Relationship between Gross Tonnage and Overall Length for vessels on the ICCAT Record: Implications for Unique Vessel Identifiers

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1. Introduction

The use of Unique Vessel Identifiers (UVIs) that allow for the accurate identification of fishing vessels globally is recognized as an essential tool for combatting IUU fishing and improved monitoring. For this reason, UVIs are of interest to markets, RFMOs and NGOs. The FAO is working towards the establishment of a Global Record[1] that would use UVIs, but this project is not expected to become operational until several years from now. Today, the most widely recognized UVI scheme is the IMO ship identification number scheme, which was introduced by the IMO in 1987 and administered by IHS Fairplay[2] on behalf of IMO. IMO numbers are relatively simple to obtain for vessels greater than 100 Gross Tonnes. At its discretion, IHS Fairplay can also assign IMO numbers to vessels under 100 GT.

In the context of moving rapidly towards a Tuna UVI system while the FAO Global Record develops, several members of tuna RFMOs have recently expressed interest in considering whether or not IMO numbers should be required for vessels on their authorized lists, at least for large-scale ones. For instance, this was discussed at a July 2013 meeting of ICCAT on Integrated Monitoring Measures.

There are questions, both technical and legal, about which fishing vessels are eligible to obtain IMO numbers. This document deals with only one technical question: How vessel size relates to GT, and in particular how the 100 GT "threshold" and vessel length relate to each other. The analyses are made using data from the ICCAT *Record of Vessels Authorized to Operate on the Convention Area*[3].

While vessel owners will usually know the GT of their vessels (or they can have the vessels measured), fishery managers that rely on the RFMO vessel records will often not know them. This document is intended to help managers understand some of the difficulties that could potentially be encountered if they were to require IMO numbers for vessels above a given length (e.g., 20 or 24 m LOA).

2. Data and Methods

The data used were from the ICCAT Vessel Record as of July 2, 2013 (n=15,694). The entries on the ICCAT Record vary in the way vessel characteristics are recorded. For vessel tonnage, either GT, GRT or Unknown are given. For size, most measurements are

[1] http://www.fao.org/fishery/topic/18021/en
[2] http://www.ihsfairplay.com
[3] http://iccat.int/en/vesselsrecord.asp

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reported as Overall Length (LOA), but others such as Length-Between-Perpendiculars and Unknown are frequent as well. For this reason, it is not possible to make a complete enumeration of the number of vessels that are above or below 100 GT without some kind of extrapolation. A statistical approach is used here, which consists basically in using a subset of the Record and modeling the relationship between vessel LOA and GT, and the variability around it.

The analyses were restricted to vessels with Tonnage Type = GT and Length Type = LOA. Vessels other than fishing vessels (e.g., carriers, tow boats, support vessels) were also removed (n=2,094 vessels remained for analysis). It should be noted that there is no uniform quality control of entries in the Record as different ICCAT members may use different validation systems. There is therefore no guarantee that entries reported as GT and LOA are indeed GT and LOA. Furthermore, there is no guarantee that the reported magnitudes for GT and LOA for a given vessel are correct. With these caveats in mind, the results presented below should be treated with circumspection.

The first analysis looks graphically at how LOA varies with GT. The analyses are presented by vessel type, and calculate median vessel length for a range of GT around 100 (80 to 120 GT).

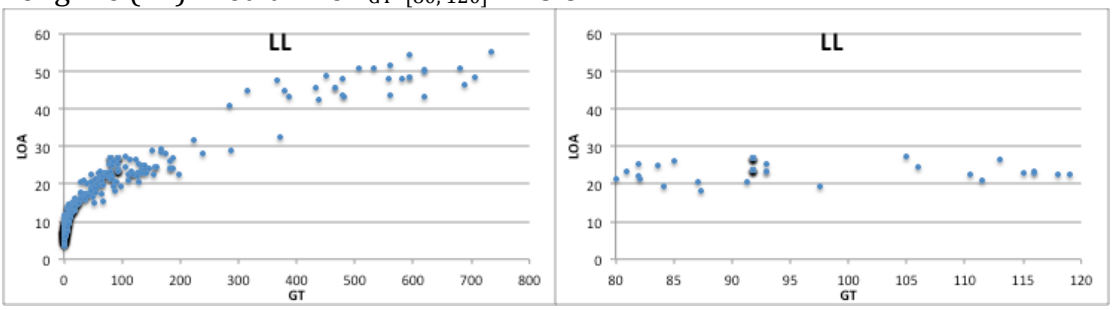
Upon examination of plots between GT and LOA, it appears that the relationship between the two can be explained by a power function. The second analysis is a simple regression approach, made by linearizing the power relationship through logarithmic transformation. The results of this analysis are then used to calculate 95% prediction confidence intervals for GT around different LOA levels.

3. Results

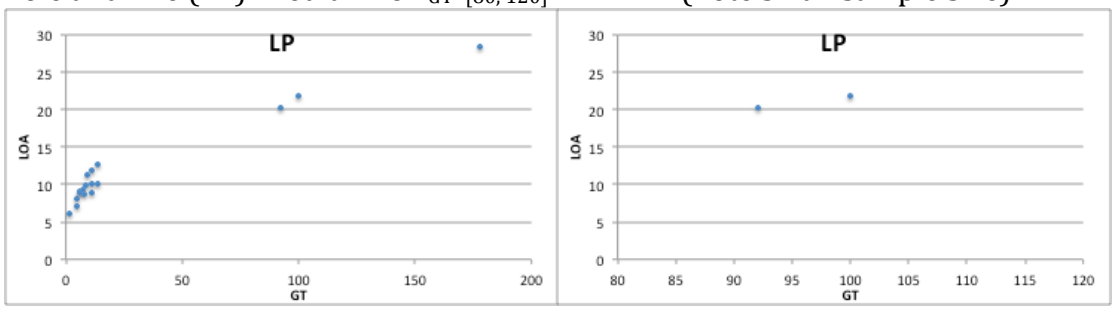
3.1. LOA vs GT by Vessel Type

Plots between LOA and GT by type of vessel are shown in **Figure 1**. The plots on the left display the available data for each vessel type, and the ones on the right show the relationship for a restricted GT range of [80, 120]. The median LOA corresponding to the GT range [80, 120] is also given above each plot.

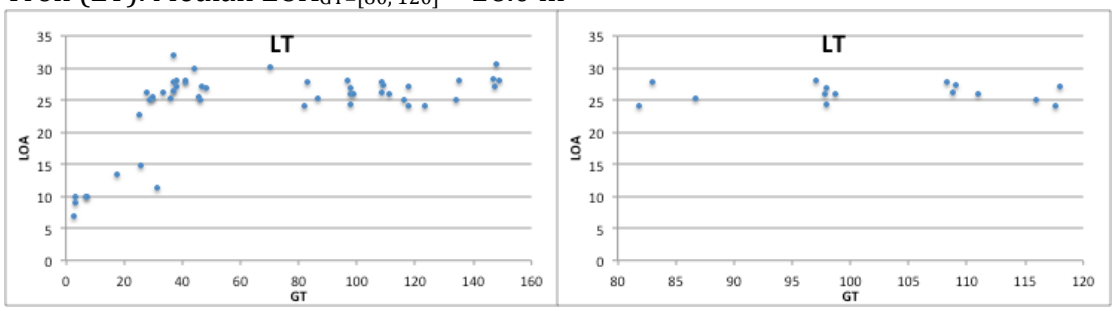
Longline (LL). Median $LOA_{GT=[80, 120]}$ = 23.8 m



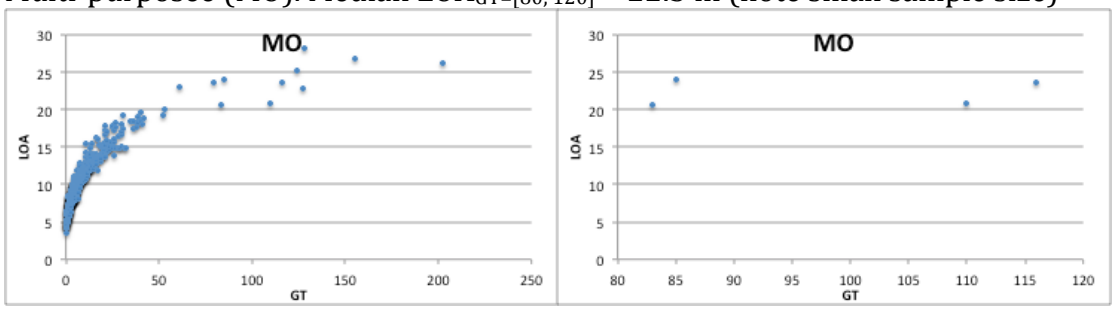
Pole and line (LP). Median $LOA_{GT=[80, 120]}$ = 21.1 m (note small sample size)



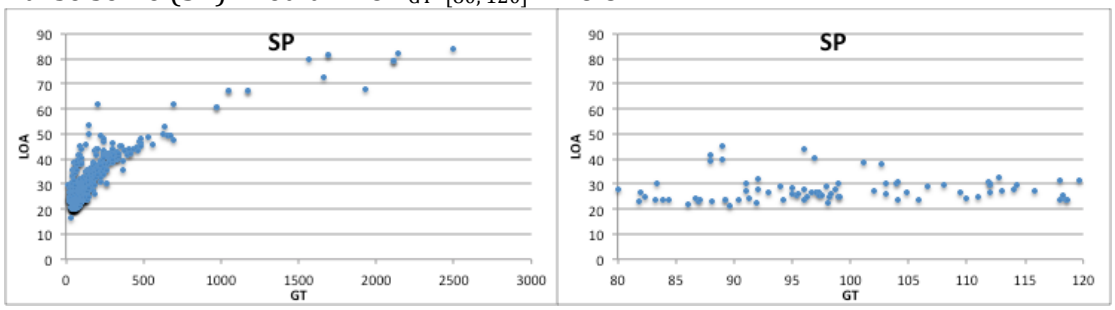
Troll (LT). Median $LOA_{GT=[80, 120]}$ = 26.0 m



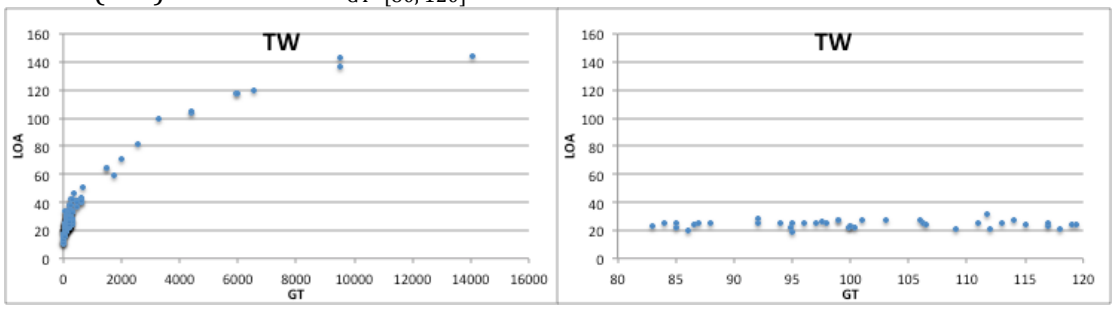
Multi-purposee (MO). Median $LOA_{GT=[80, 120]}$ = 22.3 m (note small sample size)



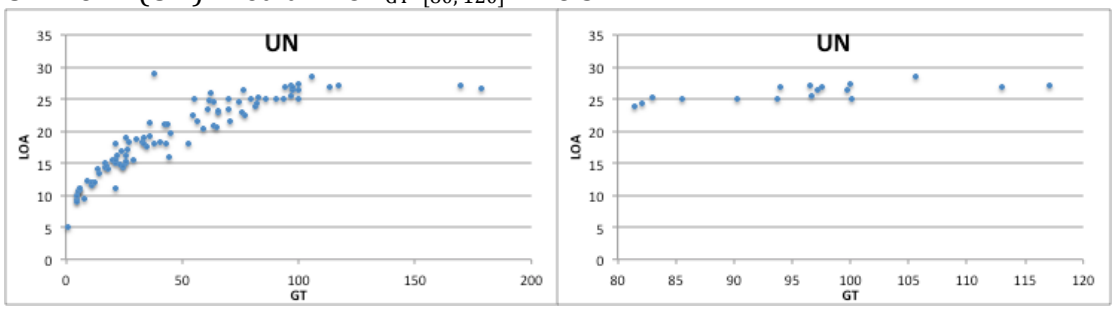
Purse seine (SP). Median $LOA_{GT=[80, 120]}$ = 26.8 m



Trawl (TW). Median $LOA_{GT=[80, 120]}$ = 25.3 m



Unknown(UN). Median $LOA_{GT=[80, 120]}$ = 26.3 m



All vessels (ALL). Median $LOA_{GT=[80, 120]}$ = 25.1 m

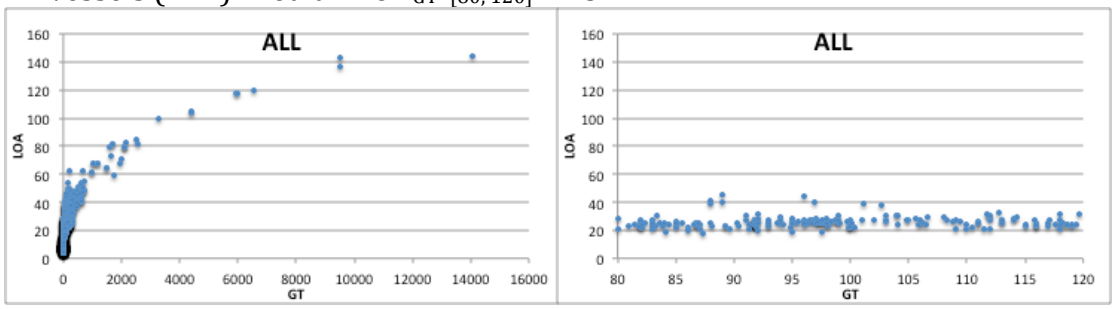


Figure 1. Relationship between Length Overall (LOA, m) and Gross Tonnes (GT) for vessels on the ICCAT Record, by vessel type. The median LOA value for GT values between 80 and 100 is given above each plot. The left panels show the relationship for all available data, and the right panels show the relationship for a restricted range of GT.

The overall LOA-GT relationship increases rapidly near the origin and becomes nearly asymptotic at large (>2,000 t) GT levels (**Figure 1**). However, in the range 80 to 120 GT, LOA values are relatively flat. Median vessel lengths in this range vary a little by vessel type, though these differences may not be statistically significant (note the small sample sizes for some vessel types). The overall median LOA corresponding to GT=[80,120] for all vessels combined is about 25 m.

3.2. Predicted GT at different LOA

A linear regression between ln(GT) and ln(LOA) for all data (**Figure 2**) resulted in the following parameter estimates:

$$\ln(GT) = -5.062 + 2.935 \ln(LOA)$$

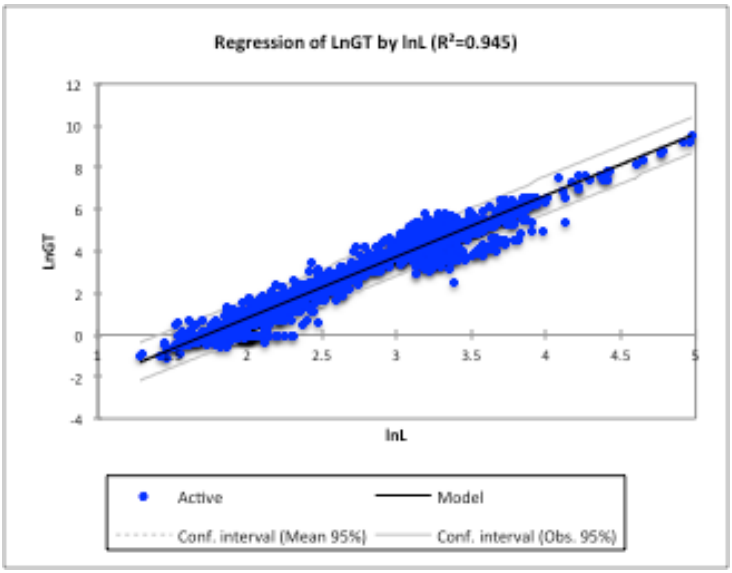


Figure 2. Linear regression fit to the ICCAT Record data on GT and LOA (log-transformed).

The fit seems to be reasonably good (R^2=0.945), although there appear to be some bands of points that deviate from the rest and could merit further examination.

The fitted line and 95% confidence limits were back-transformed to the original scale (**Figure 3**) using the bias correction factor (Hayes et al., 1995):

$CF = e^{\sigma^2/2}$, where $\sigma^2 = 0.201$, the mean square error from the fitted regression.

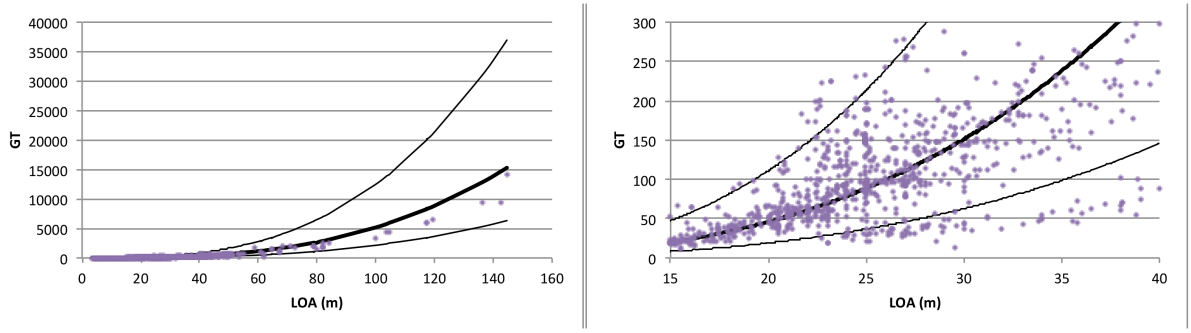


Figure 3. Results of the linear regression fit to the ICCAT Record data on GT and LOA (untransformed scale). The fitted line and 95% confidence limits are shown. The panel on the right shows a subset of the data for vessels between 15 and 40 m LOA.

Using these regression results, the following estimates can be made about vessel LOAs corresponding to the 100 GT value:

- Upper confidence limit corresponding to 100 GT: 19.3 m
- Expected value at 100 GT: 26.0 m
- Lower confidence limit corresponding to 100 GT: 35.2 m

4. Conclusions

Assuming that the results above apply to all the tuna RFMOs, it appears that there should be no technical impediment for the large majority of vessels larger than 35 m LOA to obtain IMO numbers (but note, as stated in the Data section, the data were used

"as-is" without any validation of accuracy). However, the situation is not so clear for smaller vessels: Only about one-half of the vessels of 26 m LOA would be expected to be under 100 GT and could potentially be denied IMO numbers. Below 19 m LOA, most of the vessels seem to be under 100 GT.

Therefore, at present, if managers decide to require vessels in the lower end of Large-Scale (20 - 24 m, depending on the RFMO) to obtain IMO numbers, they could face a situation where many vessel owners would be denied such numbers because their vessels will be below 100 GT.

Therefore, two simultaneous lines of action are recommended:

1. That tuna RFMOs actively work with IMO and IHS Fairplay to ensure that vessels in the authorized vessel records can obtain an IMO number, even if they are under 100 GT.

2. That tuna RFMO Secretariats, in putting together the Consolidated List of Authorized Vessels (CLAV[4]), examine potential ways in which strong UVIs could be assigned to vessels that cannot obtain an IMO number for technical or other reasons.

The recommendations above are without prejudice to the ongoing work by FAO to create a Global Record that includes UVIs.

Acknowledgments

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References

Hayes, D. B., J. K. T. Brodziak, and J. B. O'Gorman. 1995. Efficiency and bias of estimators and sampling designs for determining the length-weight relationships of fish. Can. J. Fish. Aquat. Sci. 52:84-92.

[4] http://tuna-org.org/GlobalTVR.htm