# REPORT OF THE 2019 THIRD INTERSESSIONAL MEETING OF THE ICCAT BLUEFIN TUNA MSE TECHNICAL GROUP

(Madrid, Spain, 19-21 September 2019)

# 1. Opening, adoption of agenda and meeting arrangements

The meeting was held at the ICCAT Secretariat in Madrid, September 19 to 21, 2019. Drs Doug Butterworth (Professor Emeritus, University of Cape Town) and Gary Melvin (SCRS Chair), the Bluefin MSE Technical Group ("the Group") Rapporteurs and meeting Chairs, opened the meeting. The ICCAT Executive Secretary, Mr. Camille Jean Pierre Manel, welcomed the participants and highlighted the importance of ICCAT's Atlantic bluefin tuna Management Strategy Evaluation (MSE) process. He thanked the participants for their work so far and emphasized the importance of this work for the Commission. The Chairs proceeded to review the Agenda, which was adopted with a small change (**Appendix 1**). Due to the time constraints, the Group focused only on the main outputs from the meeting in compiling this report.

The List of Participants is included in **Appendix 2**. The List of Documents presented at the meeting is attached as **Appendix 3**. The abstracts of all SCRS documents and presentations provided at the meeting are included in **Appendix 4**. The following served as Rapporteurs:

Sections	Rapporteur
Items 1, 8	A. Kimoto
Items 2-7	M. Lauretta, C. Fernandez, D. Butterworth, G. Melvin, J. Walter

# 2. Review of July Meeting results regarding Operating models (OMs)

The co-chair and the Contractee gave two presentations (SCRS/P/2019/062) updating the progress in OM developments since the meeting held in St. Andrews in July 2019. This intersessional work proceeded along the priority lines indicated in the July MSE meeting report (Section 12 of that report: Anon., 2019a), focusing particularly on the top three priorities, i.e.

- Check changes made to OM conditioning code during the July MSE meeting, and update the Trials Specification Document to include the revised selectivity specifications
- Investigate how re-weighting of contributions to the penalised log-likelihood affects model fit
- Investigate options for modeling selectivity in response to points raised at the July MSE meeting

Regarding the first bullet point, the changes made to the code were checked and no errors were found. The issue of not being able to estimate the biomass scale of the West and East areas realistically, detected at the July MSE meeting after the code changes, remained unresolved. This inability to determine scale is a consequence of failure to fit many of the abundance indices reasonably.

Regarding the third bullet point above, a revised fleet definition splitting the Japanese longline fishing fleet CPUE into an earlier series (before 2010) and a recent series (2010 and afterwards) was implemented. Therefore, 18 fishing fleets, instead of 17, are now reflected in the OMs. The selectivity of the two Japanese (East and West) longline CPUE indices corresponding to the year 2010 and onwards was modified accordingly. The selectivity of the Canadian rod and reel fishing fleet is now assigned an asymptotic shape.

The most complex investigations concerned the second bullet point, i.e. the investigation of how the weightings of different contributions to the penalised log-likelihood impacted on the model fits. The process followed to address this was:

- 1. First develop a better-based baseline (default) weighting approach from which to investigate sensitivities to alternative weightings.
- 2. Also use the analysis as a basis to understand what informs biomass scale, and whether appropriate weighting might re-establish that scale through improved fits to abundance indices.

The new default weighting scheme developed assigns weights equal to 1 for all datasets except for the catch length composition data, which are assigned weights smaller than 1 (to allow for the lack of independence

across lengths). Priors are also assigned weights equal to 1, whereas catches (disaggregated by year, quarter, fleet and region) are assigned weights smaller than 1. Initial broad-scale findings were:

- The default weighting does not achieve a reasonable biomass scale (at least for the OMs without past regime shifts in recruitment)
- Upweighting the Gulf of Mexico (GOM) larval index (relative to the default weighting) can get biomass scale in the West area (and also in the East area for a very high weighting)
- Upweighting the MED (Mediterranean) larval index (relative to the default weighting) can get biomass scale in the East area
- Data conflicts detected:

Increases in abundance in the East area (implied especially by the MED larval index) imply increases in abundance the West area because of the numbers of eastern fish which the stock of origin (SOO) data then suggest to be there; however, the West area abundance indices for locations where these eastern fish are expected to be present do not show as much increase as the first two sources of data suggest.

 Alternative weightings (upweighting or downweighting different data sources in turn) have impacts on estimates of both biomass trend and magnitude, as well as on the "Superman effect" (a strong recent rate of increase in East biomass).

The Group requested that individual data series log-likelihood components be presented to better understand their influence compared to the sum of log-likelihoods by data type.

A sub-group reviewed the Trial Specification Document's (TSD) Table 2.1, 2.2, and 3.1 and cross-referenced the information in these tables with the data file used in the operating model (M3.dat file). Tables were also reviewed for accuracy in the correct quarter (Q), strata (the 7 areas of the operating model), fleet assignment, relationships with abundance for fishery independent indices, and size range for selectivities, among others (see details in **Appendix 5**). A major change was made regarding the Canadian acoustic survey, which is to be assumed to be proportional to the eastern and western combined stock abundance in numbers of fish >159 cm (ageclasses<sup>1</sup> 2 and 3) in quarter 3 in the Gulf of St. Lawrence (GSL) stratum only. Originally it had been assumed to be proportional to the spawning stock biomass (SSB) of western stock for all strata combined. This change was made because the data in recent years show that the GSL has a mix of eastern and western origin fish (Anon., 2017), and the unit for this index is number of fish rather than biomass. Furthermore, the relationships of the Western MED Larval survey, USA Larval Survey, and GBYP Aerial survey indices should be to the SSB in the stratum where and the quarter when the survey has taken place. Some minor changes were made to the USA rod and reel size range of selectivites that were established during the July MSE meeting.

# 3. Compile candidate reference and robustness sets Oms

After discussing the results from the presentations on OM developments (SCRS/P/2019/062), the Group agreed on the following actions:

1. Further investigate the causes and robustness of the estimated large increase in eastern stock biomass in the most recent years of the model (i.e. the Superman effect). Try to identify what data series cause this effect, and if possible, group individual series that produce similar and produce contrary effects to create alternative scenarios for candidate management procedure (CMP) testing. Showing the table with log-likelihood values separated by individual indices of abundance (for both fishery-dependent and fishery-independent indices) could help interpret the results. The Contractee presented the outcomes of downweighting the individual indices on estimated biomass trend and scale. The MED larval survey and GSL fishery index were found to be influential in producing the Superman effect, and the Group considered that alternative runs with these indices downweighted might produce desired alternative scenarios in stock trend and absolute biomass. It was noted that it is more appropriate to downweight individual series than completely remove them, so that the statistical properties of the indices remain estimated which in turn allows these indices to still be projected and hence utilised by CMPs. The decision as to whether to include these trials as part of the reference set of models or robustness tests will be evaluated by the Group after model refitting and evaluation of results. The next

<sup>&</sup>lt;sup>1</sup>Ageclass 1 refers to ages 0 to 4, ageclass 2 refers to ages 5 to 8, and ageclass 3 refers to ages 9+.

step is to evaluate the suite of models that do not result in a Superman effect, evaluate their convergence, and determine if they give consistent trends and provide biomass scale.

- 2. Examine the effect of differentially weighting the two components of SOO data (microchemistry and genetics). Conduct a sensitivity run assigning a weight of 1/3 (of the default) to the genetics SOO dataset, and one run with the same downweighting of the microchemistry SOO dataset. The microchemistry data were found to be in some contradiction with most data sources, while genetics data impact in the opposite direction and have little influence on the overall objective function or biomass estimates. The Contractee noted that the SOO data were highly influential and a major source of conflict with the indices of abundance for the West area mixed stock fisheries. The Group noted that the longer time series for these data (which go back to the 1970s) compared to the more recent genetic data. Although downweighting the SOO data did not have a large effect on the stock trend or biomass scale, the effect on other aspects of model fit had yet to be considered, and the measure of influence is best evaluated by the effect on performance of candidate management procedures. A need identified was to determine alternative weights for the SOO data.
- 3. A subgroup was formed to further consider issues connected with movement, in particular, if there is additional information that could be usefully incorporated in the model (for example, via the prior distribution for the movement parameters) (see details in **Appendix 6**). The Group noted that previously movement restrictions identified had been implemented in the package, including exclusion of GOM-origin fish migration into the MED and MED-origin fish migration into the GOM, no residency of fish in the GOM during Q3, and no fish present in the GSL during Q1. The Group initially identified two additional movement constraints that should be parameterized in the model:
  - 1) the biomass of GOM-origin ageclass 3 fish should be greatest in the GOM during the spawning season (Q2), and
  - 2) the biomass of MED-origin ageclasses 2 and 3 should be greatest in the MED during the spawning season (also Q2); ageclass 1 was not included because most of the juveniles remain in the MED and hence should not be used to estimate seasonality effects in the MED.

These dynamics were based on the knowledge of the fishery seasonality and catch histories, and supported by electronic tagging observations. The recommendations were agreed upon by the Group, and incorporated into the OMs as specified in more detail below; this is because it was important to capture the known biology of the stock accurately.

- The seasonality of the GOM spawning biomass was estimated from a joint U.S.-Mexico longline CPUE analysis conducted during the workshop in Mexico City (Walter *et al.* 2017). The quarterly distribution of spawning biomass (ageclass 3) in the GOM was estimated therefrom to be Q1: 31% Q2: 61% Q3: 7% and Q4: 1%.
- The preferred approach is to use quarterly coefficients estimated from an index standardization model using the Spanish longline data operating in the MED during the 1990s; however, this will first require consultation with the Spanish scientists to confirm that those data are available. In the interim, the nominal catch rates in the MED from the Spanish longline fleet operating during the 1990s were considered to be the best available appropriate information. The quarterly biomass distribution (ageclasses 2 and 3) was estimated therefrom to be Q1: 11% Q2: 63% Q3: 22% and Q4: 4%.
- The movement of the fish between strata from one quarter to the next will be restricted to movements that have been observed from conventional tag returns or electronic tag tracks (**Table 1**).

The Contractee agreed to run the MSE with each of the proposed revisions (seasonality of spawning residency, restrictions on regional transitions, and fleet modifications). The results will be reviewed during the 2019 Bluefin Species Group meeting prior to final acceptance of these revisions.

# 4. Develop plausibility weighting scenarios

There was insufficient time to address this item.

5. Develop graphical presentation of CMP results

There was insufficient time to address this item.

# 6. Other matters

### Workplan and schedule 2020

An initial draft roadmap (see **Appendix 7**) was outlined as to how to advance the MSE process in 2020, such that TAC advice could be provided from an MP potentially adopted by the Commission in October 2021. To accomplish this, a series of meetings was proposed, which included 1) a small technical group meeting to develop proposals for the final operating models parameterizations and performance, 2) a Bluefin MSE Technical Group meeting (as part of the bluefin stock assessment data preparatory meeting) to review and adopt the final operating models, 3) a meeting of candidate management procedure developers to compare and evaluate their proposed procedures, 4) a final Bluefin MSE Technical Group meeting to evaluate and select management procedure candidates for initial presentation to the Commission in October 2020, and 5) meetings between scientists and stakeholders to review and revise, as necessary, the management procedure candidates over the October 2020 to October 2021 period.

An important milestone that must be met in order to remain on Schedule for an MP adoption in October 2021 is to have OMs adopted by April 2020 at the latest. One possibility raised was to have a pre-workshop webinar to evaluate the OMs prior to or during December 2019, so that model performance, diagnostics, and any necessary revisions could be communicated and addressed in advance of 2020 workshops.

A final roadmap will need more detail; this will best be developed following discussions in the Bluefin Species Group on assessment plans for 2020.

The Group reviewed the details of advances in the MSE process made at this meeting, as provided in **Appendix 8**. As regards the set of proposed robustness tests, additional tests were identified to span the range of uncertainties in the data and model assumptions; these are listed in **Appendix 8**. It was noted that it is highly desirable to have a range of OMs that range across the results of the stock assessments in terms of absolute biomass of both the stocks as well as the stock status estimates.

A need was identified to review the set of reality checks (2019 Intersessional Meeting of the ICCAT Bluefin Tuna Species Group in February: Anon. (in press) for screening OMs by the Bluefin MSE Technical and Bluefin Species Groups. It was recommended that this revised set of diagnostics be developed during the Bluefin Species Group meeting.

# 7. Recommendations

The Group recommended that the Contractee implement the changes identified above.

# 8. Adoption of the report and closure

The report was adopted during the meeting. The meeting was adjourned.

# References

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- Anonymous. (in press). Report of the 2019 Second Intersessional Meeting of the ICCAT Bluefin Tuna MSE Technical Group (St. Andrews, Canada 23-27 July 2019). Document SCRS/2019/12: 22 p.
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- Teo SLH, Boustany A, Dewar H, Stokesbury MJW, Weng KC. 2007. Annual migrations, diving behavior, and thermal biology of Atlantic bluefin tuna, *Thunnus thynnus*, on their Gulf of Mexico breeding grounds. Mar. Biol. 151: 1–18.

**Table 1**. Movements between spatial strata by stock and quarter used to restrict the movement of fish based on conventional tag returns or electronic tag tracks in the OMs. These are possible movements present in a particular stratum (row) that move to a stratum (column) in the following quarter for all ageclasses. The left panel applies to the Western Stock (i.e. excludes the MED), and the right panel to the Eastern Stock (i.e. excludes the GOM). Insertions are 1 if at least one such movement has been observed, and 0 if none have been observed.

West stock (all age classes)				Po	ssible:	64%	East stock	(all ag	e class	es)		Po	ssible:	67%	
Quarter 1								Quarter 1							
	GOM	WATL	GSL	SATL	NATL	EATL	MED		GOM	WATL	GSL	SATL	NATL	EATL	MED
GOM	1	1	0	0	0	0	0	GOM	0	1	0	0	0	0	0
WATL	1	1	1	1	1	1	0	WATL	0	1	1	1	1	1	0
GSL	1	1	1	1	1	1	0	GSL	0	1	1	1	1	1	0
SATL	0	1	0	1	1	1	0	SATL	0	1	0	1	1	1	1
NATL	0	1	0	1	1	1	0	NATL	0	1	0	1	1	1	1
EATL	0	1	0	1	1	1	0	EATL	0	1	0	1	1	1	0
MED	0	0	0	1	0	1	0	MED	0	0	0	1	0	1	1
Quarter 2								Quarter 2							
	GOM	WATL	GSL	SATL	NATL	EATL	MED		GOM	WATL	GSL	SATL	NATL	EATL	MED
GOM	1	1	1	1	0	0	0	GOM	0	1	1	1	0	0	1
WATL	1	1	1	1	1	1	0	WATL	0	1	1	1	1	1	1
GSL	0	0	1	0	0	0	0	GSL	0	0	1	0	0	0	0
SATL	1	1	1	1	1	1	0	SATL	0	1	1	1	1	1	1
NATL	1	1	1	1	1	1	0	NATL	0	1	1	1	1	1	1
EATL	1	1	1	1	1	1	0	EATL	0	1	1	1	1	1	1
MED	0	0	0	1	0	0	0	MED	0	0	0	1	0	0	1
Quarter 3								Quarter 3							
	GOM	WATL	GSL	SATL	NATL	EATL	MED		GOM	WATL	GSL	SATL	NATL	EATL	MED
GOM	1	1	1	0	0	0	0	GOM	0	1	1	0	0	0	0
WATL	0	1	1	1	1	1	0	WATL	0	1	1	1	1	1	1
GSL	0	1	1	0	1	1	0	GSL	0	1	1	0	1	1	0
SATL	0	1	1	1	1	1	0	SATL	0	1	1	1	1	1	1
NATL	0	1	1	1	1	1	0	NATL	0	1	1	1	1	1	1
EATL	0	1	1	1	1	1	0	EATL	0	1	1	1	1	1	1
MED	0	1	1	1	1	1	0	MED	0	1	1	1	1	1	1
Ouarter 4								Ouarter 4							
C	GOM	WATL	GSL	SATL	NATL	EATL	MED		GOM	WATL	GSL	SATL	NATL	EATL	MED
GOM	1	1	1	0	0	0	0	GOM	0	1	1	0	0	0	0
WATL	1	1	1	1	1	1	0	WATL	0	1	1	1	1	1	1
GSL	1	1	1	1	1	1	0	GSL	0	1	1	1	1	1	0
SATL	0	1	1	1	1	1	0	SATL	0	1	1	1	1	1	1
NATL	0	1	1	1	1	1	0	NATL	0	1	1	1	1	1	1
EATL	0	1	1	1	1	1	0	EATL	0	1	1	1	1	1	1
MED	0	1	1	1	1	1	0	MED	0	1	1	1	1	1	1
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#### Agenda

- 1. Opening, adoption of agenda and meeting arrangements
- 2. Review of July meeting results regarding Operating models (OMs)
- 3. Compile candidate reference and robustness sets OMs
- 4. Develop plausibility weighting scenarios
- 5. Develop graphical presentation of CMP results
- 6. Other matters
  - Workplan and schedule 2020
- 7. Recommendations
- 8. Adoption of the report and closure

## List of participants

#### **CONTRACTING PARTIES**

#### ALGERIA

# Kouadri-Krim, Assia

Chef de Bureau, Ministère de l'Agriculture du Développement rural et de la Pêche, Direction Générale de la Pêche et de l'Aquaculture, CTE 800 Logements, Bâtiment 41, Nº 2 Mokhtar Zerhouni Mouhamadia, 16000 Tel: +213 558 642 692, Fax: +213 21 43 31 97, E-Mail: dpmo@mpeche.gov.dz; assiakrim63@gmail.com

#### CANADA

**Carruthers**, Thomas 335 Fisheries Centre, University of British Columbia, Vancouver Columbia V2P T29 Tel: +1 604 805 6627, E-Mail: t.carruthers@oceans.ubc.ca

#### Duprey, Nicholas

Science Advisor, Fisheries and Oceans Canada - Fish Population Science, Government of Canada, 200-401 Burrard Street, Vancouver, BC V6C 3R2 Tel: +1 604 499 0469, E-Mail: nicholas.duprey@dfo-mpo.gc.ca

#### Gillespie, Kyle

Fisheries and Oceans Canada, St. Andrews Biological Station, Population Ecology Division, 125 Marine Science Drive, St. Andrews, New Brunswick, E5B 1B3 Tel: +1 506 529 5725, Fax: +1 506 529 5862, E-Mail: kyle.gillespie@dfo-mpo.gc.ca

#### Hanke, Alexander

Scientist, St. Andrews Biological Station/ Biological Station, Fisheries and Oceans Canada, 125 Marine Science Drive, St. Andrews New Brunswick E5B 0E4 Tel: +1 506 529 5912, Fax: +1 506 529 5862, E-Mail: alex.hanke@dfo-mpo.gc.ca

#### **EUROPEAN UNION**

Andonegi Odriozola, Eider

AZTI, Txatxarramendi ugartea z/g, 48395 Sukarrieta Bizkaia, España Tel: +34 667 174 414, E-Mail: eandonegi@azti.es

**Biagi**, Franco Directorate General for Maritime Affairs and Fisheries (DG-Mare) - European Commission, Rue Joseph II, 99, 1049 Bruxelles, Belgium Tel: +322 299 4104, E-Mail: franco.biagi@ec.europa.eu

#### Di Natale, Antonio

Aquastudio Research Institute, Via Trapani 6, 98121 Messina, Italy Tel: +39 336333366, E-Mail: adinatale@acquariodigenova.it

**Fernández**, Carmen Instituto Español de Oceanografía, Avda. Príncipe de Asturias, 70 bis, 33212 Gijón, España Tel: +34 985 309 804, Fax: +34 985 326 277, E-Mail: carmen.fernandez@ieo.es

#### Gordoa, Ana

Centro de Estudios Avanzados de Blanes (CEAB - CSIC), Acc. Cala St. Francesc, 14, 17300 Blanes Girona, España Tel: +34 972 336101, E-Mail: gordoa@ceab.csic.es

#### Merino, Gorka

AZTI - Tecnalia /Itsas Ikerketa Saila, Herrera Kaia Portualdea z/g, 20100 Pasaia - Gipuzkoa, España Tel: +34 94 657 4000; +34 664 793 401, Fax: +34 94 300 4801, E-Mail: gmerino@azti.es

#### **JAPAN**

#### Butterworth, Douglas S.

Emeritus Professor, Department of Mathematics and Applied Mathematics, University of Cape Town, Rondebosch, 7701 Cape Town, South Africa

Tel: +27 21 650 2343, E-Mail: doug.butterworth@uct.ac.za

#### Nakatsuka, Shuya

Head, Pacific Bluefin Tuna Resources Group, National Research Institute of Far Seas Fisheries, Japan Fisheries Research and Education Agency, Shizuoka Shimizu 424-8633

#### Suzuki, Ziro

Senior Research Scientist, Pacific Bluefin Tuna Resources Group, National Research Institute of Far Seas Fisheries, Japan Fisheries Research and Education Agency, 5-7-1 Orido, Shizuoka Shimizu 424-8633 Tel: +81 54 336 6039, Fax: +81 54 335 9642, E-Mail: zsuzuki@affrc.go.jp; sszuzukizziro@gmail.com

#### Tsukahara, Yohei

National Research Institute of Far Seas Fisheries, 5-7-1 Orido, Shizuoka Shimizu-ku 424-8633 Tel: +81 54 336 6000, Fax: +81 54 335 9642, E-Mail: tsukahara\_y@affrc.go.jp

### **MAURITANIA**

Braham, Cheikh Baye Halieute, Géo-Statisticien, modélisateur; Chef du Service Statistique, Institut Mauritanien de Recherches Océanographiques et des Pêches (IMROP), BP 22 Nouadhibou Tel: +222 2242 1038, E-Mail: baye\_braham@yahoo.fr; baye.braham@gmail.com

# **MOROCCO**

### Bensbai, Jilali

Chercheur, Institut National de Recherche Halieutique à Casablanca - INRH/Laboratoires Centraux, sidi Abderrhman / Ain Diab, 20000 Casablanca

Tel: +212 661 59 8386, Fax: +212 522 397 388, E-Mail: bensbaijilali@gmail.com

# **TUNISIA**

#### Zarrad, Rafik

Institut National des Sciences et Technologies de la Mer (INSTM), BP 138 Ezzahra, Mahdia 5199 Tel: +216 73 688 604; +216 972 92111, Fax: +216 73 688 602, E-Mail: rafik.zarrad@instm.rnrt.tn; rafik.zarrad@gmail.com

#### **UNITED STATES**

Brown, Craig A. Chief, Highly Migratory Species Branch, Sustainable Fisheries Division, NOAA Fisheries Southeast Fisheries Science Center, 75 Virginia Beach Drive, Miami Florida 33149 Tel: +1 305 586 6589, Fax: +1 305 361 4562, E-Mail: craig.brown@noaa.gov

#### Lauretta, Matthew

NOAA Fisheries Southeast Fisheries Center, 75 Virginia Beach Drive, Miami Florida 33149 Tel: +1 305 361 4481, E-Mail: matthew.lauretta@noaa.gov

#### Walter, John

NOAA Fisheries, Southeast Fisheries Center, Sustainable Fisheries Division, 75 Virginia Beach Drive, Miami Florida 33149 Tel: +305 365 4114, Fax: +1 305 361 4562, E-Mail: john.f.walter@noaa.gov

## **OBSERVERS FROM NON-GOVERNMENTAL ORGANIZATIONS**

#### **PEW CHARITABLE TRUSTS - PEW**

Cox, Sean School of Resource and Environmental Management, Simon Fraser University, 8888 University Drive, British Columbia Burnaby V5A1S6, Canada

Tel: +1 78 782 5778, Fax: +1 778 782 4968, E-Mail: spcox@sfu.ca

### THE OCEAN FOUNDATION

Miller, Shana The Ocean Foundation, 1320 19th St., NW, 5th Floor, Washington, DC 20036, United States Tel: +1 631 671 1530, E-Mail: smiller@oceanfdn.org

### **SCRS CHAIRMAN**

# Melvin, Gary

SCRS Chairman, St. Andrews Biological Station - Fisheries and Oceans Canada, Department of Fisheries and Oceans, 285 Water Street, St. Andrews, New Brunswick E5B 1B8, Canada Tel: +1 506 651 6020, E-Mail: gary.d.melvin@gmail.com; gary.melvin@dfo-mpo.gc.ca

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# **ICCAT Secretariat**

C/ Corazón de María 8 – 6th floor, 28002 Madrid – Spain Tel: +34 91 416 56 00; Fax: +34 91 415 26 12; E-mail: info@iccat.int

Neves dos Santos, Miguel Ortiz, Mauricio Kimoto, Ai Alemany, Francisco

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# List of Papers and Presentations

Number	Title	Authors
SCRS/P/2019/062	Progress on Operating Model Conditioning since St Andrews	Butterworth D. and Carruthers T.

# SCRS Document and Presentations Abstracts as provided by the authors

*SCRS/P/2019/062* – The authors presented progress on Operating Model Conditioning since St Andrews at the second BFT MSE TG meeting. It was checked the changes made to OM conditioning code were correct, and those changes were included in the Trial Specification Document. Investigation on how iterative reweighting of likelihood data components affects model fit was conducted, but it was found that the weighting does not get scale in SSB. Alternative approach was investigated by changing the weighting of the larval indices in the Gulf of Mexico and in the Mediterranean.

# **Report of sub-group on Trial Specification Document**

A sub-group reviewed the Trial Specification Document's (TSD) **Tables 2.1, 2.2, and 3.1,** and crossreferenced the information in these tables with the data file used for the operating model (M3.dat file). Tables were also reviewed and updated for accuracy regarding the correct quarter (Q), strata (operating model 7-areas), fleet assignment, relationships with abundance for fishery independent indices, and size ranges for selectivities. Major changes were made to the relationships all fishery-independent indices except the French Aerial survey. The Canadian acoustic survey should relate to abundance in numbers of combined east and west stocks in quarter 3 for the GSL stratum only. Originally it was assumed to relate to the SSB of the western stock for all strata combined. This change was made because the data in recent years shows the GSL has a mix of eastern and western stock (Anon. 2017), and the unit of this index is the number of fish. The relationships for the Western MED Larval survey, GOM Larval Survey, and Aerial survey (GBYP) should be SSB in the stratum and the quarter where the survey has taken place. Some minor changes were also made to the US rod and reel size range of selectivites that were established in July 2019 MSE meeting.

The sub-group recognized that there are still challenges in using CATDIS for quarterly allocated catches by stratum by fleet in the OMs. These challenges arise from the estimation of catches that had missing data and hence failed to report Catch/Effort by quarter (e.g. purse seine catch in the Med after 2009). Further revisions may be considered later for a better understanding of the catch distribution.

**TSD-Table 2.1** The standardized CPUE indices used to fit the operating models (many of which are used in stock assessments previously conducted by ICCAT). Many of these indices are available after 2016 but the operating model uses data to 2016 only due to the unavailability of CATDIS updated catch data for more recent years at the original time of model conditioning. The right-most column indicates the fishing fleets used to assign selectivity to each CPUE index; the fishing fleets are described in **Table 3.1**.

	Flag	Gear	Details	Fleet (selectivity) assigned
1	Spain	Baitboat	1964-2006, Q3, E Atl	3: BBold
2	Spain / France	Baitboat	2007-2014, Q3, E Atl	4: BBnew
3	Morocco / Spain	Trap	1981-2011, Q2, S Atl	12: TPold
4	Morocco / Portugal	Trap	2012-2016, Q2, S Atl	13: TPnew
5	Japan	Longline	1975-2009, Q2, S Atl	2: LLJPN
6	Japan	Longline	1990-2009, Q4, N Atl	2: LLJPN
7	Japan	Longline	2010-2016, Q4, N Atl	18: LLJPNnew
8	US (66cm - 114cm)	Rod and reel	1993-2016, Q3, W Atl	15: RRUSAFS (50 – 125cm)
9	US (115cm -	Rod and reel	1993-2016, Q3, W Atl	15: RRUSAFS (100 – 150cm)
	144cm)			
10	US (177cm+)	Rod and reel	1993-2016, Q3, W Atl	16: RRUSAFB (175cm+)
11	US (<145cm)	Rod and reel	1980-1992 (gap in	15: RRUSAFS (50 – 150cm)
			1984), Q3, W Atl	
12	US (195cm+)	Rod and reel	1983-1992, Q3, W Atl	16: RRUSAFB (200cm+)
13	US	Longline	1987-1991, Q2, GOM	1: LLOTH
14	US	Longline	1992-2016, Q2, GOM	1: LLOTH
15	Japan	Longline	1974-1980, Q2, GOM	2: LLJPN
16	Japan	Longline	1976-2009, Q4, W Atl	2: LLJPN
17	Japan	Longline	2010-2016, Q4, W Atl	18: LLJPNnew
18	Canada GSL	Rod and reel	1984-2016, Q3, GSL	14: RRCAN
19	Canada SWNS	Rod and reel	1988-2016, Q3, W Atl	14: RRCAN

	Туре	Details	Infers:
1	French aerial survey past	2000-2003, Q3, Med	Vulnerable biomass in Q3 in Med, according to the RRUSAFS selectivity due to similar assumed size of fish
2	French aerial survey recent	2009-2016 (gap in 2013), Q3, Med	Vulnerable biomass in Q3 in Med, according to the RRUSAFS selectivity due to similar assumed size of fish
3	Western Med Larval	2001-2015 (gaps in 2006- 2011) 02 Med	SSB eastern stock in Q2 in Med
4	Canadian acoustic survey	1994-2016, Q3, GSL, index in number of fish greater than 159cm	Number of combined eastern and western fish in Q3 for the GSL stratum according to the estimated vulnerable biomass available to the CANRR fleet for 150cm plus
5	USA Larval Survey	1977-2016 (gaps in 1979-1980, and 1985) 02 COM	SSB western stock in Q2 in
6	Aerial survey – GBYP*	2010-2015 (gaps in 2012, 2014, and 2016), Q2, Med	SSB eastern stock in Q2 in Med

**TSD-Table 2.2** Fishery-independent indices used in the fitting of operating models.

\* Only the Balearic component is used for SSB (because there are problems with consistency regarding patchy or low biomass inference in other regions surveyed in the Med).

							Selectivity
No.	Name	Gear	Flag	Strata	Quarter	Start – End	type/Bounds on
			Allowcont		A11		fleet selectivity*
1	LLOTH	LL	Japan	All (no GSL)	All	1964-2016	DN; 12.5 - 412.5
2	LLJPNold	LL	Japan	All (no GSL)	All	1964-2009	DN; 12.5 – 387.5
3	BBold	BB	EU.Spain, EU.France	Bay of Biscay (EATL)	2,3,4	1960-2006	DN; 12.5 – 262.5
4	BBnew	BB	EU.Spain, EU.France	Bay of Biscay (EATL)	2,3,4	2007-2016	DN; 12.5 – 312.5
5	PSMEDold	PS	All except EU.Croatia	MED	1,3,4	1960-2008	DN; 12.5 – 387.5
6	PSMEDold- Q2	PS	All except EU.Croatia	MED	2	1960-2008	DN; 12.5 – 337.5
7	PSMEDnew	PS	All except EU.Croatia	MED	All	2009-2016	DN; 12.5 – 387.5
8	PSNOR	PS	Norway	NATL, EATL	3,4	1964-2016	DN; 112.5 – 362.5
9	PSHRV	PS	EU.Croatia	MED	All	1991-2016	DN; 12.5 – 337.5
10	PSWold	PS	USA, Canada	WATL	2,3,4	1964-1984	DN; 12.5 – 362.5
11	PSWnew	PS	USA, Canada	WATL	All	1985-2015	DN; 62.5 – 337.5
			EU.Spain,		All		DN; 37.5 – 362.5
12	TPold	ТР	Morocco, EU.	St. Gibraltar (SATL, MED)		1964-2011	
13	TPnew	TP	Portugal EU.Spain, Morocco, EU. Portugal	St. Gibraltar (SATL)	2,3,4	2012-2016	DN; 37.5 – 387.5
14	RRCAN	RR	Canada	WATL, GSL	All	1964-2016	Logistic; 12.5 – 387.5
15	RRUSAFS	RR	USA	WATL	2,3,4	1964-2016	DN; 12.5 – 187.5
16	RRUSAFB	RR	USA	WATL	2,3,4	1964-2016	DN; 62.5 – 387.5
17	ОТН	other	other	All	All	1964-2016	DN; 12.5 – 387.5
18	LLJPNnew	LL	Japan	WATL, SATL, NATL, EATL	All	2010-2016	DN; 62.5 – 337.5

**TSD-Table 3.1** Fishing fleets included in the operating model, based on the selectivities of fleets active historically in the Atlantic. Catch and length composition by fleet are prepared by year, quarter, and strata from the revised CATDIS (Kimoto *et al.* (in press)) and screened Task 2 Size. The columns of "Strata" and "Quarter" list the strata and quarters that have catches in the revised CATDIS (Kimoto *et al.* (in press)).

\* Selectivity type DN means double normal. Boundary shows the middle point in a length bin (width of length bin is 25cm).

#### THIRD BLUEFIN TUNA MSE TECHNICAL MEETING - MADRID 2019

| Tab  | ole   | 1.  | Sumr   | nary   | tal   
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| Fishery  |   |     |  |  | 1:  
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  |   |  
  |   | 2: LLJPNo  
  | old  |  |  |   |   | 3:  | BBold  | 4: BBnew   | 5: PSMEDold  | 6:<br>PSMEDoldO2 | 7: P  | SMEDnew  |                              |
| Country  |   |     |  |  | All exc   
   | cept Japan   |                                     |  
  |  |  |  |   |   
  |   |  
  |   | Japan  
  |  |  | 1  |   |   |   | EU.Spain, EU   | J.France   |  | All except EU.C  | roatia  |  |                              |
| Strata   | 1:GOM   |     | 2:WATL   | 4:S/   | ATL   
   | 5:NATL   | 6:E                                 | ATL  
  | 7:N  | IED  | 1:GO   | M   | :   
  | 2:WATL  |  
  | 4:SAT   | L  
  | 5:N  | IATL   | 6:EAT  | rL.   | 7:MED   |   | 6:EAT  | L  |  | 7:MED            |   |  |                              |
| Quarter  | 1 2   | 3 4 | 1 2 3  | 4 1 2  | 3 4   
   | 1 2 3  | 4 1 2                               | 3 4  
  | 1 2  | 3  | 1 1  | 2 3 4   | 1   
  | 2 3   | 4  
  | 1 2   | 3 4  
  | 1 2  | 3 4  | 1 2  | 3 4   | 1 2 3   | 4 2   | 3 4  | 2 3  | 4 1 3  | 4 2              | 1   | 2 3  | 4                            |
| 1951<br>1952<br>1953<br>1954<br>1955<br>1954<br>1956<br>1957<br>1959<br>1959<br>1959<br>1959<br>1959<br>1950<br>1961<br>1962<br>1963<br>1964<br>1965<br>1964<br>1965<br>1964<br>1965<br>1964<br>1967<br>1971<br>1973<br>1974<br>1977<br>1977<br>1977<br>1977<br>1977<br>1977<br>1977 | 6         0         0         7         0           0         0         7         0         7         0           3         10         10         1 |     | 2         2         2         2           0         0         0         0           1         1         1         1           4         4         4         1           10         10         10         11           21         21         21         21           21         21         21         21           24         25         25         21         16           127         18         127         18         12           130         64         9         4         2           1         21         2         1         1           18         121         13         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        34         20           35         371           36         15           31         6           31         6           31         6           31         6           < | 19         63           30         31           41         15           101         1           207         3           43         5           14         12           15         1           12         14           21         14           22         14           33         4           53         13           34         6           53         13           13         34           65         13           131         14           60         11           100         100           1100         100           120         35           34         6           35         13           36         6           37         7           2         25           36         7           37         2           38         37           39         1           30         31           31         1           31         1           32         3 </td <td>2<br/>5<br/>5<br/>3<br/>37<br/>37<br/>37<br/>3<br/>3<br/>3<br/>3<br/>3<br/>3<br/>3<br/>3<br/>3<br/>3<br/>3<br/>3</td> <td>5 5<br/>101 101<br/>6 6 7<br/>7 1<br/>1</td> <td>2<br/>5<br/>5<br/>1<br/>4<br/>4<br/>4<br/>5<br/>7<br/>1<br/>34<br/>117<br/>7<br/>32<br/>0<br/>6<br/>24<br/>9<br/>0<br/>6<br/>28<br/>0<br/>6<br/>28<br/>0<br/>6<br/>7<br/>7<br/>31<br/>2<br/>2</td> <td>200         200           75         75           100         100           175         75           175         75           175         75           175         75           170         100           100         100           110         110           12         32           13         31           14         58           150         123           16         1129           23         256           12         246           123         256           14         58           15         99           16         2,450           25         588           22         2,471           88         1,185           614         5,2509           7         922           244         5,2037           714         1,856           123         2,869           94         1,258           43         442           25         2,861           124         2,269           125</td> <td>200         200         201           75         10         10         10           1125         125         125         125           1126         121         125         125           127         12         12         12           131         13         13         13           151         6         16         17           153         13         13         14           151         6         16         17           151         6         10         10           161         11         11         11           171         11         11         11           1727         13         14         14           1010         52         14         11           1101         15         16         14           1101         15         16         14           1101         15         16         14           1101         15         16         14           1101         16         14         13           1101         16         14         14           1101         16</td> <td>22 1<br/>4<br/>0 3<br/>5<br/>32 1,2<br/>316 73<br/>713 7<br/>11,153 2<br/>448 26</td> <td>1 1<br/>3<br/>3<br/>40<br/>0<br/>0<br/>1<br/>1<br/>22<br/>25<br/>88<br/>22<br/>1<br/>1<br/>0<br/>3<br/>3<br/>10<br/>0<br/>50<br/>50<br/>50</td> <td>15           140           27           180           3013           3133           1313           1313           1313           1313           1313           1313           1313           1313           1313           131           131           1406           1212           1214           1214           1214           1214           1214           1214           1214           1214           1214           1214           1214           1214           1214           131           131           132           1331           137           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1</td><td>26         3         3           3         3         3           43         3         1           1595         1         2           531         1         2           2         2         2           2         2         2           2         2         2           344         2         6           551         1         2           344         2         6           354         1         2           3605         2         2           374         2         6           3605         2         2           3745         1         2           3846         2         2           491         11         1           491         11         1           493         1         1           278         2         1           374         1         2           491         1         2           493         1         2           494         1         2           495         2         1           <t< td=""><td>2<br/>0<br/>0<br/>155<br/>1<br/>1<br/>1<br/>1<br/>1<br/>1<br/>1<br/>1<br/>1<br/>1<br/>1<br/>1<br/>1</td><td>5 26<br/>1 1<br/>1 1<br/>10 46<br/>10 47<br/>10 10<br/>10 0<br/>10 0<br/>10</td><td>1 0<br/>0 1<br/>1 7<br/>1 1<br/>1 1<br/>1 1<br/>1 1<br/>1 1<br/>1 1<br/>1 1<br/>1 1<br/>1</td><td>2 0<br/>0 0<br/>1 0<br/>1 0<br/>0 0<br/>1 0<br/>0 0<br/>1 0<br/>0 0<br/>0 3<br/>1 0<br/>1 0<br/>1 0<br/>1 0<br/>1 0<br/>1 0<br/>1 0<br/>1 0<br/>1 0<br/>1 0</td><td>0<br/>1<br/>4<br/>2<br/>9<br/>29<br/>4<br/>61<br/>29<br/>33<br/>0<br/>15<br/>15<br/>15<br/>15<br/>15<br/>15<br/>1<br/>3<br/>0<br/>1<br/>5<br/>1<br/>5<br/>1<br/>5<br/>1<br/>5<br/>1<br/>5<br/>1<br/>5<br/>1<br/>5<br/>5<br/>1<br/>5<br/>5<br/>1<br/>5<br/>5<br/>5<br/>1<br/>5<br/>5<br/>5<br/>5<br/>5<br/>5<br/>5<br/>5<br/>5<br/>5<br/>5<br/>5<br/>5</td><td>0<br/>5<br/>217<br/>332<br/>27<br/>3<br/>0<br/>0<br/>2<br/>111<br/>17<br/>7<br/>1<br/>2<br/>10<br/>2<br/>32<br/>27<br/>3<br/>2<br/>3<br/>2<br/>11<br/>17<br/>7<br/>1<br/>2<br/>10<br/>1<br/>17<br/>7<br/>1<br/>2<br/>3<br/>2<br/>3<br/>3<br/>2<br/>3<br/>3<br/>2<br/>3<br/>3<br/>3<br/>3<br/>3<br/>3<br/>3<br/>3<br/>3<br/>3<br/>3<br/>3<br/>3</td><td>43 68<br/>243 3<br/>1.861 33<br/>1.861 334<br/>756 392<br/>274 246<br/>6 55<br/>277 24<br/>26<br/>576 392<br/>9134 92<br/>317 299<br/>914 92<br/>313 8<br/>270<br/>33 8<br/>1 241 16<br/>101 26<br/>172 1<br/>280<br/>1 241 16<br/>101 26<br/>172 2<br/>122 1<br/>536<br/>172 2<br/>125 2<br/>125 2<br/>133 8<br/>1 241 16<br/>101 26<br/>172 2<br/>125 2<br/>125 2<br/>125 2<br/>135 2<br/>135 2<br/>135 2<br/>135 2<br/>136 5<br/>556 466<br/>80<br/>18</td><td>110         3.           120         3.           182         3.           182         3.           182         3.           182         3.           182         3.           182         3.           182         3.           182         3.           182         3.           182         3.           182         3.           182         3.           182         3.           187         3.           187         3.           197         1.           198         1.           198         1.           198         1.           198         1.           198         1.           198         1.           198         1.           198         1.           198         1.           198         1.           198         1.           198         1.           198         1.           198         1.           198         1.           198         1.</td><td>103         508           103         508           104         508           134         639           406         850           134         639           406         850           137         527           139         655           130         527           131         612           132         527           139         655           141         272           130         515           407         544           653         203           411         272           131         665           132         327           231         225           321         726           147         324           131         667           132         171           143         422           147         125           153         406           154         426           153         406           154         426           155         1306           1647         18           187</td><td>340 1,764<br/>0.34 700 55<br/>6 881 5<br/>13 506 8<br/>404 5<br/>0 173 4<br/>2 2<br/>2 2<br/>2 5 93 1<br/>2 5 93 1<br/>2</td><td>1.33         4.63           250         5533           256         6.23           252         556           312         830           255         566           155         433           155         333           155         333           155         333           151         336           165         131           384         413           384         413           384         413           384         412           118         290           363         759           366         1.290           367         759           368         1.129           363         759           944         1.266           1.302         2.660           1.420         7.419           1.421         1.902           1.640         3.141           1.640         3.144           1.640         3.144           1.640         7.703           844         4.309           1.222         2.660           1.234         7.64</td><td>133        </td><td>366 9.7.1<br/>194 4.0<br/>26 5.7.6<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.5.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.5</td><td>0 366 3<br/>4 194 1<br/>5 391<br/>0 933<br/>0 947<br/>8 1.575 1.1.4</td><td>166<br/>194<br/>35<br/>21<br/>21</td></t<></td></t<></td> | 2<br>5<br>5<br>3<br>37<br>37<br>37<br>3<br>3<br>3<br>3<br>3<br>3<br>3<br>3<br>3<br>3<br>3<br>3 | 5 5<br>101 101<br>6 6 7<br>7 1<br>1 | 2<br>5<br>5<br>1<br>4<br>4<br>4<br>5<br>7<br>1<br>34<br>117<br>7<br>32<br>0<br>6<br>24<br>9<br>0<br>6<br>28<br>0<br>6<br>28<br>0<br>6<br>7<br>7<br>31<br>2<br>2 | 200         200           75         75           100         100           175         75           175         75           175         75           175         75           170         100           100         100           110         110           12         32           13         31           14         58           150         123           16         1129           23         256           12         246           123         256           14         58           15         99           16         2,450           25         588           22         2,471           88         1,185           614         5,2509           7         922           244         5,2037           714         1,856           123         2,869           94         1,258           43         442           25         2,861           124         2,269           125 | 200         200         201           75         10         10         10           1125         125         125         125           1126         121         125         125           127         12         12         12           131         13         13         13           151         6         16         17           153         13         13         14           151         6         16         17           151         6         10         10           161         11         11         11           171         11         11         11           1727         13         14         14           1010         52         14         11           1101         15         16         14           1101         15         16         14           1101         15         16         14           1101         15         16         14           1101         16         14         13           1101         16         14         14           1101         16 | 22 1<br>4<br>0 3<br>5<br>32 1,2<br>316 73<br>713 7<br>11,153 2<br>448 26 | 1 1<br>3<br>3<br>40<br>0<br>0<br>1<br>1<br>22<br>25<br>88<br>22<br>1<br>1<br>0<br>3<br>3<br>10<br>0<br>50<br>50<br>50 | 15           140           27           180           3013           3133           1313           1313           1313           1313           1313           1313           1313           1313           1313           131           131           1406           1212           1214           1214           1214           1214           1214           1214           1214           1214           1214           1214           1214           1214           1214           131           131           132           1331           137           230           231           132           1331           135           243           25           193           343           350           369           369           100 <t< td=""><td>3         0           116         2           12         2           23         4           42         112           42         12           13         3           14         12           15         19           16         2           17         49           18         24           14         11           4         9           13         3           14         12           15         3           14         1           15         19           16         2           17         49           10         1           14         1           15         3           16         0           17         4           1         1           1         1           1         1           1         1           1         1           1         1           1         1           1         1           1         1</td><td>26         3         3           3         3         3           43         3         1           1595         1         2           531         1         2           2         2         2           2         2         2           2         2         2           344         2         6           551         1         2           344         2         6           354         1         2           3605         2         2           374         2         6           3605         2         2           3745         1         2           3846         2         2           491         11         1           491         11         1           493         1         1           278         2         1           374         1         2           491         1         2           493         1         2           494         1         2           495         2         1           <t< td=""><td>2<br/>0<br/>0<br/>155<br/>1<br/>1<br/>1<br/>1<br/>1<br/>1<br/>1<br/>1<br/>1<br/>1<br/>1<br/>1<br/>1</td><td>5 26<br/>1 1<br/>1 1<br/>10 46<br/>10 47<br/>10 10<br/>10 0<br/>10 0<br/>10</td><td>1 0<br/>0 1<br/>1 7<br/>1 1<br/>1 1<br/>1 1<br/>1 1<br/>1 1<br/>1 1<br/>1 1<br/>1 1<br/>1</td><td>2 0<br/>0 0<br/>1 0<br/>1 0<br/>0 0<br/>1 0<br/>0 0<br/>1 0<br/>0 0<br/>0 3<br/>1 0<br/>1 0<br/>1 0<br/>1 0<br/>1 0<br/>1 0<br/>1 0<br/>1 0<br/>1 0<br/>1 0</td><td>0<br/>1<br/>4<br/>2<br/>9<br/>29<br/>4<br/>61<br/>29<br/>33<br/>0<br/>15<br/>15<br/>15<br/>15<br/>15<br/>15<br/>1<br/>3<br/>0<br/>1<br/>5<br/>1<br/>5<br/>1<br/>5<br/>1<br/>5<br/>1<br/>5<br/>1<br/>5<br/>1<br/>5<br/>5<br/>1<br/>5<br/>5<br/>1<br/>5<br/>5<br/>5<br/>1<br/>5<br/>5<br/>5<br/>5<br/>5<br/>5<br/>5<br/>5<br/>5<br/>5<br/>5<br/>5<br/>5</td><td>0<br/>5<br/>217<br/>332<br/>27<br/>3<br/>0<br/>0<br/>2<br/>111<br/>17<br/>7<br/>1<br/>2<br/>10<br/>2<br/>32<br/>27<br/>3<br/>2<br/>3<br/>2<br/>11<br/>17<br/>7<br/>1<br/>2<br/>10<br/>1<br/>17<br/>7<br/>1<br/>2<br/>3<br/>2<br/>3<br/>3<br/>2<br/>3<br/>3<br/>2<br/>3<br/>3<br/>3<br/>3<br/>3<br/>3<br/>3<br/>3<br/>3<br/>3<br/>3<br/>3<br/>3</td><td>43 68<br/>243 3<br/>1.861 33<br/>1.861 334<br/>756 392<br/>274 246<br/>6 55<br/>277 24<br/>26<br/>576 392<br/>9134 92<br/>317 299<br/>914 92<br/>313 8<br/>270<br/>33 8<br/>1 241 16<br/>101 26<br/>172 1<br/>280<br/>1 241 16<br/>101 26<br/>172 2<br/>122 1<br/>536<br/>172 2<br/>125 2<br/>125 2<br/>133 8<br/>1 241 16<br/>101 26<br/>172 2<br/>125 2<br/>125 2<br/>125 2<br/>135 2<br/>135 2<br/>135 2<br/>135 2<br/>136 5<br/>556 466<br/>80<br/>18</td><td>110         3.           120         3.           182         3.           182         3.           182         3.           182         3.           182         3.           182         3.           182         3.           182         3.           182         3.           182         3.           182         3.           182         3.           182         3.           187         3.           187         3.           197         1.           198         1.           198         1.           198         1.           198         1.           198         1.           198         1.           198         1.           198         1.           198         1.           198         1.           198         1.           198         1.           198         1.           198         1.           198         1.           198         1.</td><td>103         508           103         508           104         508           134         639           406         850           134         639           406         850           137         527           139         655           130         527           131         612           132         527           139         655           141         272           130         515           407         544           653         203           411         272           131         665           132         327           231         225           321         726           147         324           131         667           132         171           143         422           147         125           153         406           154         426           153         406           154         426           155         1306           1647         18           187</td><td>340 1,764<br/>0.34 700 55<br/>6 881 5<br/>13 506 8<br/>404 5<br/>0 173 4<br/>2 2<br/>2 2<br/>2 5 93 1<br/>2 5 93 1<br/>2</td><td>1.33         4.63           250         5533           256         6.23           252         556           312         830           255         566           155         433           155         333           155         333           155         333           151         336           165         131           384         413           384         413           384         413           384         412           118         290           363         759           366         1.290           367         759           368         1.129           363         759           944         1.266           1.302         2.660           1.420         7.419           1.421         1.902           1.640         3.141           1.640         3.144           1.640         3.144           1.640         7.703           844         4.309           1.222         2.660           1.234         7.64</td><td>133        </td><td>366 9.7.1<br/>194 4.0<br/>26 5.7.6<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.5.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.5</td><td>0 366 3<br/>4 194 1<br/>5 391<br/>0 933<br/>0 947<br/>8 1.575 1.1.4</td><td>166<br/>194<br/>35<br/>21<br/>21</td></t<></td></t<> | 3         0           116         2           12         2           23         4           42         112           42         12           13         3           14         12           15         19           16         2           17         49           18         24           14         11           4         9           13         3           14         12           15         3           14         1           15         19           16         2           17         49           10         1           14         1           15         3           16         0           17         4           1         1           1         1           1         1           1         1           1         1           1         1           1         1           1         1           1         1 | 26         3         3           3         3         3           43         3         1           1595         1         2           531         1         2           2         2         2           2         2         2           2         2         2           344         2         6           551         1         2           344         2         6           354         1         2           3605         2         2           374         2         6           3605         2         2           3745         1         2           3846         2         2           491         11         1           491         11         1           493         1         1           278         2         1           374         1         2           491         1         2           493         1         2           494         1         2           495         2         1 <t< td=""><td>2<br/>0<br/>0<br/>155<br/>1<br/>1<br/>1<br/>1<br/>1<br/>1<br/>1<br/>1<br/>1<br/>1<br/>1<br/>1<br/>1</td><td>5 26<br/>1 1<br/>1 1<br/>10 46<br/>10 47<br/>10 10<br/>10 0<br/>10 0<br/>10</td><td>1 0<br/>0 1<br/>1 7<br/>1 1<br/>1 1<br/>1 1<br/>1 1<br/>1 1<br/>1 1<br/>1 1<br/>1 1<br/>1</td><td>2 0<br/>0 0<br/>1 0<br/>1 0<br/>0 0<br/>1 0<br/>0 0<br/>1 0<br/>0 0<br/>0 3<br/>1 0<br/>1 0<br/>1 0<br/>1 0<br/>1 0<br/>1 0<br/>1 0<br/>1 0<br/>1 0<br/>1 0</td><td>0<br/>1<br/>4<br/>2<br/>9<br/>29<br/>4<br/>61<br/>29<br/>33<br/>0<br/>15<br/>15<br/>15<br/>15<br/>15<br/>15<br/>1<br/>3<br/>0<br/>1<br/>5<br/>1<br/>5<br/>1<br/>5<br/>1<br/>5<br/>1<br/>5<br/>1<br/>5<br/>1<br/>5<br/>5<br/>1<br/>5<br/>5<br/>1<br/>5<br/>5<br/>5<br/>1<br/>5<br/>5<br/>5<br/>5<br/>5<br/>5<br/>5<br/>5<br/>5<br/>5<br/>5<br/>5<br/>5</td><td>0<br/>5<br/>217<br/>332<br/>27<br/>3<br/>0<br/>0<br/>2<br/>111<br/>17<br/>7<br/>1<br/>2<br/>10<br/>2<br/>32<br/>27<br/>3<br/>2<br/>3<br/>2<br/>11<br/>17<br/>7<br/>1<br/>2<br/>10<br/>1<br/>17<br/>7<br/>1<br/>2<br/>3<br/>2<br/>3<br/>3<br/>2<br/>3<br/>3<br/>2<br/>3<br/>3<br/>3<br/>3<br/>3<br/>3<br/>3<br/>3<br/>3<br/>3<br/>3<br/>3<br/>3</td><td>43 68<br/>243 3<br/>1.861 33<br/>1.861 334<br/>756 392<br/>274 246<br/>6 55<br/>277 24<br/>26<br/>576 392<br/>9134 92<br/>317 299<br/>914 92<br/>313 8<br/>270<br/>33 8<br/>1 241 16<br/>101 26<br/>172 1<br/>280<br/>1 241 16<br/>101 26<br/>172 2<br/>122 1<br/>536<br/>172 2<br/>125 2<br/>125 2<br/>133 8<br/>1 241 16<br/>101 26<br/>172 2<br/>125 2<br/>125 2<br/>125 2<br/>135 2<br/>135 2<br/>135 2<br/>135 2<br/>136 5<br/>556 466<br/>80<br/>18</td><td>110         3.           120         3.           182         3.           182         3.           182         3.           182         3.           182         3.           182         3.           182         3.           182         3.           182         3.           182         3.           182         3.           182         3.           182         3.           187         3.           187         3.           197         1.           198         1.           198         1.           198         1.           198         1.           198         1.           198         1.           198         1.           198         1.           198         1.           198         1.           198         1.           198         1.           198         1.           198         1.           198         1.           198         1.</td><td>103         508           103         508           104         508           134         639           406         850           134         639           406         850           137         527           139         655           130         527           131         612           132         527           139         655           141         272           130         515           407         544           653         203           411         272           131         665           132         327           231         225           321         726           147         324           131         667           132         171           143         422           147         125           153         406           154         426           153         406           154         426           155         1306           1647         18           187</td><td>340 1,764<br/>0.34 700 55<br/>6 881 5<br/>13 506 8<br/>404 5<br/>0 173 4<br/>2 2<br/>2 2<br/>2 5 93 1<br/>2 5 93 1<br/>2</td><td>1.33         4.63           250         5533           256         6.23           252         556           312         830           255         566           155         433           155         333           155         333           155         333           151         336           165         131           384         413           384         413           384         413           384         412           118         290           363         759           366         1.290           367         759           368         1.129           363         759           944         1.266           1.302         2.660           1.420         7.419           1.421         1.902           1.640         3.141           1.640         3.144           1.640         3.144           1.640         7.703           844         4.309           1.222         2.660           1.234         7.64</td><td>133        </td><td>366 9.7.1<br/>194 4.0<br/>26 5.7.6<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.5.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.7.5<br/>5.5</td><td>0 366 3<br/>4 194 1<br/>5 391<br/>0 933<br/>0 947<br/>8 1.575 1.1.4</td><td>166<br/>194<br/>35<br/>21<br/>21</td></t<> | 2<br>0<br>0<br>155<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1 | 5 26<br>1 1<br>1 1<br>10 46<br>10 47<br>10 10<br>10 0<br>10 | 1 0<br>0 1<br>1 7<br>1 1<br>1 1<br>1 1<br>1 1<br>1 1<br>1 1<br>1 1<br>1 1<br>1 | 2 0<br>0 0<br>1 0<br>1 0<br>0 0<br>1 0<br>0 0<br>1 0<br>0 0<br>0 3<br>1 0<br>1 0<br>1 0<br>1 0<br>1 0<br>1 0<br>1 0<br>1 0<br>1 0<br>1 0 | 0<br>1<br>4<br>2<br>9<br>29<br>4<br>61<br>29<br>33<br>0<br>15<br>15<br>15<br>15<br>15<br>15<br>1<br>3<br>0<br>1<br>5<br>1<br>5<br>1<br>5<br>1<br>5<br>1<br>5<br>1<br>5<br>1<br>5<br>5<br>1<br>5<br>5<br>1<br>5<br>5<br>5<br>1<br>5<br>5<br>5<br>5<br>5<br>5<br>5<br>5<br>5<br>5<br>5<br>5<br>5 | 0<br>5<br>217<br>332<br>27<br>3<br>0<br>0<br>2<br>111<br>17<br>7<br>1<br>2<br>10<br>2<br>32<br>27<br>3<br>2<br>3<br>2<br>11<br>17<br>7<br>1<br>2<br>10<br>1<br>17<br>7<br>1<br>2<br>3<br>2<br>3<br>3<br>2<br>3<br>3<br>2<br>3<br>3<br>3<br>3<br>3<br>3<br>3<br>3<br>3<br>3<br>3<br>3<br>3 | 43 68<br>243 3<br>1.861 33<br>1.861 334<br>756 392<br>274 246<br>6 55<br>277 24<br>26<br>576 392<br>9134 92<br>317 299<br>914 92<br>313 8<br>270<br>33 8<br>1 241 16<br>101 26<br>172 1<br>280<br>1 241 16<br>101 26<br>172 2<br>122 1<br>536<br>172 2<br>125 2<br>125 2<br>133 8<br>1 241 16<br>101 26<br>172 2<br>125 2<br>125 2<br>125 2<br>135 2<br>135 2<br>135 2<br>135 2<br>136 5<br>556 466<br>80<br>18 | 110         3.           120         3.           182         3.           182         3.           182         3.           182         3.           182         3.           182         3.           182         3.           182         3.           182         3.           182         3.           182         3.           182         3.           182         3.           187         3.           187         3.           197         1.           198         1.           198         1.           198         1.           198         1.           198         1.           198         1.           198         1.           198         1.           198         1.           198         1.           198         1.           198         1.           198         1.           198         1.           198         1.           198         1. | 103         508           103         508           104         508           134         639           406         850           134         639           406         850           137         527           139         655           130         527           131         612           132         527           139         655           141         272           130         515           407         544           653         203           411         272           131         665           132         327           231         225           321         726           147         324           131         667           132         171           143         422           147         125           153         406           154         426           153         406           154         426           155         1306           1647         18           187 | 340 1,764<br>0.34 700 55<br>6 881 5<br>13 506 8<br>404 5<br>0 173 4<br>2 2<br>2 2<br>2 5 93 1<br>2 5 93 1<br>2 | 1.33         4.63           250         5533           256         6.23           252         556           312         830           255         566           155         433           155         333           155         333           155         333           151         336           165         131           384         413           384         413           384         413           384         412           118         290           363         759           366         1.290           367         759           368         1.129           363         759           944         1.266           1.302         2.660           1.420         7.419           1.421         1.902           1.640         3.141           1.640         3.144           1.640         3.144           1.640         7.703           844         4.309           1.222         2.660           1.234         7.64 | 133              | 366 9.7.1<br>194 4.0<br>26 5.7.6<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.5.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.7.5<br>5.5 | 0 366 3<br>4 194 1<br>5 391<br>0 933<br>0 947<br>8 1.575 1.1.4 | 166<br>194<br>35<br>21<br>21 |

#### THIRD BLUEFIN TUNA MSE TECHNICAL MEETING - MADRID 2019

# Table 1. Continued.

Fishery	8: PSNOF	R	9: PSHRV	10: PSWold	11: PSWnew	12: TPold	13: TPnew	14: RRCAN	15:RRUSAFS	16:RRUSAFB			17: OTH			18:	LJPNnew	
Country	Norway		EU.Croatia	USA	A, Canada	EU.Spain, Morocco, EU. Portuga	1	Canada	US	A			other				Japan	
Strata	5:NATL	6:EA	7:MED	2	:WATL	4:SATL 7:MED	4:SATL	2:WATL 3:GSL	2:WA	TL	1:GOM	2:WATL 3:G	4:SATL 5:NATL	6:EATL	7:MED	2:WATL	S 5:NAT	L 6:E
Quarter	3 4	3	1 2 3	4 2 3	4 1 2 3	4 1 2 3 4 1 2 3	4 2 3	1 2 3 4 3	2 3 4	2 3	4 2 3	3 1 2 3 4 3 1	1 2 3 4 3	1 2 3	4 1 2 3 4	1 3 4	2 1 3	4
1951 1952 1953 1954 1955 1956 1956 1957 1958 1959 1960 1961 1962 1963 1964 1965 1964 1965 1964 1965 1967 1970 1973 1973 1973 1974 1973 1975 1977 1978 1979 1973 1974 1973 1975 1977 1978 1979 1980 1980 1980 1980 1980 1981 1982 1982 1983 1984 1985 1985 1985 1985 1987 1988 1989 1993 1994 1995 1995 1995 2000 2001 2002 2004 2005 2007 2008 2011 2013 2014 2015 2016 2016 2016 2016 2016 2016 2016 2016 2016 2016 2016 2016 2016 2016 2016 2016 2016 2016 2017 2016 2016 2016 2016 2017 2016 2017 2016 2017 2016 2017 2016 2017 2016 2017 2016 2017 2016 2017 2016 2017 2016 2017	6,728 14,752 10,217 12,145 4,333 4,347 3,360 2,437 4,215 8,553 8,730 1,67 1,67 1,67 1,67 1,67 1,67 1,67 2,506 2,915 7,5 8,42 4,70 2,015 5,5 7,5 7,5 7,5 7,5 7,5 7,5 7,5 7,5 7,	47	1,212 206 29 7 799 24 60 44 858 990 399 2 857 346 1 355 385 2 764 308 1 355 385 2 764 308 1 355 385 2 365 307 109 14 376 451 338 6 49 329 6 516 340 6 516 34	94         6           130         8           735         4           735         4           261         11           850         52           3.548         222           1.48         3.602           4         3.227           1.44         3.627           1.43         3.227           1.06         2.062           2.062         3.543           2.062         3.547           1.01         1.066           960         493           1.626         960           493         1.827           1.582         1.204           299         1.93           1.071         159           1.02         213           66         107           107         223           107         223           2         5           6         1           8         0           0         5           2         5           8         0           0         5           5         8           0 <t< td=""><td>1100 209 6 96 200 6 98 204 6 98 204 6 98 204 6 98 204 3 385 249 249 249 249 249 201 249 249 249 249 249 249 249 249 249 249</td><td>11         7.226         1.068         553         4.41         44           16         7.387         1.222         856         6.42         77           10         1.055         1.133         8.48         6.22         77           10         1.055         1.13         4.48         6.22         77           10         1.055         1.13         4.46         522         323         323         34           7         1.231         1.660         370         384         433         443         4431         4431         4431         4433         4433         4433         4433         4433         4433         4410         000         1.82         533         1.0561         1.057         1.0561         1.051         1.051         1.051         1.051         1.051         1.051         1.051         1.055         1.055         1.055         1.055         1.055         1.055         1.055         1.051         1.051         1.051         1.051         1.051         1.051         1.051         1.051         1.051         1.051         1.051         1.051         1.051         1.051         1.051         1.051         1.051         1.051         1</td><td>2,124 111 77 2,434 99 30 2,146 23 207 1,875 695 35 2,363 258 35</td><td>209         5         71         14           283         7         55         11           168         24         3         40         8           121         3         7         1         36         1         2         0           42         1         3         1         3         7         1         36         1         2         0         4         1         3         1         7         1         37         1         7         1         3         7         1         37         1         34         7         1         1         61         16         1</td><td>0         1         0           1         4         0           3         9         1           1         3         9         1           1         2         5         0           2         5         0         2           5         16         1         3           30         91         6     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1.034           1.135           1.734           4.34           2.223           3.3           4.4           2.23           3.44           2.25           2.25           2.25           2.3           3.8           3.1           2.1           2.2           2.3           3.8           3.1           2.1           1.2           1.2           1.2           2.3           3.8           3.1           2.1           3.2           3.3           3.4           3.3           3.4           3.3           3.4           3.3           3.4           3.3           3.3           3.3           3.3           3.3           3.3</td><td>323         2.637         2.078         323           367         1.859         1.389         3.281           367         2.854         2.854         4.50           375         2.259         1.822         3.57           375         2.259         1.822         3.57           375         2.259         1.822         3.57           344         1.752         1.752         3.84           22         2.023         3.83         4.22           242         2.025         1.834         4.22           252         2.138         1.814         4.25           242         2.025         1.503         3.81           259         1.450         1.144         4.14           321         1.480         1.299         3.97           157         1.414         1.816         1.299           91         1.061         1.390         1.62           92         1.061         1.991         5.67           1.781         3.96         1.60         2.99           91         1.061         2.39         1.991           1.68         5.65         3.421         1.991     &lt;</td><td>201 11 140 369 60 149 56 233 28 158 131 59 233 1 71 274</td><td>9 1 25 5 5 38 122</td><td>1.070 1.084 1.084 1.093 1.124 1.075 1.344</td></th1<></th12.9<></td></t<>	1100 209 6 96 200 6 98 204 6 98 204 6 98 204 6 98 204 3 385 249 249 249 249 249 201 249 249 249 249 249 249 249 249 249 249	11         7.226         1.068         553         4.41         44           16         7.387         1.222         856         6.42         77           10         1.055         1.133         8.48         6.22         77           10         1.055         1.13         4.48         6.22         77           10         1.055         1.13         4.46         522         323         323         34           7         1.231         1.660         370         384         433         443         4431         4431         4431         4433         4433         4433         4433         4433         4433         4410         000         1.82         533         1.0561         1.057         1.0561         1.051         1.051         1.051         1.051         1.051         1.051         1.051         1.055         1.055         1.055         1.055         1.055         1.055         1.055         1.051         1.051         1.051         1.051         1.051         1.051         1.051         1.051         1.051         1.051         1.051   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          1         1         1         1         1           1         1         1         1         1           1         1         1         1         1           1         1         1         1         1           1         1         1         1         1           1         1         1         1         1           1         1         1         1         1           1         1         1         1         1           1         1         1         1         1           1         1         1         1         1           1         1         1         1         1           1	9662211111457753116911164415788610140440768860950440440768860950950400444076886095095040044076886009509709711111836634	12.9         12.9 <th12.9< th="">         12.9         12.9         <th1< td=""><td>Hat         Hat         <thhat< th=""> <thhat< th=""> <thhat< th=""></thhat<></thhat<></thhat<></td><td>1.502           2.418           1.115           2.633           2.222           1.034           2.223           1.034           1.135           1.734           4.34           2.223           3.3           4.4           2.23           3.44           2.25           2.25           2.25           2.3           3.8           3.1           2.1           2.2           2.3           3.8           3.1           2.1           1.2           1.2           1.2           2.3           3.8           3.1           2.1           3.2           3.3           3.4           3.3           3.4           3.3           3.4           3.3           3.4           3.3           3.3           3.3           3.3           3.3           3.3</td><td>323         2.637         2.078         323           367         1.859         1.389         3.281           367         2.854         2.854         4.50           375         2.259         1.822         3.57           375         2.259         1.822         3.57           375         2.259         1.822         3.57           344         1.752         1.752         3.84           22         2.023         3.83         4.22           242         2.025         1.834         4.22           252         2.138         1.814         4.25           242         2.025         1.503         3.81           259         1.450         1.144         4.14           321         1.480         1.299         3.97           157         1.414         1.816         1.299           91         1.061         1.390         1.62           92         1.061         1.991         5.67           1.781         3.96         1.60         2.99           91         1.061         2.39         1.991           1.68         5.65         3.421         1.991     &lt;</td><td>201 11 140 369 60 149 56 233 28 158 131 59 233 1 71 274</td><td>9 1 25 5 5 38 122</td><td>1.070 1.084 1.084 1.093 1.124 1.075 1.344</td></th1<></th12.9<>	Hat         Hat <thhat< th=""> <thhat< th=""> <thhat< th=""></thhat<></thhat<></thhat<>	1.502           2.418           1.115           2.633           2.222           1.034          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       22         2.023         3.83         4.22           242         2.025         1.834         4.22           252         2.138         1.814         4.25           242         2.025         1.503         3.81           259         1.450         1.144         4.14           321         1.480         1.299         3.97           157         1.414         1.816         1.299           91         1.061         1.390         1.62           92         1.061         1.991         5.67           1.781         3.96         1.60         2.99           91         1.061         2.39         1.991           1.68         5.65         3.421         1.991     <	201 11 140 369 60 149 56 233 28 158 131 59 233 1 71 274	9 1 25 5 5 38 122	1.070 1.084 1.084 1.093 1.124 1.075 1.344

# Report of sub-group on seasonal variability in the Gulf of Mexico and in the Mediterranean

A sub-group met to discuss the current state of knowledge of stock migrations and the estimation of movement in the OMs used for the MSE. The sub-group highlighted that the current OM reports do not reflect seasonal variation in Mediterranean biomass; this is considered biologically unrealistic.

The sub-group noted that movement restrictions identified previously have been implemented in the OM conditioning, including the exclusion of GOM-origin fish migration into the MED and MED-origin fish migration into the GOM, no residency of fish in the GOM during quarter (Q) 3, and no fish present in the GSL during Q1. The sub-group first identified two additional movement constraints that should be included in the OMs:

- 1) the biomass of GOM-origin ageclass<sup>†</sup> 3 fish should be greatest in the GOM during the spawning season (Q2), and
- 2) the biomass of MED-origin ageclasses 2 and 3 should be greatest in the MED during the spawning season (also Q2). Ageclass 1 was not included because most of the juveniles stay in the MED and hence should not be used to estimate the seasonality in the MED.

The sub-group was asked to provide values of the relative proportions of residency of biomass by quarter within each spawning ground. After revising the available information for each of these two strata, it was evident that the estimation of those proportions had to use different approaches for each of these two strata. The recommendations that follow were agreed upon by the sub-group as being critical to capture the known biology of the stocks accurately.

# Quarterly distribution of BFT in Gulf of Mexico

To obtain a quarterly relative distribution of fish in the Gulf of Mexico, the catch rate was estimated from the model applied in the Joint CPUE standardization exercise (Walter *et al.* 2017) which uses data from Mexico and United States pelagic longline fleets. The standardization model used in Walter *et al.* 2017 is a negative binomial generalized linear model with year, flag, hook type, day/night of set, area and quarter, with an offset for effort in number of hooks. The model in Walter *et al.* 2017 also used sea surface temperature which, in this analysis, was removed as it had an undesirable impact on the standardization by increasing the predicted catch of BFT in the summer quarter, when the fish are actually less abundant. The model accounts for much of the differential targeting and differences in fishing practices between the fleets. It also benefits substantively from using data from both fleets as they cover the entire Gulf of Mexico, for which there appears to be slightly different spatial habitat utilization by quarter with fish in the Southern part in quarter 1 and Northern part in the quarter 2, as indicated by electronic tag track inference (Teo *et al.*, 2015). As the data are from onboard observers, they account for both catch and discarded fish. The quarterly distribution is obtained from the least square means of the quarter effect, calculated across mean levels of the other factors. The percent distribution across the four quarters can be summarized as 31, 61, 7 and 1% for Jan-Mar (Q1), Apr-June (Q2), July-Sept (Q3) and Oct-Dec (Q4) respectively (**Figure 1**).

This index of distribution is assumed to apply to western spawning bluefin tuna. As the Mexico and U.S. longline fleets fish throughout the year, these estimates should represent an unbiased view of the relative temporal distribution of Gulf of Mexico spawning fish.

<sup>&</sup>lt;sup>+</sup> Ageclass 1 refers to ages 0 to 4, ageclass 2 refers to ages 5 to 8, and ageclass 3 refers to ages 9+

	Log scale				Arithmetic	%
Quarter	estimate	SE	LCL	UCL	mean	distribution
1	-3.2022	0.0684	-3.3362	-3.0681	0.0407	31%
2	-2.5059	0.0584	-2.6203	-2.3915	0.0816	61%
3	-4.6247	0.0989	-4.8186	-4.4309	0.0098	7%
4	-7.1735	0.2648	-7.6925	-6.6545	0.0008	1%

**Table 1**. Log scale estimate and standard errors for the quarterly distribution of BFT in the Gulf of Mexico.

#### Quarterly distribution of BFT in The Mediterranean

After reviewing the CATDIS estimates by quarter and gear, it was noted that catches of BFT in the Mediterranean have many "substitutions", as few CPCs have reported catch/effort (C/E) by month/quarter. Therefore, it was decided to use only those catches of Mediterranean BFT from fleets that had submitted C/E by month/quarter in the 1990's to avoid the impact of management regulations.

The selected fisheries/fleets were Spanish traps, PS and LL which for almost all years in the 1990s reported catch per quarter. An average proportion of the total annual catch by quarter was estimated from this information (**Table 2**). These percentages can be used as a proxy for BFT relative availability for the western Mediterranean. This index was applied to the entire Mediterranean in the absence of any additional information on relative seasonal abundance. Overall these averages indicated higher percentages of catches in Q2 and Q3, with relative lower catches for Q4 and Q1 (**Table 2**).

**Table 2**. The percentage of Atlantic bluefin tuna catch by quarter in Task 2 Catch and Effort data by Gear, CPC and Period.

# % of Nominal Catch per quarter

Gear	Country	Periods	Q1	Q2	Q3	Q4
Trap	Spain	1990's	0	92	8	0
Purse Seine	Spain	1990's	0	52	39	9
Longline	Spain	1990´s	7	55	33	4

Two of the gears were disregarded because they had not operated all year around (Traps and Purse Seine) or because they were mostly targeting ageclass 1 (Purse Seine). Consequently, the selected vector of proportions by quarter corresponds to the Spanish longline fleet.

However, the use of nominal catches as a proxy of seasonal variability in the region raised concerns because the associated underlying assumption is that fishing effort is constant throughout the year. Consequently, the sub-group decided on two actions. First, to find out if there is any standardized index of CPUE by quarter; this question will be addressed to the Spanish research scientists working on this fishery (IEO). Secondly, to extract the effort by quarter for Spanish LL from the ICCAT Task 2 Catch and Effort data. The latter was achieved during the meeting, and the catches by quarter and year were divided by the corresponding efforts. The CPUE per quarter was estimated by averaging the CPUE's over the period considered (the 1990s). The final relative CPUE per quarter was:

% of CPUE	Q1	Q2	Q3	Q4
Spain longline 1990's	11%	63%	22%	4%

Additionally, the E-tag data also showed seasonality in the Mediterranean for ageclasses 2 and 3, but higher residency for ageclass 1 (**Figure 1**).

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**Figure 1**. Mean proportions of days spent in the Mediterranean by quarter from electronically tagged fish at liberty >364 days and which entered this spawning ground (all fish were tagged in the western Atlantic, sample size = 5 fish).

To summarise, nominal CPUE data were used to derive a preliminary prior for seasonal trend in ageclasses 2 and 3 fish in the Mediterranean. The impact of this preliminary prior will be tested in the model while more rigorous CPUE standardization options are investigated.

#### Movements (Spatial biomass distribution and regional transition restrictions)

The OMs can predict spatial biomass distributions that would be difficult to reconcile with the current knowledge of the biology and distribution of the stocks (for example placing a large fraction of fish in the South Atlantic stratum due to the complete lack of model constraints for this stratum). A possible solution is to constrain the range of fish movements in the model to those that have been identified from either conventional tag returns or from electronic tracks. The OM conditioning already includes a 'movement exclusion matrix' that is currently used to prevent movements of eastern-origin fish to the GOM and western-origin fish to the Mediterranean. In order to constrain the model further in its estimation of plausible quarterly movements, the electronic tagging and conventional tagging data will be analysed to identify transitions that have never been observed; these will then be used to extend the movement exclusion matrix (**Table 3**). The impact of this new constraint will be investigated before it might be incorporated in the finalised conditioning process.

**Table 3**. Movements between spatial strata by stock and quarter used to restrict the movement of fish based on conventional tag returns or electronic tag tracks in the OMs. These are possible movements present in a particular stratum (row) that move to a stratum (column) in the following quarter for all ageclasses. The left panel applies to the Western Stock (i.e. excludes the MED), and the right panel to the Eastern Stock (i.e. excludes the GOM). Insertions are 1 if at least one such movement has been observed, and 0 if none have been observed.

West stock (all age classes)				Po	ssible	64%	East stock	t (all ag	e class	es)		Po	ssible	67%	
Quarter 1								Quarter 1							
	GOM	WATL	GSL	SATL	NATL	EATL	MED		GOM	WATL	GSL	SATL	NATL	EATL	MED
GOM	1	1	0	0	0	0	0	GOM	0	1	0	0	0	0	0
WATL	1	1	1	1	1	1	0	WATL	0	1	1	1	1	1	0
GSL	1	1	1	1	1	1	0	GSL	0	1	1	1	1	1	0
SATL	0	1	0	1	1	1	0	SATL	0	1	0	1	1	1	1
NATL	0	1	0	1	1	1	0	NATL	0	1	0	1	1	1	1
EATL	0	1	0	1	1	1	0	EATL	0	1	0	1	1	1	0
MED	0	0	0	1	0	1	0	MED	0	0	0	1	0	1	1
Quarter 2								Quarter 2							
	GOM	WATL	GSL	SATL	NATL	EATL	MED		GOM	WATL	GSL	SATL	NATL	EATL	MED
GOM	1	1	1	1	0	0	0	GOM	0	1	1	1	0	0	1
WATL	1	1	1	1	1	1	0	WATL	0	1	1	1	1	1	1
GSL	0	0	1	0	0	0	0	GSL	0	0	1	0	0	0	0
SATL	1	1	1	1	1	1	0	SATL	0	1	1	1	1	1	1
NATL	1	1	1	1	1	1	0	NATL	0	1	1	1	1	1	1
EATL	1	1	1	1	1	1	0	EATL	0	1	1	1	1	1	1
MED	0	0	0	1	0	0	0	MED	0	0	0	1	0	0	1
Quarter 3								Quarter 3							
	GOM	WATL	GSL	SATL	NATL	EATL	MED		GOM	WATL	GSL	SATL	NATL	EATL	MED
GOM	1	1	1	0	0	0	0	GOM	0	1	1	0	0	0	0
WATL	0	1	1	1	1	1	0	WATL	0	1	1	1	1	1	1
GSL	0	1	1	0	1	1	0	GSL	0	1	1	0	1	1	0
SATL	0	1	1	1	1	1	0	SATL	0	1	1	1	1	1	1
NATL	0	1	1	1	1	1	0	NATL	0	1	1	1	1	1	1
EATL	0	1	1	1	1	1	0	EATL	0	1	1	1	1	1	1
MED	0	1	1	1	1	1	0	MED	0	1	1	1	1	1	1
Quarter 4								Quarter 4							
	GOM	WATL	GSL	SATL	NATL	EATL	MED		GOM	WATL	GSL	SATL	NATL	EATL	MED
GOM	1	1	1	0	0	0	0	GOM	0	1	1	0	0	0	0
WATL	1	1	1	1	1	1	0	WATL	0	1	1	1	1	1	1
GSL	1	1	1	1	1	1	0	GSL	0	1	1	1	1	1	0
SATL	0	1	1	1	1	1	0	SATL	0	1	1	1	1	1	1
NATL	0	1	1	1	1	1	0	NATL	0	1	1	1	1	1	1
EATL	0	1	1	1	1	1	0	EATL	0	1	1	1	1	1	1
		1	1	1	1	1	0	MED		1	1	1	1	1	1

# An initial attempt at an updated roadmap

D. S. Butterworth and G. Melvin

NB: Any schedule such as suggested below will depend on the nature of the stock assessment process intended to reach finalisation in September 2020 – this will be debated at the forthcoming bluefin session.

Note that this document should be read noting the contents of **Appendix 8**, which summarises decisions relating to the adjustments agreed at this MSE Technical Group meeting which are to be incorporated in advancing the MSE process.

1. Mini technical review meeting (5 days; +- February 2020)

The paragraph following in *italics* is in the form of draft text for possible inclusion in the main text of a meeting report.

The meeting considered that to advance the process of finalising the Operating Models (OMs) for the bluefin MSE process, it would be important for a very small group of technical experts in constructing and conditioning OMs to meet early in 2020 for a week with the contractee. The meeting would be to review in detail the contractee's work to that time to take account of all issues raised at September 2019 meeting of the MSE Technical Group (see the items listed in **Appendix 8**) so as to:

- *i) investigate possible modifications,*
- *ii) finalise those changes following further computer runs,*
- *iii) critically review the OMs to confirm their conditioning as being satisfactory,*
- *iv)* develop a full proposal for a complete set OMs for consideration for adoption at a subsequent meeting as detailed in 2) below, and
- v) provide suggestions for approaches (e.g. a Delphi method) to plausibility-weight these OMs for review at that subsequent meeting.

The Contractee together with 5-6 persons (to be selected in an appropriate manner) would be needed for this mini technical review meeting, for which funding from the GBYP is to be sought.

It must be stressed that this meeting would not have any authority to make final decisions. Rather its purpose is to prepare the material required by the subsequent meeting (2. below) to make such decisions. This meeting will also need to make proposals for which the indices might be used as input to CMPs.

Electronic exchanges with MSE Technical Group members (possibly including webinars) will be needed both before and after this meeting to inform and to assist progress in reaching consensus on the final OM selection.

**Deliverables**: Candidate Reference set of OMs (and associated standard HTML reports for each OM and comparing amongst OMs) will need to be provided at an appropriate time prior to meeting 2.

2. BFT MSE Technical Group meeting (likely within BFT WG meeting) (3 days; +- April 2020)

Note that this meeting would form part of the BFT WG "Data prep" meeting needed at that time to prepare for the assessment to be completed in September 2020.

The primary purpose (of the MSE component) is to thoroughly review the output from meeting 1. above for a complete set of OMs, to amend this if necessary, and then to have the BFT WG adopt these as the **FINAL** set to be used in testing the CMPs advanced from which one is eventually intended to be adopted by the Commission in October 2021.

This meeting will also need to agree upon a process to plausibility-weight these OMs.

**Deliverables**: Final Reference grid of OMs and major robustness trials. Final set of candidate indices recommended for use as input to CMPs. A process to plausibility-weight OMs.

3. CMP developers' mini-meeting (4 days; +- July 2020)

Following 2), the contractee would update the "package" for CMP testing, which CMP developers would then use intersessionally to further develop their CMPs. At this meeting their results are tabled and discussed to assist these developers in subsequently refining their CMPs further.

Note that this might be either a "mini" meeting constituted similarly to that in 1) above, or a meeting of the MSE Technical Group, but the core target attendees are the CMP developers.

**Deliverables:** CMPs from each development team, summarized performance results across the Reference grid and major robustness test OMs. These are to be presented in an agreed common format, making use of the existing shinyapp, and in terms of a tuning process agreed by the meeting.

4. BFT MSE Technical Group meeting (3 days before bluefin session, September 2020)

Revised CMPs are reviewed and reduced to provide a set of probably 2-3 to take further through to, in turn, the bluefin session, the SCRS, and then the Commission. Each remaining CMP might be taken forward for a range of utilization vs conservation trade-offs.

**Deliverables**: 2-3 CMPs, each tuned to 2 or 3 agreed different conservation levels, with tables and plots of performance statistics.

5. October 2020 to October 2021

An appropriate series of meetings between scientists and stakeholders/managers/decision makers to refine and reduce the number of CMPs further. This process would aim to present one or at most a very few options to the 2021 Commission meeting, for that meeting to then make a selection (if necessary) and adopt the MP to be used to recommend future TACs.

Note that advice has already been received from Panel 2 regarding CMP objectives. It is envisaged that the next such interaction would take place only after October 2020, when results for CMPs are available to show to decision makers, so they can become aware of the limitations imposed by the feasible region for trade-off space before advising further.

# Further operating model specifications for commencing an updated roadmap

T. Carruthers and D. S. Butterworth

a) "Priors" to nudge seasonal patterns in the GOM and Med to correspond to inferences from data For both natal spawning areas, the Gulf of Mexico and the Mediterranean, a seasonal vector of relative abundance will be added to the model as a prior. This is intended to address a current 'reality' test in which the model estimates seasonally constant biomass in those areas (See **Appendix 6**).

### b) Default weighting in vs Revised default weighting out

Likelihood component	Symbol	Value of ω	
Scheme #		Default weighting coming to Sept 2019 meeting	Default weighting coming out of meeting
Total catches (weight)	ω <sub>c</sub>	1/100	1/1000
Fishery independent index of biomass (e.g. a larval survey for spawning stock biomass)	ω Flindex	1	1
Fishery dependent index of exploitable biomass (CPUE index)	ω <sub>CPUE</sub>	1	1
Length composition	ω <sub>CAL</sub>	1/1000	1/10000
Stock of origin	ω <sub>soo</sub>	1	1/10: genetics 1/60: microchemistry
Electronic tag (known stock of origin)	ω <sub>ET</sub>	1	1/10

Compared to the earlier suggestion, all data-based components except the abundance (biomass) indices have been reduced by a multiplicative factor of 1/10 – this is to ensure reasonable fits to those abundance indices and hence restoration of "scale".

The SOO (micro-chemistry) contribution has been (somewhat arbitrarily) down-weighted by a further factor of 1/6 for this revised default; 1/3 for balance with the greater number of micro-chemistry data compared to genetic data, and a further  $\frac{1}{2}$  given some potential uncertainties related to the micro-chemistry estimates.

c) Revised specifications for incorporating abundance indices in the model fit

The specification of fishery dependent CPUE indices and fishery independent survey indices has been reviewed and updated (Trial Specifications document Tables 2.1 and 2.2, respectively) (See **Appendix 5**).

# d) Specification of a "low Superman" trial

A principal source of uncertainty not currently considered in the reference set of operating models is the recent trend in eastern stock biomass. Some indices are consistent with a steep increase over the most recent 15 years ('Superman'); others are consistent with a much less pronounced increase ('low Superman'). Following investigation of fits, a low Superman reference operating model has been proposed that may be achieved by heavily down-weighting two principal indices: the Canadian rod and reel CPUE index in the Gulf of St Lawrence and the western Mediterranean larval survey.

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e) Updated set for i	interim	grid
The current grid		

	Western stock	Eastern stock	
Recruitme	nt		
1	B-H with h=0.6 ("high R0") switches to h = 0.9 ("low R0") starting from 1975	50-87 B-H h=0.98 switches to 88+ B-H <i>h</i> =0.98	
2	B-H with h=0.6 fixed, high R0	B-H with h=0.7 fixed, high R0	
3	Historically as in Level 1. In projections, "low R0" switches back to "high R0" after 10 years	Historically as in Level 1. In projections, 88+ B-H with $h=0.98$ switches back to 50- 87 B-H with $h=0.98$ after 10 years.	
Spawning fraction both stocks		Natural Mortality rate both stocks	
A	Younger (E+W same)	High	
В	Older (E+W older but different for the 2 stocks)	Low	
Mixing			
Ι	Best estimates		
II	Four times increase in weight of likelihood component for electronic tags (increased Eastern stock in West, decreased Western stock in East)		

Addition from this meeting:

Recent east stock trend

i	Steep increase ('Superman') [i.e. as at present in all the interim grid OMs]
ii	Less steep increase ('low Superman') [as specified in d) above]

f) Updated set of MAJOR robustness trials

Taking account also of CMP evaluations carried out for the July 2019 BFT MSE Technical Group meeting they following seem to remain major robustness OMs:

- 1. Stock scale (east magnitude reduced by e.g. down-weighting fishery independent indices)
- 2. Brazilian catches
- 3. Senescence
- 4. Decreased weight of fishery dependent CPUE indices
- 5. Use of the Western growth curve for Eastern stock

g) Further conditioning evaluations

1. Evaluate model component weightings  $\boldsymbol{\omega}$  in the light of applicable statistical principles and sensitivity of results to different weighting scenarios

2. Profiling of key parameters (e.g. R0)

3. Split the MED larval and GSL indices (can the Superman/not Superman dichotomy be achieved by simply invoking a change in catchability in these indices under a hypothesis that varying availability of fish to these surveys could have occurred?)