ISC/15/PBFWG-2/03

A minor change in the estimation of length composition data of Japanese troll fisheries

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November 2015

Information paper submitted to the ISC Pacific bluefin tuna Working Group, International Scientific Committee for Tuna and Tuna-Like Species in the North Pacific Ocean (ISC), 18-25 November 2015, Kaohsiung, Taiwan.

Introduction

Japanese troll fishery which mainly cautch age-0 PBF are widely operated in the coastal areas of west part of Japan by small vessels based on many small ports. The management system was changed from registration system to licensing system at 2014, and the number of vessels licensed by Fishery Agency of Japan were more than 20,000 vessels. Even though it was very difficult to measure the size of landed fish in high coverage, NRIFSF organized the size sampling framework to measure fish intensively in several major landing ports since 2007 (ISC/07/PBF-2/12). This sampling program resulted in large sample sizes in major landing ports. These effort should be continued to secure the coverage of size sampling in the major landing ports.

Even with this improvement of size sampling program, the data should be raised properly to the total catches to make a size composition data which represented actual catch number at size in each quarter. In the previous works, spatial and temporal strata were considered on 'Area' and 'quarter' basis, respectively. However, since the nature of this species that grew very fast at Summer time, it would be better to set a temporal strata on 'month'. In this document, we tried to estimate size composition of PBF caught by troll fishery with stratification of areas and months.

Materials and Methods

Data

Size sampling data were derived from Research project on Japanese Bluefin tuna (RJB data) from 1994 to 2015. Annual catch data are available by prefecture from 1994 to 2007, from the Annual Report of Catch Statistics on Fishery and Aquaculture published by the Statistics Department, Ministry of Agriculture, Forestry and Fisheries of Japan (SD report). The amounts of quarterly catch in each prefecture are estimated using the proportions of catch among quarters based on the RJB catch data. For the period of 2008 to 2011, we used the monthly catch data by landing ports, derived from the Survey on Catch of Bluefin Tuna in Japan's Coastal Areas implemented by Fisheries Agency, Ministry of Agriculture, Forestry and Fisheries of Japan (JFA data). Logbook data from troll fisheries, which were collected by Fishery Agency of Japan, were available since 2011.

Stratification

As described in ISC/12-1/PBFWG/04, the lengths of PBF caught by trolls show significant seasonal variations (Fig. 1). This seasonal variations should be representing the growth of 0-age PBF after being hatched around April to August. Especially, median value of each month were increased rapidly during summer time. With this result, we changed the minimum temporal stratum as 'month' from 'quarter' in this document.

We used same definition of the spatial strata by ISC/12-1/PBFWG/04, namely 4 areas of: 'Nagasaki' which has principal landing ports; 'Yamaguchi' which has characteristic size distribution

with a large share in the catch; 'Rest of the Pacific Coast'; and 'Rest of the Japan sea coast'. The latter 2 areas contain multiple prefectures though, the contribution of each prefecture in the catch is less than 1.5% except for Shimane, Kochi, and Wakayama.

Data substitution

Size measurement data were used to raise the catch data when there are more than 9 measurement (> 9) in a stratum. The data substitution was attempted using the data in lower resolution strata or the data in the other area as below in case there were some catch data but no size measurement data in each stratum.

Spatial strata		Temporal strata				
Area		Best	2nd best	3rd choice	4th choice	Lowest resolution
Nagasaki	July-Sept.	Month	Pacific-Month	Quarter	Pacific-Quarter	Monthly mean [1]
	Oct.-June	Month	Quarter			
Pacific side		Month	Quarter			
Japan Sea side		Month	Quarter			
Yamaguchi		Month	Quarter			

[1]: 'Monthly mean' indicated an average composition in each area-month during 1994 to 2015.

Estimation of Catch at size

The probability that the fish at the length bin of *i* occurred in the population at a temporal stratum *t* (p_{it}) can be described as follows:

$$p_{it} = \sum_{k=1}^{K} r_{kt}\, p_{ikt}$$

where, r_{kt} is relative catch 'in number' in spatial stratum (k) at temporal stratum (t). PBF catch in number for each area was calculated as a quarterly catch in weight divided by average weight of individual fish. The average weights were estimated from direct measurements of weights, and when the weight data are missing, converted from length measurements using the weight-length relationship of this fishery (Fig. 3).

Note that the weighted catch at size were not re-raised to the total catch. Hence, sum of weights of fish converted from the catch at size do not agree with total catch.

Results and Discussion

Fig. 4 shows the total catch in number with (dense gray) and without (light gray) enough corresponding length data (Over the best to 4th choice) in each stratum. The proportions of catch with corresponding length data (dense gray) are also shown as coverage. Average catch with samples make up 83% of total. We still have low coverage in some quarters especially those with small catches. In general, it had been difficult to measure the size of fish caught by troll in the season, which fishing condition was not good. In those quarters, if more than 20 % of catch were not raised by the corresponding size measurement data (coverage < 80%), we will not recommend to use those composition data to fit in the assessment model.

Weighted size composition data were not different from the data used in the latest stock assessment except 3rd quarter (Fig. 5). In 3rd quarter, the mode of composition data shifted to small size. The reason for these differences would be that we set a detailed temporal stratum.

In the stock assessment model of SS III we are expected to skip some quarterly size composition data of this fleet according to the coverage rates to secure the credibility of each length composition. If we skip the quarterly size composition which were raised on the basis of less than 80% coverage (i.e. more than 20% of the catch had no corresponding size data), we will lose 17 quarters of length composition (4.9 % of total catch in number) during 3rd quarter of 1994 to 2nd quarter of 2015 (84 quarters in total).

Table 1. Catch and Size sampling in the major landing ports for the troll fisheries during 1994-2011.

	Nagasaki	Shimane	Yamaguchi	Kochi	Wakayama
Catch(ton)	29698	4274	4073	1914	1325
Percentage in the total catch	66%	10%	9%	4%	3%
Size sampling	38314	4019	17064	20164	15914
percentage in the total sampling	29%	3%	13%	15%	12%

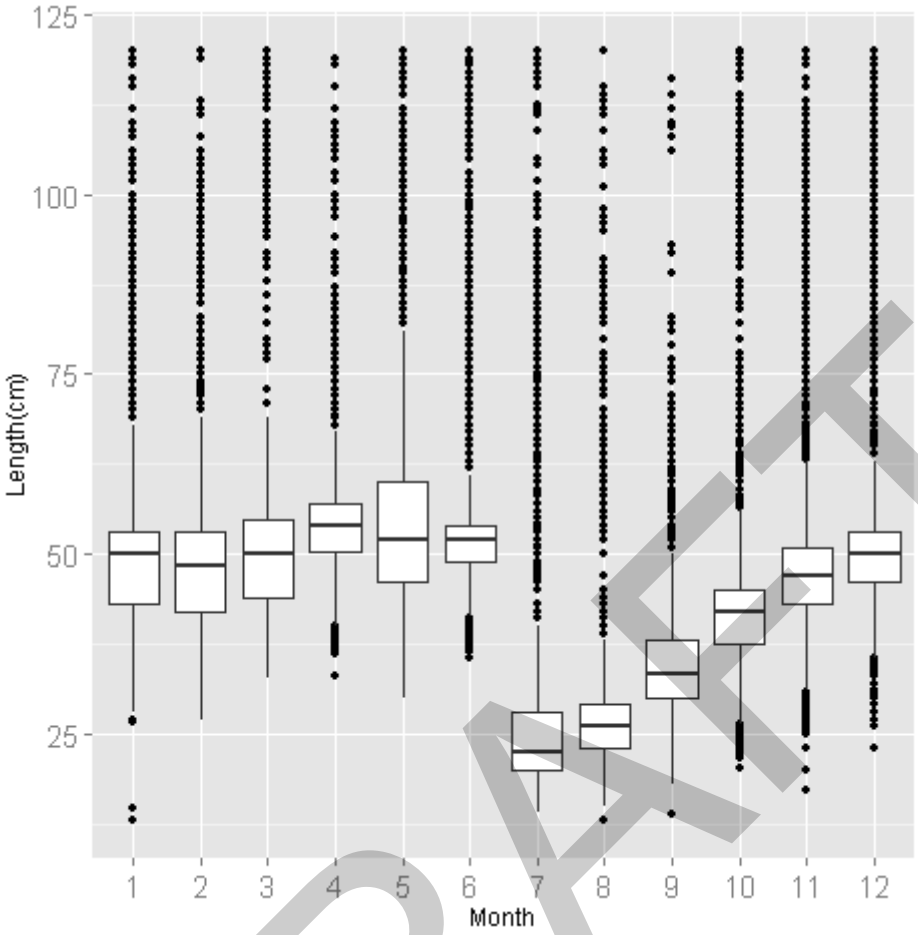


Fig. 1 Box-Plots of monthly size data caught by troll from 1994-2015.

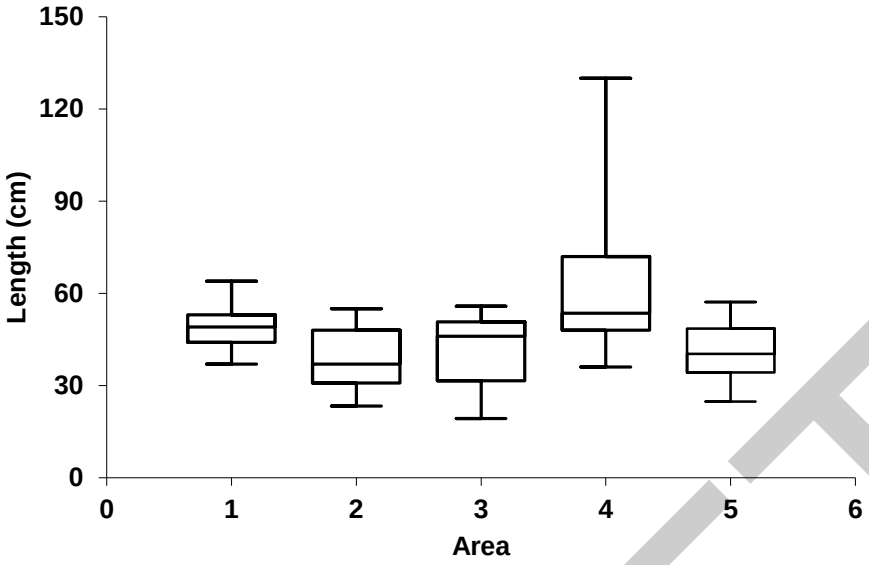


Fig. 2 Box-Plots of size data caught by main landing prefectures from 1994-2011. 1; Nagasaki, 2; Shimane, 3; Kochi, 4; Yamaguchi, 5; Wakayama.

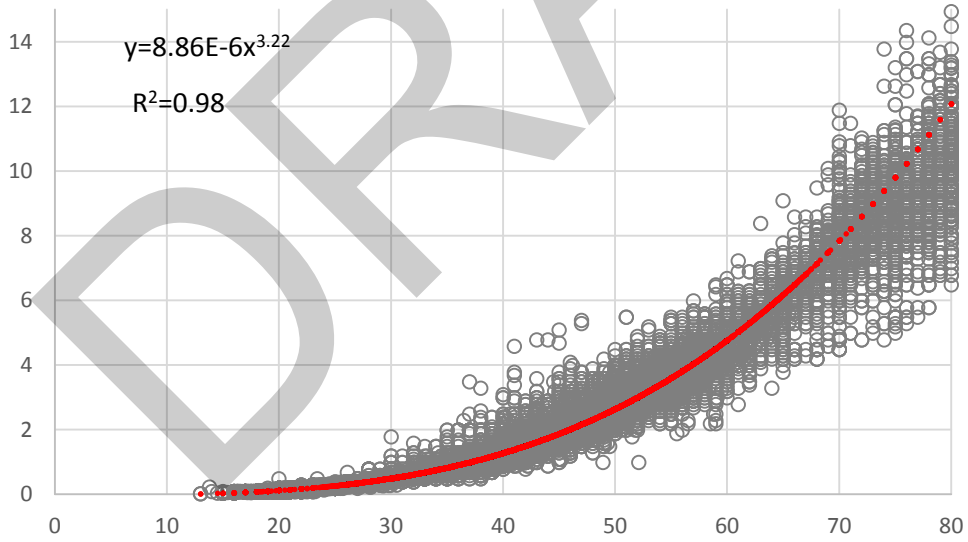


Fig. 3 Length-weight relationship of PBF which caught by troll.

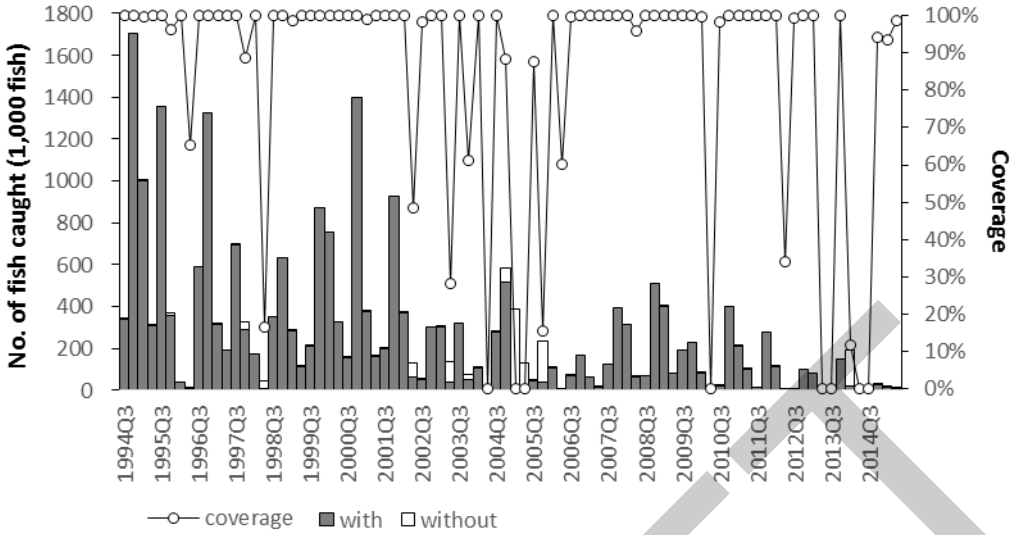


Fig. 4 Total catch with (dense gray bar) and without (white bar) enough corresponding length frequency data (n > 9) in each area-quarter. The lines with open circles are coverage, the ratio of dense gray in the total bars height.

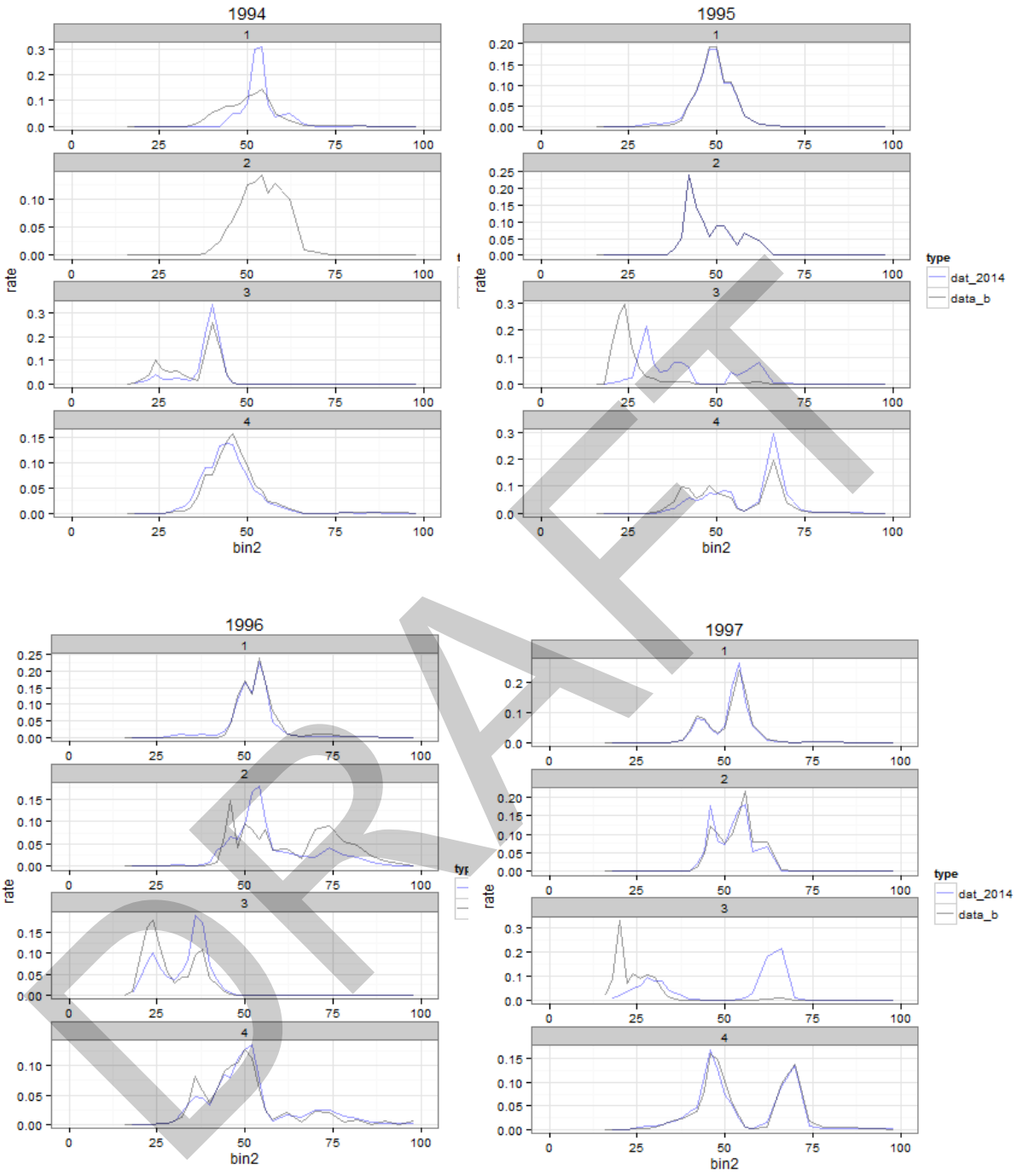
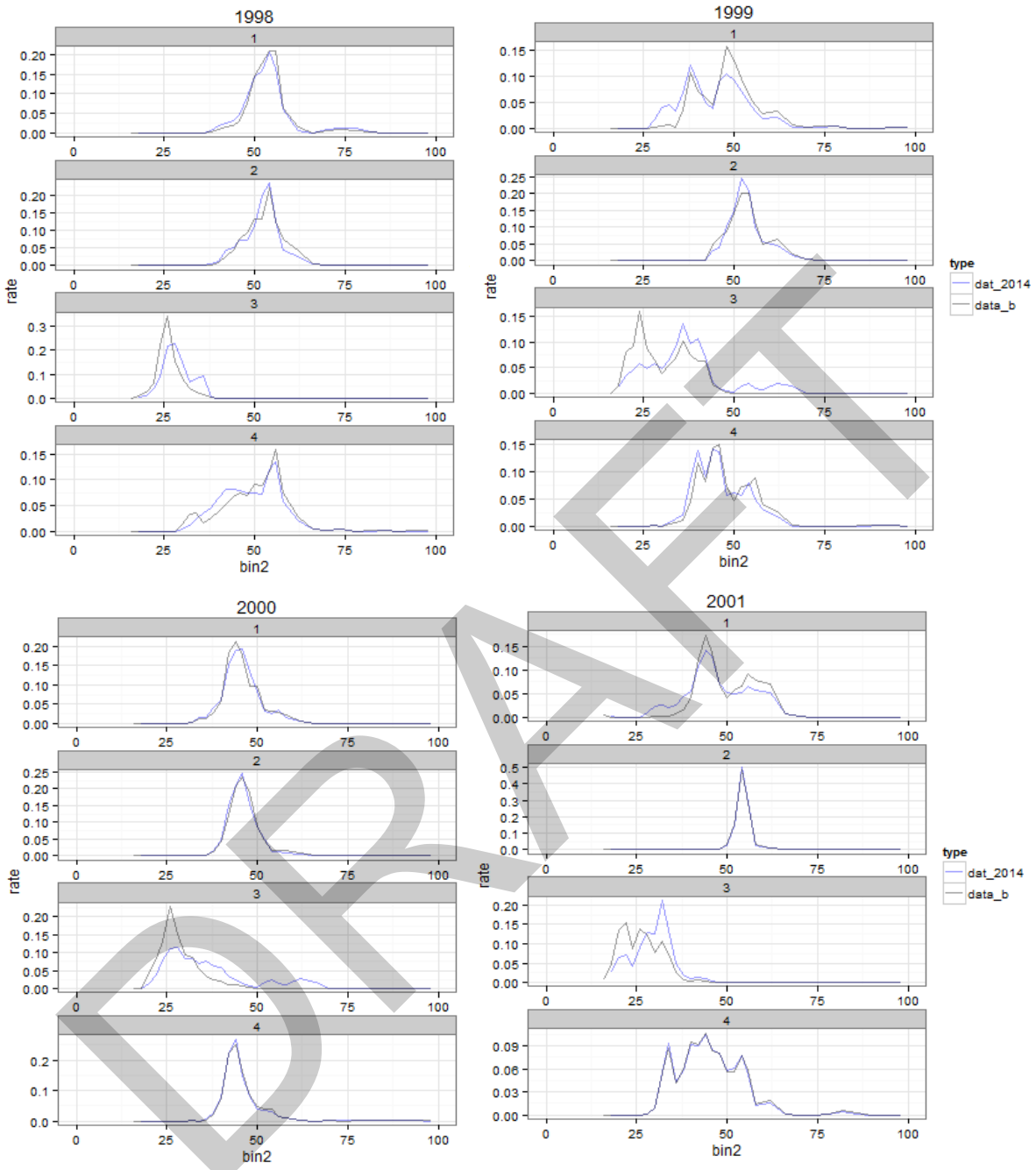


Fig. 5 Quarterly Length Composition data used in the 2014 stock assessment of PBF (dat_2014) and estimated one (data_b).



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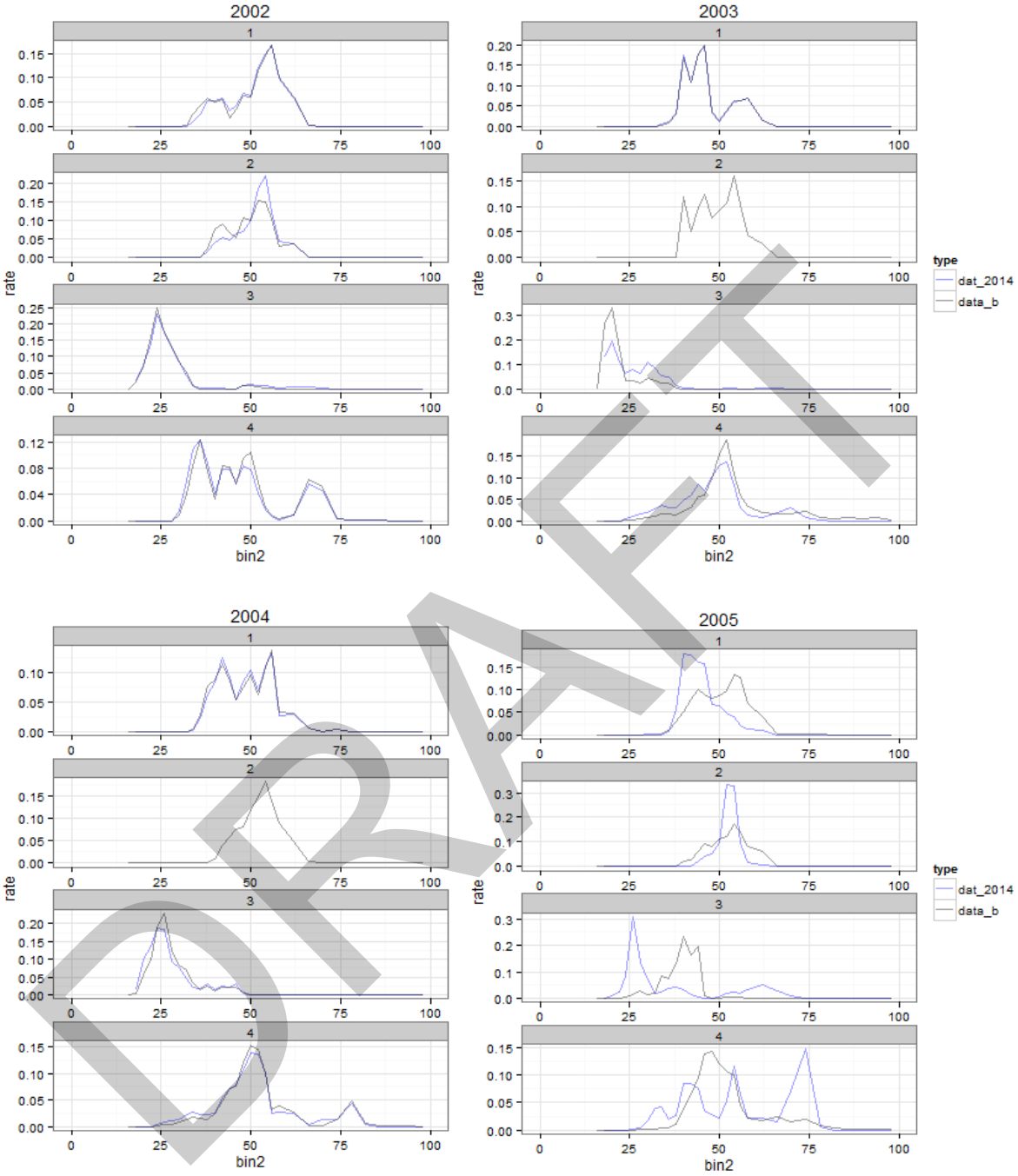

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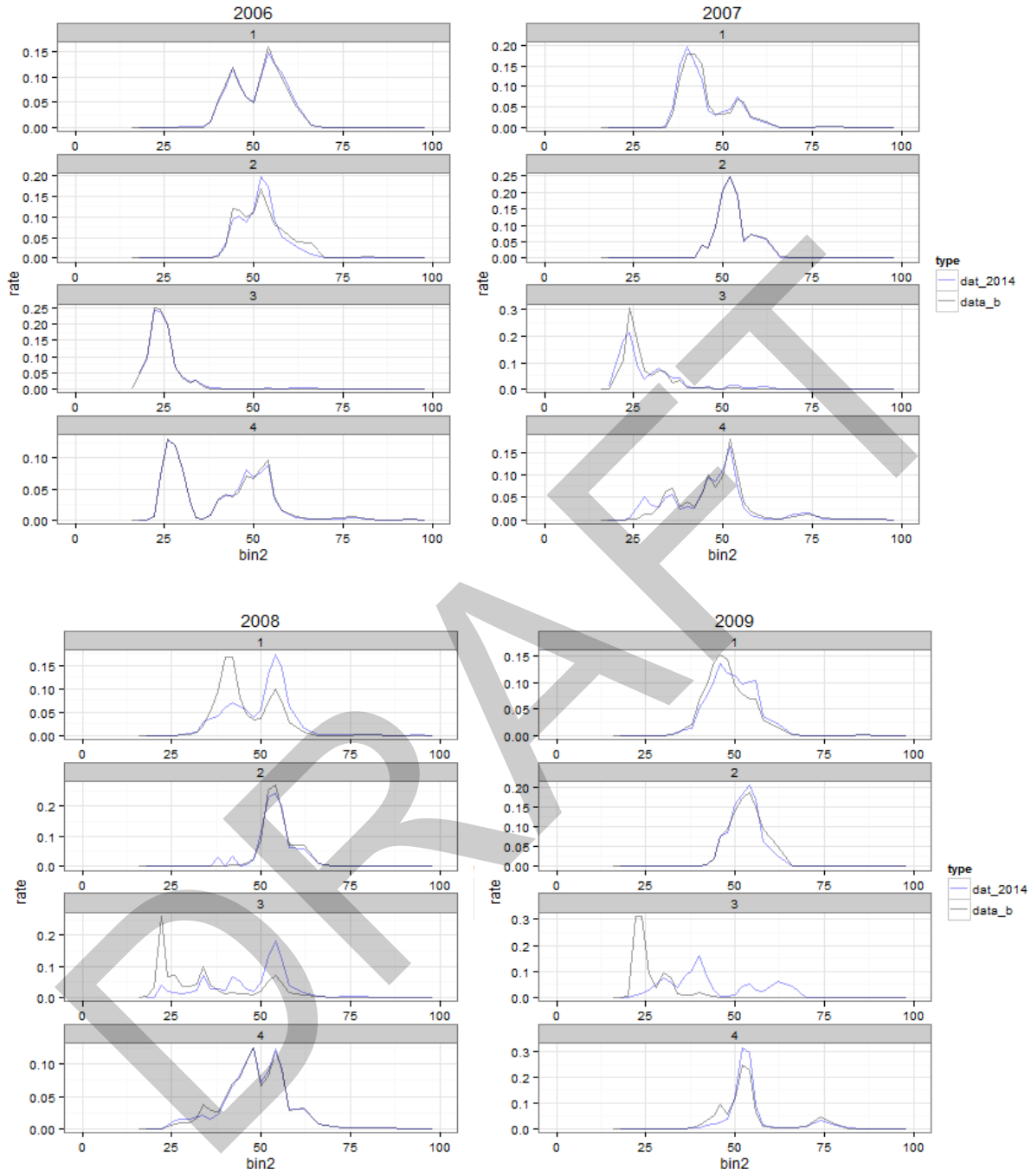

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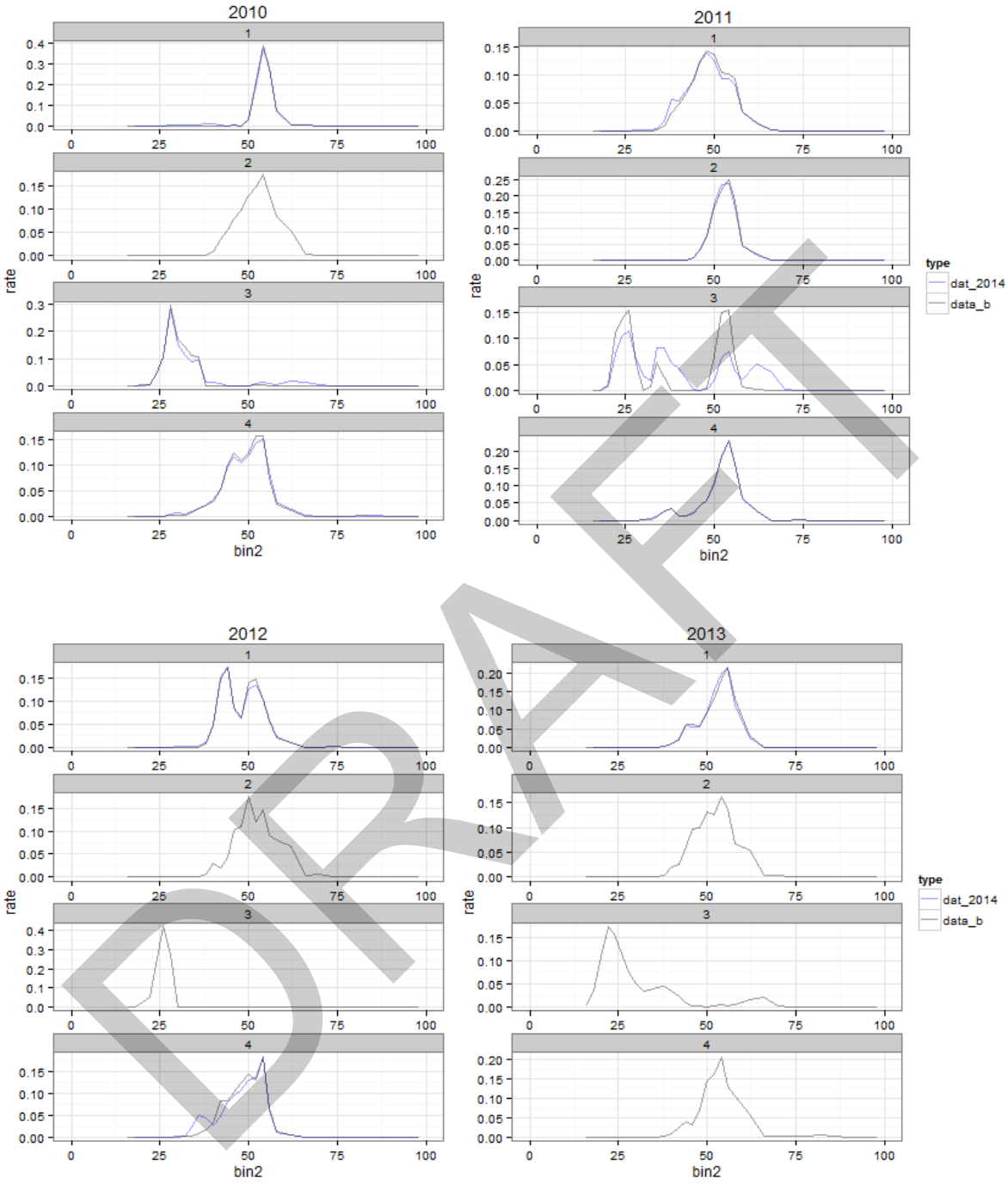

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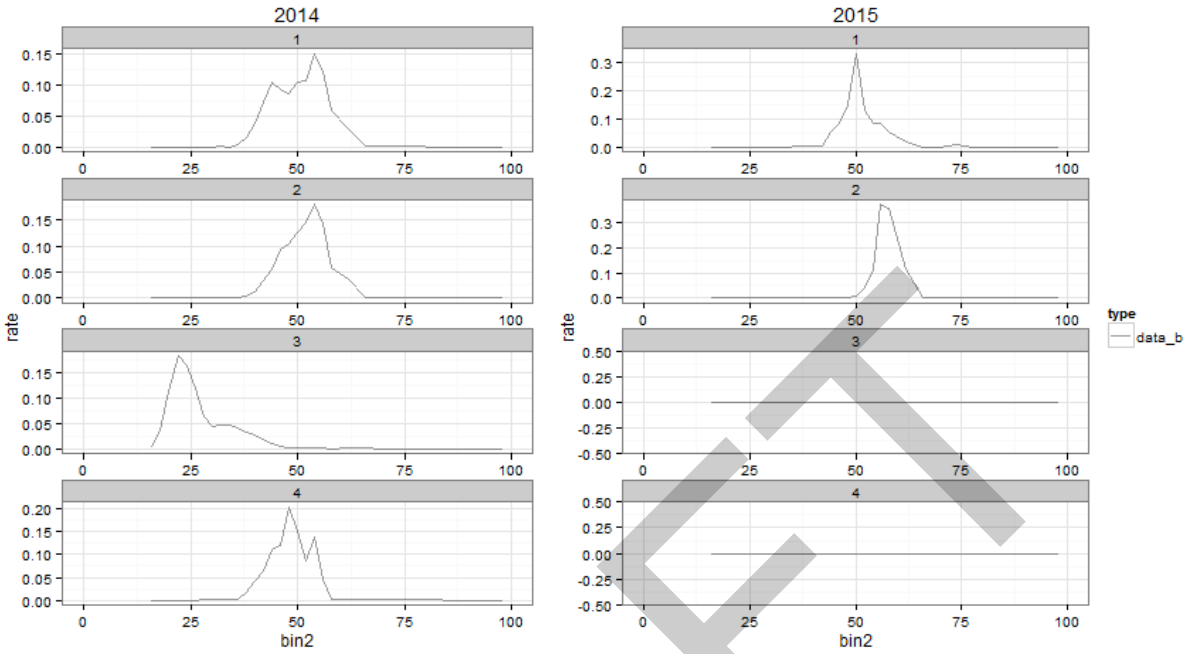

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