



Appropriate LRPs for Southwest Pacific Ocean Striped Marlin and Other Billfish

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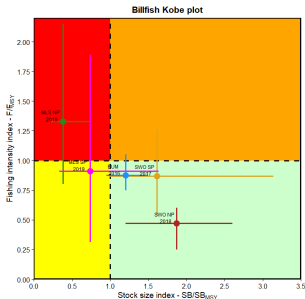
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- ▶ No agreed billfish LRPs, stocks assessed against a **range of metrics** reported against defaults.
- ▶ **23 different metrics** reported across 5 WCPFC billfish stock assessments.
- ▶ This presentation is structured around responding to the terms of reference for project 104.



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LRPs in other jurisdictions

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- ▶ Globally, there are a number stock assessments of striped marlin as well as other billfish. Most report against MSY related defaults.
- ▶ These default metrics are used as there are few agreed billfish-specific LRPs.
- ▶ A number of jurisdictions have recognised LRPs for striped marlin and other billfish as reported in Table 8.

LRPs in other jurisdictions

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Area	Species	LRP	TRP
Australia	Swordfish Striped marlin	20% $B_{F=0}$ or B_0 and $F/F_{MSY} = 1$ Default	None
ICCAT	Swordfish	$0.4 * B_{MSY}$	B_{MSY}
IOTC	Swordfish	$0.4 * B_{MSY}$ and $1.4 * F_{MSY}$	B_{MSY} and F_{MSY}
New Zealand	Swordfish Striped marlin	10 and 20% SB_0 Default	$B > B_{MSY}$ and $F < F_{MSY}$
USA	Swordfish Blue marlin Other billfish	MFMT, MSST, and B_{FLAG}	None

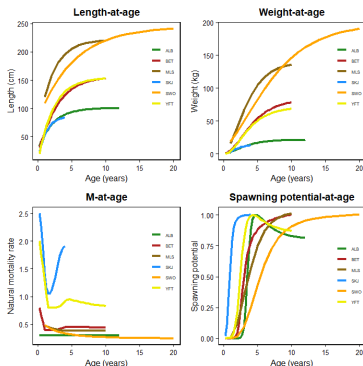


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Levels of depletion for LRPs

- ▶ Generally speaking striped marlin and swordfish life history parameters that would indicate similar levels of productivity compared to the target tuna species.
- ▶ As such it is reasonable that the LRP applied to tuna is also relevant to these species i.e. $20\% SB/SB_{F=0}$.
- ▶ Blue marlin are likely less productive than swordfish; black marlin and sailfish appear similar to striped marlin; and the biology of shortbilled spearfish is poorly understood.



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Level	Condition	LRP metrics
Level 1	A reliable estimate of steepness is available.	F_{MSY} and B_{MSY}
Level 2	Steepness is not known well, if at all, but the key biological (natural mortality, maturity) and fishery (selectivity) variables are reasonably well estimated.	$Fx\%_{SPR,F=0}$ and either $x\% SB_0$ or $x\% SB_{current,F=0}$
Level 3	The key biological and fishery variables are not well estimated or understood.	$x\% SB_0$ or $x\% SB_{current,F=0}$
Level 4	Poor biological information, fishery data sparse or patchy with no ability to estimate parameters noted above, or other metrics considered important. But a reliable CPUE index is available.	$CPUE_{t1-t2}$ or $CPUE_{low}$
Level 5	The key biological variables (age, reproduction, intrinsic rate of increase and carrying capacity) are reliably estimated.	$F/F_{crash} > 1$ or $F/F_{lim} > 1$



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We considered three different LRP groups

- ▶ Biomass and Fishing Mortality Based LRPs.
- ▶ Empirical LRPs.
- ▶ Time Bound LRPs.
- ▶ Risk-based Fishing Mortality Benchmarks.

We tested these against data from the 2019 SWP MLS stock assessment outputs (SA-WP-07)

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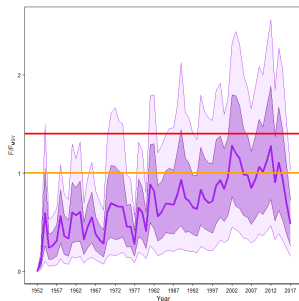
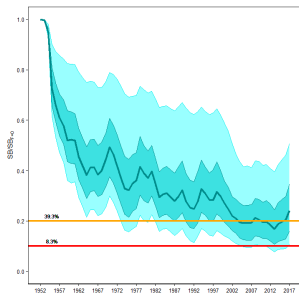
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Biomass and F-based LRPs from the 2019 SWP MLS assessment, values chosen to reflect examples found in the literature.



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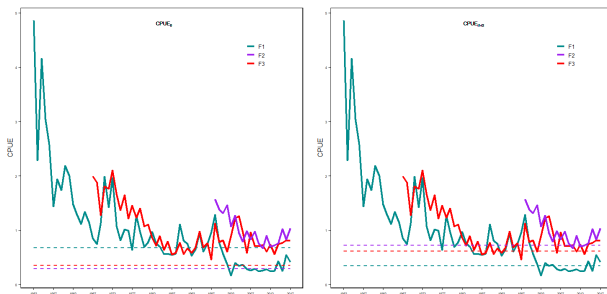
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[Time bound empirical LRPs from medium data assessment]

eg Chose 20% $CPUE_0$ as an example for each

For $CPUE_0$ it may be better to chose a range of years eg first 5 years.

If using $CPUE_{low}$ or $CPUE_{t_1-t_2}$ the stock should have increased from the low point.



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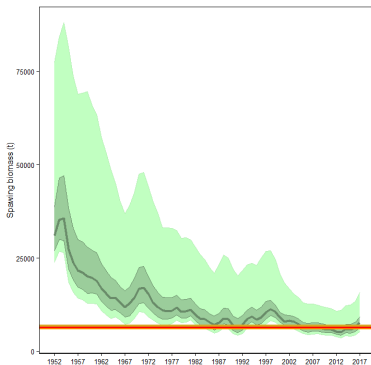
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[Time bound LRP from data rich assessment]
Choosing a low biomass similar to NP ALB SSB-ATHL



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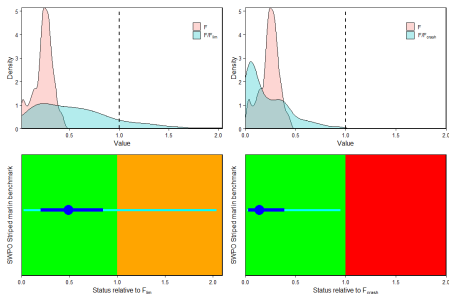


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F_{lim} corresponds to $\sim 25\%$ B_0 and $\sim 20\%$ $SB/SB_{F=0}$.

F_{crash} is the point at which there is high probability of stock collapse and **if fishing mortality is maintained** at or above F_{crash} the population will eventually collapse.



If the consequence of breaching the LRP is **high** the **risk should be low**.

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From the 2019 SWP STM assessment
Number of runs in the grid that breached the LRP

- ▶ **29-39%**- 20% $SB/SB_{F=0}$, $SB_{1990-1992}$ and SB_{1991} .
- ▶ **23-20%**- 20% SB_0 , 20% $CPUE_0$.
- ▶ **8-14%**- $F/F_{MSY} < 1$, 10% $SB/SB_{F=0}$ and $F/F_{lim} > 1$.
- ▶ **<2%**- $F/F_{MSY} < 1.4$, $SB/SB_{F=0}$ 2012-2014, $CPUE_{t1-t2}$ and $F/F_{crash} > 1$.

Time bound LRPs can be modified to by choosing a time period that is **relevant to management objectives**, and **quality** of the data.



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Key data requirements and final LRP lists

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- ▶ 13 metrics [+3 with specific values] in Table 7 that could be used as LRPs for SWP striped marlin and other billfish.
- ▶ We also include Table 9 that has suggestions for species specific LRP, based on target and bycatch groupings and the level of available information for assessment.



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Key data requirements and final LRP lists

The metrics are presented in Table 7. They fall within three categories with respect to their data requirements:

1. **Data Rich** - From assessment model - $SB/SB_{F=0}$; $SB/SB_{F=0} t1-t2$; $SB/SB_{F=0_low}$; $x\% B_0$; B_{0t1-t2} ; and $Biomass_low$. [Assessment model](#).
2. **Medium data** - Empirical reference point - $x\% CPUE_0$, $CPUE_{t1-t2}$ and $CPUE_low$. [Reliable CPUE index](#).
3. **Data Poor** - Spawning potential ratio (SPR) and risk-based fishing mortality benchmarks - F/F_{lim} , and F/F_{crash} . [Biological parameters](#).

It is technically [feasible to calculate](#) all of these metrics for SWPO striped marlin. However, not all of these metrics would be useful.

The risk-based fishing mortality benchmarks are relatively [static](#).

The empirical reference points requires some reflection on how well the [index reflects trends in biomass](#).

The metrics derived from an [integrated stock assessment model](#) are likely to be the most useful and should be applied [preferentially over the other metrics](#).

Additional information requirements

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Higher levels of observer coverage particularly on the high seas to

- ▶ Improve catch estimates and verify logsheet catch.
- ▶ Provide length data,
- ▶ Better estimates of the fate and condition.
- ▶ Collect biological material to get WCPO specific biological data including growth and maturity.

For all species, [increased reporting of gear covariates in logbooks](#) (such as light stick use/bait type/float line depth/branch line depth/etc. . .) would be useful to augment CPUE standardization and [develop representative indices of abundance](#).



Recommendations

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The following recommendations are proposed:

1. The WCPFC should **develop interim objectives** for SWPO striped marlin to guide the appropriate levels for any agreed LRP and the associated maximum risk levels for breaching a LRP.
2. In the **interim**, a LRP equivalent to 20% $SB/SB_{F=0}$ for SWPO striped marlin could be used, consistent with the logic behind the application to **key tuna stocks**.
3. For the other WCPO billfish - develop objectives as **species groups**, by dividing Western and Central Pacific Ocean (WCPO) billfish into: **target species** (swordfish); **data-rich bycatch** species (striped and blue marlin); **medium information** species with **moderate levels of catch** (black marlin); and **data-poor low-catch bycatch** (shortbilled spearfish and sailfish).
4. Consider **Table 7 as a list of LRP metrics** that could be used for WCPO billfish.



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Recommendations continued

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5. Consider the [values presented in Table 9](#) as potential LRPs for SWPO striped marlin.
6. Assess the remaining stocks against the proposed LRPs in Tables 7 and 9 to determine the [appropriate LRP levels](#).
7. Any new LRP metrics that are developed, should be assessed against those presented in Table 7.
8. Incorporate these decisions into the [Billfish Research Plan](#) that is scheduled to be developed in 2022 and focus that work on developing objectives, assessing LRPs for each species, and determining if a [pathway to a higher level of information](#) and knowledge should be developed.
9. The risk-based fishing mortality benchmarks should be defined as dependent variables in the two main assessment platforms used (SS and MFCL) so that statistical uncertainty of the estimates can be calculated.



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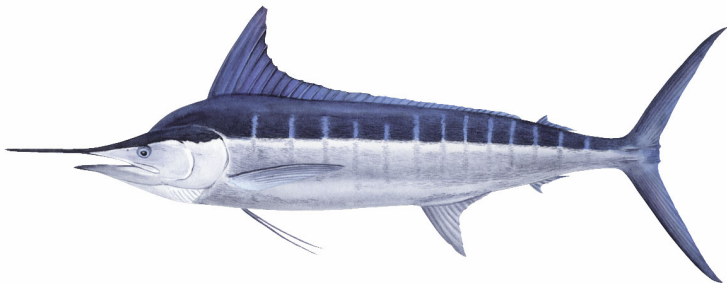
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Thanks for listening



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Table 7: Proposed list of potential Limit Reference Points for consideration for WCPFC billfish, categorised as Target or Bycatch and by assessment type. Grey shading is simply for easy separation of LRP groups.

LRP	Group	Assessment type	Comments
$F/F_{MSY} = 1$	Target	Data rich	Hold target species to the same standard as target tuna stocks.
$x\% F/F_{MSY}$	Bycatch	Data rich	Choose the level of x based on an evaluation.
$20\% SB/SB_{F=0}$	Target	Data rich	Hold target species to the same standard as target tuna stocks.
$x\% SB/SB_{F=0}$	Bycatch	Data rich	Choose the level of x based on an evaluation.
$25\% SB_0$	Target	Data rich	Hold target species to the same standard as target tuna stocks.
$x\% SB_0$	Bycatch	Data rich	Choose the level of x based on an evaluation.
$SPR\ x\% SB_{F=0}$	Bycatch	Medium data or data poor	Choose the level of x based on an evaluation.
$x\% CPUE_0$	Target & Bycatch	Data rich or Medium data	Choose the start of a reliable CPUE series and the level of x .
$SB/SB_{F=0t1-t2}$	Target & Bycatch	Data rich	Choose a time period where the stock was considered in an undesirable state (and should be avoided in future), but recovered back to suitable levels.
SB_{t1-t2}	Target & Bycatch	Data rich	Choose a time period where the stock was considered in an undesirable state (and should be avoided in future), but recovered back to suitable levels.
$CPUE_{t1-t2}$	Target & Bycatch	Data rich or Medium data	Choose a time period where the stock was considered in an undesirable state (and should be avoided in future), but recovered back to suitable levels.
$SB/SB_{F=0_low}$	Target & Bycatch	Data rich	Choose a low year where the stock was considered in an undesirable state (and should be avoided in future), but recovered back to suitable levels.
SB_{low}	Target & Bycatch	Data rich	Choose a low year where the stock was considered in an undesirable state (and should be avoided in future), but recovered back to suitable levels.
$CPUE_{low}$	Target & Bycatch	Data rich or Medium data	Choose a low year where the stock was considered in an undesirable state (and should be avoided in future), but recovered back to suitable levels. Note $CPUE_{t1-t2}$ is more precautionary.
$F/F_{lim} > 1$	Bycatch	Data poor	Use as an interim LRP until a more reliable metric can be generated.
$F/F_{trah} > 1$	Bycatch	Data poor	Use as an interim LRP until a more reliable metric can be generated.



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Table 9: WCPFC billfish table showing proposed species groupings, assessment data type and proposed Limit Reference Points.

Name	Species	Group	Assessment data	Proposed Limit Reference Points	Can we do it?
Swordfish - NP	<i>Xiphias gladius</i>	Target species	Data-rich	20% SB/SB _{F=0} and F/F _{MSY} =1	Yes
Swordfish - SP	<i>Xiphias gladius</i>	Target species	Data-rich	20% SB/SB _{F=0} and F/F _{MSY} =1	Yes
Striped marlin - NP	<i>Kajikia audax</i>	Bycatch	Data-rich	20% SB/SB _{F=0} and F/F _{MSY} =1	Yes
Striped marlin - SP	<i>Kajikia audax</i>	Bycatch	Data-rich	20% SB/SB _{F=0} and F/F _{MSY} =1	Yes
Blue marlin	<i>Makaira nigricans</i>	Bycatch	Data-rich	20% SB/SB _{F=0} and F/F _{MSY} =1	Yes
Black marlin	<i>Istiompax indica</i>	Bycatch	Medium-data	20% CPUE ₀ or CPUE _{E1-12} or CPUE _{low} or F/F _{CPUE0} or F/F _{lim}	Probably
Sailfish	<i>Istiophorus platypterus</i>	Bycatch	Data-poor	20% CPUE ₀ or CPUE _{E1-12} or CPUE _{low} or F/F _{CPUE0} or F/F _{lim}	Possibly
Shortbilled spearfish	<i>Tetrapturus angustirostris</i>	Bycatch	Data-poor	20% CPUE ₀ or CPUE _{E1-12} or CPUE _{low} or F/F _{CPUE0} or F/F _{lim}	Possibly



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