Effects of release conditions on recovery rates of tagged tropical tunas during the AOTTP

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Introduction

- The condition at release of tuna during tagging programmes can affect their probability of recapture. (Hoyle et al. , 2014 ; Beverton et al. ,1959).

- This recovery probability reduction knows as “tagging failure” can introduce bias into stock assessments of fishing mortality with tagging data (Hoyle et al., 2014). So, Estimation of tagging failure is very important and unavoidable for the good use of tagging data.

- Several studies have highlighted the effects of some release conditions on tag recovery rate, among others: fish length , fish conditions at release, species, tag type, time outside the water, quality of tag placement, tagging station, tagger…

- This study investigates factors that affect the recovery rate among taggers (skills), fish condition at released , tagging station (vessel used) and tagging platform (schooltype). We finally estimate the tagging failure rate for the AOTTP data.

Data: AOTTP tagging data from June 2016 to April 2020

Event:

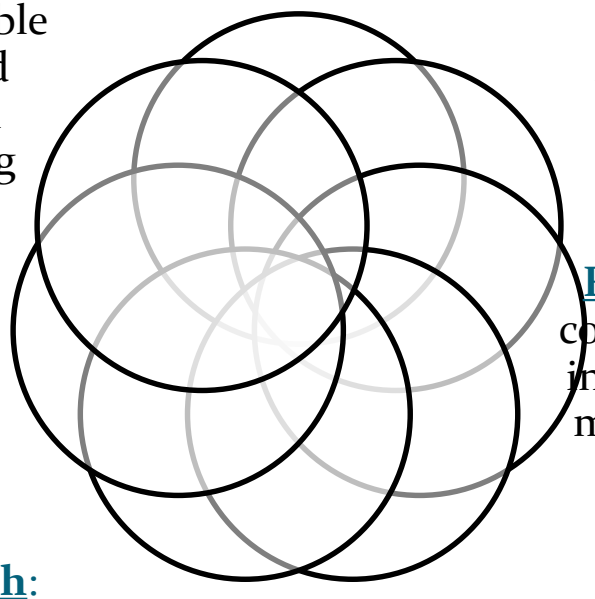
A session of continuous tagging on one day at one location

Tagtype: 3 type.

Conventional tag, double conventional tag and chemical or internal archival or pop up tag

Tagger:

the identity of the person applying the tag. it contains their experience and ability.



Schooltype:

Fish operation mode (FADs, Free school, etc) during releases operation

Fish-condition: fish condition was classified into unknown, perfect, moderate damage and severe damage

Length:

Length of fish at release

Vessel:

Vessel fleet code at releases (ICCAT code)

Data cleaning and variables selection

- Releases with the following characteristics were removed for estimation of the optimal conditions.

Length ≤15 cm ; taggers who had not tagged at least 100 tuna and events with less than 15 tuna tagged

- Variables with no significant information value and chi square were removed:

Variable	Information value	Chi.square	Chi2 p-value
Tagging_Vessel	0.984*	10288*	0
Event	1.68*	20843*	0
Tagger	1.08*	11719*	0
Schooltype	0.49*	6600*	0
Species	0.306*	3884*	0
len	0.209*	Not tested	0
Fish_condition	0	4.1	0.251
Tag_type	0.006	80*	0

Methods : Hoyle et al. (2014)+Berger et al. (2014)+ **weight of evidence (WOE) and binning variables (Sharma, 2011)**

- Step 1: Binning variables based on their weight of evidence

$$WOE_{modality\_i} = \ln\left(\frac{\%tag\ recovered_{of\ the\ modality\_i\_among\_all\_modalities}}{\%tag\ not\ recovered_{of\ the\ modality\_i\_among\_all\_modalities}}\right)$$

Construct bins: grouping each variable by class (news modalities) based on their weight of evidence and information value.

- Step 2: Logistic regression with weight of evidence after binning

$y_i \sim Bernoulli(p_i)$, (tag recovered=1 and tag not recovered=0)

$$log\left(\frac{p_i}{1-p_i}\right) = \beta_0 + \beta_1 Tagger\_woe_i + \beta_2 Event\_woe_i + \beta_3\ Length\_woe_i + \beta_4 Schooltype\_woe_i + \beta_5 Species\_woe_i + \beta_6 Vessel\_woe_i$$

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- Step 3: Prediction of recovery rate in optimal and observe conditions

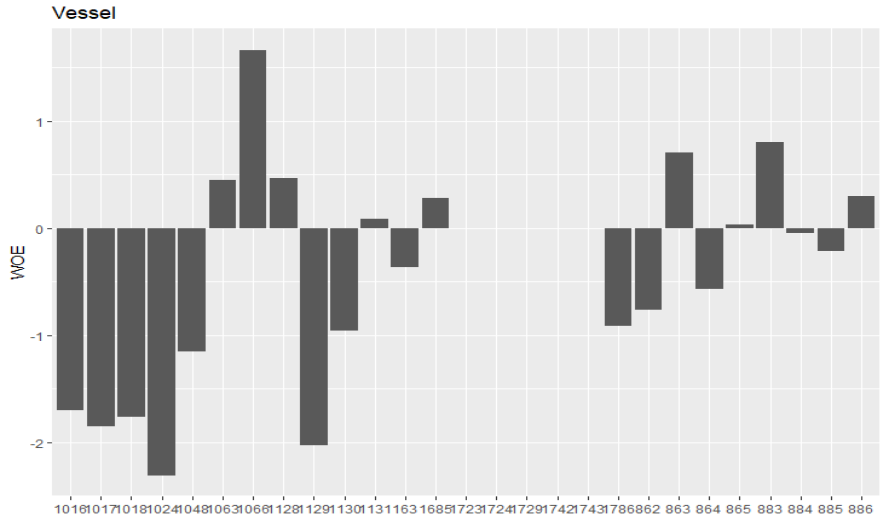
$$\mu_i{}^{opt} = logit^{-1}(\beta_0 + \beta_1 Tagger\_woe_{opt} + \beta_4 Schooltype\_woe_{opt} + \beta_6 Vessel\_woe_{opt} + \beta_2 Event\_woe_i + \beta_3\ Lenght\_woe_i + \beta_5 Species\_woe_i)$$

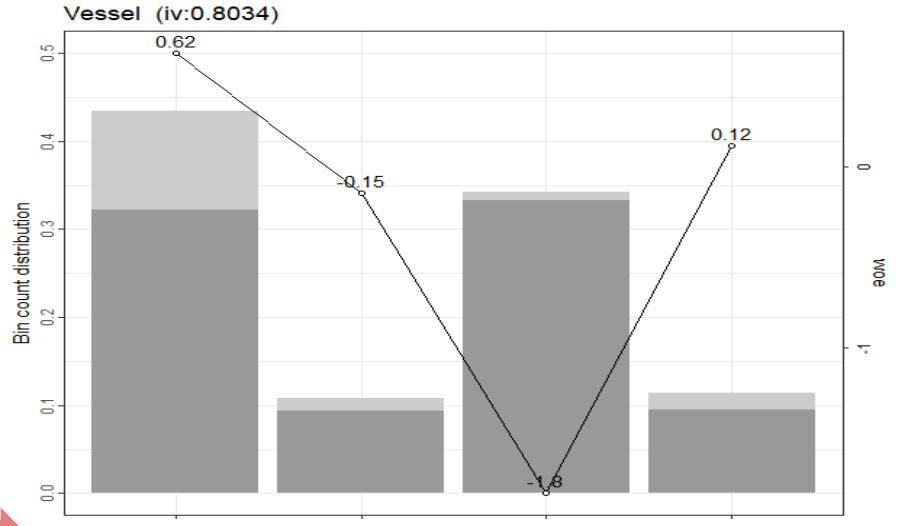
$$\mu_i{}^{obs} = logit^{-1}(\beta_0 + \beta_1 Tagger\_woe_i + \beta_4 Schooltype\_woe_i + \beta_6 Vessel\_woe_i + \beta_2 Event\_woe_i + \beta_3\ Lenght\_woe_i + \beta_5 Species\_woe_i)$$

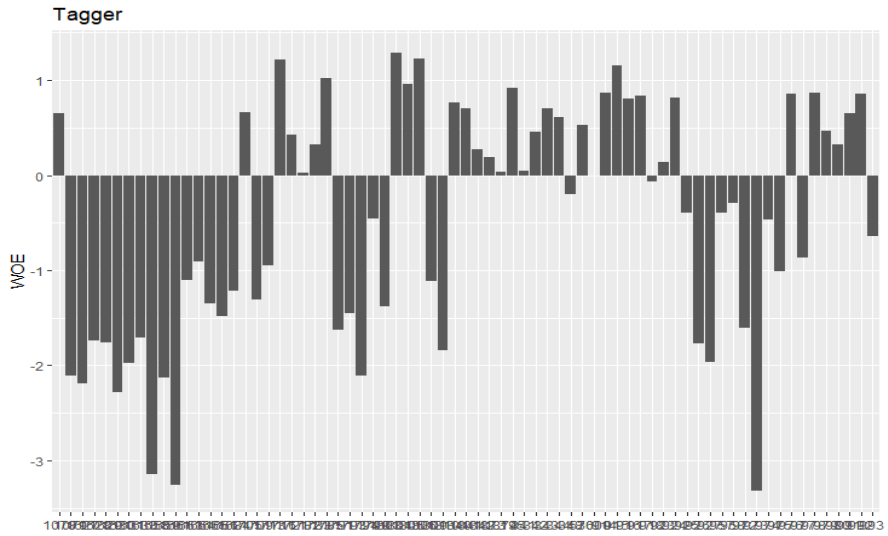
- Step 4: Estimate tagging failure rate: difference between recovery rate on optimal conditions and those on observe conditions.

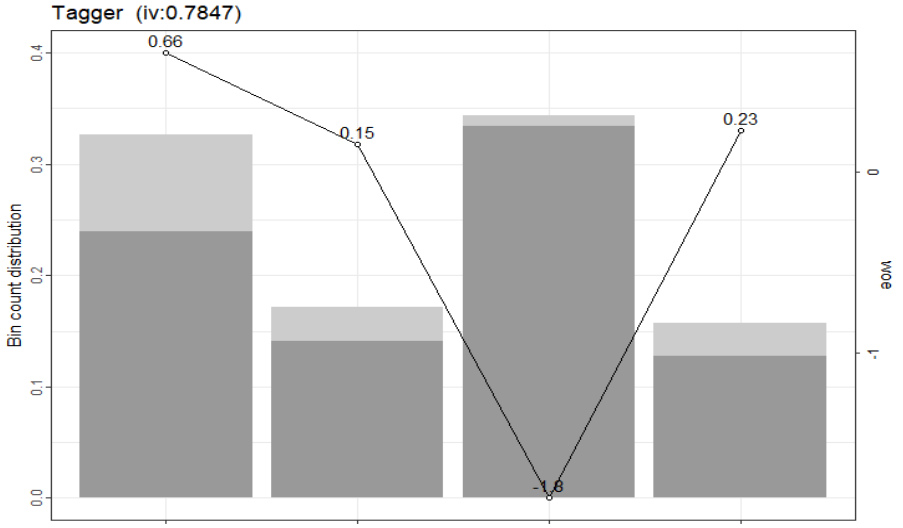
$$TaggingF = \frac{(recovery\ on\ optimal\ cond - recoverey\ on\ observe\ cond) * 100}{Total\ released}$$

Results: WOE results and binning variables (step 1)



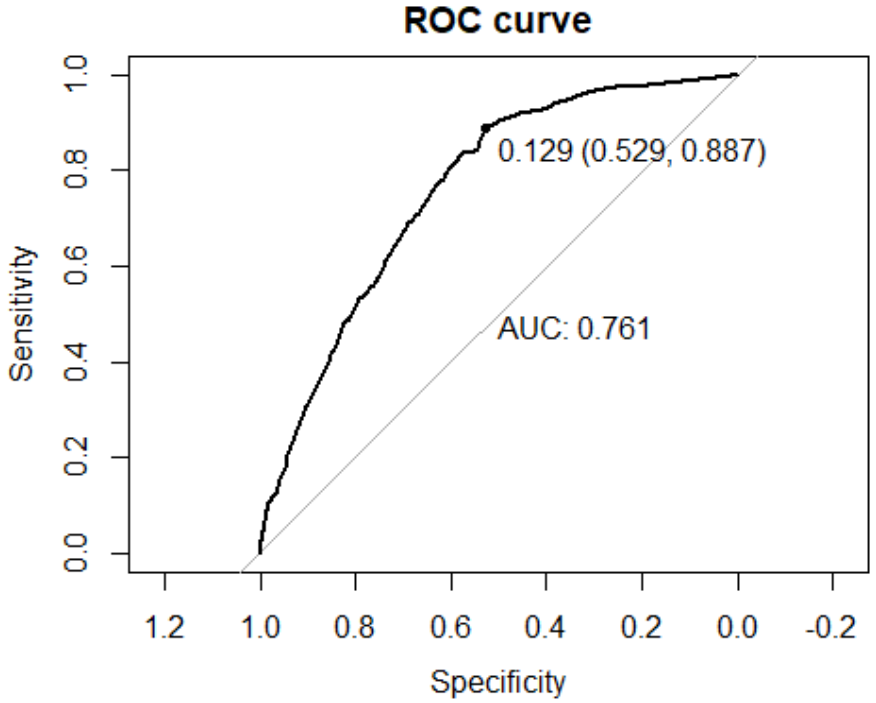






Results: Logistic regression results (step 2)

Optimal conditions	Value
VesselID	163; 862 and 863
Tagger	195; 341; 342; 343; 344; 348; 536; 914; 915; 916; 917; 918; 923; 924
Schooltype	OIL and SMO

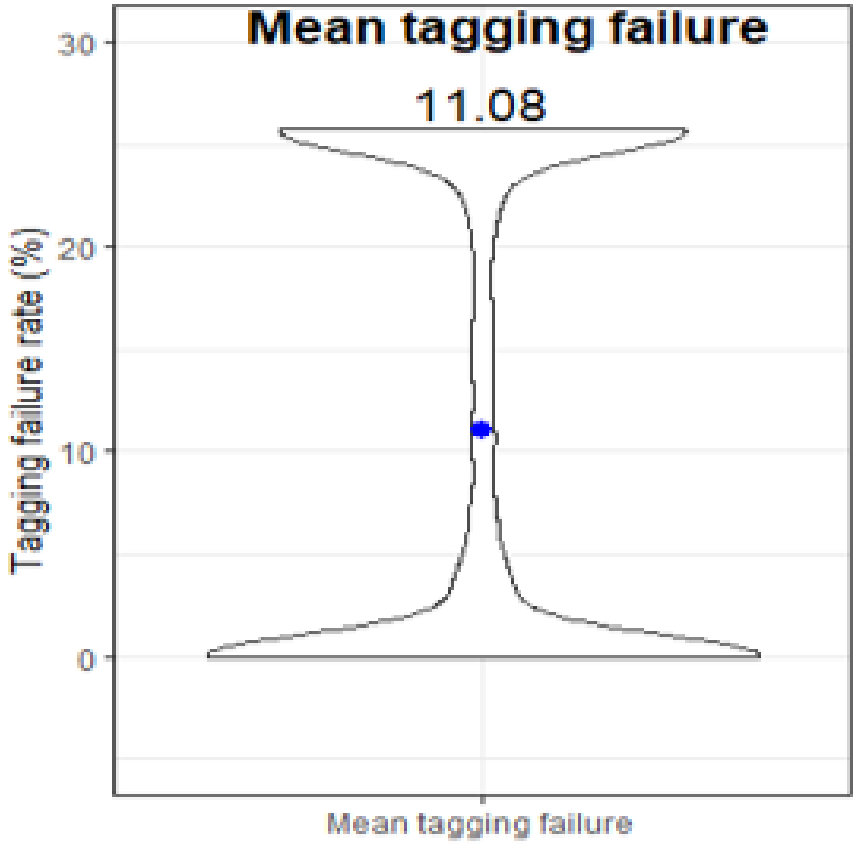


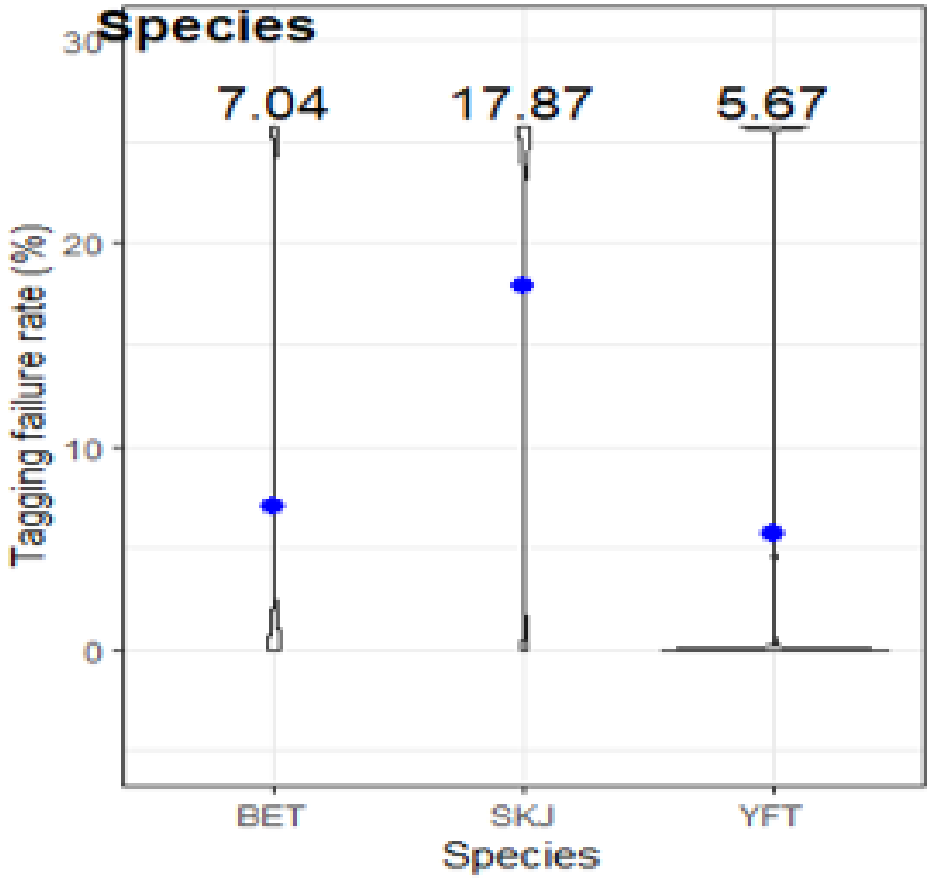
- **Summary**

- **ROC= 0.761: The classification performance of the model is intermediate.**
- **The predicted values will be corrected to filter the noise generated by the model.**
- **Recovery rate predictions will be corrected by the positive predictive value**

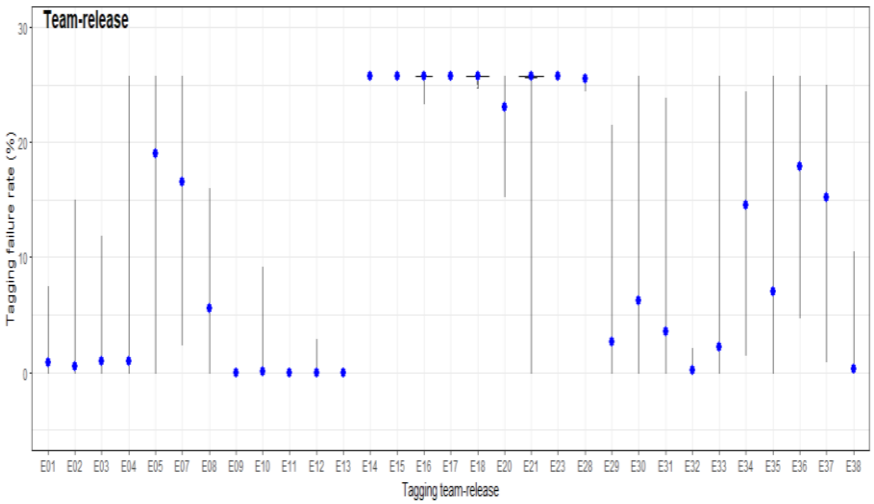
Statistic of the glm model	value
balance accuracy	0.712
Positive predictive value	0.258
Negative predictive value	0.964
Positive class	Tag recovered

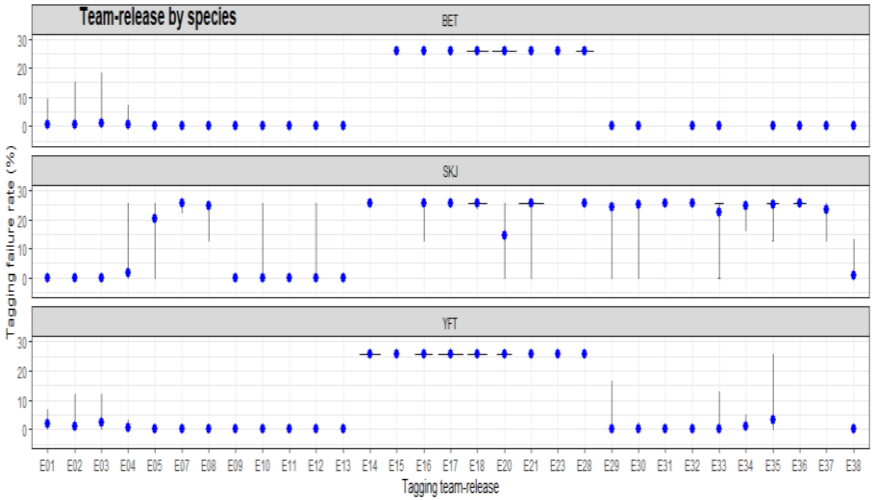
Results: estimates of the failure rate based on the step 4 and extrapolation of results for species

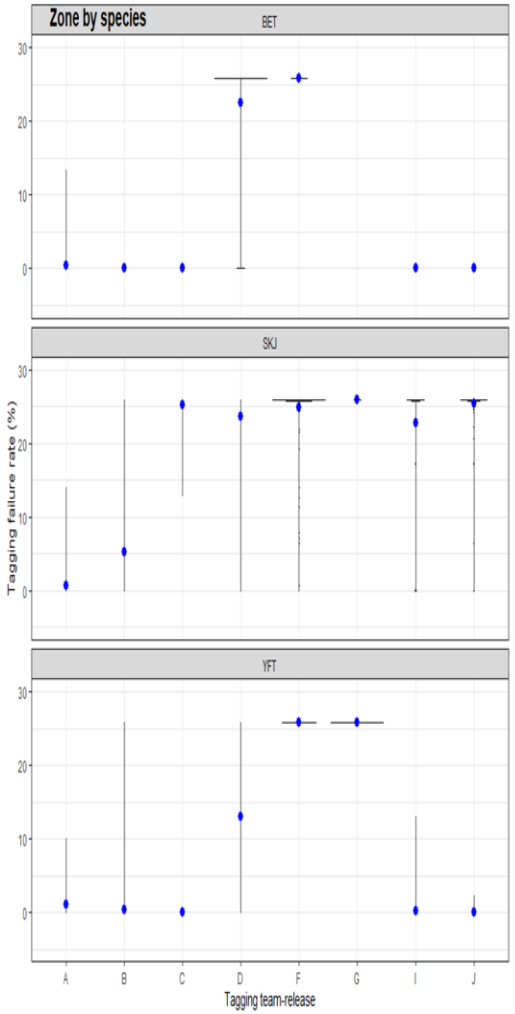


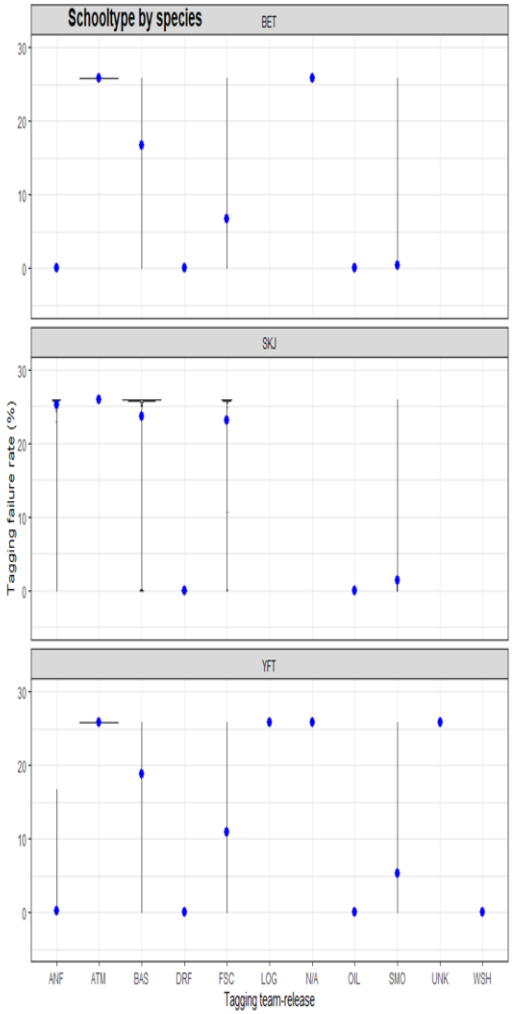


Results: estimates of the failure rate based on the step 4 with extrapolation of results for others variables









Discussions

Benefits of the methods

The WOE-binning generates optimal creation classes for both categorical and numeric variables to ensure convergence and interpretation of the model.

The correction of the predicted values of the model avoids the noise generated by the quality of the logistic regression (ROC, Accuracy…).

Comparison to other results

Hoyle and al. (2014), and Berger and al. (2014) find mean tagging failure (correction factor for Berger) higher than those find in this study.

However, correcting predictive values with the proportion of good classification of the model could change significantly the results.

Use of the results

Tagging failure rate can be included in future stock assessment via reporting rate priors to correct the actual tag released data before using AOTTP data

Acknowledgements

- ICCAT and AOTTP funders
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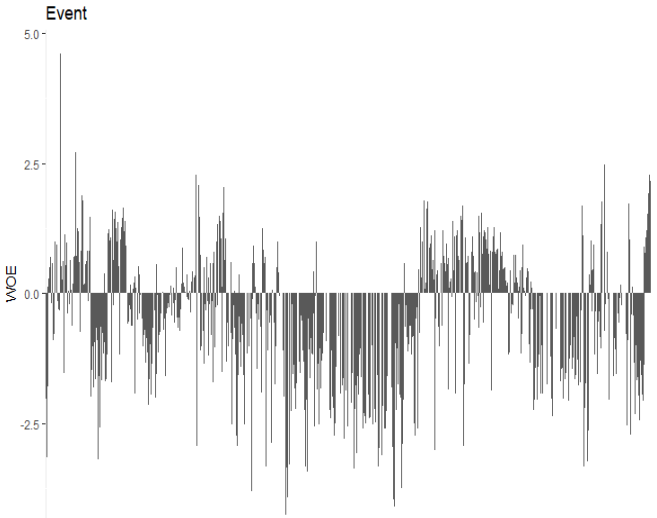
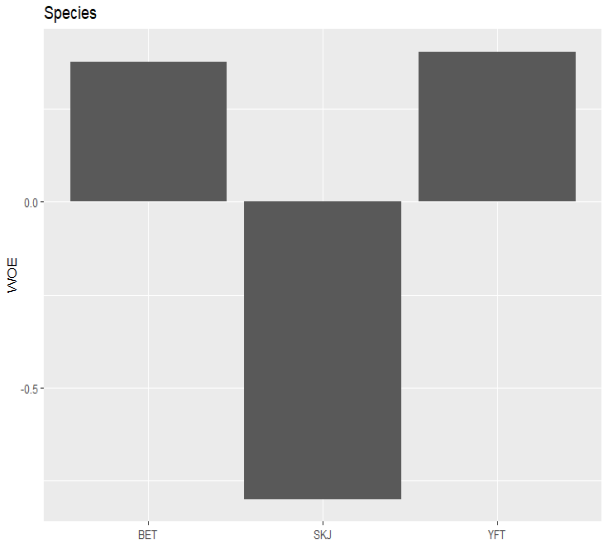
- All AOTTP team : tag release and recovery teams, scientists…

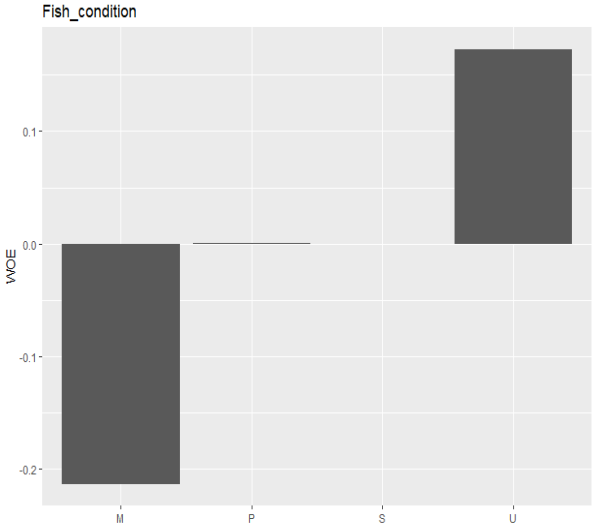
Thank You

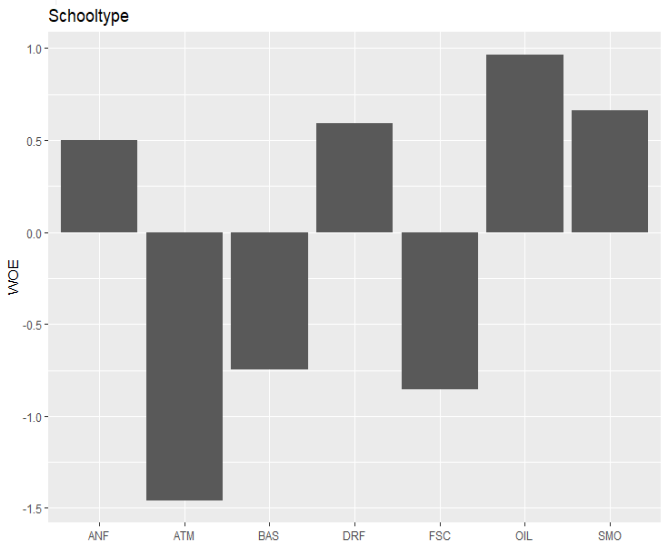
ANY QUESTION???

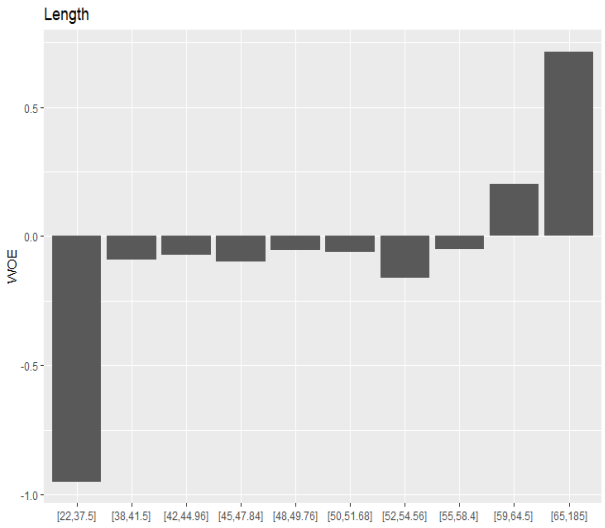
Results: WOE and descriptive statistics

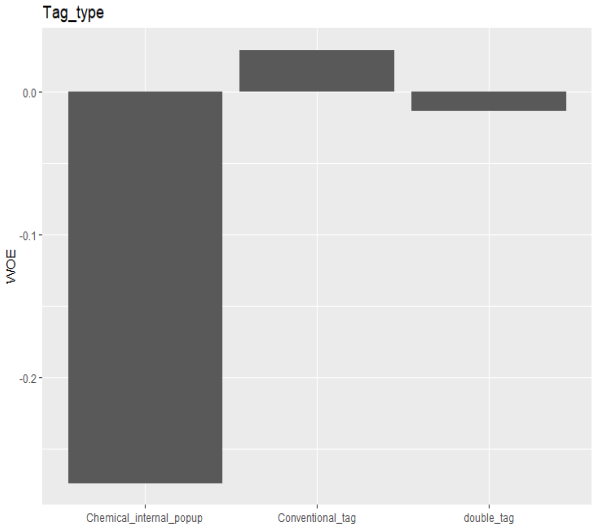




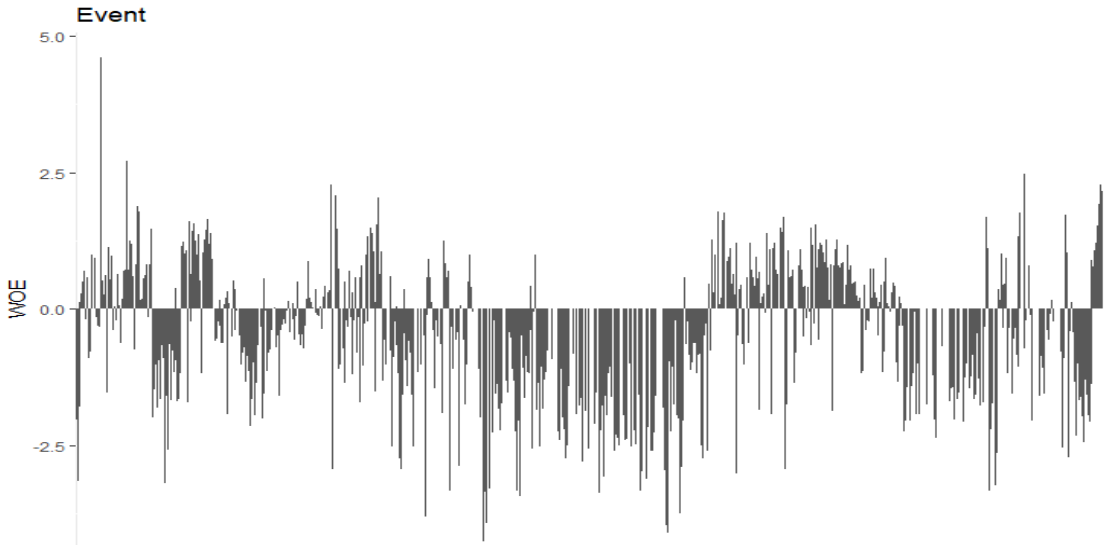


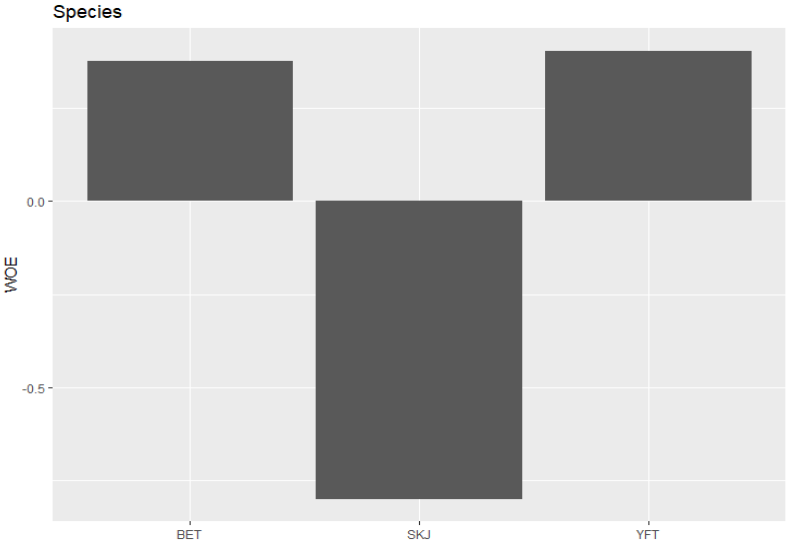


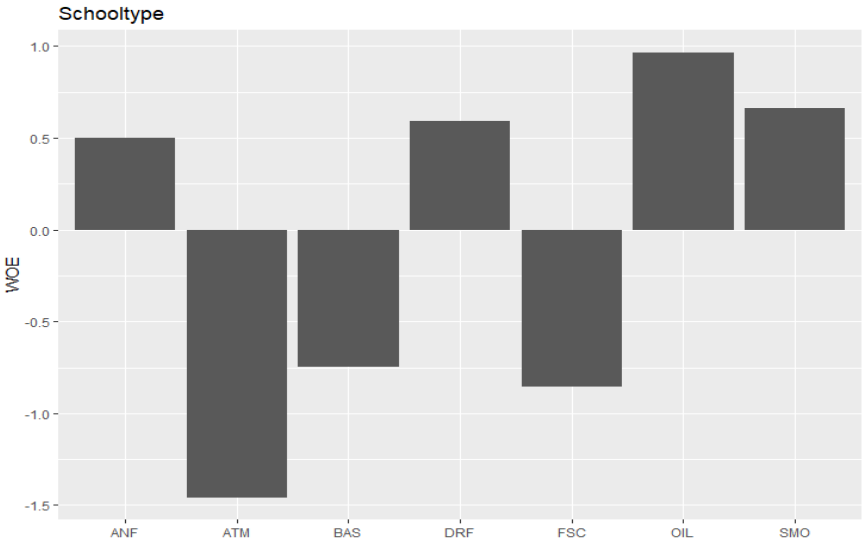


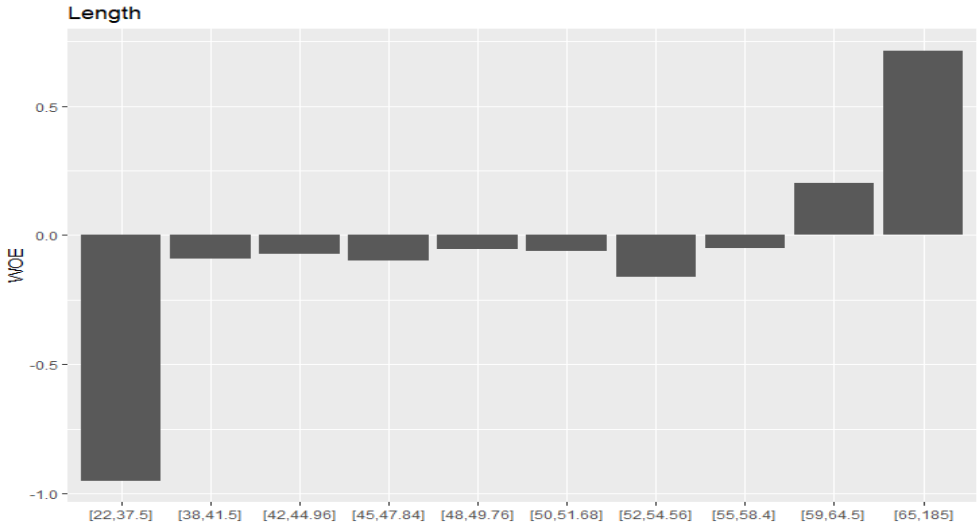


Results: WOE and descriptive statistics









Results: binning and descriptive statistics