Standardized purse seine CPUE of Yellowfin tuna in the Indian Ocean for the European fleet

Loreleï Guéry[1,2], David Kaplan[3], Francis Marsac[3], Maitane Grande[4], Francisco Abascal[5], Jose Carlos Baez[6] and Daniel Gaertner[3]

SUMMARY

The time series of EU purse seine fleet catches per unit effort (CPUE) of small (<10kg) and large (>=10kg) yellowfin tuna (YFT) from the Indian Ocean were standardized using an extension of the Delta-lognormal GLMM to three components. These components are: (i) the detection rate of schools per unit of searching time, (ii) the proportion of sets for which the targeted size category is present and (iii) the biomass of the targeted size category in the fish school. The aim was to use the commercial size categories as a proxy to depict the trend in abundance for adult and juvenile YFT observed in free schools (FSC), as well as for juveniles caught under floating objects (FOB).

KEYWORDS: Abundance; CPUE standardization; Purse seiner; Spatial variations; Logbooks; Yellowfin tuna

[1]Corresponding author: lorelei.guery@cirad.fr
[2]Centre International de Recherche en Agronomie pour le Développement (CIRAD), UMR PHIM, Team PRISM – FORISK, TA A-120 / D Campus international de Baillarguet 34398 Montpellier Cedex 5 France
[3]Institut de Recherche pour le Développement (IRD), UMR MARBEC, CS 30171, Av. JeanMonnet, 34203 Sete Cedex, France
[4]AZTI, Marine Research, Basque Research and Technology Alliance (BRTA). Txatxarramendi ugartea z/g, 48395 Sukarrieta - Bizkaia, Spain
[5]Instituto Español de Oceanografía (IEO), Centro Oceanográfico de Canarias. Vía Espaldón, dársenapesquera, Parcela 8 38180 Santa Cruz de Tenerife, Spain
[6]Instituto Español de Oceanografía (IEO), Centro Oceanográfico de Málaga, Puerto Pesquero, s/n Apdo., 29640, Fuengirola, Málaga, Spain

1. Introduction

In this paper, we estimate standardized catch per unit effort (CPUE) time series for yellowfin tuna (YFT, *Thunnus albacares*) to be provided to the IOTC as an input for the upcoming YFT stock assessment. CPUE time series were standardized by commercial size categories, i.e., adults (size categories 2 and 3, i.e., 10-30 kg and >30 kg, respectively) to capture the spawning-stock biomass of the population and juveniles (size category 1, <10 kg) and by fishing mode, i.e., sets on free school (FSC) and sets associated with floating objects (FOBs). Although only standardized CPUE time series on FSC sets were provided as an input to the YFT stock assessment, those under FOBs are also presented in this paper.

The methodology for FSC catch used in this paper follows the modelling approach described in Guéry et al. (2019) based on a Delta-lognormal generalized linear mixed models (GLMM). The model is composed of 3 components: (i) a Poisson first component modelling the density of free schools based on the number of sets (positive and null) per unit of vessel searching time, (ii) a binomial second component modelling the fraction of free schools with the target YFT size category based on the fraction of positive sets (i.e., sets with catch of any species; non-null sets) with catch of YFT in that size category, and (iii) a lognormal third component modelling the size of free schools with YFT based on catch of YFT in YFT positive sets. This approach is well suited for randomly encountered fish schools, i.e., FSC sets. Along with the commonly used covariates relating to vessel characteristics and spatio-temporal variability, the originality of this work consists of the inclusion of null sets, considered as presence of a FSC and time spent by cell by boat by day to constrain detectability.

For FOB catch, as FOBs may not be randomly encountered, only the lognormal third component was used, modelling the biomass of the target size category of YFT caught in non-null FOB sets.

2. Material and Methods

2.1. Conventional fishing data

To derive European purse seiner standardized CPUEs for the YFT stock assessment, T3-processed logbook data from the French and Spanish purse seine fleets targeting tropical tunas in the Indian Ocean from 1991 to 2019 and 2020 for the French fleet were analysed. Raw logbook data (Level0) produced by the skippers were corrected in terms of total catch per set (to account for the difference between reported catch at sea and landed catch) and species composition (based on port size sampling and the T3 methodology – see Pallarès and Hallier 1997) to generate the Level 1 logbook database used in this paper. Logbook data for the French and the Spanish fleets were provided by the Exploited Tropical Pelagic Ecosystems Observatory (IRD-Ob7) and the Spanish Institute of Oceanography (IEO), respectively.

The analysis was restricted to:

- FSC sets for the 3-component model; FOB sets for the 1 component model
- The period 1991-2020
- Vessels with fewer activities than the 5% of the left-hand distribution based on the cumulative number of days per boat (all activities confounded) were removed
- Total number of sets per day per boat was filtered and days with unrealistic data (> 5 sets) were removed
- Entire days with at least one activity with problematic operations (e.g., equipment failures) were removed
- All sets per boat and day were aggregated and attributed to the centroid of these set activities
- The area defined by all 1*1 degree grid cells where YFT were fished for at least 5 years over a period of no less than 15 years were selected to avoid areas that are not routinely fished

If multiple attempts to fish on the same FSC are carried out (e.g., a null set is followed shortly afterward by a successful non-null set on the same school), then this would lead to over-estimation of the rate of encounter of FSC in the first component of our 3-component model. To assess the magnitude of this effect, distances between pairs of successive FSC sets by a given vessel were calculated, separating pairs into null-null pairs and null-non-null pairs. No significant differences were observed in the distributions of distances for these two types of set pairs and therefore it was considered that multiple attempts to fish the same FSC was a relatively rare occurrence in the dataset. As such, no specific procedure was used to eliminate multiple attempts to fish the same FSC.

Basic graphs of the logbook data showing, per year, the number of boats, the number of daylight hours, the number of sets, the searching time and the set duration are presented in Figure 1.

2.2. Environmental and piracy data

Changes in depth of the mixed layer are known to affect the catchability of purse seines, as surface-dwelling tunas mostly gather above the thermocline (Green, 1967; Cayré and Marsac 1993; Bertrand et al., 2002). A deep thermocline may therefore decrease the vulnerability of tuna schools to purse seining. We used the depth of 20°C isotherm as a proxy for the depth of the mixed layer lying above the thermocline.

Piracy data is a binary variable of presence/absence of Piracy per 1ºx1º grid cell, i.e., 1/0 respectively, extracted from Figure 2.

2.3. Modelling approach

2.2.1. Delta-lognormal GLMMs

As mentioned earlier, a delta-lognormal GLMMs approach (Guéry *et al*. 2019) was used for the CPUE standardization of FSC randomly encountered including three sub-models: a Poisson GLMM that standardises the encounter rate of FSC (component 1), a binomial GLMM that takes into account the fraction of sets for which the species/commercial category of interest is present (component 2), and a lognormal LMM to describe the biomass of the species/commercial category of interest in the catch of a positive set (component 3). In this paper, this standardization procedure was applied either to adult or juvenile YFT in FSC. For adults and juveniles caught under FOB, i.e. mainly not randomly, the CPUE standardization used only the third component. Depending on the sub-model considered, the candidate variables can differ. Available candidate variables are detailed in **Table 1**.

For both adults and juveniles, we performed the Poisson GLMM (component 1) where the full model included the following fixed effects: fleet country, age of the vessel, vessel storage capacity, piracy, year, quarter, 5ºx5º grid cell and the depth of 20°C isotherm. The random structure of the model consisted of a vessel unique identifier. Searching time by day and vessel was calculated as (sun set time – sun rise time) – (number of sets*median of setting time) and was used as an offset. Compared to previous analyses, the variable number of FOB sets was removed from the analyses as it was highly correlated to the searching time. Each vessel was assigned to a 5ºx5º grid cell for a given day based on the centroid of the geographical positions of all activities reported in logbook data for that day and vessel.

Selected model for component 1:

num_sets_fsc ~ fleet country + age of the vessel + vessel storage capacity + piracy + year + quarter + 5ºx5º grid cell + depth of 20°C isotherm + (1| numbat) + offset(searching_centroid)

For both adults and juveniles, the full model for the binomial GLMM (component 2) included the following fixed effects: fleet country, year, quarter and 5ºx5º grid cell. Vessel storage capacity was excluded by the LASSO procedure for juveniles (see Table 2), and thus was only included in the standardization of CPUE for adult YFT. The random structure of these models consisted of a vessel unique identifier. The number of positive sets declared in a single line of logbook data was used as an offset to take into account the occasional aggregation of sets into a unique logbook observation in the first years of the time series. These multi-set logbook entries represent 2.86% of all sets and 0.48% of sets since 2005.

These full models, with the lower AIC, were retained for both adults and juveniles compared to models without the 5ºx5º grid cell or without depth of 20°C isotherm. Results are presented in **Table 3**.

Selected model for component 2 (adults):

fraction of positive sets with YFT ~ fleet country + vessel storage capacity + year + quarter + 5ºx5º grid cell + (1 | numbat) + offset(nb of sets)

Selected model for component 2 (juveniles):

fraction of positive sets with YFT ~ fleet country + year + quarter + 5ºx5º grid cell + (1 | numbat) + offset(nb of sets)

For both adults and juveniles, the full model for the lognormal LMM (component 3) included the following fixed effects: fleet country, vessel storage capacity, year, quarter, 5ºx5º grid cell and the depth of 20°C isotherm. The random structure of these models consisted of a vessel unique identifier. The number of positive sets declared in a single line of logbook data was used as an offset to take into account the occasional aggregation of sets into a unique logbook observation in the first years of the time series. These multi-set logbook entries represent 3.15% of all sets and 0.46% of sets since 2005.

These full models, with the lower AIC, were retained for both adults and juveniles compared to models without the 5ºx5º grid cell or without depth of 20°C isotherm. Results are presented in **Table 3**.

Selected model for component 3:

log_capture ~ fleet country + vessel storage capacity + year + quarter + 5ºx5º grid cell + depth of 20°C isotherm + (1|numbat) + offset(nb of sets)

2.2.2. Selection procedure from the LASSO regression

For multidimensional data, variable or model subset selection through stepwise selection becomes problematic. The number of possible models grows exponentially with the number of predictors and renders computation infeasible. Moreover, when the number of observations is not much larger than the number of predictors, ordinary least squares may result in over-fitting. Penalized maximum likelihood methods allow regression modelling when the number of model parameters is high compared to the number of observations and prevent over-fitting (Tibshirani 1996). Models, consisting of all predictors, were fitted with LASSO, a popular technique that constrains (i.e., regularizes) the coefficient estimates. Technically, Lasso minimizes the usual sum of squared errors, with a bound on the sum of the absolute values of the coefficients (Tibshirani, 1996, 2011).
Model selection involved the use of the LASSO regression using algorithms that handle continuous explanatory variables (R package: glmnet; Friedman *et al*. 2009, 2010) and grouped covariates (R package: grpreg; Breheny and Breheny, 2018). Given a linear regression with standardized predictors *xi* and centred response values y_i for i=1,2, …, N and j=1,2, …, p, the glmnet algorithm estimates the regression coefficients $b=\{b_j\}$ to minimize:

$$\frac{1}{N}\sum_{i=p}^{N} w_i\, l(y_i, b_0 + b^T x_i) + \lambda\left[\frac{(1-a)||b||_2^2}{2} + a||b||_1\right]$$

where λ covers a range of values, l(y,η) is the negative log-likelihood contribution for observation i and a controls the elastic-net penalty (for lasso α=1). The tuning parameter λ is chosen through cross-validation.

After the LASSO procedure, if applicable, a model selection based on AIC was conducted to depict the inclusion of 5ºx5º grid cell and/or depth of 20°C isotherm variables. The selected model was refitted without LASSO as an unrestricted GLMM (R-package: lme4; Bates et al., 2014), as LASSO estimated coefficients are known to be biased (Friedman *et al*., 2001). Finally, the standardized CPUEs were fitted using estimated means.
All the statistical analyses were computed using the software R (v3.6.3; R Core Team, 2020).

2.2.2. Dealing with mixed models

For GLMM, the predict function does not allow one to derive standard error, the reason being (from the help page of predict.merMod): “There is no option for computing standard errors of predictions because it is difficult to define an efficient method that incorporates uncertainty in the variance parameters”. This means that there is for now no way to include in the computation of the standard error for predicted values the fact that the estimated standard deviation for the random effect is imperfect and, therefore, may be more or less well estimated. We can however still derive confidence or prediction intervals keeping in mind that we might underestimate the uncertainty around the estimates. More details are given in:

- https://cran.r-project.org/web/packages/merTools/vignettes/merToolsIntro.html
- https://cran.r-project.org/web/packages/merTools/vignettes/Using_predictInterval.html

We thus used the package *arm v1.10-1* (*sim* and *fitted* functions) to simulate posterior distributions and calculate confidence intervals.

We used the R package *influ*, a package for generating step plots, influence plots, CDI plots, and influence metrics but only for linear models. Such as the R package *Dharma,* they are currently incapable of handling mixed models. The influence of our random effect was thus not evaluated here.

3. Results

3.1. Selection procedure based on LASSO regression

Results are presented in **Table 2**.

3.2. FSC sets (1991-2020 period) – Component 1: Poisson GLMM (number of sets > 0 and = 0 with YFT)

3.2.1. Diagnostics

Diagnostics are presented below, i.e., box-plots of residuals by year (Figure 3), histogram of residuals (Figure 4), plot of residuals versus fitted (Figure 5) and influence plot (Figure 6). The diagnostics of component 1 are very close for adults and juveniles as the datasets are almost identical. We thus provide the adults diagnostics but the conclusions are the same for juveniles.

3.2.2. Standardized time series

For both adults (upper plot) and juveniles (lower plot), standardized time series are presented by year-quarter (Figure 7) as well as by year (Figure 8).
Model summaries and predicted values are presented in appendices.

3.3. FSC sets (1991-2020 period) – Component 2: Binomial GLMM (fraction of positive set with large YFT)

3.3.1. Diagnostics

For both adults and juveniles, diagnostics are presented below, i.e. box-plots of residuals by year (Figure 9), histogram of residuals (Figure 10), plot of residuals versus fitted (Figure 11) and influence plot (Figure 12).

3.3.2. Standardized time series

For both adults (upper plot) and juveniles (lower plot), standardized time series are presented by year-quarter (**Figure 13**) and by year (Figure 14).
Model summaries and predicted values are presented in appendices.

3.4. FSC sets (1991-2020 period) – Component 3: Log-Normal GLMM (catch conditional to YFT catch > 0)

3.4.1. Diagnostics

For both adults and juveniles, diagnostics are presented below, i.e. box-plots of residuals by year (Figure 15), histogram of residuals (Figure 16), plot of residuals versus fitted (Figure 17) and influence plot (Figure 18).

3.4.2. Standardized time series

For both adults (upper plot) and juveniles (lower plot), standardized time series are presented by year-quarter (Figure 19) and by year (Figure 20).
Model summaries and predicted values are presented in appendices.

3.5. Delta lognormal GLMM approach

The product of the three sub-models described above provided the standardised CPUE time series for free school sets by quarter (Figure 21) and by year (Figure 22). We considered the three components independent and calculate confidence intervals with:

$$\mathrm{Var}(XY) = E(X^2Y^2) - (E(XY))^2 = \mathrm{Var}(X)\mathrm{Var}(Y) + \mathrm{Var}(X)(E(Y))^2 + \mathrm{Var}(Y)(E(X))^2$$

The formula was first applied to the product of the first (C1) and the second component (C2), then to the product of C1*C2 and the third component.

3.6. FOB sets (1991-2020 period) – Component 3: Log-Normal GLMM (catch conditional to YFT catch > 0)

3.6.1. Diagnostics

For both adults and juveniles, diagnostics are presented below, i.e., box-plots of residuals by year (Figure 23), histogram of residuals (Figure 24), plot of residuals versus fitted (Figure 25) and influence plot (Figure 26).

3.6.2. Standardized time series

For both adults (upper plot) and juveniles (lower plot), standardized time series are presented by year-quarter (Figure 27) and by year (Figure 28).
Model summaries and predicted values are presented in appendices.

4. Discussion

In this paper we applied the same approach of CPUE standardization for the tropical tuna purse seine fisheries adopted in ICCAT for YFT stock assessment to account for the hierarchical structure of fishing on tropical tuna free schools (i.e., encountering schools, presence of the species and the abundance of the species), for the non-randomised sampling and the numerous candidate variables linked to technological developments and evolving fishing strategies.

For FOB catch, as FOBs may not be randomly encountered, only the lognormal third component was used, modelling the biomass of the target size category of YFT caught in non-null FOB sets.

Overall, standardized CPUEs for adult YFT based on FSC sets is relatively stable over the last decade with perhaps a gradual long-term decline since the peak during the “golden years” 2003-2005. Two major exceptions to these trends are i) a sharp decline in 2018 likely due to a change in fishing strategy resulting from the YFT quota, followed by ii) a dramatic increase in 2019 likely linked to perturbations to the fishery resulting from COVID.

Standardized CPUEs for juvenile YFT based on FSC sets shows more short-term temporal variability than that for adult YFT, but is roughly stable over the last decade with large variations coincident with the piracy period (~2007-2011) and seemingly anomalous levels of variability in 2018-2019 coincident with YFT quota and the subsequent COVID pandemic.

Standardized catches per set based on FOB sets show a long-term decline since ~2003 for adult YFT and are approximately stable since 2010 for juvenile YFT.

A further step will be to use the R package *influence.*ME for detecting influential data in mixed effects models.

5. References

Bates, D., Maechler, M., Bolker, B. and Walker, S., (2014). lme4: Linear mixed-effects models using Eigen and S4. R package version, 1(7), pp.1-23.

Breheny, P. and Breheny, M.P., 2018. Package 'grpreg'.

Freon, P., and Misund, O. A. (1999) Dynamics of pelagic fish distribution and behaviour : effects on fisheries and stock assessment. Oxford : Fishing News Books, 360 p.

Friedman, J., Hastie, T. and Tibshirani, R., (2009). glmnet: Lasso and elastic-net regularized generalized linear models. R package version, 1(4).

Friedman, J., Hastie, T., Tibshirani, R., (2010). Regularization Paths for Generalized Linear Models via Coordinate Descent . J. Stat. Softw. 33, 1-22

Fonteneau, A., Gaertner, D., and Nordstrom, V. (1999) An overview of problems in the catch per unit of effort and abundance relationship for the tropical purse seine fisheries. Coll. Vol. Sci. Pap. ICCAT, 49 (3): 258-278.

Gaertner, D., and Pallares, P. (2002) Efficacité des Senneurs Thoniers et Effort Réels (ESTHER). Progr. 98/061. Union Européenne, DG "Fisheries" (DG XIV), Bruxelles, (Belgique). Rapport Scientifique 187 p.

Katara, I., Gaertner, D., Chassot, E., Soto, M., Abascal, F., Fonteneau, A., Floch, L., Lopez, J., Cervantes, A. (2016). A framework for the standardisation of tropical tuna purse seine CPUE: application to the yellowfin tuna in the Indian Ocean. Victoria Mahé : CTOI, (IOTC-2016-WPTT18-24), 16 p

Katara, I., Gaertner, D., Billet, N., Lopez, J., Fonteneau, A., Murua, H., Daniel, P. and Báez, J.C., (2017). Standardisation of skipjack tuna CPUE for the EU purse seine fleet operating in the Indian Ocean. IOTC-2017-WPTT19.

Lo, N.C.H., Jacobson, L.D., Squire, J.L (1992) Indices of relative abundance from fish spotter data based on delta-lognormal models. Can J Fish Aquat Sci 49:2515–2526.

Pallarés, P., and Hallier, J. P. (1997). Analyse du schéma d'échantillonnage mutlispécifique des thonidés tropicaux. Pages 1–57. Rapport scientifique, IEO/ORSTOM, Madrid.

Tibshirani, R., (1996). Regression shrinkage and selection via the lasso. J. R. Stat. Soc. Ser. B Methodol. 267–288

Tibshirani, R., (2011). Regression shrinkage and selection via the lasso: a retrospective. J. R. Stat. Soc. Ser. B Stat. Methodol. 73, 273–282.

Table 1. Candidate variables for the CPUE standardisation models.

Variable	**description**
Fleet country	France; Spain
Age	Age of the vessel calculated as Year – Year of vessel service (i.e., year that the vessel started its activity)
Vessel storage capacity	In m^3
Piracy	Binary variable of presence/absence of Piracy per 1ºx1º grid cell (1/0 respectively)
Year	Year at which the fishing set took place
Quarter	A quarter of the year at which the fishing set took place
5ºx5º grid cell	Reference grid of the fishing area at a 5ºx5º resolution
Depth of 20°C isotherm	Details in the main document
Numbat	Unique vessel identifier
Nb of positive sets	Number of sets with catch > 0
Searching time	Time (in hours) searching for fish estimated as (sun set time – sun rise time) – (number of sets* median of setting time for a given year)
D20	Depth of 20°C isotherm

Table 2. LASSO regression coefficients (Coef) for component 1 (cp1), 2 (cp2) and 3 (cp3) of standardization models. Variables with a coefficient equal to 0 (.) were not included in the standardization models.

	Adults in FSC			Juveniles in FSC			Adults under FOBs	Juveniles under FOBs
Variables	Coef. cp1	Coef. cp2	Coef. cp3	Coef. cp1	Coef. cp2	Coef. cp3	Coef. cp3	Coef. cp3
Lambda min	0.0007	0.0007	0.0003	0.0006	0.0015	0.0009	0.0003	0.0007
(Intercept)	2.267	2.532	3.241	0.321	-1.152	-1.446	0.562	0.560
Fleet country	0.315	-0.436	-0.129	-0.020	0.141	0.503	0.448	0.258
Year	-0.021	-0.003	0.002	-0.136	-0.028	-0.010	-0.009	0.001
Quarter	-0.132	-0.044	-0.074	0.029	0.057	0.117	0.011	0.010
5ºx5º grid cell	0.020	-0.070	-0.030	-0.283	0.054	-0.004	-0.009	-0.010
Numbat	-0.236	0.004	-0.001	0.003	-0.006	-0.003	0.004	0.001
Age	0.003			0.010				
Vessel capacity	0.014	0.070	0.092	-0.100	.	0.085	-0.005	0.084
Piracy	-0.090			-0.390				
Searching centroid	-0.390			-0.321				
d20_m	-0.299		-0.148	0.321		0.223	-0.110	0.081
Number of positive sets		0.340	0.470		0.008	0.467	0.330	0.545

Table 3. Model selection per component and age classes

Component	Models	AIC (adults)	AIC (juveniles)
Poisson GLMM (cp1)	5ºx5º grid cell + depth of 20°C isotherm	901037.9	832437.2
	5ºx5º grid cell	902310.5	834286.6
	depth of 20°C isotherm	914488.5	844940.3
Lognormal LMM (cp3)	5ºx5º grid cell + depth of 20°C isotherm	88583.62	46597.17
	5ºx5º grid cell	88593.64	46669.49
	depth of 20°C isotherm	89454.13	46841.93

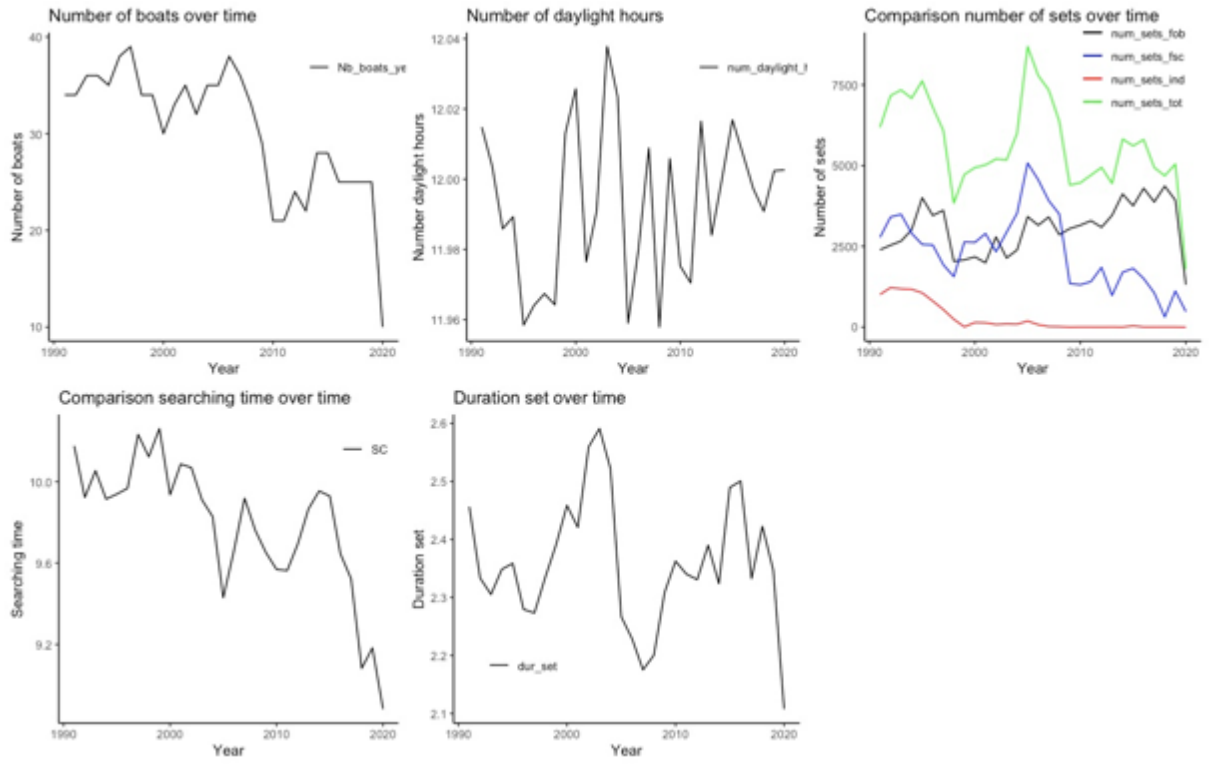


Figure 1. Trends over time of several explanatory variables.

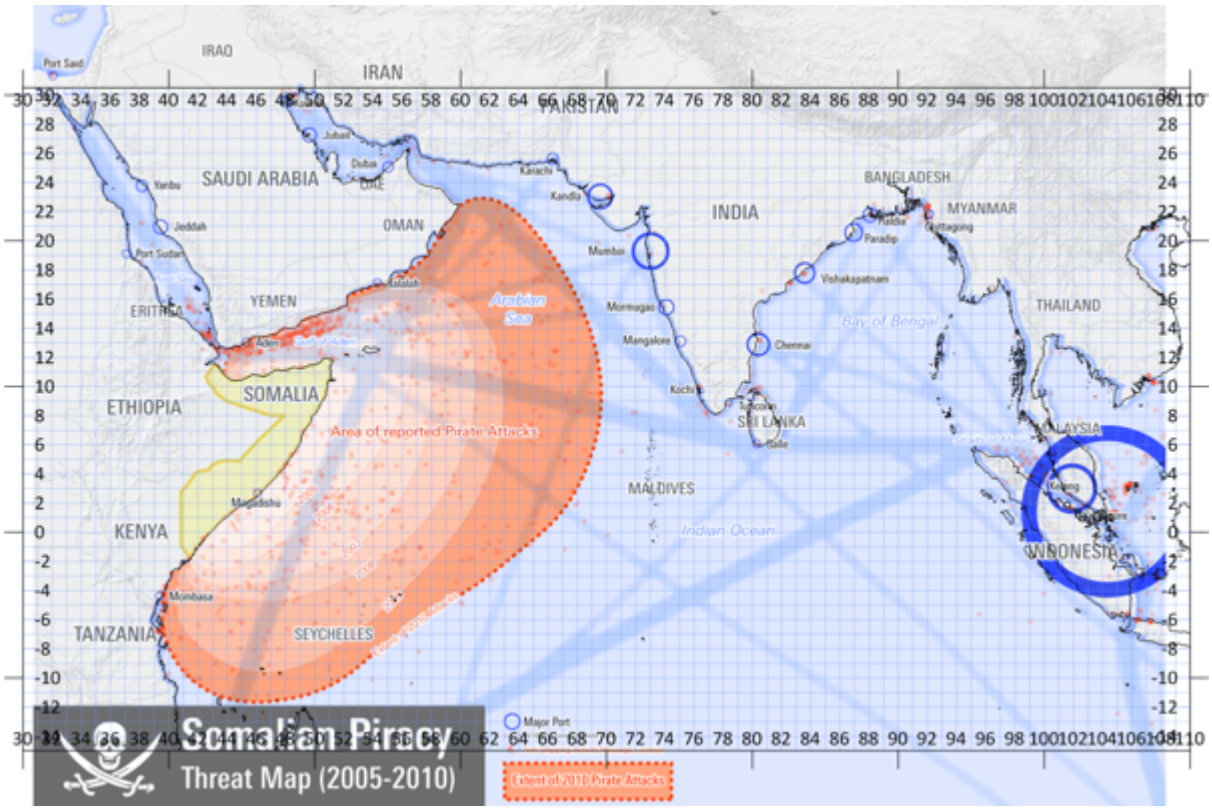


Figure 2. Somalian Piracy threat map from 2005 to 2010

Figure 3. Component 1 (Poisson GLMM) - Number of FSC sets > 0 and = 0 with YFT: box-plots of residuals by year

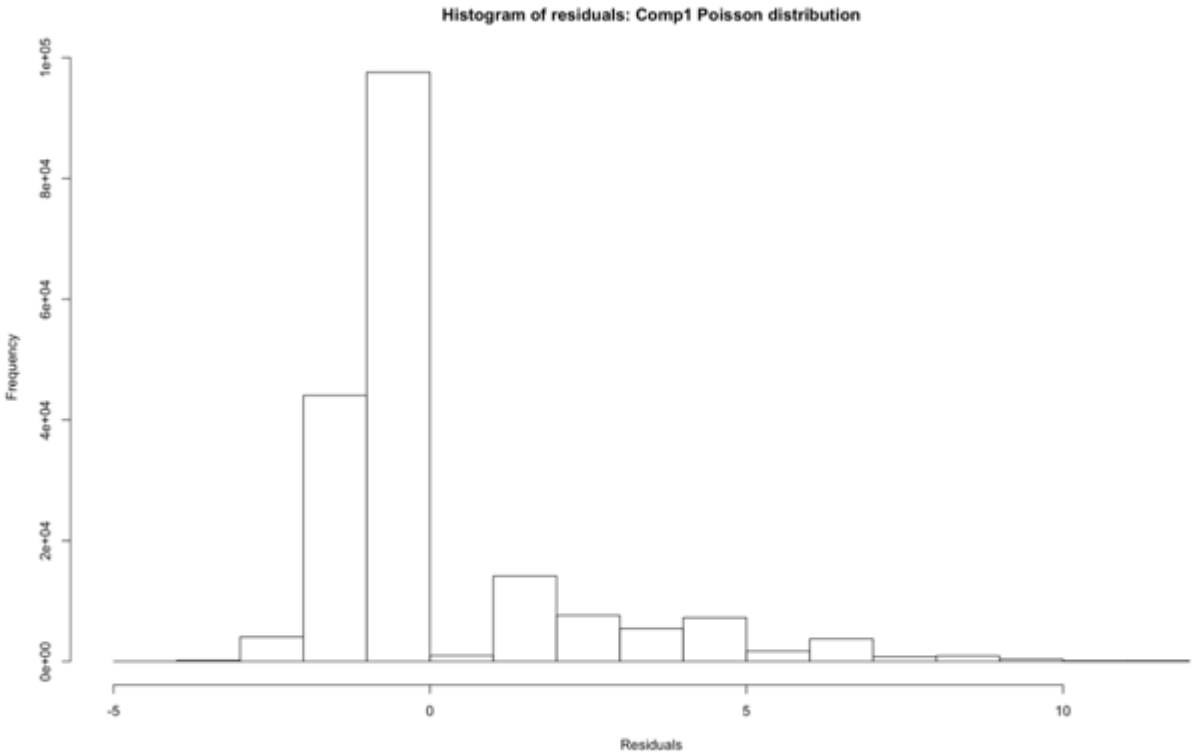


Figure 4. Component 1 (Poisson GLMM) - Number of FSC sets > 0 and = 0 with YFT: histogram of residuals

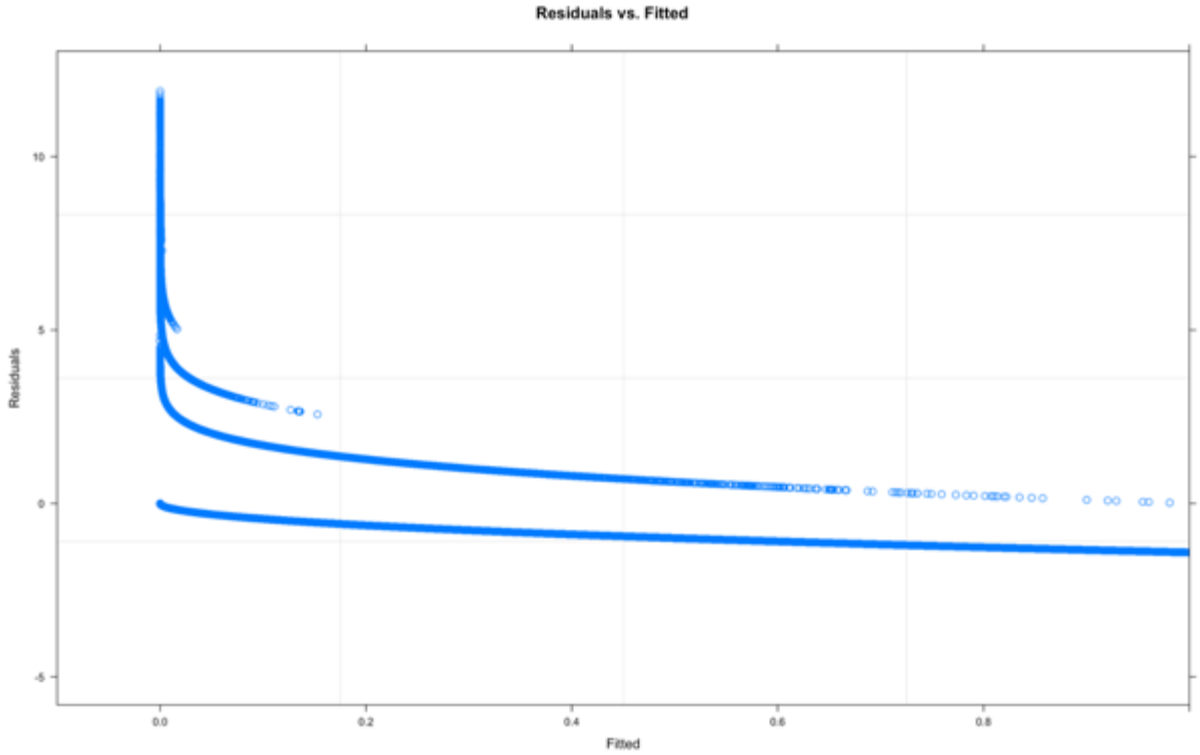


Figure 5. Component 1 (Poisson GLMM) - Number of FSC sets > 0 and = 0 with YFT: residuals versus fitted

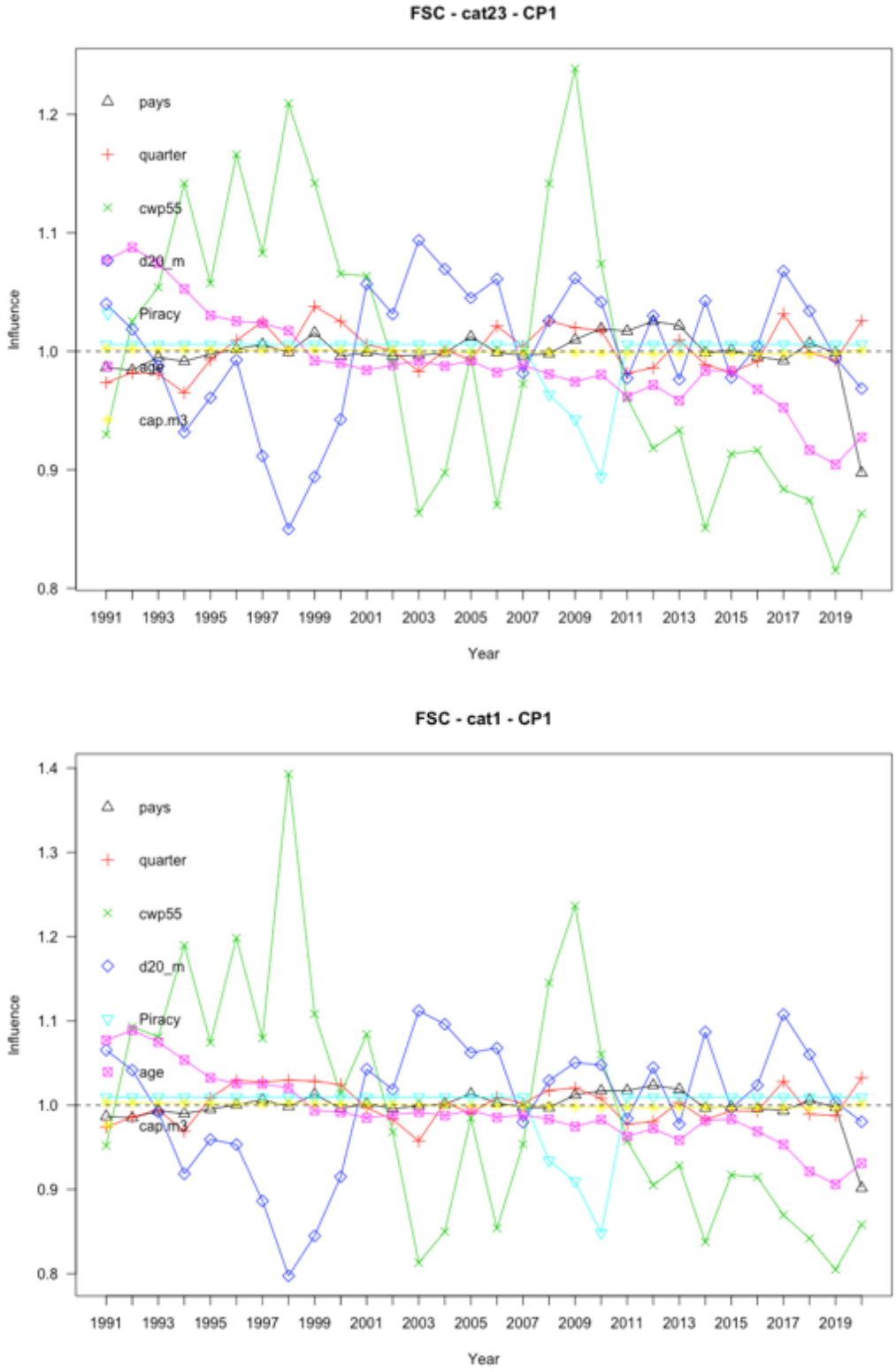


Figure 6. Component 1 (Poisson GLMM) - Number of FSC sets > 0 and = 0 with adult (upper) or juveniles (lower) YFT: influence plots

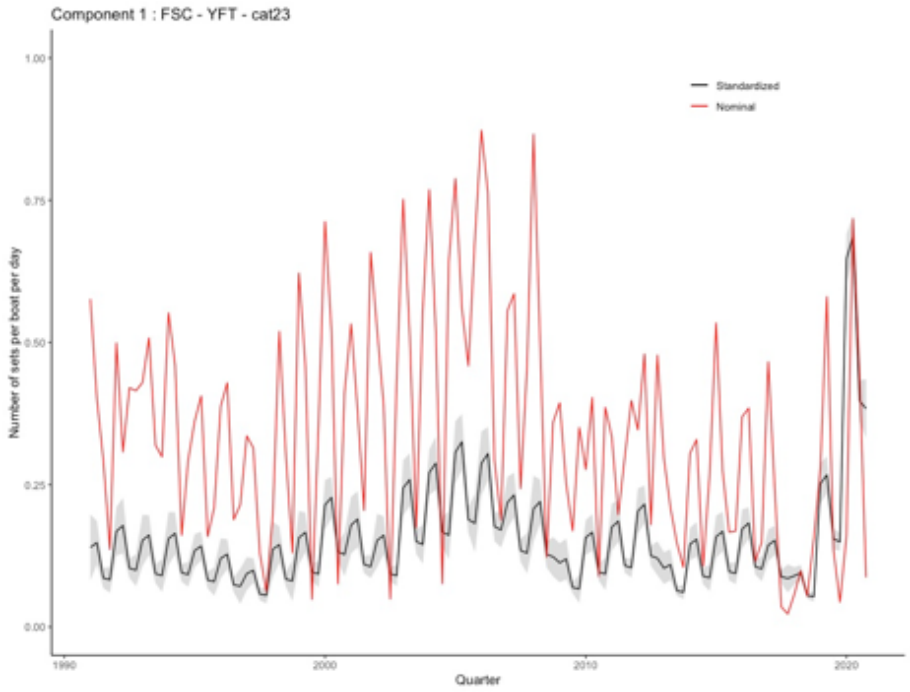


Figure 7. Component 1 (Poisson GLMM) - Number of FSC sets > 0 and = 0 with YFT: standardised time series by year-quarter (black) with 97.5% confidence intervals (grey) compared to nominal (red)

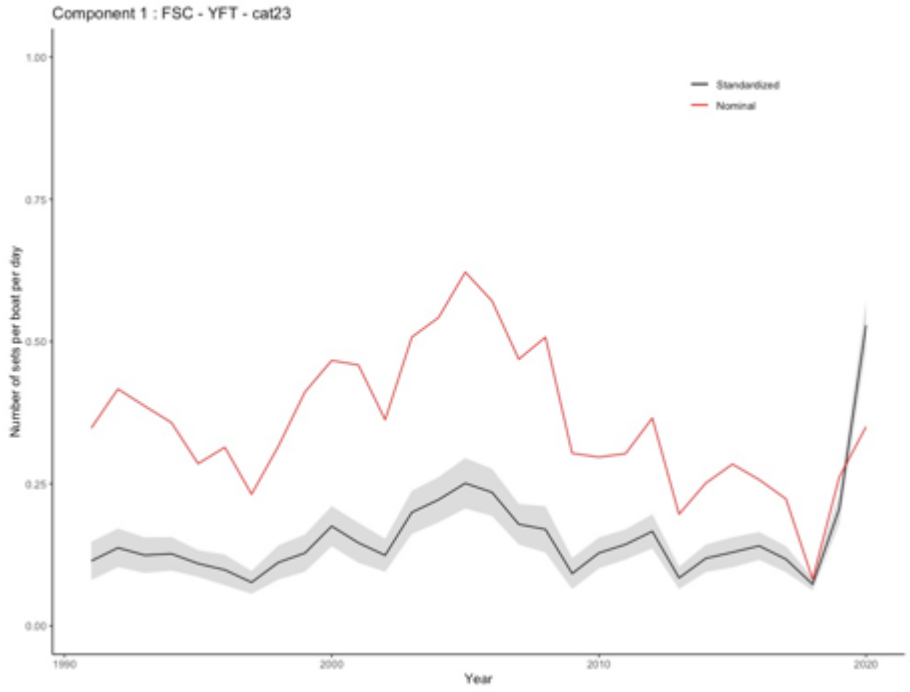


Figure 8. Component 1 (Poisson GLMM) - Number of FSC sets > 0 and = 0 with adult YFT: standardised time series by year (black) with 97.5% confidence intervals (grey) compared to nominal (red)

Figure 9. Component 2 (Binomial GLMM) - fraction of positive set with adult (upper) or juveniles (lower) YFT in FSC: box-plots of residuals by year

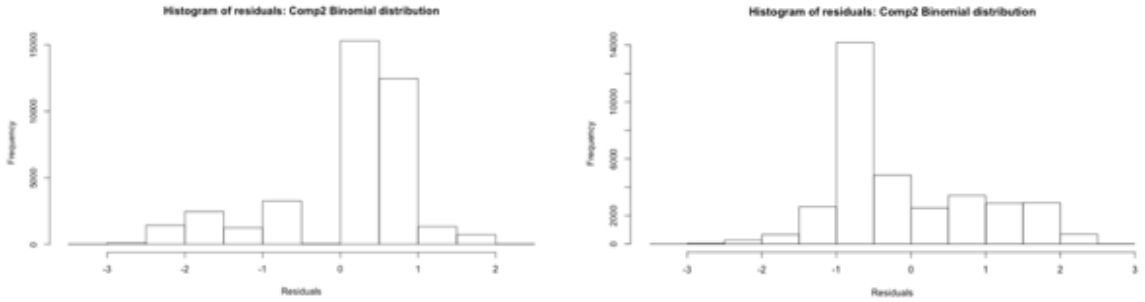


Figure 10. Component 2 (Binomial GLMM) - fraction of positive set with adult (left) or juveniles (right) YFT in FSC: histogram of residuals

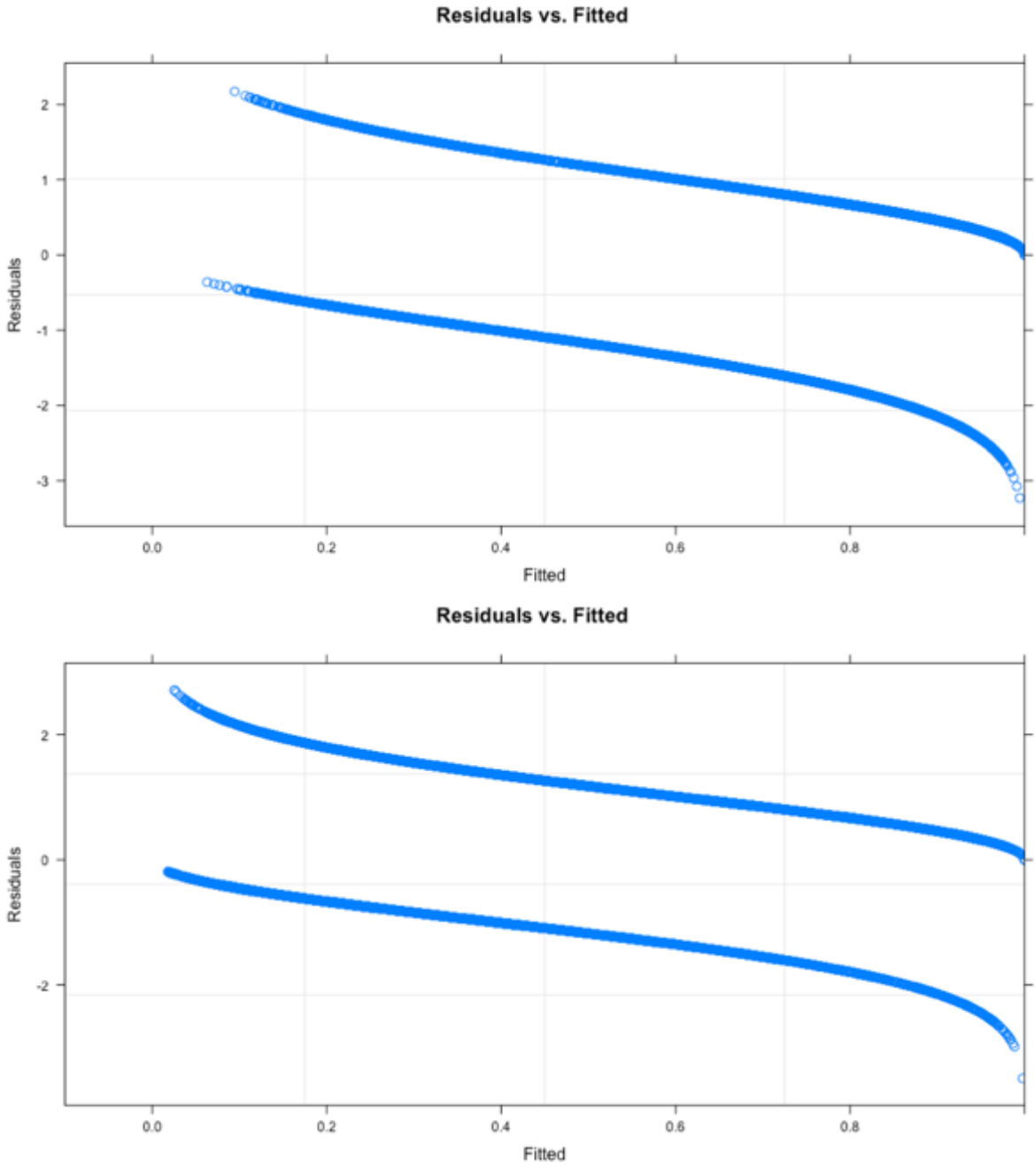


Figure 11. Component 2 (Binomial GLMM) - fraction of positive set with adult (upper) or juveniles (lower) YFT in FSC: residuals versus fitted

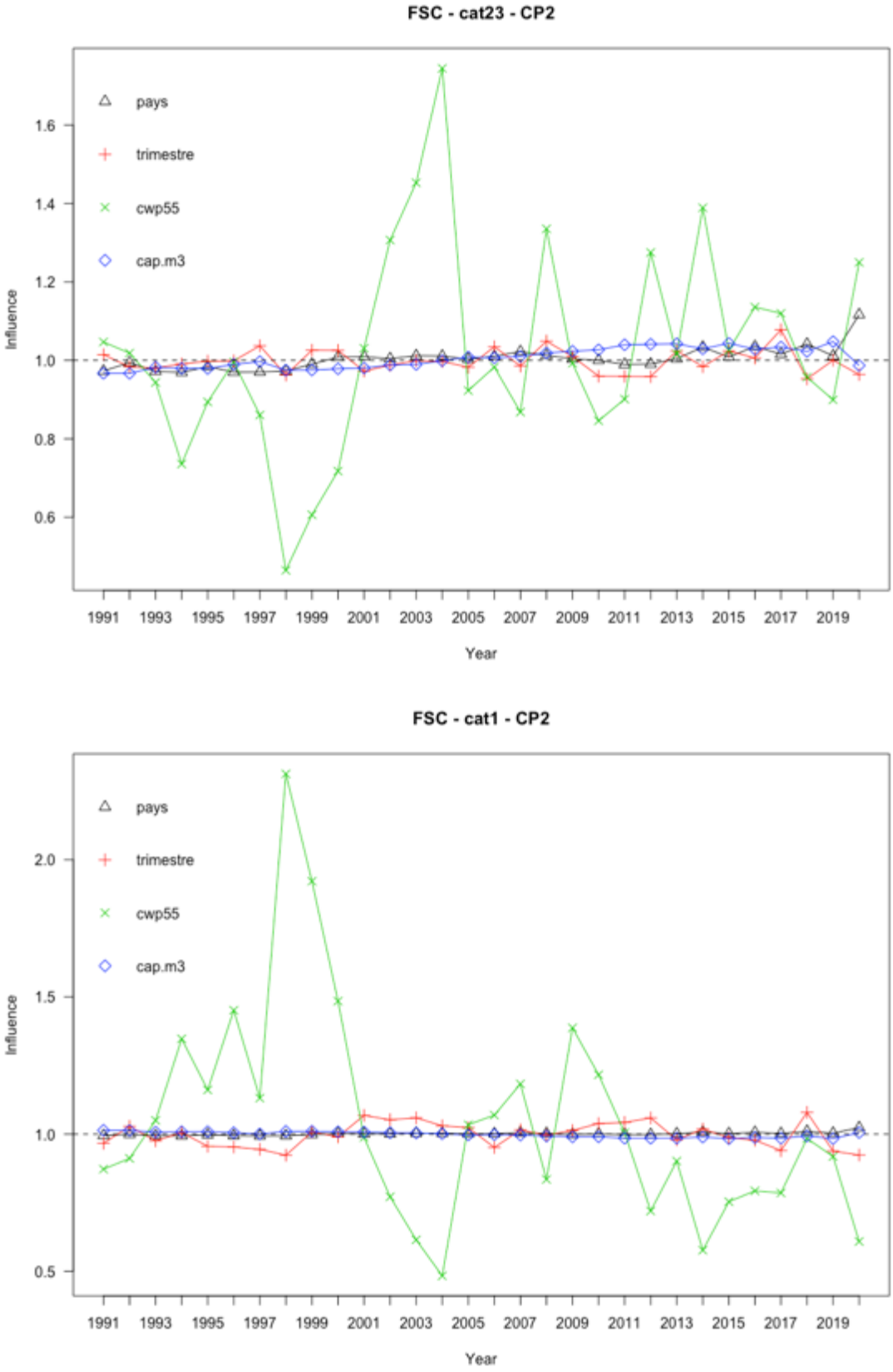


Figure 12. Component 2 (Binomial GLMM) - fraction of positive set with adult (upper) or juveniles (lower) YFT in FSC: influence plot

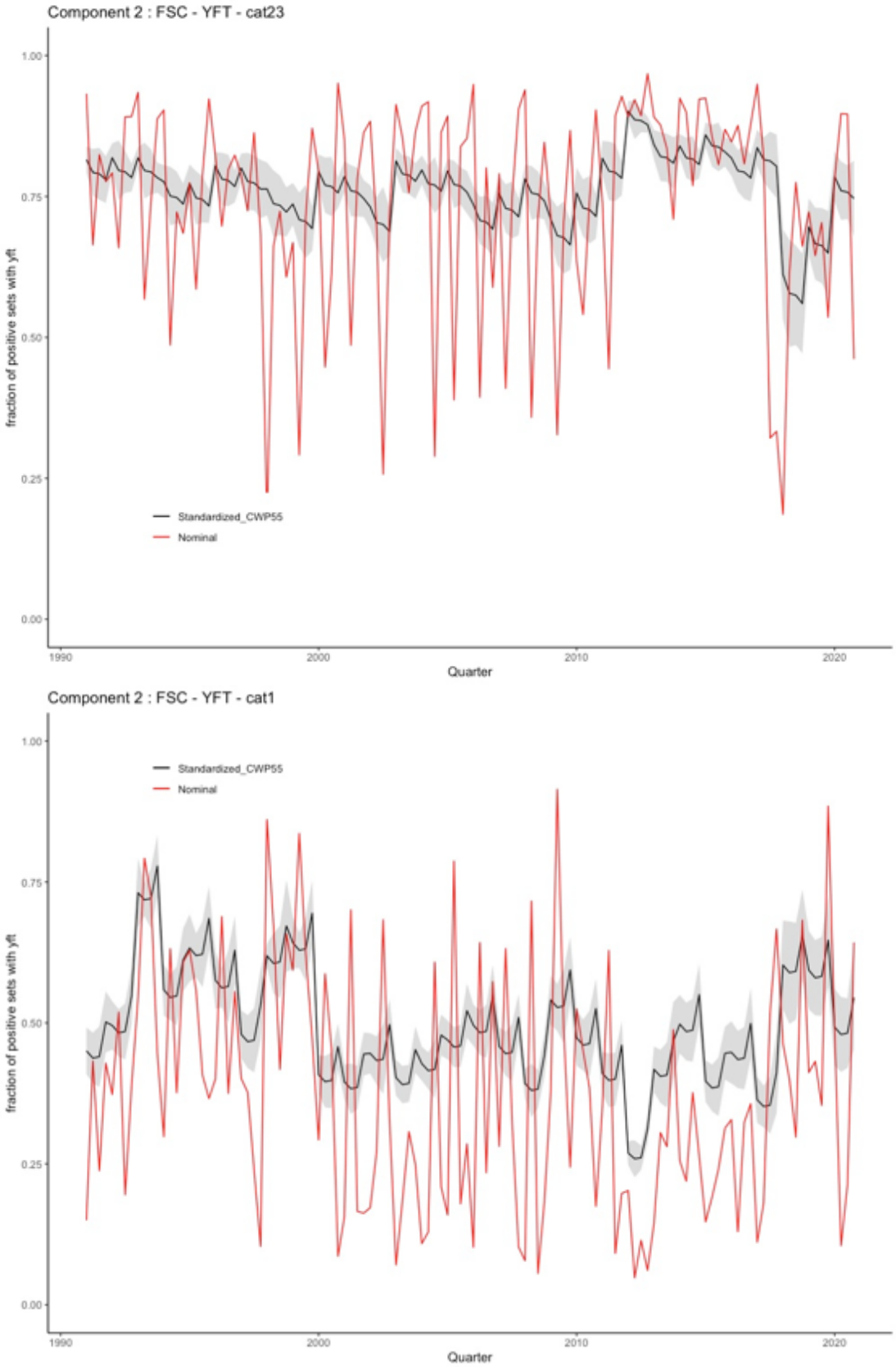
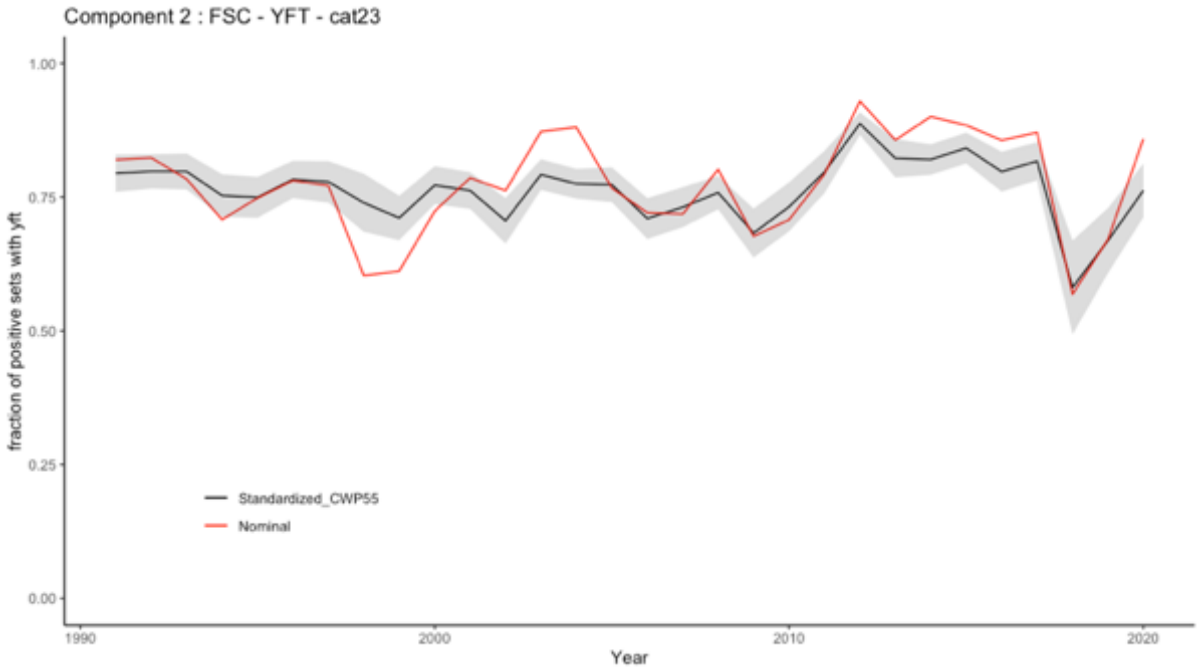


Figure 13. Component 2 (Binomial GLMM) - fraction of positive set with adult (upper) or juveniles (lower) YFT in FSC: standardised time series by year-quarter (black) with 97.5% confidence intervals (grey) compared to nominal (red)



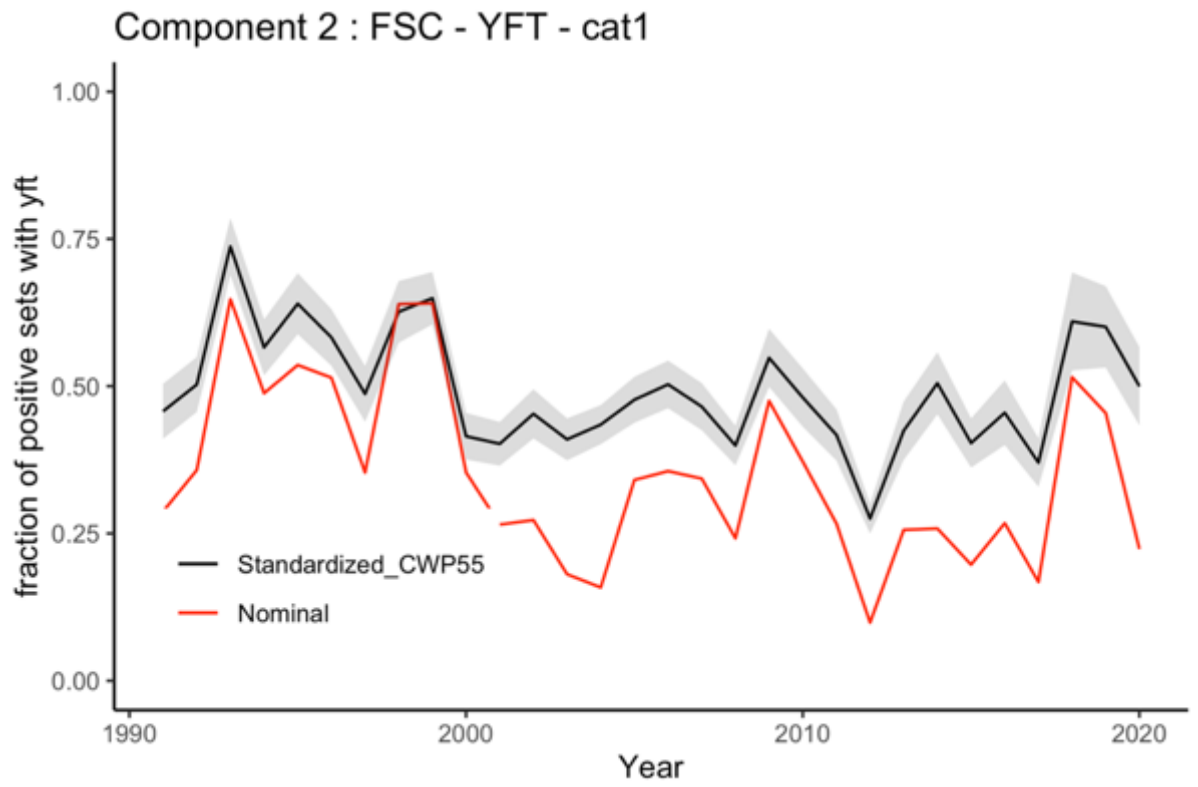


Figure 14. Component 2 (Binomial GLMM) - fraction of positive set with adult (upper) or juveniles (lower) YFT in FSC: standardised time series by year (black) with 97.5% confidence intervals (grey) compared to nominal (red)

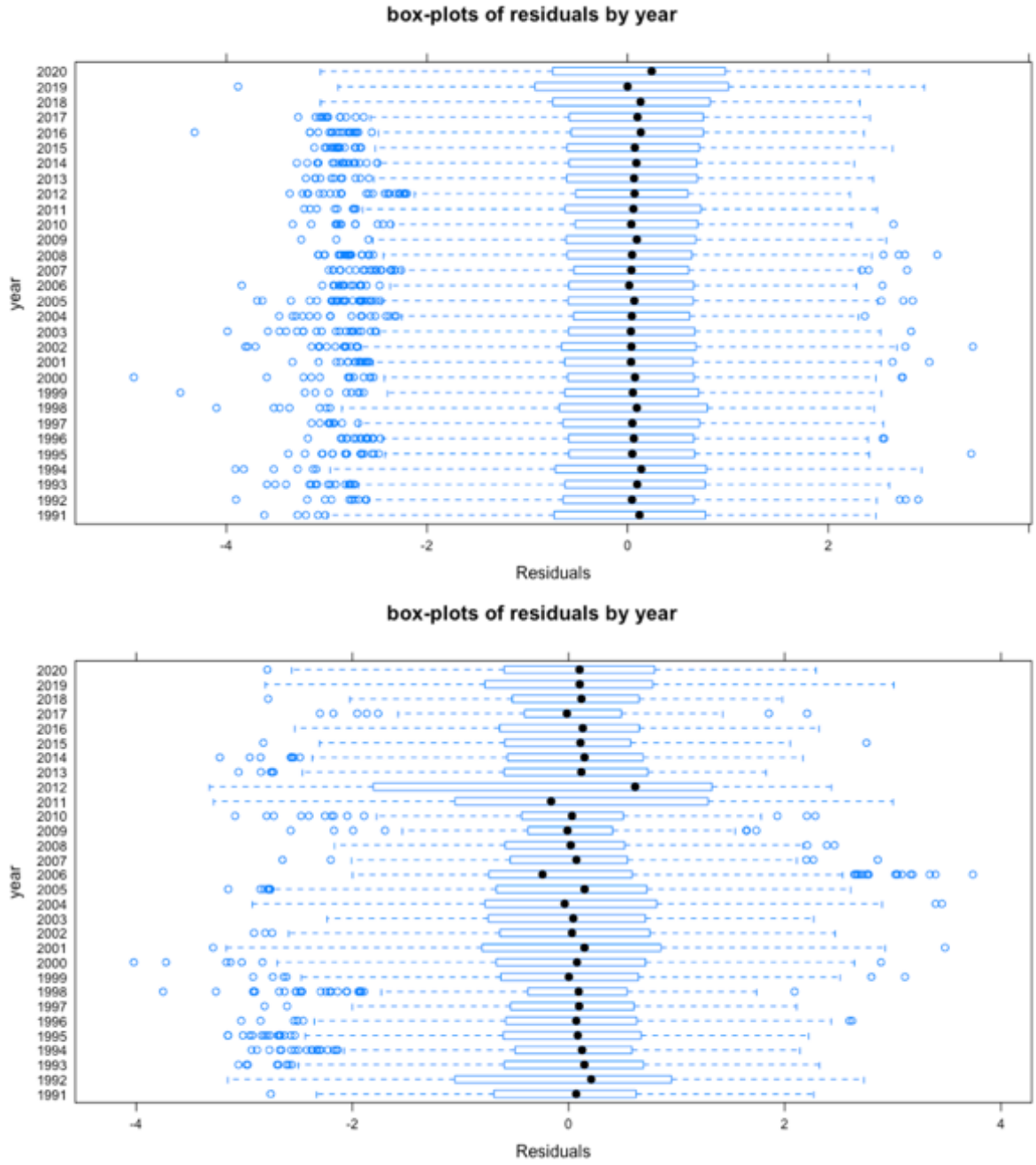


Figure 15. Component 3 (Lognormal LMM) - catch | catch > 0 with adult (upper) or juveniles (lower) YFT in FSC: box-plots of residuals by year

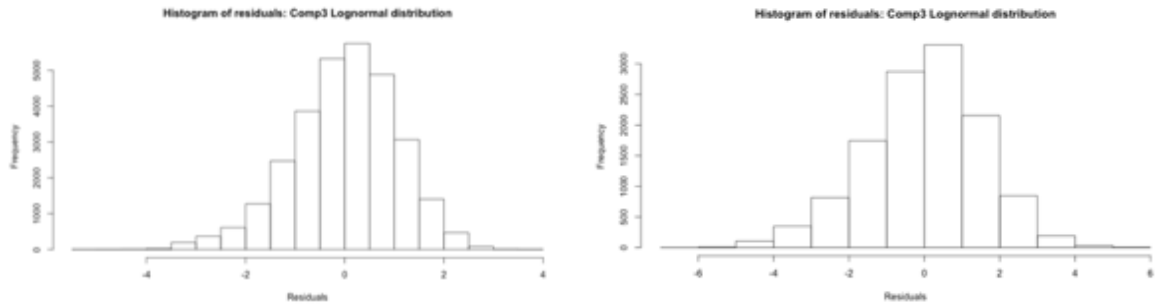


Figure 16. Component 3 (Lognormal LMM) - catch | catch > 0 with adult (left) or juveniles (right) YFT in FSC: histogram of residuals

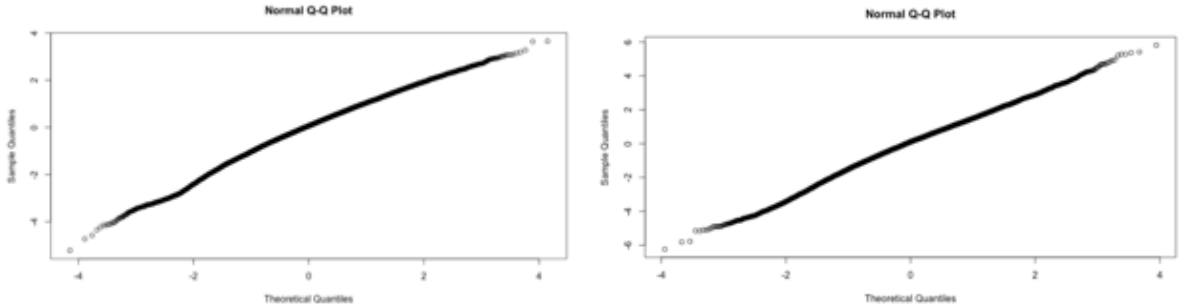


Figure 17. Component 3 (Lognormal LMM) - catch | catch > 0 with adult (left) or juveniles (right) YFT in FSC: normal Q-Q plot

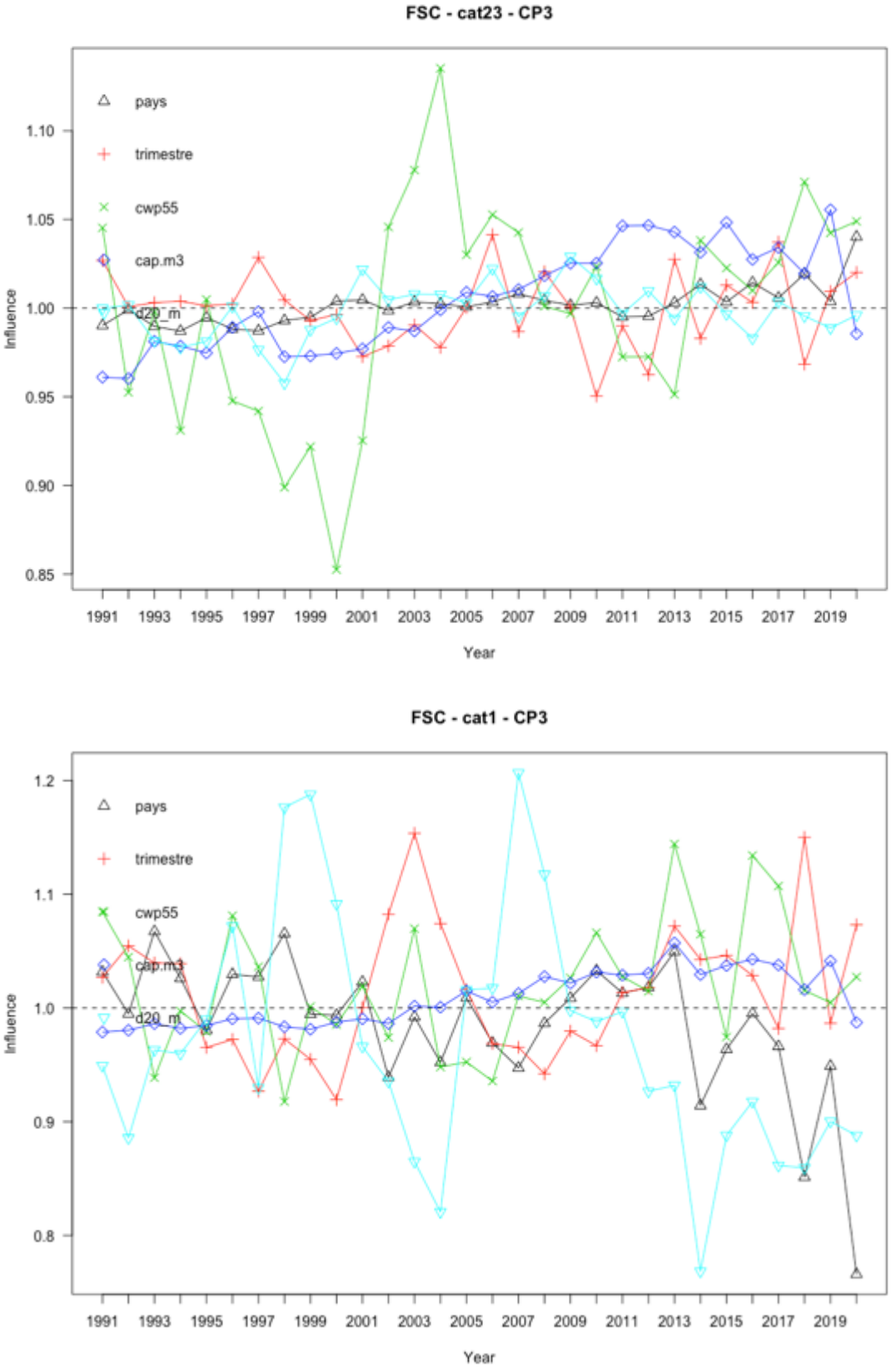


Figure 18. Component 3 (Lognormal LMM) - catch | catch > 0 with adult (left) or juveniles (right) YFT in FSC: influence plot

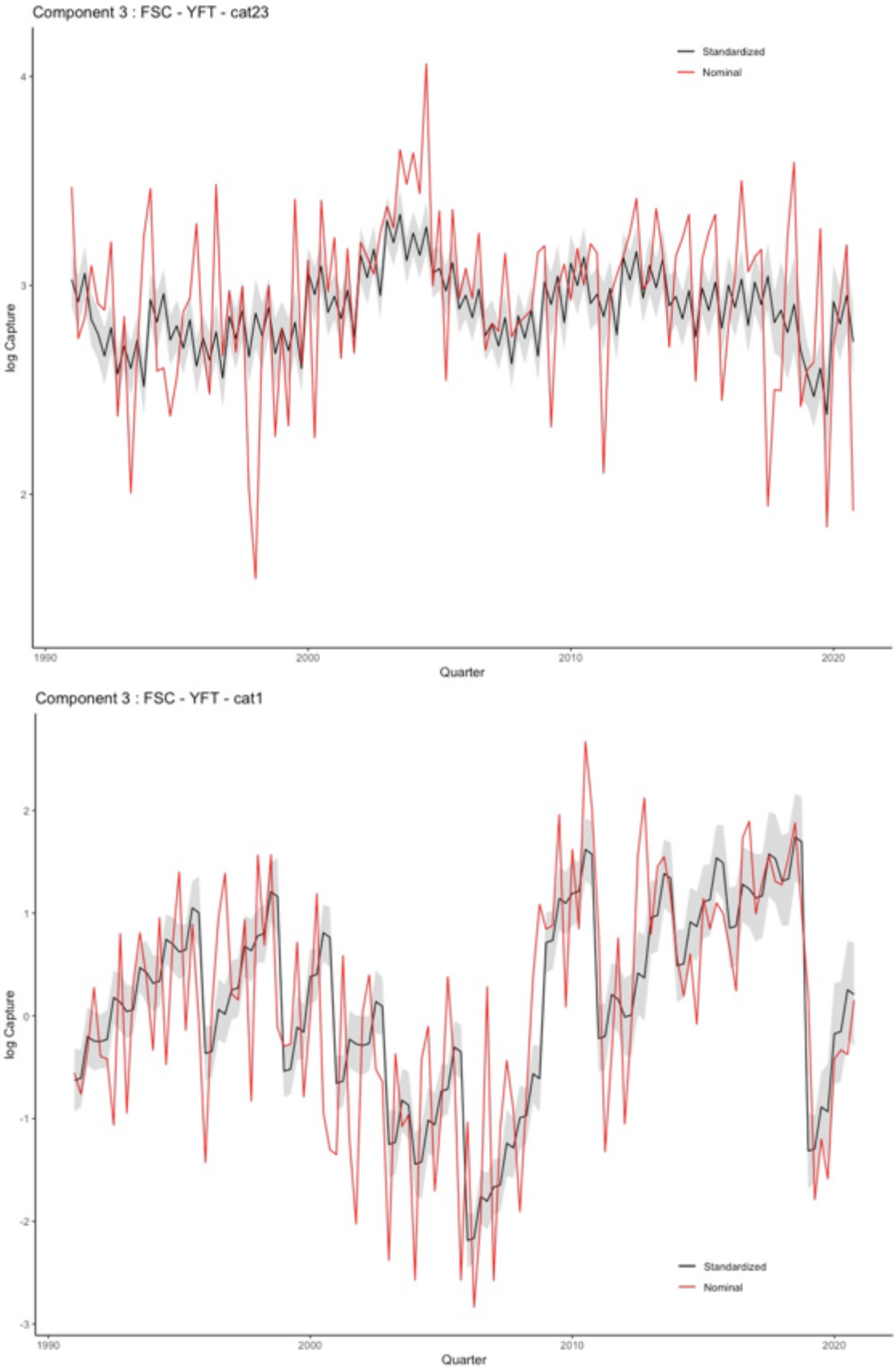


Figure 19. Component 3 (Lognormal LMM) - catch | catch > 0 with adult (upper) or juveniles (lower) YFT: standardised time series by year-quarter (black) with 97.5% confidence intervals (grey) compared to nominal (red)

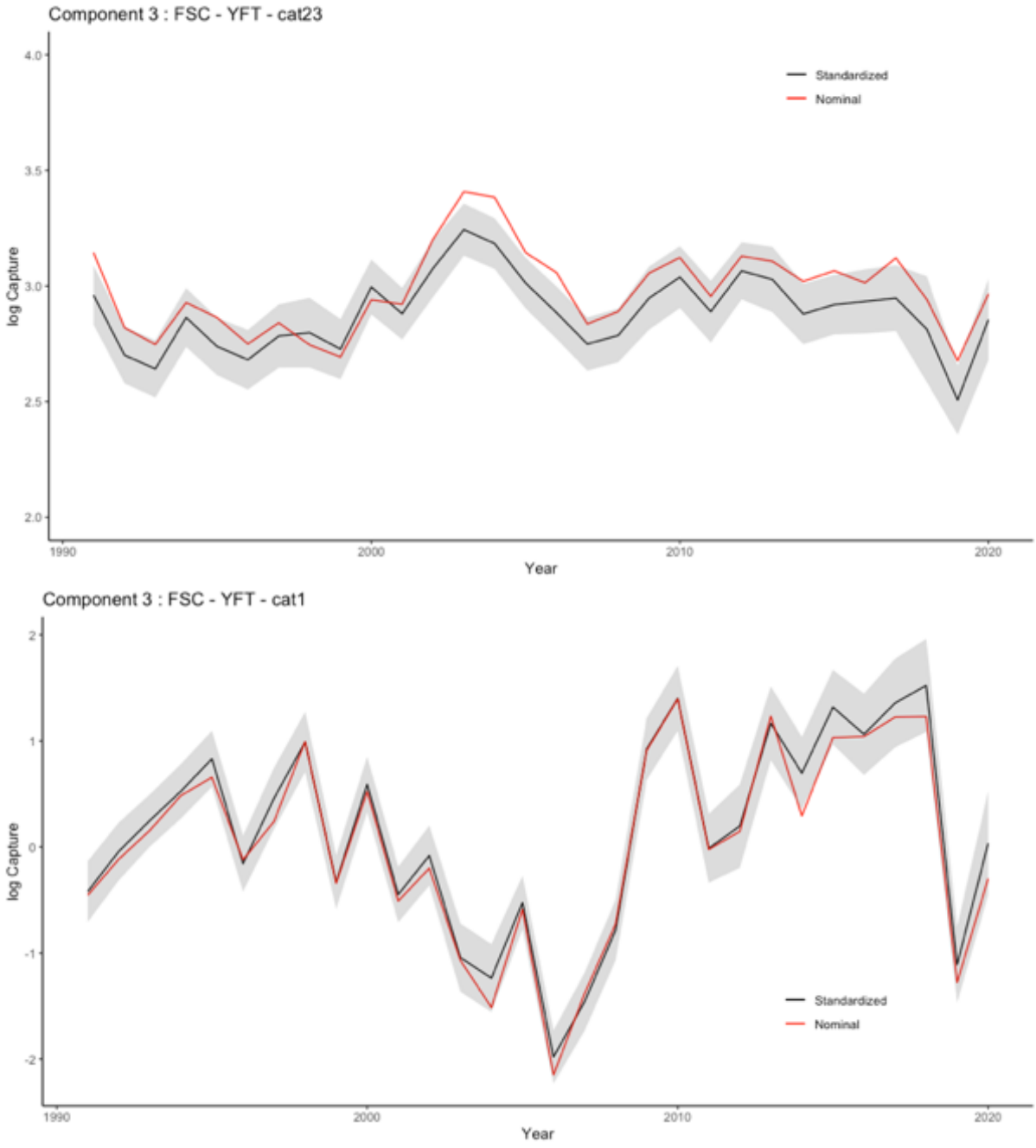


Figure 20. Component 3 (Lognormal LMM) - catch | catch > 0 with adult (upper) or juveniles (lower) YFT: standardised time series by year (black) with 97.5% confidence intervals (grey) compared to nominal (red)

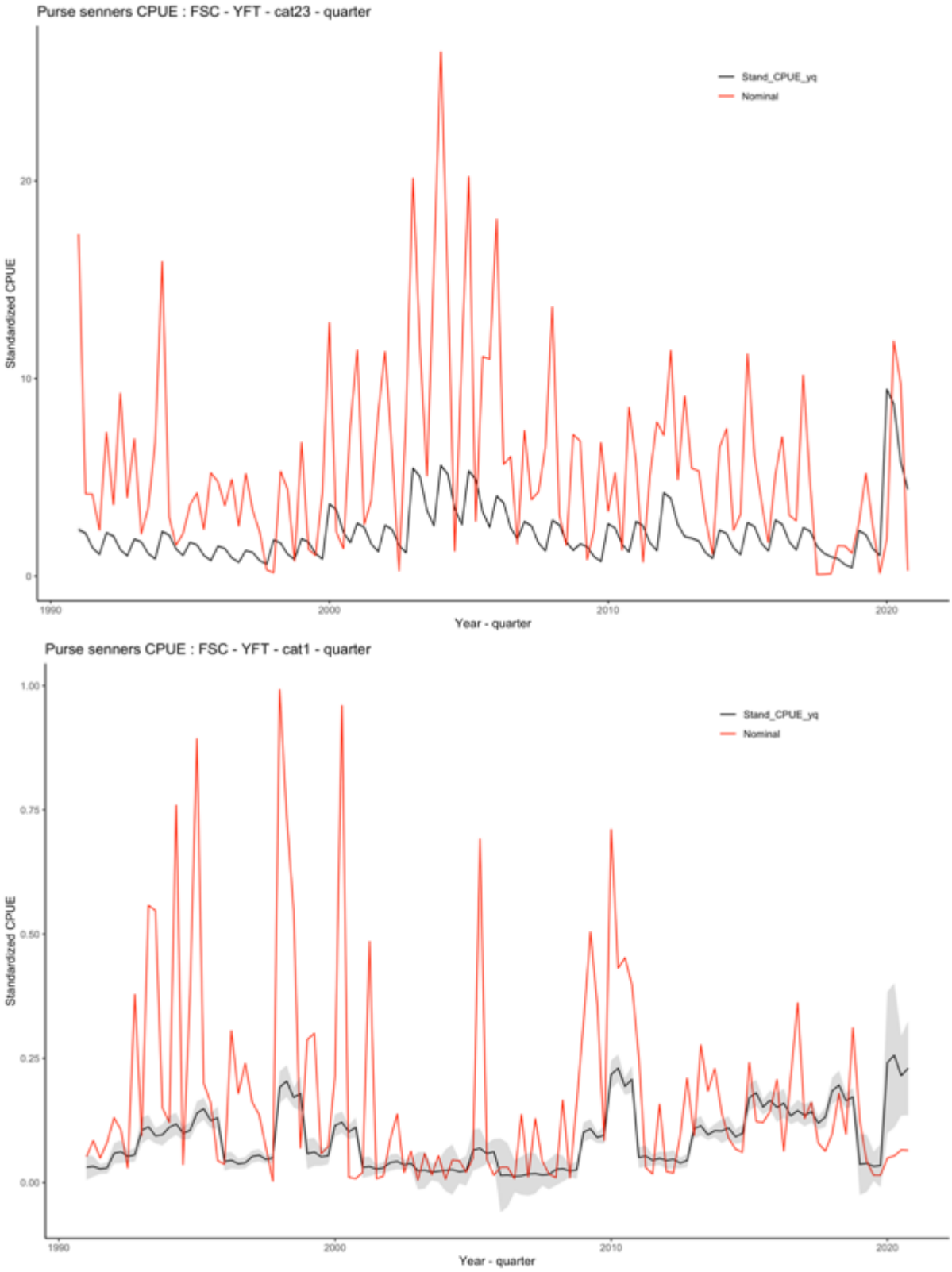


Figure 21. Standardised CPUE for free school sets of adults (upper) or juveniles (lower) yellowfin tuna (black line), with 97.5% CIs (grey,) and compared to nominal CPUE (red). Time series on a quarter basis.

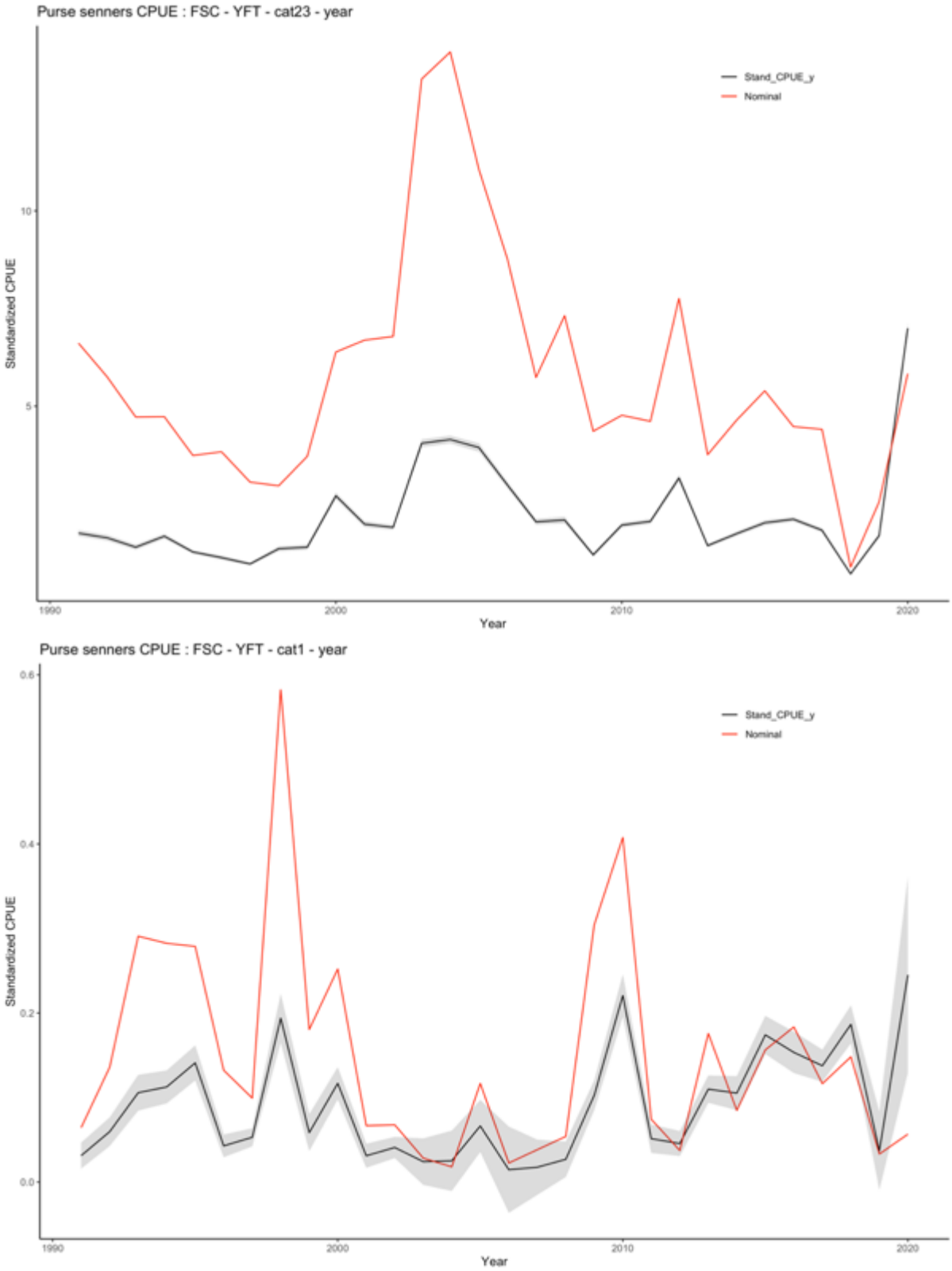


Figure 22. Standardised CPUE for free school sets of adults (upper) or juveniles (lower) yellowfin tuna (black line), with 97.5% CIs (grey,) and compared to nominal CPUE (red). Time series on an annual basis

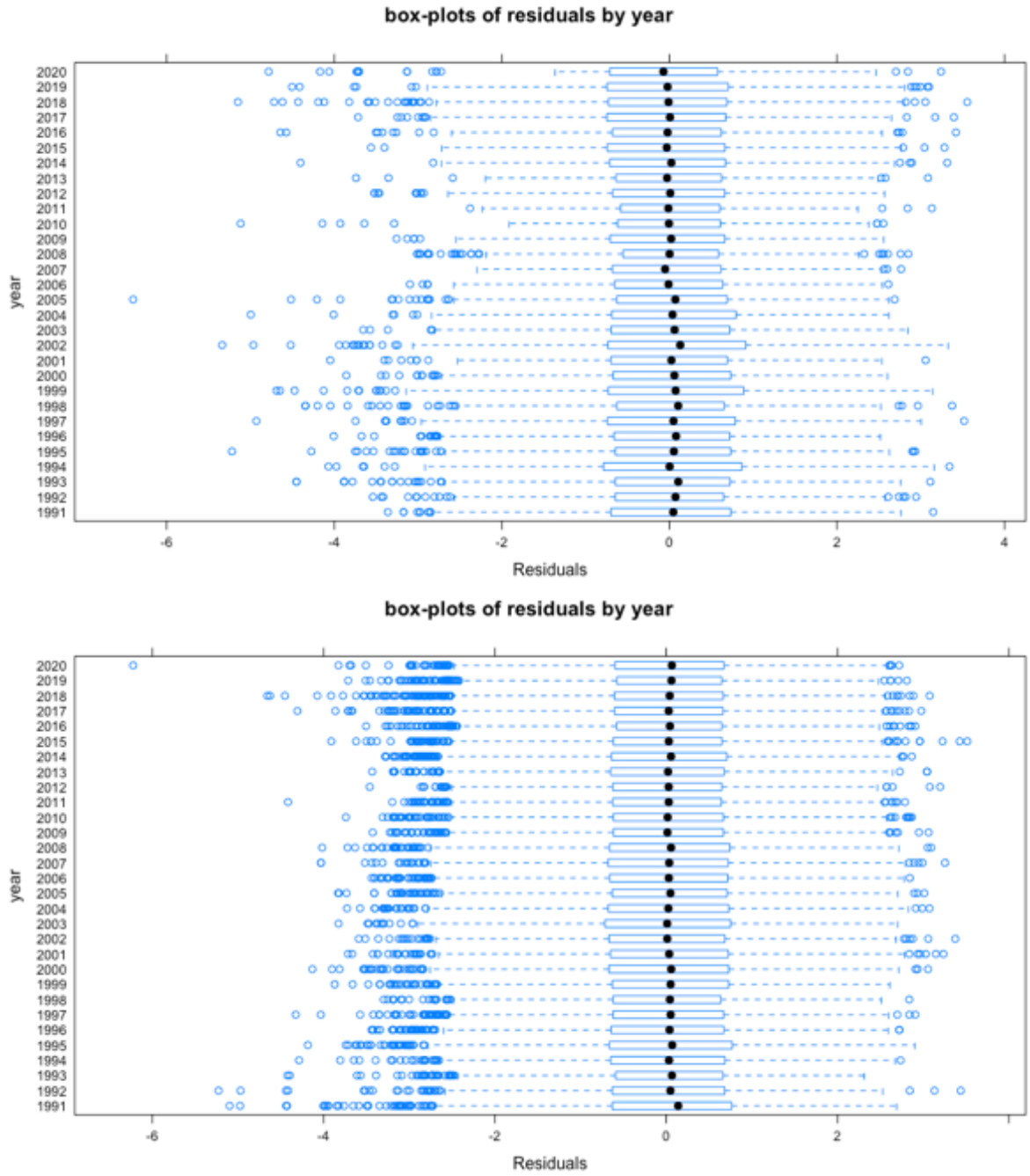


Figure 23. Component 3 (Lognormal LMM) - catch | catch > 0 with adult (upper) or juveniles (lower) YFT under FAD: box-plots of residuals by year

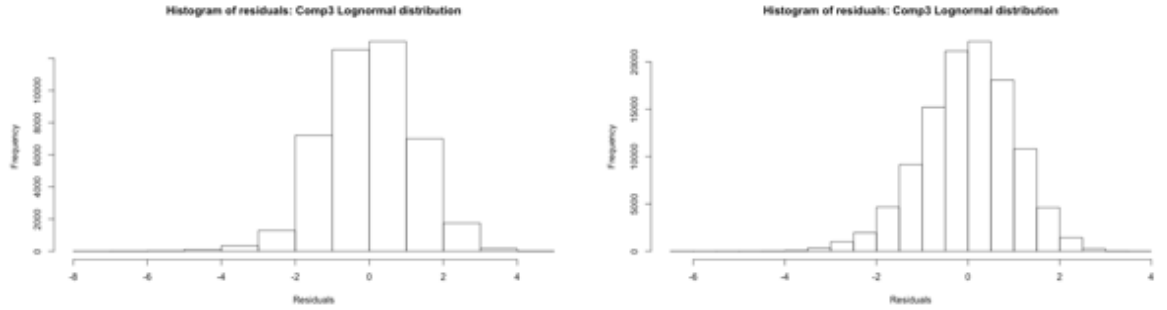


Figure 24. Component 3 (Lognormal LMM) - catch | catch > 0 with adult (left) or juveniles (right) YFT under FAD: histogram of residuals

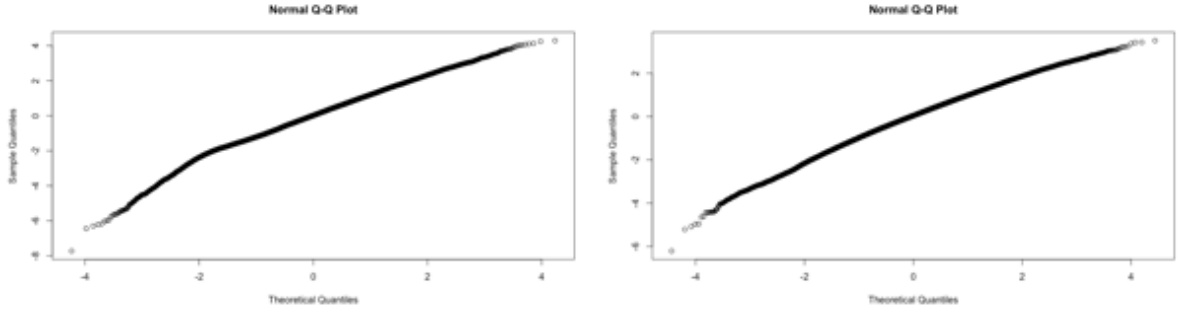


Figure 25. Component 3 (Lognormal LMM) - catch | catch > 0 with adult (left) or juveniles (right) YFT under FAD: normal Q-Q plot

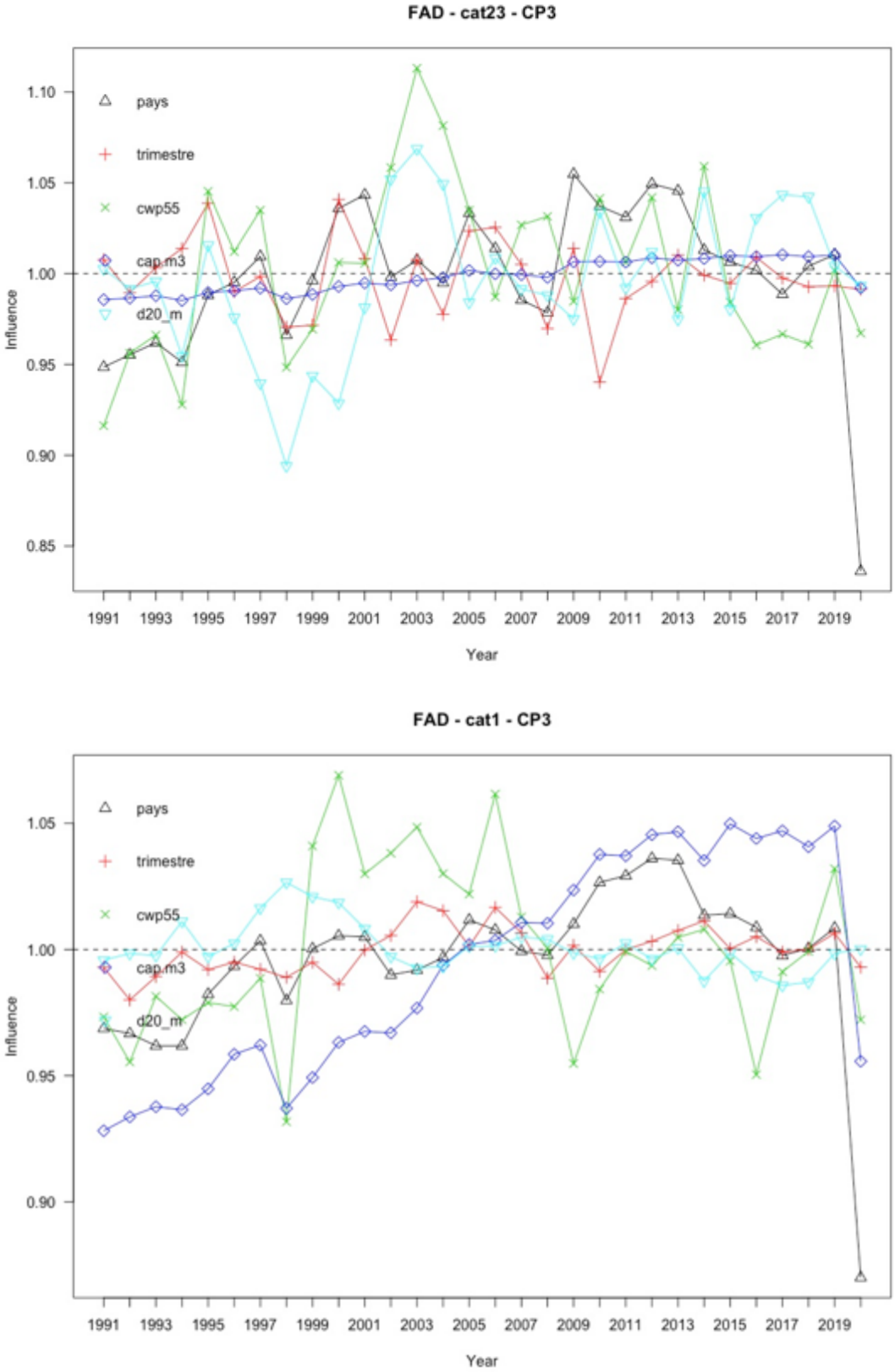


Figure 26. Component 3 (Lognormal LMM) - catch | catch > 0 with adult (upper) or juveniles (lower) YFT under FAD: influence plot

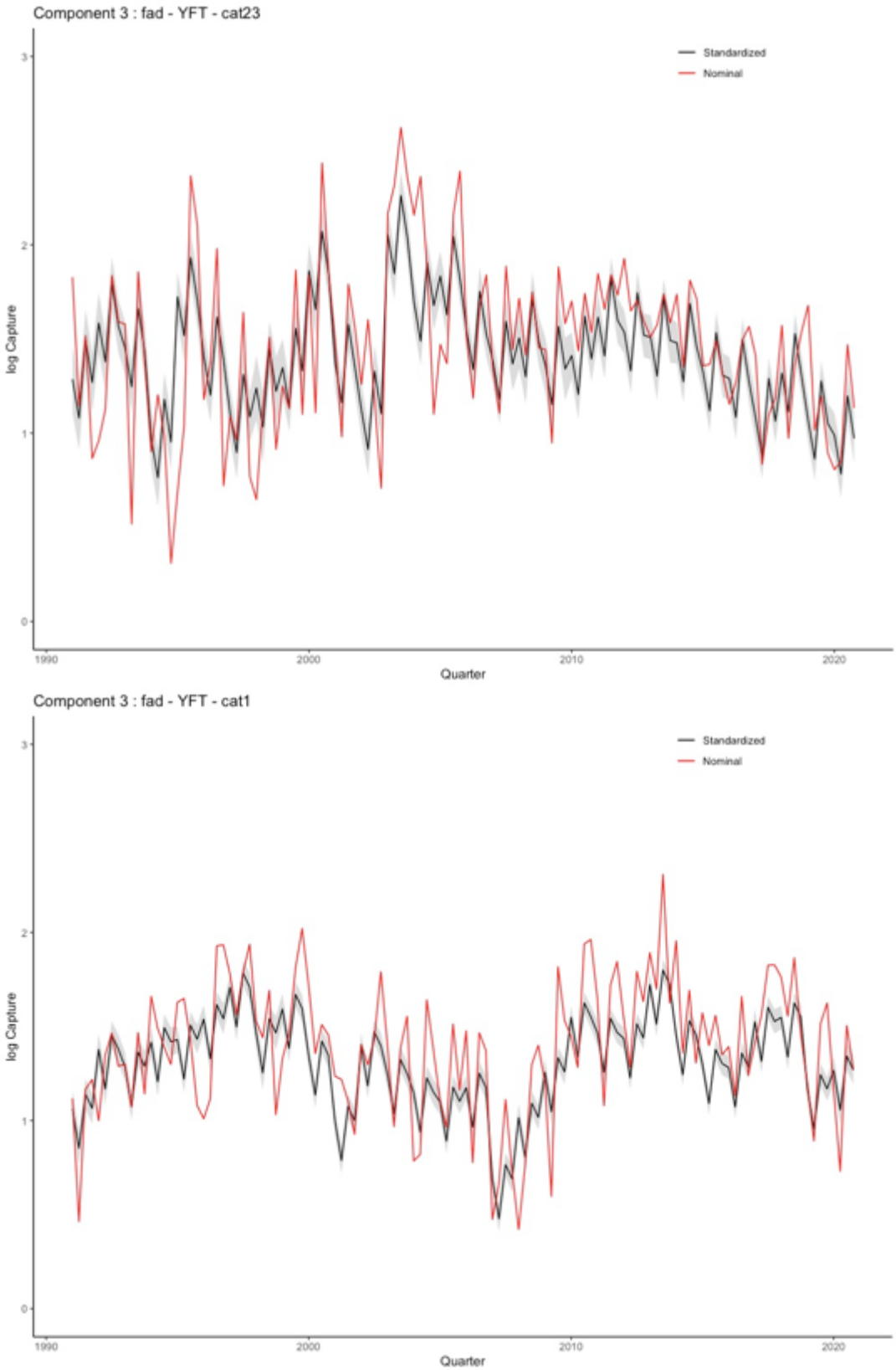


Figure 27. Component 3 (Lognormal LMM) - catch | catch > 0 with adult (upper) or juveniles (lower) YFT under FAD: standardised time series by year-quarter (black) with 97.5% confidence intervals (grey) compared to nominal (red)

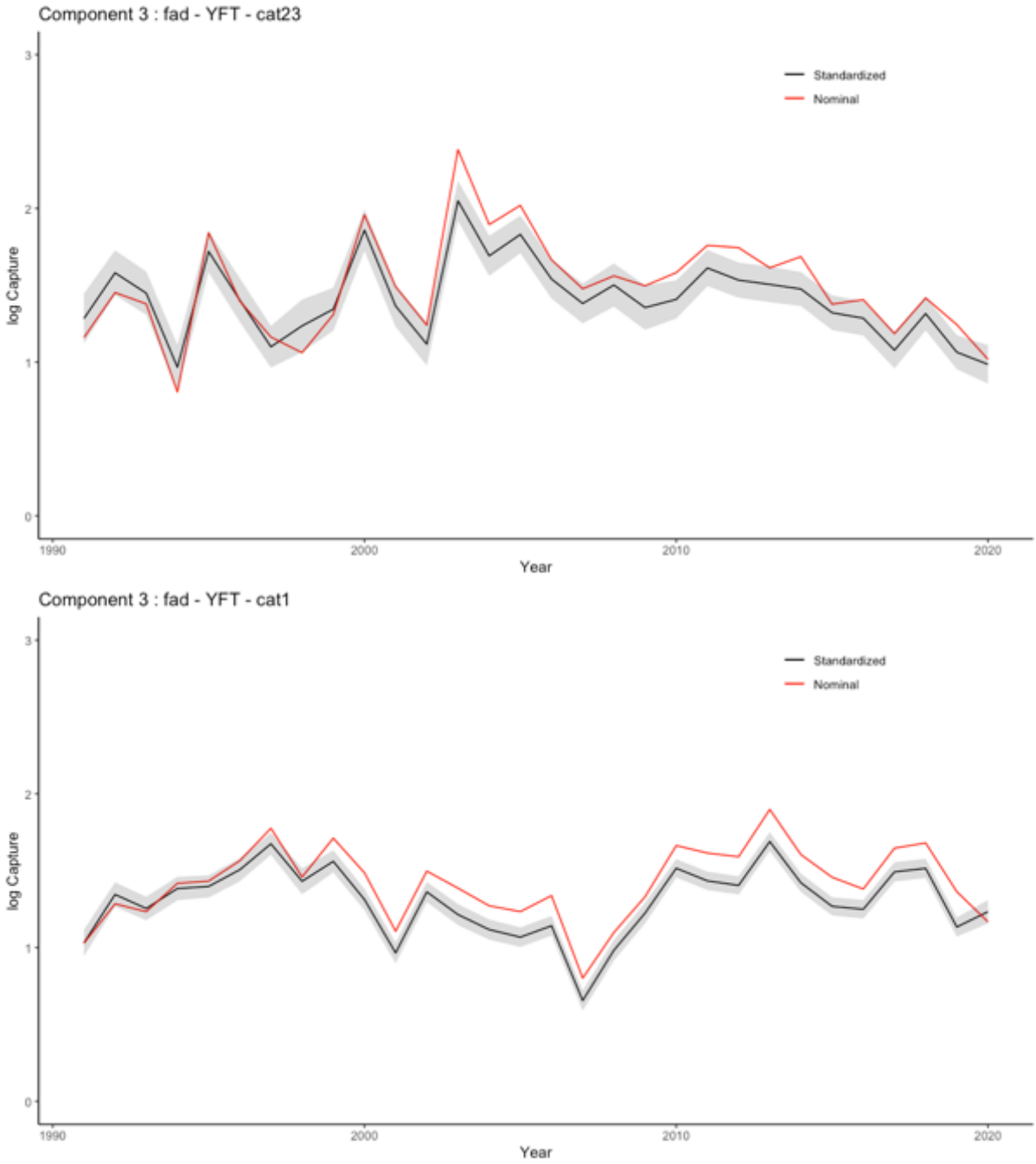


Figure 28. Component 3 (Lognormal LMM) - catch | catch > 0 with adult (upper) or juveniles (lower) YFT under FAD: standardised time series by year (black) with 97.5% confidence intervals (grey) compared to nominal (red)

APPENDICES

DATA PER YEAR-QUARTER
ADULT YFT IN FSC

Year_quarter	Stand CPUE	Lower stand CPUE (IC97.5)	Upper stand CPUE (IC97.5)	SD	CV
1991_1	2,353810088	17,29947637	2,209366606	2,49825357	2,818784376
1991_2	2,177210711	4,159480493	2,085944841	2,268476581	1,716829533
1991_3	1,441487892	4,145674716	1,396076002	1,486899782	0,902404651
1991_4	1,100101069	2,330120544	1,04828725	1,151914888	1,005450909
1992_1	2,193793498	7,273158609	2,09453404	2,293052955	2,085249526
1992_2	2,03003801	3,616294556	1,921920325	2,138155694	1,961134319
1992_3	1,34410793	9,250833611	1,303607996	1,384607864	0,77764418
1992_4	1,025976565	3,977363586	0,968060016	1,083893115	1,151796999
1993_1	1,87143925	6,944626067	1,770552155	1,972326344	2,189850852
1993_2	1,731710351	2,142082453	1,654548406	1,808872296	1,48094337
1993_3	1,146579736	3,451285087	1,107630587	1,185528885	0,813167475
1993_4	0,875192332	6,749057877	0,817338304	0,93304636	1,176776944
1994_1	2,260164224	15,91184402	2,152544309	2,367784138	2,086193938
1994_2	2,0801498	2,986252029	1,99591781	2,16438179	1,517525918
1994_3	1,376477408	1,573493958	1,337840262	1,415114554	0,73569174
1994_4	1,048087304	2,15412116	1,003230826	1,092943782	0,919061392
1995_1	1,716286268	3,61435398	1,650971572	1,781600963	1,419739879
1995_2	1,578934288	4,206503627	1,523030553	1,634838024	1,065626506
1995_3	1,044765752	2,366614912	1,011365199	1,078166305	0,679741223
1995_4	0,795361849	5,220533889	0,746739474	0,843984224	0,949304019
1996_1	1,51511491	4,777036868	1,43629411	1,59393571	1,705107406
1996_2	1,399493283	3,572475007	1,341431757	1,457554809	1,110508807
1996_3	0,926436989	4,899122191	0,895354989	0,957518988	0,561858331
1996_4	0,706581351	2,535296015	0,645178777	0,767983926	1,135570966
1997_1	1,298590757	5,181083407	1,231601083	1,36558043	1,519794672
1997_2	1,198863357	3,324683039	1,149468341	1,248258372	0,969561192
1997_3	0,793578749	2,238549329	0,767005486	0,820152013	0,4977458
1997_4	0,605107188	0,31880345	0,574682941	0,635531434	0,496845682
1998_1	1,830695892	0,174327281	1,721856012	1,939535771	1,579765236
1998_2	1,682093953	5,306045959	1,611056773	1,753131133	1,126536147
1998_3	1,112874898	4,393772404	1,081307917	1,14444188	0,505126995
1998_4	0,846729464	0,772310513	0,776348839	0,91711009	0,85838498
1999_1	1,890431526	6,766759483	1,791866823	1,988996228	2,000249852
1999_2	1,730876986	1,367665376	1,658358551	1,80339542	1,258872146
1999_3	1,144711021	1,050436357	1,108276428	1,181145614	0,479340603
1999_4	0,869547224	4,210464908	0,825956295	0,913138153	0,671637383
2000_1	3,649118796	12,82777968	3,53953685	3,758700742	1,998628868
2000_2	3,3662893	2,243819065	3,274386829	3,458191771	1,479912064
2000_3	2,228104367	1,396077093	2,180659568	2,275549167	0,611728012
2000_4	1,698342564	7,63462934	1,613513286	1,783171843	1,313319336
2001_1	2,676289381	11,44045456	2,559003296	2,793575466	2,229855798
2001_2	2,465924243	2,61581163	2,355637603	2,576210884	1,89240218
2001_3	1,631953164	3,831373726	1,593075427	1,6708309	0,569806675
2001_4	1,243257869	8,26386329	1,200164838	1,2863509	0,744054083
2002_1	2,579113458	11,3673939	2,468968584	2,689258333	2,053820055
2002_2	2,359873313	6,225435525	2,283839753	2,435906872	1,302638525
2002_3	1,560583794	0,267886028	1,524093831	1,597073756	0,505129254
2002_4	1,185093858	8,128230214	1,145813555	1,22437416	0,666504657
2003_1	5,450874032	20,11998534	5,316531804	5,585216261	2,331327161
2003_2	5,040385419	11,58006622	4,918075722	5,162695117	1,932252939
2003_3	3,33702943	5,082225859	3,274959923	3,399098937	0,969849447
2003_4	2,546371287	15,66778924	2,462366307	2,630376268	1,434246085
2004_1	5,589264416	26,51177247	5,479928852	5,698599979	2,115043262
2004_2	5,157751626	14,81902324	5,038347051	5,2771562	2,000397616
2004_3	3,413972125	1,273313248	3,33683415	3,4911101	1,122436639
2004_4	2,602643927	11,13419842	2,503684239	2,701603616	1,816537505
2005_1	5,31700028	20,1998448	5,179647768	5,454352791	2,786973668
2005_2	4,905499257	2,77881894	4,782021295	5,028977219	2,328387381
2005_3	3,246931096	11,10412276	3,185954642	3,30790755	1,16460064

[1]Corresponding author: lorelei.guery@cirad.fr
[2]Centre International de Recherche en Agronomie pour le Développement (CIRAD), UMR PHIM, Team PRISM – FORISK, TA A-120 / D Campus international de Baillarguet 34398 Montpellier Cedex 5 France
[3]Institut de Recherche pour le Développement (IRD), UMR MARBEC, CS 30171, Av. JeanMonnet, 34203 Sete Cedex, France
[4]AZTI, Marine Research, Basque Research and Technology Alliance (BRTA). Txatxarramendi ugartea z/g, 48395 Sukarrieta - Bizkaia, Spain
[5]Instituto Español de Oceanografía (IEO), Centro Oceanográfico de Canarias. Vía Espaldón, dársenapesquera, Parcela 8 38180 Santa Cruz de Tenerife, Spain
[6]Instituto Español de Oceanografía (IEO), Centro Oceanográfico de Málaga, Puerto Pesquero, s/n Apdo., 29640, Fuengirola, Málaga, Spain

2005_4	2,475067767	10,97215184	2,360645634	2,589489899	2,175621316
2006_1	4,051377365	18,05001066	3,924397784	4,178356946	2,661997762
2006_2	3,708942322	5,654207956	3,604709322	3,813175322	2,059508654
2006_3	2,452863824	6,046478849	2,391532562	2,514195086	1,084680777
2006_4	1,863134473	1,631474681	1,798647892	1,927621054	1,03315317
2007_1	2,765622953	7,36401784	2,665867205	2,8653787	2,134078824
2007_2	2,5385513	3,867352704	2,453974223	2,623128377	1,609418649
2007_3	1,679322236	4,25889034	1,632346206	1,726298267	0,823652933
2007_4	1,277115553	6,512275916	1,208275626	1,345955481	1,317892741
2008_1	2,818952668	13,61874776	2,688057501	2,949847835	2,706557246
2008_2	2,596148091	3,093201512	2,507665194	2,684630989	1,571848197
2008_3	1,718047416	1,564446137	1,664234895	1,771859937	0,85794244
2008_4	1,308563792	7,16551025	1,238447923	1,378679662	1,16515584
2009_1	1,630186746	6,822844564	1,555127815	1,705245677	1,288288757
2009_2	1,487244039	0,84088586	1,413365566	1,561122511	1,012137075
2009_3	0,983200235	2,349415479	0,957072487	1,009327983	0,303171125
2009_4	0,745630517	6,754237964	0,698173648	0,793087385	0,631593561
2010_1	2,651565251	3,291162532	2,574268064	2,728862439	1,14610901
2010_2	2,434066553	5,22333076	2,358016357	2,510116748	1,117797282
2010_3	1,610217667	1,33187387	1,570452761	1,649982573	0,468825539
2010_4	1,224609931	8,54547447	1,163607698	1,285612164	0,838558468
2011_1	2,760229527	5,796517513	2,656740548	2,863718507	1,488537676
2011_2	2,553883877	0,717513081	2,46336225	2,644405503	1,275750141
2011_3	1,690929242	5,081459336	1,654918495	1,72693999	0,516446678
2011_4	1,290639145	7,788206644	1,25129229	1,329986	0,527377416
2012_1	4,209523072	7,127305835	4,094590759	4,324455384	1,825807296
2012_2	3,938114761	11,42500262	3,842750441	4,03347908	1,413116457
2012_3	2,610546918	4,880910902	2,558973214	2,662120621	0,806089976
2012_4	2,002574431	9,110512894	1,924232041	2,080916822	1,192719014
2013_1	1,920207121	5,450292732	1,84611878	1,994295462	1,192535231
2013_2	1,782103968	5,324378998	1,712743429	1,851464506	1,10486952
2013_3	1,180323814	2,858965585	1,155550144	1,205097483	0,36673851
2013_4	0,902162745	1,112209434	0,871217963	0,933107528	0,3946563
2014_1	2,32486738	6,520465943	2,251872521	2,397862239	1,303969131
2014_2	2,157069511	7,462712724	2,083043055	2,231095966	1,319959713
2014_3	1,42862881	2,319336059	1,39000302	1,467254601	0,671049411
2014_4	1,091815079	3,130111381	1,039780838	1,143849319	0,911730216
2015_1	2,699691173	11,2395164	2,601536704	2,797845642	1,7133848
2015_2	2,511260119	6,082189391	2,424057799	2,598462438	1,489320942
2015_3	1,663669678	3,789603056	1,621016162	1,706323194	0,722602616
2015_4	1,272919878	1,693135783	1,227537964	1,318301793	0,771119788
2016_1	2,834218385	5,158800697	2,745748494	2,922688276	1,494512458
2016_2	2,622480169	7,046061441	2,553195245	2,691765094	1,095005653
2016_3	1,736356864	3,083437639	1,698426771	1,774286957	0,572669663
2016_4	1,325344684	2,80267644	1,274560537	1,376128831	0,794884554
2017_1	2,450917264	10,17071383	2,377165455	2,524669074	1,215972598
2017_2	2,273153337	4,691381756	2,207654629	2,338652045	0,998655255
2017_3	1,505449028	0,078817518	1,469988324	1,540909733	0,467390023
2017_4	1,150324575	0,092786568	1,09192203	1,20872712	0,701213069
2018_1	0,978903937	0,129314619	0,942772326	1,015035549	0,414527681
2018_2	0,880675762	1,544702178	0,845232341	0,916119182	0,29381205
2018_3	0,581322912	1,524338525	0,562254463	0,600391362	0,168282204
2018_4	0,438060162	1,162772559	0,418858685	0,45726164	0,151014486
2019_1	2,303935172	2,720591249	2,22613878	2,381731563	1,041577917
2019_2	2,098011738	5,196413873	2,025307853	2,170715623	0,840790058
2019_3	1,386691283	2,508875303	1,34248711	1,430895456	0,517384714
2019_4	1,050731186	0,147867484	1,009169886	1,092292485	0,319319244

JUVENILES YFT IN FSC

Year_quarter	Stand CPUE	Lower stand CPUE (IC97.5)	Upper stand CPUE (IC97.5)	SD	CV
1991_1	0,030805054	0,005606141	0,056003967	0,322126315	6,884860647
1991_2	0,032568356	0,012096283	0,053040429	0,236668981	4,742455588
1991_3	0,027380794	0,017745918	0,037015671	0,047776517	1,140646333
1991_4	0,029532332	0,018255233	0,040809431	0,071555495	1,653222538
1992_1	0,058771408	0,038291882	0,079250933	0,160652028	1,857017105
1992_2	0,062255145	0,039225443	0,085284847	0,160917716	1,740144343
1992_3	0,052319719	0,040778713	0,063860724	0,055678578	0,717670362
1992_4	0,055936462	0,042030379	0,069842546	0,093666088	1,179706208
1993_1	0,10489052	0,078574355	0,131206686	0,192099978	1,455450874
1993_2	0,112152742	0,088137733	0,13616775	0,216706129	1,523683071
1993_3	0,094087154	0,079003646	0,109170662	0,16323495	1,3701353
1993_4	0,09612845	0,074667121	0,117589779	0,205444371	1,747566187
1994_1	0,111193518	0,087301771	0,135085265	0,196455698	1,254003144
1994_2	0,118072188	0,095951997	0,140192378	0,220476947	1,313181643
1994_3	0,099182656	0,085740508	0,112624804	0,143975954	1,02264133
1994_4	0,104829303	0,088071169	0,121587436	0,201903287	1,41754847
1995_1	0,139568432	0,116107226	0,163029637	0,290081015	1,551210983
1995_2	0,148615662	0,126542894	0,170688431	0,253342901	1,260926994
1995_3	0,124773916	0,109307023	0,140240809	0,211841497	1,257983544
1995_4	0,130097553	0,107281929	0,152913177	0,278117767	1,651213212
1996_1	0,042298901	0,024309974	0,060287829	0,18179383	3,085996501
1996_2	0,044943822	0,028176129	0,061711514	0,162611355	2,574112165
1996_3	0,037749076	0,027301138	0,048197015	0,04129992	0,779738523
1996_4	0,039777597	0,028528494	0,0510267	0,039054156	0,73084387
1997_1	0,052170158	0,039866633	0,064473684	0,107938798	1,390307609
1997_2	0,055226864	0,042874135	0,067579593	0,087030545	1,049471021
1997_3	0,046418845	0,038383245	0,054454444	0,073012403	1,049277913
1997_4	0,049775647	0,0406959	0,058855393	0,05871063	0,821802923
1998_1	0,191829059	0,159976152	0,223681966	0,339992022	1,310662487
1998_2	0,204155918	0,172112654	0,236199182	0,372615132	1,337530205
1998_3	0,171421218	0,15141276	0,191429676	0,213098037	0,912575022
1998_4	0,179201991	0,144496785	0,213907198	0,28886384	1,234305998
1999_1	0,057880663	0,027336331	0,088424995	0,393511407	5,105815645
1999_2	0,061655177	0,033488735	0,089821618	0,312165192	3,768723675
1999_3	0,051760545	0,033538717	0,069982373	0,043040639	0,620005749
1999_4	0,053871699	0,037188821	0,070554576	0,097792814	1,410316888
2000_1	0,114955257	0,092773953	0,137136562	0,188934682	1,050783334
2000_2	0,121289673	0,099720867	0,142858478	0,193417624	1,010861159
2000_3	0,102009947	0,087741368	0,116278527	0,091121149	0,567149265
2000_4	0,1110398	0,090967313	0,131112288	0,2048296	1,220979057
2001_1	0,03057158	0,009745888	0,051397271	0,254970147	5,285479203
2001_2	0,032235139	0,012628269	0,051842008	0,236633344	4,613033871
2001_3	0,027114556	0,017550784	0,036678329	0,031498218	0,731169156
2001_4	0,029602244	0,018445416	0,040759072	0,068058692	1,507957803
2002_1	0,040306862	0,02407025	0,056543474	0,10058608	1,638000584
2002_2	0,04260549	0,027172767	0,058038213	0,089036228	1,359675425
2002_3	0,035820571	0,026191556	0,045449587	0,025780529	0,469046438
2002_4	0,038670569	0,028670647	0,048670492	0,050962767	0,896361526
2003_1	0,023760167	-0,013884137	0,061404471	0,394812767	10,58495741
2003_2	0,025062717	-0,011804059	0,061929493	0,353525906	8,909335797
2003_3	0,021079929	0,004669095	0,037490762	0,120258668	3,609091568
2003_4	0,022973805	0,000975463	0,044972148	0,223672477	6,419937393
2004_1	0,024758609	-0,016922042	0,06643926	0,506652828	13,26322477
2004_2	0,026148258	-0,024410243	0,07670676	0,5041664	12,3887242
2004_3	0,021987744	-0,001661573	0,045637061	0,179635068	5,257974281
2004_4	0,023829043	-0,006332831	0,053990917	0,368288415	10,37586562
2005_1	0,065400291	0,024096094	0,106704489	0,431007201	4,398180996
2005_2	0,069203116	0,029881655	0,108524578	0,492363152	4,705924314
2005_3	0,058170731	0,037641854	0,078699607	0,111613156	1,271248494
2005_4	0,062497313	0,037225467	0,08776916	0,234394072	2,594790068
2006_1	0,014420781	-0,05969471	0,088536272	1,304871366	61,48617078
2006_2	0,015275799	-0,048604854	0,079156452	1,119598551	49,35340943
2006_3	0,012837869	-0,019481036	0,045156774	0,470424158	24,71730906
2006_4	0,013724447	-0,024677185	0,052126079	0,51151525	26,26360347
2007_1	0,01724412	-0,025996412	0,060484651	0,723913947	27,79089063
2007_2	0,018237568	-0,022354826	0,058829963	0,644785241	23,19801135
2007_3	0,015331618	-0,006307316	0,036970551	0,23857688	10,2275544

2007_4	0,016510046	-0,01333435	0,046354441	0,456685698	18,97959003
2008_1	0,026456458	-0,005641555	0,05855447	0,431835367	10,32330356
2008_2	0,027891806	0,001836739	0,053946873	0,315854001	7,101958995
2008_3	0,023461856	0,010797617	0,036126096	0,081114529	2,171686596
2008_4	0,025632312	0,008112346	0,043152277	0,154450245	3,943808179
2009_1	0,101545342	0,081831909	0,121258775	0,228876697	1,580108496
2009_2	0,107754685	0,088286206	0,127223164	0,19619244	1,264715612
2009_3	0,090527357	0,079556769	0,101497946	0,080175216	0,61626178
2009_4	0,095988666	0,078607235	0,113370097	0,185220096	1,402963065
2010_1	0,217529303	0,188959828	0,246098778	0,275797637	0,848349099
2010_2	0,230214891	0,20269436	0,257735422	0,295014724	0,849806245
2010_3	0,193508	0,176570417	0,210445583	0,143586685	0,492902679
2010_4	0,207748175	0,180931184	0,234565166	0,327415502	1,093296451
2011_1	0,050469742	0,029610775	0,071328708	0,093363107	1,184613816
2011_2	0,053257055	0,031941732	0,074572377	0,087830351	1,047085157
2011_3	0,044790515	0,033524119	0,056056912	0,028263944	0,401295224
2011_4	0,04872935	0,035007291	0,062451409	0,046468597	0,632254115
2012_1	0,044597773	0,027683751	0,061511795	0,052344028	0,680438103
2012_2	0,046670875	0,02796874	0,06537301	0,028943422	0,356834067
2012_3	0,039313523	0,028630404	0,049996642	0,032177338	0,471616096
2012_4	0,044467364	0,031198237	0,057736491	0,055809643	0,750290059
2013_1	0,108234733	0,088965855	0,127503612	0,195297603	1,161260304
2013_2	0,114253176	0,094661154	0,133845197	0,19410416	1,0839927
2013_3	0,096083183	0,085668731	0,106497635	0,085410851	0,568109834
2013_4	0,104363083	0,090818407	0,117907759	0,117060036	0,747533823
2014_1	0,103791434	0,079787581	0,127795287	0,158100792	1,036490241
2014_2	0,109954041	0,086459021	0,13344906	0,159711211	0,979430017
2014_3	0,0924046	0,077982586	0,106826613	0,127232564	0,930037339
2014_4	0,098749711	0,080706129	0,116793294	0,20391683	1,457167933
2015_1	0,171307481	0,144155721	0,198459241	0,320944397	1,188436599
2015_2	0,180642048	0,154408719	0,206875378	0,278685539	0,97037886
2015_3	0,151944822	0,136590266	0,167299378	0,172055622	0,713384438
2015_4	0,165831804	0,146465877	0,18519773	0,21703057	0,859229005
2016_1	0,151177261	0,12192811	0,180426411	0,260784183	1,133736524
2016_2	0,159812192	0,130712296	0,188912089	0,196202896	0,799809692
2016_3	0,134359936	0,117853152	0,150866719	0,131658706	0,639432066
2016_4	0,144994152	0,123506389	0,166481915	0,218286309	1,02533508
2017_1	0,135265496	0,11311273	0,157418261	0,197863364	0,906760475
2017_2	0,142378696	0,120855482	0,163901909	0,179948115	0,77703589
2017_3	0,119801452	0,106742075	0,132860828	0,100739528	0,517788472
2017_4	0,131833102	0,111541855	0,152124348	0,180597301	0,878076767
2018_1	0,184506466	0,157925951	0,21108698	0,198505896	0,786828775
2018_2	0,196240713	0,167375242	0,225106184	0,169904802	0,627434732
2018_3	0,164794516	0,149105285	0,180483746	0,104771903	0,461539215
2018_4	0,17280152	0,154987975	0,190615065	0,122965203	0,539165733
2019_1	0,036523413	-0,024972488	0,098019314	0,470582894	9,365181094
2019_2	0,038833072	-0,019172358	0,096838503	0,508812961	9,43685261
2019_3	0,032612435	0,002845609	0,062379261	0,17112952	3,785901253
2019_4	0,034253715	-0,008943557	0,077450986	0,177551528	3,904322823

ADULT YFT IN FAD

Year_quarter	Stand CPUE	Lower stand CPUE (IC97.5)	Upper stand CPUE (IC97.5)
1991_1	1.2865549	1.4657444	1.1073653
1991_2	1.0802954	1.2484972	0.9120935
1991_3	1.4953052	1.6566891	1.3339213
1991_4	1.2690513	1.4264290	1.1116737
1992_1	1.5845421	1.7435610	1.4255232
1992_2	1.3782826	1.5320328	1.2245324
1992_3	1.7932924	1.9312112	1.6553736
1992_4	1.5670386	1.7079795	1.4260976
1993_1	1.4521061	1.5907146	1.3134977
1993_2	1.2458466	1.3864348	1.1052585
1993_3	1.6608564	1.7936945	1.5280184
1993_4	1.4346026	1.5822713	1.2869339
1994_1	0.9701796	1.1226992	0.8176599
1994_2	0.7639200	0.9154719	0.6123682
1994_3	1.1789299	1.3187902	1.0390695
1994_4	0.9526760	1.0989887	0.8063633
1995_1	1.7235419	1.8540247	1.5930591
1995_2	1.5172824	1.6553420	1.3792228
1995_3	1.9322922	2.0625060	1.8020784
1995_4	1.7060384	1.8461867	1.5658900
1996_1	1.4072144	1.5549806	1.2594482
1996_2	1.2009549	1.3439046	1.0580052
1996_3	1.6159647	1.7526220	1.4793074
1996_4	1.3897109	1.5323744	1.2470474
1997_1	1.1033341	1.2408264	0.9658418
1997_2	0.8970746	1.0365770	0.7575722
1997_3	1.3120844	1.4447521	1.1794168
1997_4	1.0858306	1.2180072	0.9536539
1998_1	1.2394295	1.4087338	1.0701252
1998_2	1.0331700	1.2203386	0.8460014
1998_3	1.4481798	1.5917033	1.3046563
1998_4	1.2219260	1.4051408	1.0387112
1999_1	1.3478694	1.4998332	1.1959057
1999_2	1.1416099	1.2747840	1.0084359
1999_3	1.5566197	1.6900681	1.4231714
1999_4	1.3303659	1.4727303	1.1880015
2000_1	1.8620323	2.0017240	1.7223407
2000_2	1.6557728	1.7945999	1.5169458
2000_3	2.0707826	2.2013529	1.9402124
2000_4	1.8445288	1.9798355	1.7092221
2001_1	1.3683159	1.5106655	1.2259663
2001_2	1.1620564	1.2958133	1.0282995
2001_3	1.5770662	1.7096166	1.4445158
2001_4	1.3508124	1.4837095	1.2179152
2002_1	1.1203735	1.2641907	0.9765562
2002_2	0.9141140	1.0512708	0.7769571
2002_3	1.3291238	1.4650013	1.1932462
2002_4	1.1028699	1.2421020	0.9636378
2003_1	2.0527953	2.1880476	1.9175431
2003_2	1.8465358	1.9794593	1.7136124
2003_3	2.2615456	2.3855403	2.1375510
2003_4	2.0352918	2.1663847	1.9041989
2004_1	1.6949526	1.8272337	1.5626715
2004_2	1.4886931	1.6165442	1.3608419
2004_3	1.9037029	2.0313431	1.7760627
2004_4	1.6774490	1.8088984	1.5459997
2005_1	1.8343087	1.9635932	1.7050242
2005_2	1.6280492	1.7534343	1.5026642
2005_3	2.0430590	2.1607247	1.9253934
2005_4	1.8168052	1.9398741	1.6937363
2006_1	1.5439408	1.6716952	1.4161864
2006_2	1.3376813	1.4589104	1.2164521
2006_3	1.7526911	1.8829537	1.6224284
2006_4	1.5264372	1.6507371	1.4021373
2007_1	1.3849107	1.5064621	1.2633594
2007_2	1.1786512	1.3085665	1.0487360
2007_3	1.5936610	1.7199916	1.4673304
2007_4	1.3674072	1.5089934	1.2258210
2008_1	1.5051216	1.6683225	1.3419206
2008_2	1.2988621	1.4406122	1.1571120

2008_3	1.7138719	1.8512086	1.5765352
2008_4	1.4876180	1.6155216	1.3597144
2009_1	1.3583117	1.5065145	1.2101088
2009_2	1.1520522	1.3068679	0.9972364
2009_3	1.5670620	1.6964443	1.4376796
2009_4	1.3408081	1.5071348	1.1744815
2010_1	1.4117441	1.5342468	1.2892413
2010_2	1.2054846	1.3338898	1.0770793
2010_3	1.6204944	1.7414833	1.4995055
2010_4	1.3942405	1.5130041	1.2754770
2011_1	1.6156757	1.7430936	1.4882579
2011_2	1.4094162	1.5294174	1.2894151
2011_3	1.8244261	1.9296015	1.7192506
2011_4	1.5981722	1.7194525	1.4768919
2012_1	1.5369695	1.6507825	1.4231565
2012_2	1.3307100	1.4491800	1.2122400
2012_3	1.7457198	1.8538163	1.6376234
2012_4	1.5194660	1.6363206	1.4026113
2013_1	1.5091157	1.6260915	1.3921400
2013_2	1.3028562	1.4319301	1.1737824
2013_3	1.7178661	1.8214924	1.6142397
2013_4	1.4916122	1.6095908	1.3736336
2014_1	1.4792244	1.5887474	1.3697015
2014_2	1.2729649	1.3826715	1.1632584
2014_3	1.6879747	1.7985470	1.5774025
2014_4	1.4617209	1.5728449	1.3505969
2015_1	1.3248075	1.4386206	1.2109944
2015_2	1.1185480	1.2298072	1.0072888
2015_3	1.5335578	1.6393935	1.4277222
2015_4	1.3073040	1.4247969	1.1898111
2016_1	1.2894425	1.4045238	1.1743611
2016_2	1.0831830	1.1987864	0.9675795
2016_3	1.4981928	1.6060119	1.3903736
2016_4	1.2719389	1.3850788	1.1587990
2017_1	1.0810333	1.2076055	0.9544612
2017_2	0.8747738	0.9897549	0.7597928
2017_3	1.2897836	1.3981370	1.1814302
2017_4	1.0635298	1.1798255	0.9472341
2018_1	1.3191434	1.4289456	1.2093412
2018_2	1.1128839	1.2253151	1.0004527
2018_3	1.5278937	1.6320554	1.4237320
2018_4	1.3016399	1.4122242	1.1910556
2019_1	1.0681188	1.1842485	0.9519892
2019_2	0.8618593	0.9727571	0.7509615
2019_3	1.2768691	1.3844238	1.1693145
2019_4	1.0506153	1.1564928	0.9447378

JUVENILES YFT IN FAD

Year_quarter	Stand CPUE	Lower stand CPUE (IC97.5)	Upper stand CPUE (IC97.5)
1991_1	1.0625725	1.1617859	0.9633591
1991_2	0.8527967	0.9397798	0.7658135
1991_3	1.1396484	1.2211692	1.0581277
1991_4	1.0646582	1.1475919	0.9817246
1992_1	1.3777643	1.4595118	1.2960167
1992_2	1.1679884	1.2533103	1.0826666
1992_3	1.4548402	1.5278672	1.3818132
1992_4	1.3798500	1.4561480	1.3035520
1993_1	1.2866229	1.3633546	1.2098913
1993_2	1.0768471	1.1518673	1.0018269
1993_3	1.3636989	1.4372075	1.2901902
1993_4	1.2887087	1.3683765	1.2090409
1994_1	1.4167162	1.4969230	1.3365093
1994_2	1.2069403	1.2849246	1.1289561
1994_3	1.4937921	1.5651366	1.4224476
1994_4	1.4188019	1.4960739	1.3415299
1995_1	1.4300021	1.5003653	1.3596388
1995_2	1.2202262	1.2923438	1.1481086
1995_3	1.5070780	1.5767185	1.4374375
1995_4	1.4320878	1.5082920	1.3558836
1996_1	1.5387226	1.6130824	1.4643628
1996_2	1.3289468	1.4024386	1.2554549
1996_3	1.6157985	1.6853179	1.5462792
1996_4	1.5408083	1.6216537	1.4599629
1997_1	1.7075314	1.7782703	1.6367925
1997_2	1.4977556	1.5700234	1.4254877
1997_3	1.7846073	1.8518836	1.7173310
1997_4	1.7096171	1.7842916	1.6349427
1998_1	1.4638692	1.5513468	1.3763916
1998_2	1.2540934	1.3436839	1.1645028
1998_3	1.5409451	1.6104414	1.4714489
1998_4	1.4659549	1.5561024	1.3758075
1999_1	1.5933620	1.6738304	1.5128935
1999_2	1.3835861	1.4549404	1.3122319
1999_3	1.6704379	1.7385055	1.6023702
1999_4	1.5954477	1.6672585	1.5236369
2000_1	1.3451683	1.4161414	1.2741951
2000_2	1.1353924	1.2040491	1.0667358
2000_3	1.4222442	1.4870036	1.3574848
2000_4	1.3472540	1.4162236	1.2782844
2001_1	0.9977859	1.0700988	0.9254730
2001_2	0.7880101	0.8576229	0.7183972
2001_3	1.0748618	1.1397285	1.0099951
2001_4	0.9998716	1.0673533	0.9323900
2002_1	1.3946695	1.4640205	1.3253184
2002_2	1.1848936	1.2493860	1.1204013
2002_3	1.4717454	1.5342775	1.4092133
2002_4	1.3967552	1.4656566	1.3278538
2003_1	1.2470218	1.3173240	1.1767196
2003_2	1.0372460	1.1078083	0.9666836
2003_3	1.3240977	1.3902306	1.2579648
2003_4	1.2491075	1.3158750	1.1823401
2004_1	1.1494227	1.2165334	1.0823120
2004_2	0.9396468	1.0070073	0.8722863
2004_3	1.2264986	1.2899019	1.1630953
2004_4	1.1515084	1.2173132	1.0857036
2005_1	1.1002161	1.1679314	1.0325007
2005_2	0.8904402	0.9554761	0.8254044
2005_3	1.1772920	1.2374027	1.1171813
2005_4	1.1023018	1.1664361	1.0381675
2006_1	1.1742506	1.2376157	1.1108856
2006_2	0.9644748	1.0266034	0.9023461
2006_3	1.2513265	1.3149921	1.1876610
2006_4	1.1763364	1.2407101	1.1119626
2007_1	0.6881025	0.7530754	0.6231297
2007_2	0.4783267	0.5460687	0.4105847
2007_3	0.7651785	0.8274049	0.7029520

2007_4	0.6901883	0.7612971	0.6190795
2008_1	1.0148977	1.0893878	0.9404077
2008_2	0.8051219	0.8707300	0.7395138
2008_3	1.0919737	1.1573204	1.0266269
2008_4	1.0169835	1.0810195	0.9529474
2009_1	1.2569208	1.3280986	1.1857430
2009_2	1.0471450	1.1204720	0.9738180
2009_3	1.3339967	1.3913216	1.2766719
2009_4	1.2590065	1.3255202	1.1924929
2010_1	1.5485371	1.6077862	1.4892880
2010_2	1.3387613	1.3994947	1.2780278
2010_3	1.6256130	1.6843355	1.5668906
2010_4	1.5506228	1.6102186	1.4910271
2011_1	1.4665074	1.5352004	1.3978144
2011_2	1.2567316	1.3169783	1.1964849
2011_3	1.5435833	1.5970002	1.4901665
2011_4	1.4685931	1.5268131	1.4103732
2012_1	1.4371393	1.4969336	1.3773449
2012_2	1.2273634	1.2883093	1.1664176
2012_3	1.5142152	1.5708360	1.4575943
2012_4	1.4392250	1.4995637	1.3788863
2013_1	1.7221768	1.7822010	1.6621525
2013_2	1.5124009	1.5778346	1.4469672
2013_3	1.7992527	1.8557094	1.7427959
2013_4	1.7242625	1.7870880	1.6614370
2014_1	1.4538510	1.5144129	1.3932890
2014_2	1.2440751	1.3020020	1.1861482
2014_3	1.5309269	1.5896346	1.4722192
2014_4	1.4559367	1.5163942	1.3954792
2015_1	1.3008163	1.3603473	1.2412854
2015_2	1.0910405	1.1507585	1.0313225
2015_3	1.3778923	1.4333275	1.3224570
2015_4	1.3029021	1.3641917	1.2416125
2016_1	1.2818171	1.3428436	1.2207906
2016_2	1.0720413	1.1326496	1.0114329
2016_3	1.3588930	1.4154370	1.3023491
2016_4	1.2839028	1.3468870	1.2209187
2017_1	1.5249101	1.5908611	1.4589591
2017_2	1.3151343	1.3780357	1.2522329
2017_3	1.6019861	1.6598457	1.5441265
2017_4	1.5269959	1.5914188	1.4625729
2018_1	1.5479717	1.6099528	1.4859906
2018_2	1.3381959	1.4044216	1.2719701
2018_3	1.6250476	1.6821048	1.5679904
2018_4	1.5500574	1.6160157	1.4840991
2019_1	1.1664525	1.2307361	1.1021690
2019_2	0.9566767	1.0201282	0.8932252
2019_3	1.2435285	1.3032782	1.1837787
2019_4	1.1685383	1.2309580	1.1061185

DATA PER YEAR
ADULT YFT IN FSC

Year	Stand CPUE	Lower stand CPUE (IC97.5)	Upper stand CPUE (IC97.5)	SD	CV (%)
1991	1,749741899	6,612259531	1,6691867	1,830297097	3,157806214
1992	1,631403296	5,751474301	1,556058828	1,706747764	2,973027509
1993	1,391660276	4,723567561	1,323757879	1,459562674	2,811125527
1994	1,672505445	4,73107463	1,606257783	1,738753107	2,574759412
1995	1,269561125	3,738800617	1,218980463	1,320141786	2,052544903
1996	1,124862704	3,833047799	1,066920901	1,182804507	2,2748377
1997	0,963649818	3,057110477	0,918729006	1,00857063	1,777017412
1998	1,352663441	2,963421063	1,287074307	1,418252575	1,96675467
1999	1,392348658	3,717181804	1,32629428	1,458403036	2,282328264
2000	2,706023732	6,386745638	2,62105735	2,790990114	2,75194518
2001	1,982473335	6,690443718	1,90300812	2,061938549	2,756825985
2002	1,898442213	6,784085413	1,832527396	1,964357031	2,275872081
2003	4,050879026	13,37399917	3,950260063	4,151497988	3,334781145
2004	4,145983199	14,06618411	4,04413135	4,247835048	3,569535
2005	3,943288108	11,06319618	3,835080177	4,051496039	4,225452394
2006	2,983577304	8,764709184	2,892928124	3,074226483	3,448464006
2007	2,041579724	5,737409544	1,965954778	2,117204671	2,962608022
2008	2,087257093	7,316439394	1,99873534	2,175778846	3,212128073
2009	1,196771002	4,359602563	1,139633853	1,253908151	1,65101815
2010	1,957534381	4,767880994	1,893255643	2,021813119	1,811333602
2011	2,05240516	4,613552363	1,987596553	2,117213767	1,870845453
2012	3,161685501	7,757048629	3,077402578	3,245968424	2,610119761
2013	1,43177285	3,758397592	1,381211779	1,48233392	1,543800104
2014	1,733069659	4,63078298	1,67394635	1,792192969	2,101422383
2015	2,017172414	5,392848899	1,949903122	2,084441706	2,328527291
2016	2,107521778	4,478802229	2,046224333	2,168819222	1,972185117
2017	1,82639902	4,407752026	1,768261236	1,884536805	1,707175942
2018	0,709643102	0,883289513	0,682320643	0,736965561	0,511647908
2019	1,688548838	2,554617228	1,630754645	1,746343031	1,3434321

JUVENILES YFT IN FSC

Year	Stand CPUE	Lower stand CPUE (IC97.5)	Upper stand CPUE (IC97.5)	SD	CV (%)
1991	0,031251438	0,015894709	0,046608167	0,287322638	6,319649609
1992	0,059554783	0,042625959	0,076483608	0,186292318	2,217998287
1993	0,105649358	0,084485558	0,126813159	0,384079193	3,007021016
1994	0,112504992	0,093017712	0,131992272	0,412323779	2,713648559
1995	0,140956477	0,120251064	0,161661889	0,535414314	2,955025051
1996	0,042780441	0,029356277	0,056204606	0,170042944	2,976883102
1997	0,052886077	0,042189051	0,063583103	0,196459615	2,605657036
1998	0,193805038	0,164886902	0,222723174	0,638761574	2,540990995
1999	0,058442099	0,036654996	0,080229202	0,372323744	4,986548996
2000	0,116760761	0,097639793	0,13588173	0,344464698	1,969588613
2001	0,031063863	0,01684883	0,045278897	0,252999736	5,390178295
2002	0,040895783	0,028364093	0,053427474	0,099910019	1,674164688
2003	0,024137206	-0,003353136	0,051627547	0,518682582	14,29457166
2004	0,025132997	-0,010528703	0,060794696	0,761223348	20,49681892
2005	0,066314337	0,035527973	0,097100701	0,599366727	6,296636687
2006	0,014612877	-0,036373185	0,065598938	1,668576571	80,9832325
2007	0,017490378	-0,015166168	0,050146924	0,999355311	39,48761957
2008	0,026884962	0,005941204	0,047828719	0,460493801	11,31302481
2009	0,102786935	0,085227544	0,120346326	0,382131961	2,719334134
2010	0,220548489	0,195432972	0,245664005	0,535931224	1,697276111
2011	0,051258837	0,034431399	0,068086274	0,106059326	1,383582081
2012	0,045540983	0,030745232	0,060336734	0,079098896	1,05236981
2013	0,109903596	0,09372772	0,126079472	0,325211958	1,988521283
2014	0,105168959	0,085007938	0,125329979	0,335220401	2,263685578
2015	0,174058557	0,151456838	0,196660277	0,524212959	1,995067023
2016	0,15337842	0,128953625	0,177803215	0,42412022	1,897362348
2017	0,13758918	0,118533466	0,156644895	0,344760634	1,622359392
2018	0,186483878	0,164029297	0,20893846	0,314937348	1,287889902
2019	0,036923096	-0,009218991	0,083065182	0,627708752	12,88643837

ADULT YFT IN FAD

Year	Stand CPUE	Lower stand CPUE (IC97.5)	Upper stand CPUE (IC97.5)
1991	1.2828017	1.444477	1.1211262
1992	1.5807889	1.726648	1.4349294
1993	1.4483530	1.588848	1.3078575
1994	0.9664264	1.112660	0.8201929
1995	1.7197887	1.854254	1.5853235
1996	1.4034612	1.545565	1.2613575
1997	1.0995809	1.234894	0.9642673
1998	1.2356763	1.406848	1.0645043
1999	1.3441162	1.483636	1.2045962
2000	1.8582792	1.992630	1.7239279
2001	1.3645627	1.499305	1.2298204
2002	1.1166203	1.255113	0.9781272
2003	2.0490421	2.179353	1.9187314
2004	1.6911994	1.821005	1.5613934
2005	1.8305555	1.952933	1.7081776
2006	1.5401876	1.666401	1.4139745
2007	1.3811575	1.510416	1.2518986
2008	1.5013684	1.641922	1.3608144
2009	1.3545585	1.499257	1.2098597
2010	1.4079909	1.531924	1.2840580
2011	1.6119226	1.729575	1.4942698
2012	1.5332163	1.647231	1.4192020
2013	1.5053626	1.620893	1.3898319
2014	1.4754713	1.585752	1.3651908
2015	1.3210543	1.433623	1.2084854
2016	1.2856893	1.398287	1.1730912
2017	1.0772801	1.195208	0.9593523
2018	1.3153902	1.424620	1.2061606
2019	1.0643656	1.174881	0.9538506

JUVENILES YFT IN FAD

Year	Stand CPUE	Lower stand CPUE (IC97.5)	Upper stand CPUE (IC97.5)
1991	1.0299190	1.1144939	0.9453441
1992	1.3451107	1.4242692	1.2659523
1993	1.2539694	1.3304923	1.1774465
1994	1.3840626	1.4599428	1.3081824
1995	1.3973485	1.4694619	1.3252351
1996	1.5060691	1.5809713	1.4311668
1997	1.6748778	1.7461713	1.6035844
1998	1.4312157	1.5154743	1.3469570
1999	1.5607084	1.6327648	1.4886520
2000	1.3125147	1.3804005	1.2446289
2001	0.9651324	1.0329807	0.8972841
2002	1.3620159	1.4275601	1.2964718
2003	1.2143683	1.2821908	1.1465457
2004	1.1167691	1.1822647	1.0512735
2005	1.0675625	1.1311546	1.0039704
2006	1.1415971	1.2052728	1.0779214
2007	0.6554490	0.7214927	0.5894053
2008	0.9822442	1.0482110	0.9162774
2009	1.2242673	1.2908035	1.1577310
2010	1.5158836	1.5754145	1.4563526
2011	1.4338539	1.4932055	1.3745023
2012	1.4044857	1.4637071	1.3452644
2013	1.6895232	1.7502678	1.6287786
2014	1.4211974	1.4807266	1.3616682
2015	1.2681628	1.3272512	1.2090743
2016	1.2491636	1.3093666	1.1889606
2017	1.4922566	1.5548226	1.4296906
2018	1.5153181	1.5776915	1.4529448
2019	1.1337990	1.1961882	1.0714098

COEFFICIENTS OF THE COMPONENT 1 (POISSON DISTRIBUTION) FOR ADULT YFT IN FSC

Generalized linear mixed model fit by maximum likelihood (Laplace Approximation) [glmerMod]
Family: poisson (log)
Formula: num_sets_fsc ~ pays + yr + quarter + cwp55 + d20_m + Piracy + age + cap.m3 + (1 | numbat) + offset(searching_centroid_yr)
Data: D1

AIC	BIC	logLik	deviance	df.resid
901037.9	901697.6	-450453.9	900907.9	188869

Scaled residuals:

Min	1Q	Median	3Q	Max
-3.3	-0.7	-0.3	0.0	4311.1

Random effects:

Groups	Name	Variance	Std.Dev.
numbat	(Intercept)	0.1859	0.4311

Number of obs: 188934, groups: numbat, 78

Fixed effects:

	Estimate	Std. Error	z value	Pr(>|z|)	
(Intercept)	-13.383556	0.149195	-89.705	< 2.00E-16	***
pays4	0.369494	0.127128	2.906	0.003655	**
yr1992	0.184710	0.026751	6.905	5.03e-12	***
yr1993	0.085550	0.028218	3.032	0.002431	**
yr1994	0.105263	0.031732	3.317	0.000909	***
yr1995	-0.040763	0.035588	-1.145	0.252037	
yr1996	-0.147883	0.039231	-3.770	0.000164	***
yr1997	-0.399546	0.044719	-8.935	< 2.00E-16	***
yr1998	-0.023307	0.050460	-0.462	0.644152	
yr1999	0.115772	0.052035	2.225	0.026089	*
yr2000	0.429458	0.056704	7.574	3.63e-14	***
yr2001	0.246564	0.061325	4.021	5.80e-05	***
yr2002	0.084154	0.066871	1.258	0.208227	
yr2003	0.559367	0.071365	7.838	4.57e-15	***
yr2004	0.664853	0.076161	8.730	< 2.00E-16	***
yr2005	0.787475	0.080796	9.746	< 2.00E-16	***
yr2006	0.721643	0.086131	8.378	< 2.00E-16	***
yr2007	0.448687	0.091813	4.887	1.02e-06	***
yr2008	0.397011	0.097365	4.078	4.55e-05	***
yr2009	-0.215502	0.105021	-2.052	0.040170	*
yr2010	0.116275	0.111630	1.042	0.297593	
yr2011	0.227490	0.115048	1.977	0.048002	*
yr2012	0.376080	0.119502	3.147	0.001649	**
yr2013	-0.302942	0.126974	-2.386	0.017039	*
yr2014	0.039871	0.130315	0.306	0.759639	
yr2015	0.125629	0.135514	0.927	0.353898	
yr2016	0.209266	0.141308	1.481	0.138627	
yr2017	0.027648	0.147370	0.188	0.851183	

yr2018	-0.442767	0.159384	-2.778	0.005470	**
yr2019	0.590406	0.158211	3.732	0.000190	***
yr2020	1.533178	0.167499	9.153	< 2.00E-16	***
quarter2	0.057719	0.010580	5.456	4.88e-08	***
quarter3	-0.487537	0.013632	-35.764	< 2.00E-16	***
quarter4	-0.522702	0.011126	-46.981	< 2.00E-16	***
cwp55100050	0.183359	0.083948	2.184	0.028948	*
cwp55100055	0.742565	0.084212	8.818	< 2.00E-16	***
cwp55105050	-0.474297	0.207873	-2.282	0.022509	*
cwp55200040	0.376700	0.090999	4.140	3.48e-05	***
cwp55200045	0.637075	0.082738	7.700	1.36e-14	***
cwp55200050	0.655283	0.082368	7.956	1.78e-15	***
cwp55200055	0.304014	0.082900	3.667	0.000245	***
cwp55200060	0.953857	0.083953	11.362	< 2.00E-16	***
cwp55200065	1.140370	0.084659	13.470	< 2.00E-16	***
cwp55200070	1.722069	0.085723	20.089	< 2.00E-16	***
cwp55200075	1.510954	0.097779	15.453	< 2.00E-16	***
cwp55205040	0.883072	0.086746	10.180	< 2.00E-16	***
cwp55205045	0.641964	0.083251	7.711	1.25e-14	***
cwp55205050	0.611971	0.083117	7.363	1.80e-13	***
cwp55205055	0.702716	0.083430	8.423	< 2.00E-16	***
cwp55205060	0.597552	0.084608	7.063	1.63e-12	***
cwp55205065	0.769772	0.085694	8.983	< 2.00E-16	***
cwp55205070	1.440500	0.093237	15.450	< 2.00E-16	***
cwp55205075	1.898723	0.141847	13.386	< 2.00E-16	***
cwp55210040	2.060183	0.084491	24.383	< 2.00E-16	***
cwp55210045	1.714892	0.083984	20.419	< 2.00E-16	***
cwp55210050	0.950680	0.091696	10.368	< 2.00E-16	***
cwp55210055	1.168192	0.100653	11.606	< 2.00E-16	***
cwp55215035	2.890251	0.097370	29.683	< 2.00E-16	***
cwp55215040	2.469064	0.083658	29.514	< 2.00E-16	***
cwp55220035	1.157330	0.292432	3.958	7.57e-05	***
d20_m	-0.221769	0.006461	-34.322	< 2.00E-16	***
Piracy1	-0.123461	0.032475	-3.802	0.000144	***
age	-0.230667	0.044840	-5.144	2.69e-07	***
cap.m3	0.018160	0.069530	0.261	0.793949	

Signif. codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

COEFFICIENTS OF THE COMPONENT 1 (POISSON DISTRIBUTION) FOR JUVENILES YFT IN FSC

Generalized linear mixed model fit by maximum likelihood (Laplace Approximation) [
glmerMod]
 Family: poisson (log)
Formula: num_sets_fsc ~ pays + yr + quarter + cwp55 + d20_m + Piracy +
    age + cap.m3 + (1 | numbat) + offset(searching_centroid_yr)
   Data: D1

      AIC   BIC   logLik deviance df.resid
 832437.2 833084.9 -416154.6 832309.2   183727

Scaled residuals:
   Min   1Q Median   3Q   Max
 -3.2   -0.7   -0.3   0.0 4370.0

Random effects:
 Groups Name   Variance Std.Dev.
 numbat (Intercept) 0.1754   0.4188
Number of obs: 183791, groups: numbat, 78

Fixed effects:
             Estimate Std. Error z value Pr(>|z|)
(Intercept) -1.354e+01 1.395e-01 -97.099 < 2e-16 ***
pays4   3.579e-01 1.215e-01   2.946 0.003224 **
yr1992   1.720e-01 2.730e-02   6.301 2.96e-10 ***
yr1993   7.153e-02 2.859e-02   2.502 0.012365 *
yr1994   1.231e-01 3.139e-02   3.922 8.79e-05 ***
yr1995   -8.006e-02 3.520e-02 -2.274 0.022959 *
yr1996   -1.900e-01 3.868e-02 -4.912 9.01e-07 ***
yr1997   -4.159e-01 4.307e-02 -9.657 < 2e-16 ***
yr1998   1.020e-01 4.760e-02   2.142 0.032170 *
yr1999   1.871e-01 4.867e-02   3.845 0.000121 ***
yr2000   4.056e-01 5.272e-02   7.694 1.43e-14 ***
yr2001   1.507e-01 5.672e-02   2.657 0.007876 **
yr2002   -6.049e-02 6.259e-02 -0.966 0.333804
yr2003   4.746e-01 6.623e-02   7.166 7.72e-13 ***
yr2004   6.489e-01 7.010e-02   9.257 < 2e-16 ***
yr2005   8.158e-01 7.379e-02 11.056 < 2e-16 ***
yr2006   7.041e-01 7.872e-02   8.945 < 2e-16 ***
yr2007   4.420e-01 8.386e-02   5.271 1.36e-07 ***
yr2008   3.501e-01 8.896e-02   3.936 8.30e-05 ***
yr2009   -3.324e-01 9.692e-02 -3.430 0.000604 ***
yr2010   8.406e-02 1.025e-01   0.820 0.412256
yr2011   1.796e-01 1.051e-01   1.709 0.087362 .
yr2012   2.684e-01 1.093e-01   2.456 0.014033 *
yr2013   -2.533e-01 1.156e-01 -2.191 0.028428 *
yr2014   -9.871e-04 1.185e-01 -0.008 0.993354
yr2015   1.046e-01 1.232e-01   0.849 0.395828
yr2016   1.149e-01 1.286e-01   0.893 0.371770
yr2017   -8.318e-02 1.347e-01 -0.618 0.536822
yr2018   -4.429e-01 1.456e-01 -3.042 0.002347 **
yr2019   5.819e-01 1.437e-01   4.050 5.13e-05 ***
yr2020   1.517e+00 1.532e-01   9.902 < 2e-16 ***
quarter2   6.416e-02 1.086e-02   5.909 3.44e-09 ***

```
quarter3    -5.225e-01  1.404e-02 -37.217  < 2e-16 ***
quarter4    -5.318e-01  1.188e-02 -44.784  < 2e-16 ***
cwp55100050  3.264e-01  7.863e-02   4.151 3.31e-05 ***
cwp55100055  8.463e-01  7.871e-02  10.752  < 2e-16 ***
cwp55100060  3.639e-01  1.831e-01   1.987 0.046874 *
cwp55105050 -1.842e-01  1.315e-01  -1.401 0.161363
cwp55105055 -1.016e-01  1.150e-01  -0.883 0.377200
cwp55105060  1.362e-01  2.396e-01   0.568 0.569720
cwp55200040  5.924e-01  9.150e-02   6.475 9.51e-11 ***
cwp55200045  8.140e-01  7.761e-02  10.489  < 2e-16 ***
cwp55200050  8.187e-01  7.714e-02  10.613  < 2e-16 ***
cwp55200055  9.368e-01  7.773e-02  12.052  < 2e-16 ***
cwp55200060  1.080e+00  7.897e-02  13.681  < 2e-16 ***
cwp55200065  1.220e+00  8.030e-02  15.196  < 2e-16 ***
cwp55200070  1.907e+00  8.400e-02  22.707  < 2e-16 ***
cwp55205040  7.881e-01  8.811e-02   8.944  < 2e-16 ***
cwp55205045  7.347e-01  7.850e-02   9.360  < 2e-16 ***
cwp55205050  6.991e-01  7.803e-02   8.958  < 2e-16 ***
cwp55205055  7.831e-01  7.843e-02   9.985  < 2e-16 ***
cwp55205060  7.110e-01  8.019e-02   8.866  < 2e-16 ***
cwp55205065  8.650e-01  8.278e-02  10.449  < 2e-16 ***
cwp55210040  2.172e+00  7.916e-02  27.441  < 2e-16 ***
cwp55210045  1.918e+00  7.887e-02  24.323  < 2e-16 ***
cwp55215035  3.146e+00  8.961e-02  35.110  < 2e-16 ***
cwp55215040  2.667e+00  7.855e-02  33.955  < 2e-16 ***
cwp55215045  2.444e+00  1.025e-01  23.841  < 2e-16 ***
cwp55220040  1.884e+00  2.158e-01   8.729  < 2e-16 ***
d20_m       -2.945e-01  7.032e-03 -41.882  < 2e-16 ***
Piracy1     -1.855e-01  3.378e-02  -5.492 3.97e-08 ***
age         -2.359e-01  4.112e-02  -5.737 9.66e-09 ***
cap.m3       1.036e-02  6.611e-02   0.157 0.875486
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

COEFFICIENTS OF THE COMPONENT 2 (BINOMIAL DISTRIBUTION) FOR ADULT YFT IN FSC

Generalized linear mixed model fit by maximum likelihood (Laplace Approximation) [
glmerMod]
 Family: binomial (logit)
Formula: yft_cat23_pos ~ pays + yr + trimestre + cwp55 + cap.m3 + (1 |
    numbat) + offset(nombre_de_calees_pos)
   Data: D2

     AIC   BIC   logLik deviance df.resid
 31422.2 31952.5 -15649.1 31298.2   38287

Scaled residuals:
    Min   1Q Median   3Q   Max
-13.5063 0.1784 0.3109 0.4431 3.0966

Random effects:
 Groups Name   Variance Std.Dev.
 numbat (Intercept) 0.05336 0.231
Number of obs: 38349, groups: numbat, 78

Fixed effects:

	Estimate	Std. Error	z value	Pr(>|z|)	
(Intercept)	-0.25204	0.32021	-0.787	0.431218	
pays4	-0.23039	0.07763	-2.968	0.002998	**
yr1992	0.02955	0.10913	0.271	0.786583	
yr1993	0.02807	0.10611	0.265	0.791350	
yr1994	-0.33494	0.10562	-3.171	0.001519	**
yr1995	-0.36090	0.11030	-3.272	0.001068	**
yr1996	-0.09722	0.11329	-0.858	0.390783	
yr1997	-0.13304	0.12036	-1.105	0.269014	
yr1998	-0.43718	0.12282	-3.559	0.000372	***
yr1999	-0.64134	0.11120	-5.767	8.05e-09	***
yr2000	-0.18470	0.11193	-1.650	0.098916	.
yr2001	-0.26273	0.11063	-2.375	0.017560	*
yr2002	-0.67787	0.11349	-5.973	2.33e-09	***
yr2003	-0.02145	0.11688	-0.184	0.854350	
yr2004	-0.16280	0.11723	-1.389	0.164896	
yr2005	-0.17655	0.10269	-1.719	0.085553	.
yr2006	-0.64875	0.10404	-6.236	4.50e-10	***
yr2007	-0.49780	0.10826	-4.598	4.26e-06	***
yr2008	-0.29305	0.11424	-2.565	0.010313	*
yr2009	-0.83378	0.12811	-6.508	7.60e-11	***
yr2010	-0.49275	0.13218	-3.728	0.000193	***
yr2011	0.02087	0.13690	0.152	0.878830	
yr2012	0.94192	0.15488	6.081	1.19e-09	***
yr2013	0.24902	0.16004	1.556	0.119712	
yr2014	0.22785	0.14334	1.590	0.111923	
yr2015	0.43163	0.13954	3.093	0.001980	**
yr2016	0.02466	0.14481	0.170	0.864766	
yr2017	0.19860	0.16352	1.215	0.224541	
yr2018	-1.46930	0.18592	-7.903	2.73e-15	***
yr2019	-0.92778	0.13113	-7.075	1.49e-12	***

yr2020	-0.26209	0.20439	-1.282	0.199729	
trimestre2	-0.19954	0.04231	-4.716	2.40e-06	***
trimestre3	-0.22033	0.05034	-4.376	1.21e-05	***
trimestre4	-0.30604	0.04541	-6.740	1.58e-11	***
cwp55100050	0.06921	0.30631	0.226	0.821242	
cwp55100055	0.54075	0.30770	1.757	0.078849	.
cwp55105050	-0.79129	0.52957	-1.494	0.135119	
cwp55200040	1.32888	0.33310	3.989	6.62e-05	***
cwp55200045	1.14992	0.30483	3.772	0.000162	***
cwp55200050	1.10764	0.30394	3.644	0.000268	***
cwp55200055	1.21911	0.30543	3.991	6.57e-05	***
cwp55200060	2.04782	0.31186	6.566	5.15e-11	***
cwp55200065	2.23351	0.31856	7.011	2.36e-12	***
cwp55200070	2.97942	0.34205	8.711	< 2,00E-16	***
cwp55200075	2.46490	0.40017	6.160	7.29e-10	***
cwp55205040	1.48638	0.32083	4.633	3.60e-06	***
cwp55205045	2.03450	0.30898	6.585	4.56e-11	***
cwp55205050	1.85665	0.30617	6.064	1.33e-09	***
cwp55205055	1.94031	0.30685	6.323	2.56e-10	***
cwp55205060	2.22301	0.31510	7.055	1.73e-12	***
cwp55205065	2.56543	0.32711	7.843	4.41e-15	***
cwp55205070	3.16097	0.42355	7.463	8.46e-14	***
cwp55205075	3.07184	0.78424	3.917	8.97e-05	***
cwp55210040	-0.99621	0.30804	-3.234	0.001221	**
cwp55210045	-1.59830	0.30897	-5.173	2.30e-07	***
cwp55210050	1.45803	0.34103	4.275	1.91e-05	***
cwp55210055	2.32140	0.43717	5.310	1.10e-07	***
cwp55215035	-0.08911	0.33669	-0.265	0.791271	
cwp55215040	-1.00827	0.30614	-3.294	0.000989	***
cwp55220035	12.67416	257.37561	0.049	0.960725	
cap.m3	0.07720	0.03765	2.051	0.040312	*

Signif. codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

COEFFICIENTS OF THE COMPONENT 2 (BINOMIAL DISTRIBUTION) FOR JUVENILES YFT IN FSC

Generalized linear mixed model fit by maximum likelihood (Laplace Approximation) [
glmerMod]
 Family: binomial (logit)
Formula: yft_cat1_pos ~ pays + yr + trimestre + cwp55 + (1 | numbat) +
    offset(nombre_de_calees_pos)
   Data: D2

     AIC   BIC   logLik deviance df.resid
 34298.6 34806.5 -17089.3 34178.6   35019

Scaled residuals:
    Min   1Q Median   3Q   Max
-21.1313 -0.5187 -0.3704   0.4815   6.1850

Random effects:
 Groups Name   Variance Std.Dev.
 numbat (Intercept) 0.1468   0.3832
Number of obs: 35079, groups: numbat, 78

Fixed effects:
             Estimate Std. Error z value Pr(>|z|)
(Intercept) -0.379588   0.300040 -1.265 0.205827
pays4   -0.189260   0.096301 -1.965 0.049381 *
yr1992   0.295951   0.095348   3.104 0.001910 **
yr1993   1.807088   0.094848 19.052 < 2e-16 ***
yr1994   0.700909   0.096853   7.237 4.59e-13 ***
yr1995   1.169294   0.100663 11.616 < 2e-16 ***
yr1996   0.807747   0.103896   7.775 7.57e-15 ***
yr1997   0.193688   0.111009   1.745 0.081021 .
yr1998   1.082003   0.119052   9.089 < 2e-16 ***
yr1999   1.228829   0.104021 11.813 < 2e-16 ***
yr2000   -0.285852   0.104677 -2.731 0.006318 **
yr2001   -0.373220   0.103409 -3.609 0.000307 ***
yr2002   -0.029507   0.113480 -0.260 0.794850
yr2003   -0.321970   0.111666 -2.883 0.003935 **
yr2004   -0.151773   0.110068 -1.379 0.167926
yr2005   0.128806   0.094610   1.361 0.173377
yr2006   0.298159   0.097629   3.054 0.002258 **
yr2007   0.052039   0.104002   0.500 0.616818
yr2008   -0.393506   0.111277 -3.536 0.000406 ***
yr2009   0.587054   0.125605   4.674 2.96e-06 ***
yr2010   0.153470   0.128144   1.198 0.231058
yr2011   -0.269877   0.128497 -2.100 0.035706 *
yr2012   -1.314338   0.147060 -8.937 < 2e-16 ***
yr2013   -0.220775   0.137595 -1.605 0.108599
yr2014   0.310921   0.116885   2.660 0.007813 **
yr2015   -0.363801   0.122486 -2.970 0.002977 **
yr2016   -0.017077   0.128034 -0.133 0.893895
yr2017   -0.597015   0.155775 -3.833 0.000127 ***
yr2018   0.978022   0.181557   5.387 7.17e-08 ***
yr2019   0.920866   0.123623   7.449 9.41e-14 ***
yr2020   0.277038   0.181137   1.529 0.126157

```
trimestre2  -0.084921   0.042163  -2.014 0.043996 *
trimestre3  -0.068805   0.046637  -1.475 0.140122
trimestre4   0.336522   0.039620   8.494  < 2e-16 ***
cwp55100050 -0.652904   0.286314  -2.280 0.022585 *
cwp55100055 -0.854422   0.286544  -2.982 0.002865 **
cwp55100060  0.532980   0.513676   1.038 0.299466
cwp55105050  0.009314   0.408631   0.023 0.981815
cwp55105055  0.498589   0.400726   1.244 0.213421
cwp55105060  0.938289   1.115617   0.841 0.400320
cwp55200040 -1.892120   0.325206  -5.818 5.95e-09 ***
cwp55200045 -1.801284   0.283943  -6.344 2.24e-10 ***
cwp55200050 -1.853820   0.283351  -6.542 6.05e-11 ***
cwp55200055 -1.788583   0.284789  -6.280 3.38e-10 ***
cwp55200060 -2.415479   0.288555  -8.371  < 2e-16 ***
cwp55200065 -2.572916   0.293498  -8.766  < 2e-16 ***
cwp55200070 -3.570985   0.325313 -10.977  < 2e-16 ***
cwp55205040 -1.736536   0.315782  -5.499 3.82e-08 ***
cwp55205045 -2.459098   0.288011  -8.538  < 2e-16 ***
cwp55205050 -2.337839   0.285035  -8.202 2.37e-16 ***
cwp55205055 -2.060878   0.284754  -7.237 4.57e-13 ***
cwp55205060 -2.339212   0.290312  -8.058 7.78e-16 ***
cwp55205065 -2.652379   0.299531  -8.855  < 2e-16 ***
cwp55210040  0.756623   0.288727   2.621 0.008779 **
cwp55210045  1.766832   0.296306   5.963 2.48e-09 ***
cwp55215035 -0.016696   0.314799  -0.053 0.957702
cwp55215040  1.056926   0.288494   3.664 0.000249 ***
cwp55215045  1.994937   0.487246   4.094 4.23e-05 ***
cwp55220040 11.257957  14.326014   0.786 0.431961
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

COEFFICIENTS OF THE COMPONENT 3 (LOGNORMAL DISTRIBUTION) FOR ADULT YFT IN FSC

Linear mixed model fit by REML ['lmerMod']
Formula: log_capture ~ pays + yr + trimestre + cwp55 + cap.m3 + d20_m + (1 | numbat) + offset(nombre_de_calees_pos)
  Data: D3

REML criterion at convergence: 88455.6

Scaled residuals:
   Min   1Q Median   3Q   Max
-4.9219 -0.6090 0.0600 0.6888 3.4425

Random effects:
 Groups   Name   Variance Std.Dev.
 numbat   (Intercept) 0.01058 0.1028
 Residual   1.12486 1.0606
Number of obs: 29819, groups: numbat, 78

Fixed effects:

	Estimate	Std. Error	t value
(Intercept)	1.52049	0.19114	7.955
pays4	-0.05661	0.03383	-1.673
yr1992	-0.25908	0.04350	-5.955
yr1993	-0.31865	0.04361	-7.307
yr1994	-0.09660	0.04633	-2.085
yr1995	-0.22169	0.04734	-4.683
yr1996	-0.27919	0.04649	-6.005
yr1997	-0.17661	0.05040	-3.504
yr1998	-0.16207	0.06235	-2.599
yr1999	-0.23316	0.05054	-4.613
yr2000	0.03515	0.04790	0.734
yr2001	-0.08022	0.04621	-1.736
yr2002	0.11590	0.04894	2.368
yr2003	0.28329	0.04530	6.254
yr2004	0.22289	0.04543	4.906
yr2005	0.05235	0.04270	1.226
yr2006	-0.07541	0.04457	-1.692
yr2007	-0.21120	0.04690	-4.503
yr2008	-0.17403	0.04601	-3.783
yr2009	-0.01287	0.05833	-0.221
yr2010	0.07823	0.06037	1.296
yr2011	-0.07102	0.05774	-1.230
yr2012	0.10510	0.05044	2.084
yr2013	0.06772	0.06158	1.100
yr2014	-0.08133	0.05248	-1.550
yr2015	-0.04086	0.05217	-0.783
yr2016	-0.02685	0.05730	-0.469
yr2017	-0.01276	0.06120	-0.209
yr2018	-0.14692	0.11021	-1.333
yr2019	-0.45348	0.06520	-6.955
yr2020	-0.10568	0.08157	-1.295

trimestre2	-0.10734	0.02010	-5.340
trimestre3	0.02866	0.02268	1.264
trimestre4	-0.19325	0.01729	-11.177
cwp55100050	0.59856	0.18950	3.159
cwp55100055	0.64980	0.18895	3.439
cwp55105050	0.93983	0.41983	2.239
cwp55200040	0.87132	0.19692	4.425
cwp55200045	0.73751	0.18691	3.946
cwp55200050	0.78575	0.18670	4.209
cwp55200055	0.54351	0.18723	2.903
cwp55200060	0.51199	0.18790	2.725
cwp55200065	0.65880	0.18839	3.497
cwp55200070	0.68558	0.18940	3.620
cwp55200075	0.93563	0.19989	4.681
cwp55205040	0.79056	0.19188	4.120
cwp55205045	0.82712	0.18760	4.409
cwp55205050	0.65262	0.18750	3.481
cwp55205055	0.42014	0.18777	2.238
cwp55205060	0.53061	0.18858	2.814
cwp55205065	0.63301	0.18944	3.341
cwp55205070	0.55383	0.19575	2.829
cwp55205075	1.15650	0.23582	4.904
cwp55210040	-0.15052	0.19369	-0.777
cwp55210045	-0.23026	0.19608	-1.174
cwp55210050	0.55196	0.19675	2.805
cwp55210055	0.37132	0.20358	1.824
cwp55215035	-0.10762	0.21467	-0.501
cwp55215040	-0.25575	0.19096	-1.339
cwp55220035	-0.29999	0.50968	-0.589
cap.m3	0.06935	0.01652	4.199
d20_m	-0.04424	0.01005	-4.403

COEFFICIENTS OF THE COMPONENT 3 (LOGNORMAL DISTRIBUTION) FOR JUVENILES YFT IN FSC

Linear mixed model fit by REML ['lmerMod']
Formula: log_capture ~ pays + yr + trimestre + cwp55 + cap.m3 + d20_m +
(1 | numbat) + offset(nombre_de_calees_pos)
Data: D3

REML criterion at convergence: 46471.2

Scaled residuals:
Min 1Q Median 3Q Max
-4.0211 -0.6218 0.0669 0.6750 3.7414

Random effects:
Groups Name Variance Std.Dev.
numbat (Intercept) 0.06892 0.2625
Residual 2.41114 1.5528
Number of obs: 12437, groups: numbat, 77

Fixed effects:

	Estimate	Std. Error	t value
(Intercept)	-1.25911	0.27175	-4.633
pays4	0.39969	0.08439	4.736
yr1992	0.37862	0.10602	3.571
yr1993	0.66950	0.09798	6.833
yr1994	0.94494	0.10261	9.209
yr1995	1.25065	0.10633	11.762
yr1996	0.26172	0.10629	2.462
yr1997	0.87958	0.11934	7.371
yr1998	1.40875	0.11474	12.277
yr1999	0.08854	0.10393	0.852
yr2000	1.00991	0.11078	9.116
yr2001	-0.02814	0.11620	-0.242
yr2002	0.33921	0.12793	2.651
yr2003	-0.62263	0.13535	-4.600
yr2004	-0.81589	0.13607	-5.996
yr2005	-0.10522	0.10304	-1.021
yr2006	-1.55917	0.10586	-14.728
yr2007	-1.03947	0.11148	-9.324
yr2008	-0.36466	0.12310	-2.962
yr2009	1.34233	0.12598	10.655
yr2010	1.82032	0.13578	13.406
yr2011	0.40706	0.14510	2.805
yr2012	0.61628	0.18530	3.326
yr2013	1.58555	0.15915	9.963
yr2014	1.11568	0.14052	7.939
yr2015	1.73795	0.14817	11.730
yr2016	1.48159	0.14962	9.902
yr2017	1.77680	0.18964	9.369
yr2018	1.94166	0.18450	10.524
yr2019	-0.68770	0.13632	-5.045
yr2020	0.45420	0.22913	1.982
trimestre2	0.02012	0.04219	0.477
trimestre3	0.42776	0.05507	7.768
trimestre4	0.38170	0.04846	7.876
cwp55100050	-0.90128	0.25732	-3.503
cwp55100055	-0.09383	0.25746	-0.364
cwp55100060	-0.46746	0.40637	-1.150
cwp55105050	0.01031	0.34012	0.030
cwp55105055	-0.41066	0.31433	-1.306

cwp55105060	-0.77979	0.61055	-1.277
cwp55200040	0.29160	0.32798	0.889
cwp55200045	-0.58460	0.25693	-2.275
cwp55200050	-0.89174	0.25521	-3.494
cwp55200055	-1.01096	0.25828	-3.914
cwp55200060	-0.57872	0.26669	-2.170
cwp55200065	-1.51040	0.27469	-5.499
cwp55200070	-1.49178	0.33408	-4.465
cwp55205040	-0.40925	0.31727	-1.290
cwp55205045	-0.70248	0.26806	-2.621
cwp55205050	-0.55899	0.26211	-2.133
cwp55205055	-0.50612	0.26159	-1.935
cwp55205060	-0.76420	0.27126	-2.817
cwp55205065	-1.27677	0.28769	-4.438
cwp55210040	-0.68484	0.25785	-2.656
cwp55210045	-0.84272	0.25736	-3.274
cwp55215035	-0.63883	0.27952	-2.285
cwp55215040	-0.48910	0.25669	-1.905
cwp55215045	-0.28780	0.30695	-0.938
cwp55220040	-0.27174	0.53483	-0.508
cap.m3	0.05867	0.03859	1.520
d20_m	0.28667	0.03285	8.727

COEFFICIENTS OF THE COMPONENT 3 (LOGNORMAL DISTRIBUTION) FOR ADULTS YFT IN FAD

Linear mixed model fit by REML ['lmerMod']
Formula: log_capture ~ pays + yr + trimestre + cwp55 + cap.m3 + d20_m +
(1 | numbat) + offset(nombre_de_calees_pos)
Data: D3

REML criterion at convergence: 140178.8

Scaled residuals:
Min 1Q Median 3Q Max
-6.3999 -0.6830 0.0136 0.6860 3.5545

Random effects:
Groups Name Variance Std.Dev.
numbat (Intercept) 0.07658 0.2767
Residual 1.45637 1.2068
Number of obs: 43470, groups: numbat, 78

Fixed effects:

	Estimate	Std. Error	t value
(Intercept)	0.202296	0.082570	2.450
pays4	0.419585	0.077277	5.430
yr1992	0.297987	0.050210	5.935
yr1993	0.165551	0.051208	3.233
yr1994	-0.316375	0.052535	-6.022
yr1995	0.436987	0.046820	9.333
yr1996	0.120660	0.050318	2.398
yr1997	-0.183221	0.051923	-3.529
yr1998	-0.047125	0.059623	-0.790
yr1999	0.061315	0.057635	1.064
yr2000	0.575477	0.053233	10.810
yr2001	0.081761	0.054203	1.508
yr2002	-0.166181	0.059909	-2.774
yr2003	0.766240	0.056615	13.534
yr2004	0.408398	0.056981	7.167
yr2005	0.547754	0.052466	10.440
yr2006	0.257386	0.051433	5.004
yr2007	0.098356	0.052601	1.870
yr2008	0.218567	0.059298	3.686
yr2009	0.071757	0.066161	1.085
yr2010	0.125189	0.059114	2.118
yr2011	0.329121	0.054485	6.041
yr2012	0.250415	0.055430	4.518
yr2013	0.222561	0.052951	4.203
yr2014	0.192670	0.052991	3.636
yr2015	0.038253	0.053906	0.710
yr2016	0.002888	0.051901	0.056
yr2017	-0.205522	0.054630	-3.762
yr2018	0.032589	0.050744	0.642
yr2019	-0.218436	0.051699	-4.225
yr2020	-0.297595	0.061461	-4.842
trimestre2	-0.206260	0.018981	-10.867
trimestre3	0.208750	0.018559	11.248
trimestre4	-0.017504	0.018059	-0.969
cwp55100050	-0.085996	0.046503	-1.849
cwp55100055	-0.201097	0.048836	-4.118
cwp55100060	-0.466718	0.061967	-7.532
cwp55100065	-0.258222	0.084358	-3.061
cwp55105050	0.384785	0.062886	6.119

cwp55105055	0.033199	0.054167	0.613
cwp55105060	-0.316316	0.079261	-3.991
cwp55105065	-0.466270	0.458865	-1.016
cwp55110055	0.177074	0.111216	1.592
cwp55110060	0.141041	0.206672	0.682
cwp55200040	0.295184	0.058049	5.085
cwp55200045	0.181599	0.047187	3.848
cwp55200050	-0.033414	0.047927	-0.697
cwp55200055	-0.182686	0.051911	-3.519
cwp55200060	-0.464939	0.059058	-7.873
cwp55200065	-0.426282	0.059435	-7.172
cwp55200070	-0.227014	0.137324	-1.653
cwp55200075	-0.393661	0.112860	-3.488
cwp55205040	0.218501	0.056696	3.854
cwp55205045	0.019649	0.052827	0.372
cwp55205050	-0.206418	0.052727	-3.915
cwp55205055	-0.304810	0.056630	-5.382
cwp55205060	-0.546071	0.064413	-8.478
cwp55205065	-0.477091	0.077717	-6.139
cwp55205070	-0.272720	0.406154	-0.671
cwp55210040	-0.035538	0.054788	-0.649
cwp55210045	-0.126545	0.054423	-2.325
cwp55210050	-0.114300	0.095380	-1.198
cwp55210055	-0.241394	0.138069	-1.748
cwp55215035	-0.244166	0.116911	-2.088
cwp55215040	-0.133529	0.057019	-2.342
cwp55215045	-0.042922	0.140839	-0.305
cwp55220035	-0.249660	0.406064	-0.615
cwp55220040	-0.176362	0.202476	-0.871
cap.m3	0.075101	0.041886	1.793
d20_m	-0.115439	0.009942	-11.611

COEFFICIENTS OF THE COMPONENT 3 (LOGNORMAL DISTRIBUTION) FOR JUVENILES YFT IN FAD

Linear mixed model fit by REML ['lmerMod']
Formula: log_capture ~ pays + yr + trimestre + cwp55 + cap.m3 + d20_m +
(1 | numbat) + offset(nombre_de_calees_pos)
Data: D3

REML criterion at convergence: 314638.3

Scaled residuals:
Min 1Q Median 3Q Max
-6.2232 -0.6306 0.0417 0.6896 3.5154

Random effects:
Groups Name Variance Std.Dev.
numbat (Intercept) 0.0110 0.1049
Residual 0.9952 0.9976
Number of obs: 110867, groups: numbat, 78

Fixed effects:

	Estimate	Std. Error	t value
(Intercept)	0.183138	0.038394	4.770
pays4	0.237588	0.029903	7.945
yr1992	0.315192	0.027991	11.260
yr1993	0.224050	0.028218	7.940
yr1994	0.354144	0.026873	13.178
yr1995	0.367430	0.026054	14.103
yr1996	0.476150	0.026375	18.053
yr1997	0.644959	0.025955	24.849
yr1998	0.401297	0.029743	13.492
yr1999	0.530789	0.027876	19.041
yr2000	0.282596	0.027781	10.172
yr2001	-0.064787	0.028150	-2.301
yr2002	0.332097	0.027145	12.234
yr2003	0.184449	0.029286	6.298
yr2004	0.086850	0.028960	2.999
yr2005	0.037644	0.027495	1.369
yr2006	0.111678	0.026871	4.156
yr2007	-0.374470	0.027510	-13.612
yr2008	-0.047675	0.027774	-1.717
yr2009	0.194348	0.028052	6.928
yr2010	0.485965	0.027877	17.432
yr2011	0.403935	0.027823	14.518
yr2012	0.374567	0.028946	12.940
yr2013	0.659604	0.027690	23.821
yr2014	0.391278	0.027736	14.107
yr2015	0.238244	0.027962	8.520
yr2016	0.219245	0.027246	8.047
yr2017	0.462338	0.027849	16.601
yr2018	0.485399	0.026986	17.987
yr2019	0.103880	0.027539	3.772
yr2020	0.203461	0.034701	5.863
trimestre2	-0.209776	0.009807	-21.391
trimestre3	0.077076	0.009728	7.923
trimestre4	0.002086	0.009500	0.220
cwp55100050	-0.022356	0.022411	-0.998
cwp55100055	-0.150511	0.023305	-6.458
cwp55100060	-0.345808	0.028736	-12.034
cwp55100065	-0.322067	0.038722	-8.317
cwp55100075	-0.934762	0.333426	-2.804

cwp55100080	-0.983436	0.333441	-2.949
cwp55105045	-0.274533	0.183486	-1.496
cwp55105050	0.044164	0.029888	1.478
cwp55105055	0.047402	0.025500	1.859
cwp55105060	-0.100087	0.031622	-3.165
cwp55105065	-0.486663	0.070181	-6.934
cwp55110055	0.379642	0.040764	9.313
cwp55110060	0.107850	0.041614	2.592
cwp55110065	-0.075465	0.070886	-1.065
cwp55115055	0.519754	0.316374	1.643
cwp55115060	0.559751	0.145777	3.840
cwp55200040	-0.112205	0.031554	-3.556
cwp55200045	-0.065267	0.023647	-2.760
cwp55200050	-0.157676	0.023667	-6.662
cwp55200055	-0.187635	0.025579	-7.336
cwp55200060	-0.386427	0.028836	-13.401
cwp55200065	-0.373647	0.030366	-12.305
cwp55200070	-0.394591	0.052159	-7.565
cwp55200075	-0.434417	0.053032	-8.192
cwp55200080	-0.434916	0.123332	-3.526
cwp55200085	-0.715834	0.333412	-2.147
cwp55205040	-0.305441	0.030688	-9.953
cwp55205045	-0.329353	0.027486	-11.983
cwp55205050	-0.359110	0.026944	-13.328
cwp55205055	-0.467458	0.029184	-16.017
cwp55205060	-0.410759	0.031842	-12.900
cwp55205065	-0.425650	0.036148	-11.775
cwp55205070	-0.406359	0.094202	-4.314
cwp55205075	-0.223669	0.219220	-1.020
cwp55210040	-0.260499	0.027456	-9.488
cwp55210045	-0.405722	0.026914	-15.075
cwp55210050	-0.285845	0.053533	-5.340
cwp55210055	-0.476312	0.076664	-6.213
cwp55210060	-0.763012	0.190030	-4.015
cwp55215035	-0.230903	0.057211	-4.036
cwp55215040	-0.211604	0.027876	-7.591
cwp55215045	-0.119356	0.066799	-1.787
cwp55220035	-0.304522	0.119312	-2.552
cwp55220040	-0.390974	0.095523	-4.093
cap.m3	0.107709	0.016131	6.677
d20_m	0.037257	0.005205	7.157