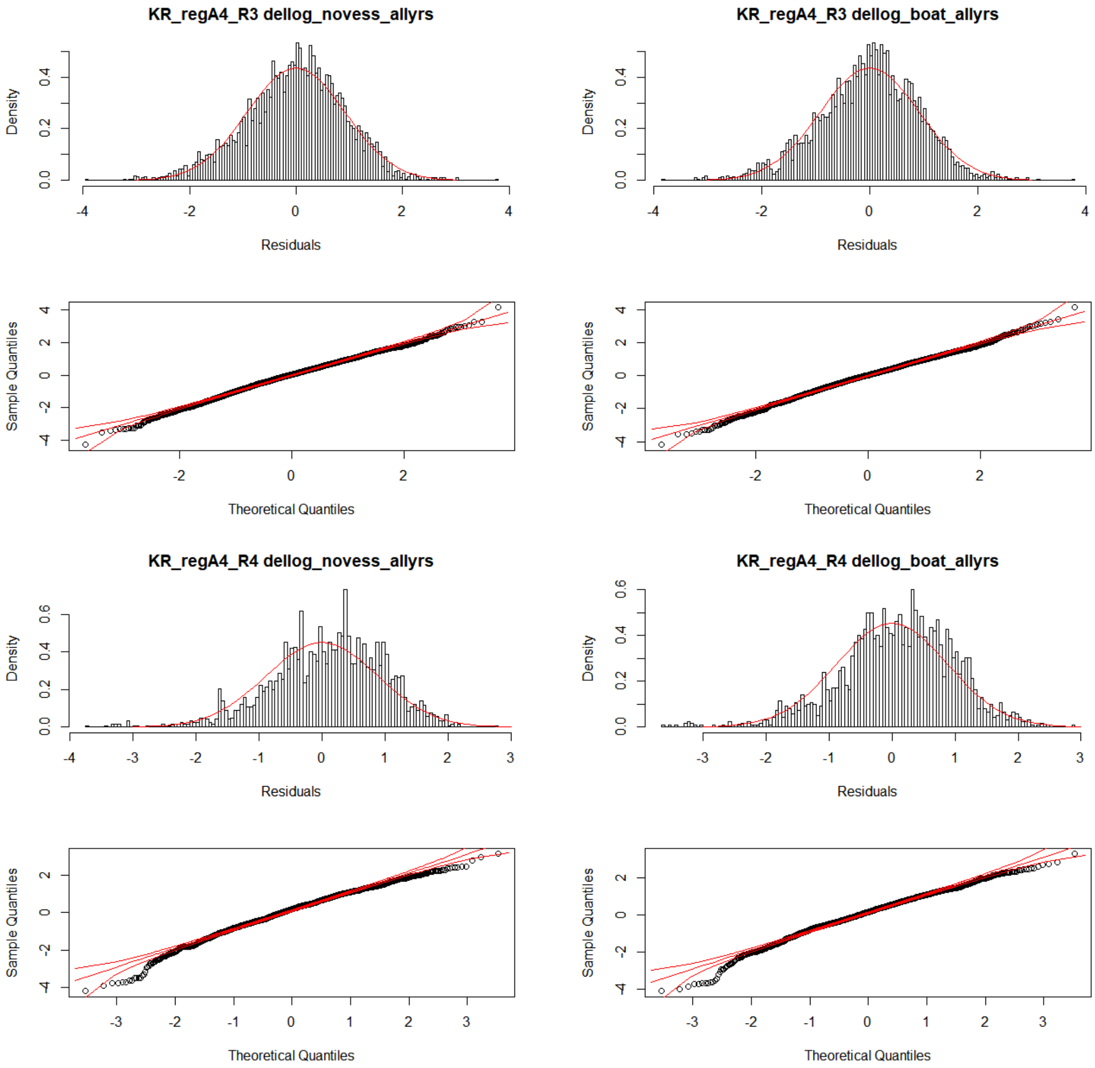

Fig. 6. Continued.

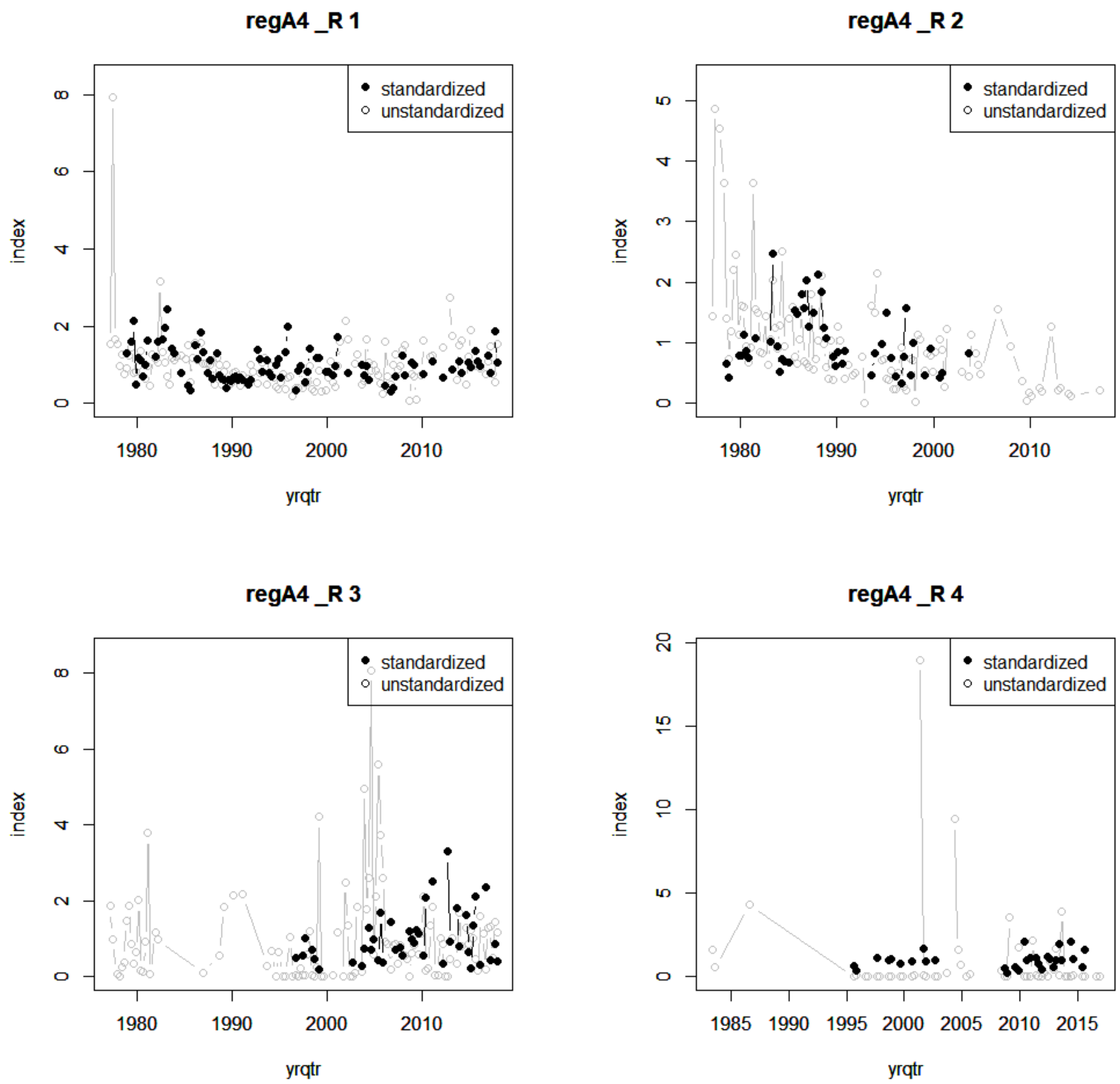

Fig. 7. Comparison plot of unstandardized and standardized indices for albacore tuna in each region (R) of structure 4 (regA4).