Report of Project 78 Shark Data Review

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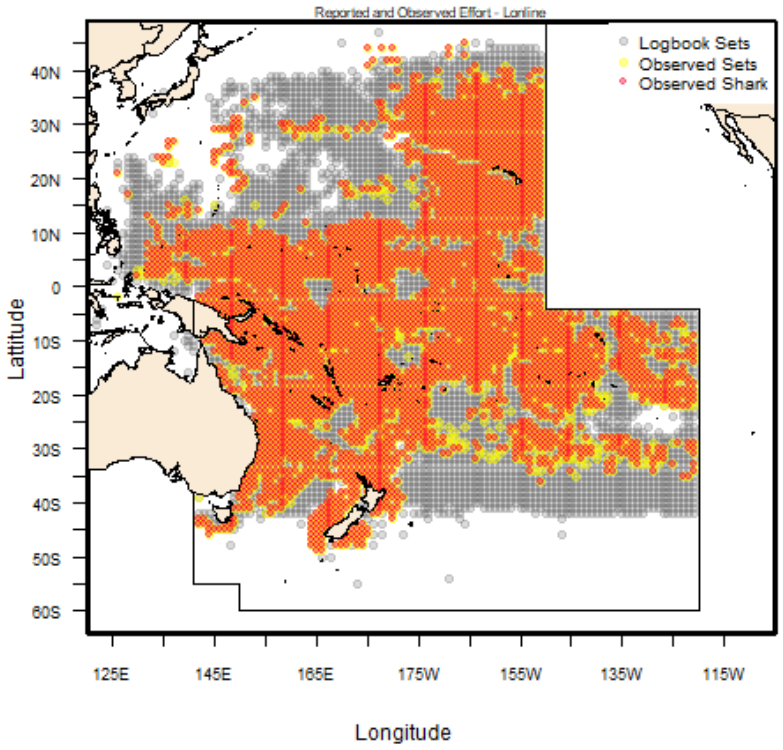
Overview of Project 78

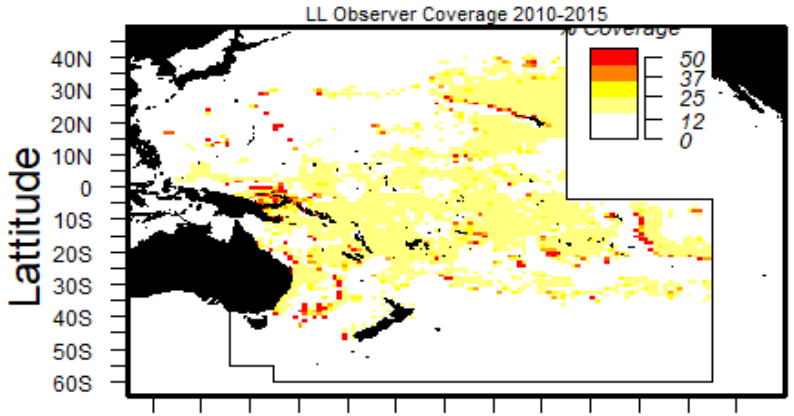
- Assess the quality of logbook and observer data currently held by SPC
- Identify gaps in the data & associated uncertainties
- Identify methods to deal with these gaps and implied uncertainties
- Review the main data assumptions for re-constructing shark catch data time series
- Examine the potential impact of key WCPFC shark related CMMs on data quality

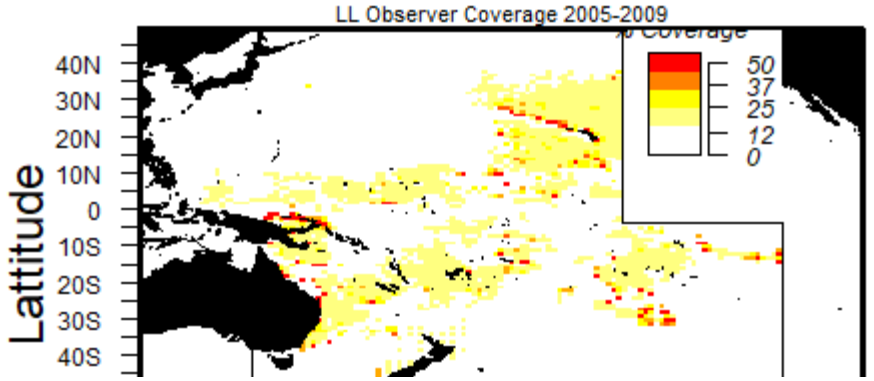
Reported and Observed Longline sets



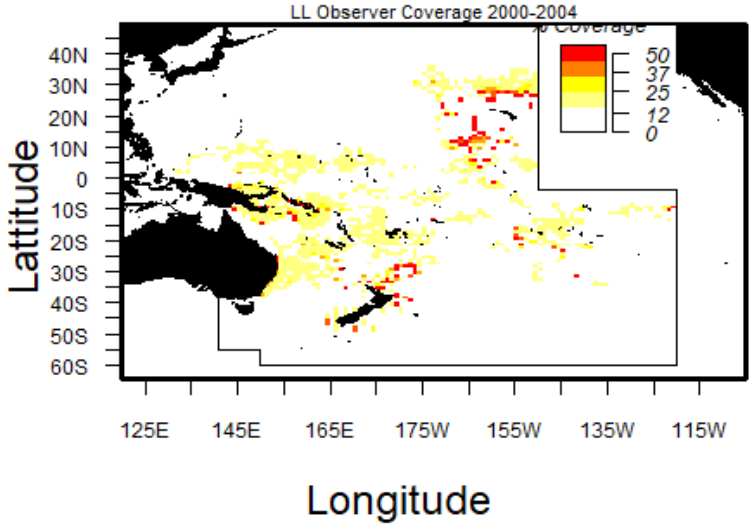
- Reported effort occurs throughout the WCPFC convention area
- Observer coverage is lacking in the Northwest area (North of 10˚N and west of 175˚ West
- Sets with observed sharks occur throughout the range of the observer data.
- Timeframe of the study was 1995-2015

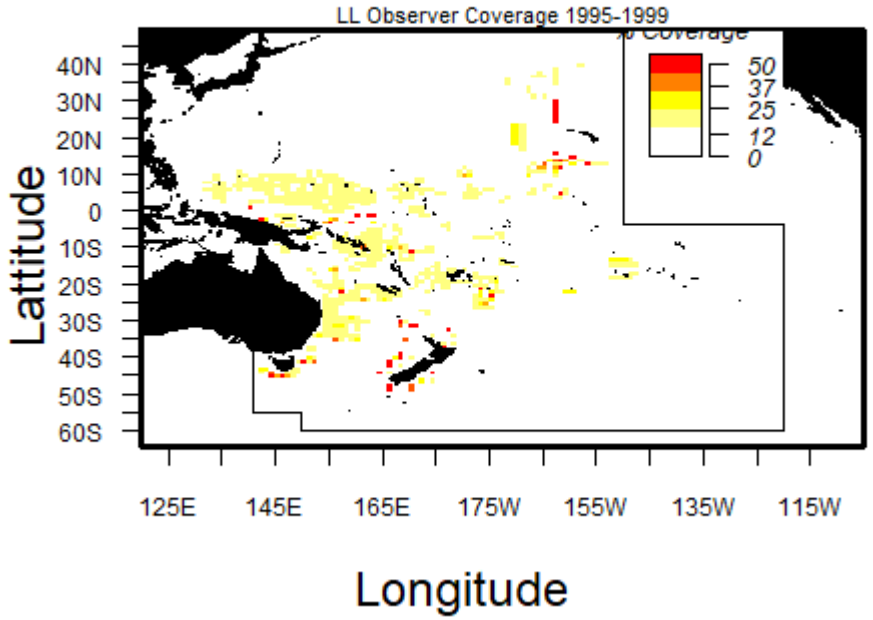
Longline observer coverage at 1˚ spatial resolution





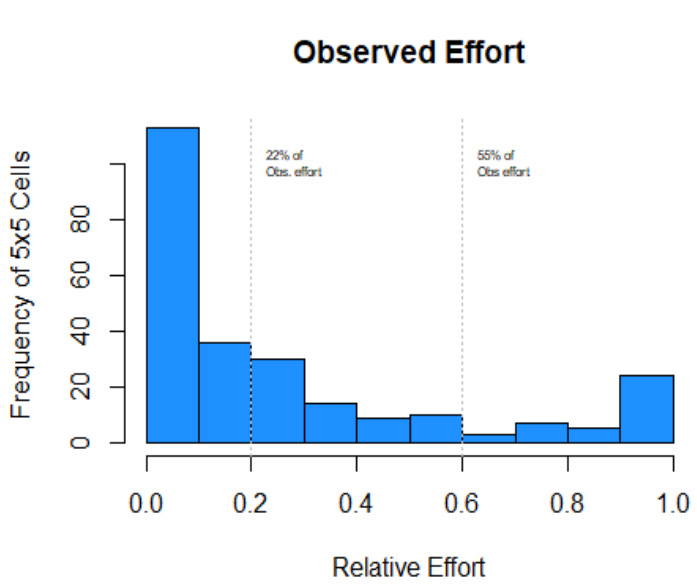
Mean observer coverage is 4%- 6% over 2010-2015.

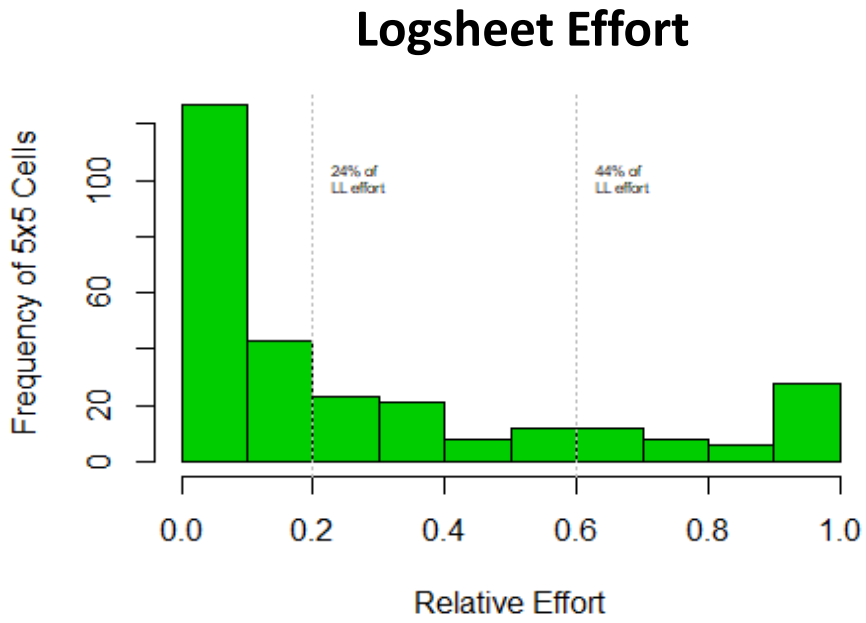


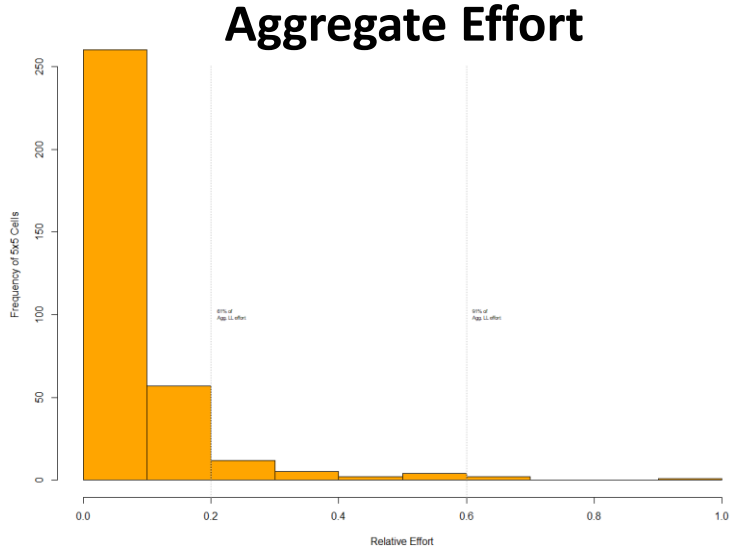


The majority of the observed longline sets are near the Hawaiian islands and clustered in the EEZs.

Relative Frequency of observed and logsheet and total aggregate effort (LL fishery)

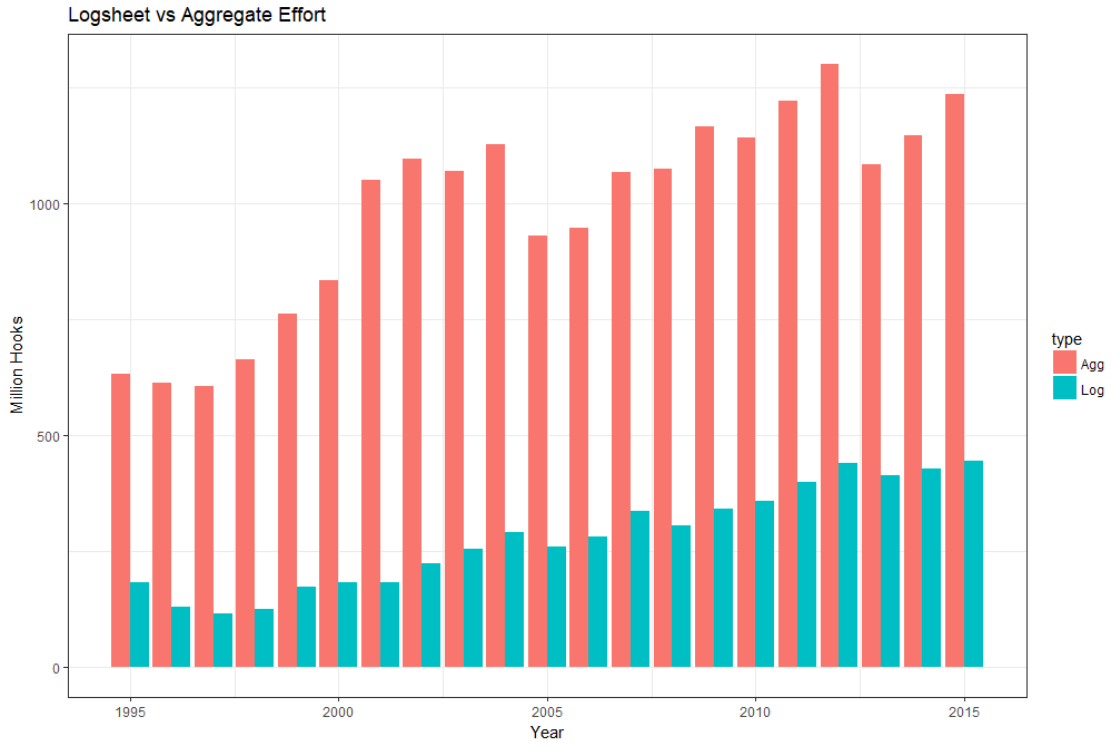




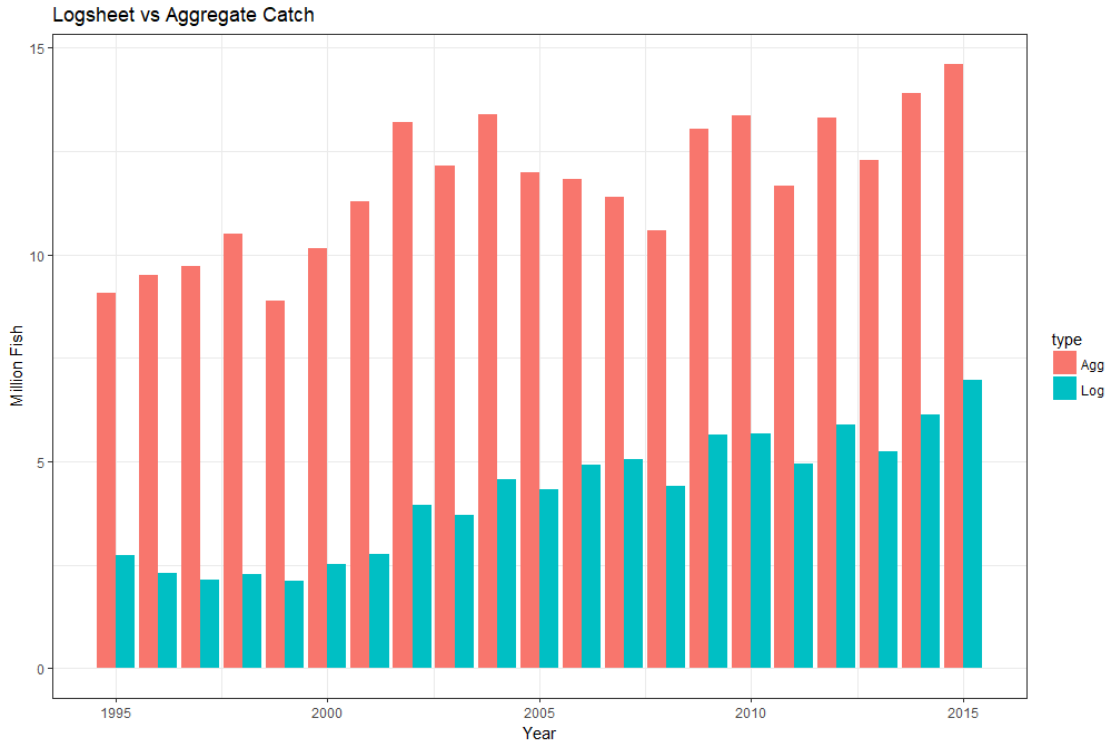


Coverage – Logsheet to Aggregate Catch and Effort. Longline fishery*

EFFORT



CATCH OF TARGET SPECIES (YFT, BET, & ALB)



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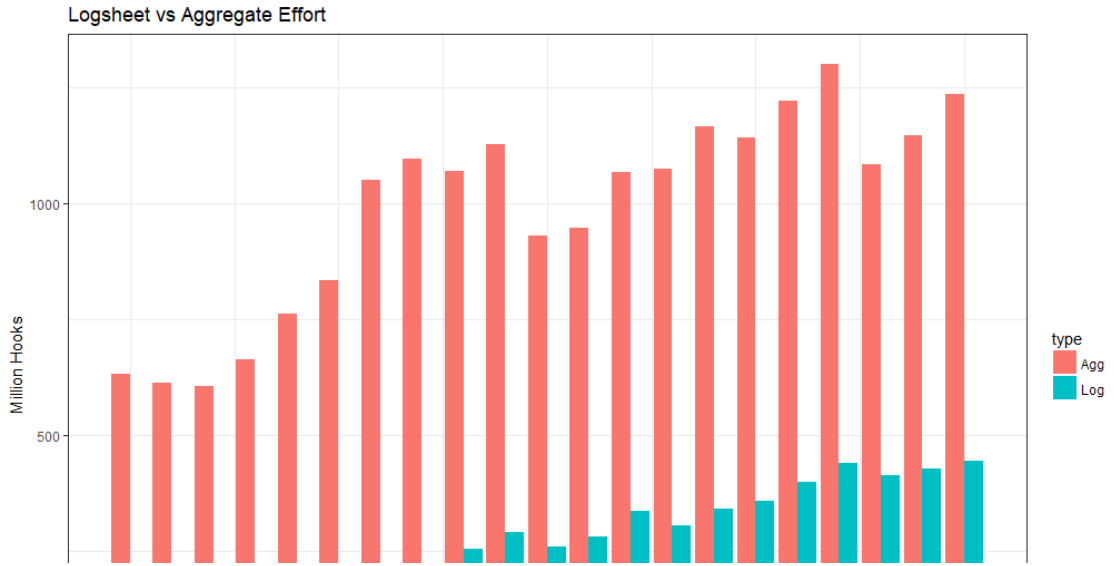

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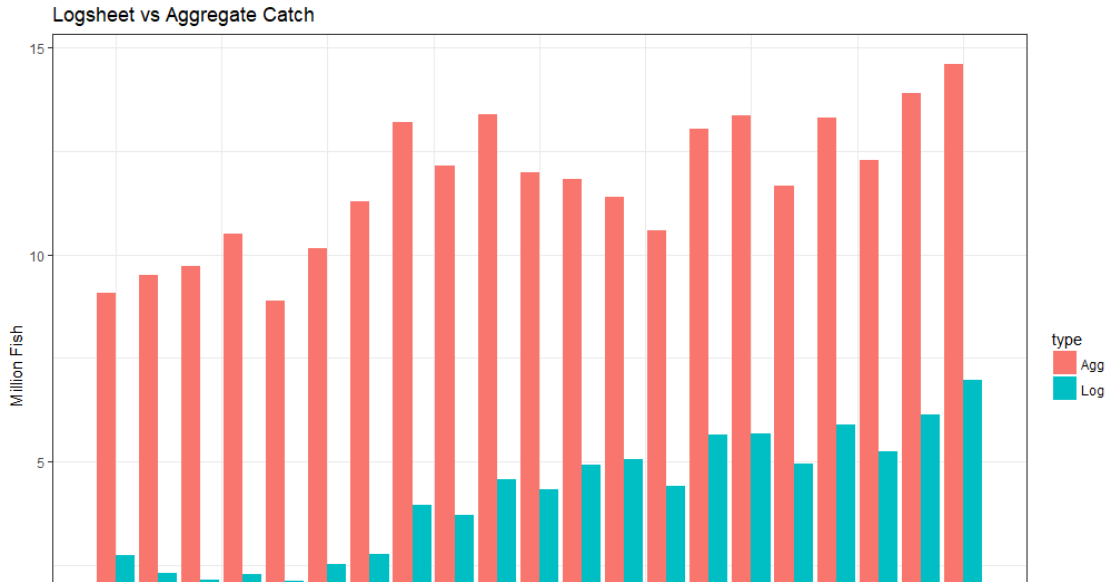
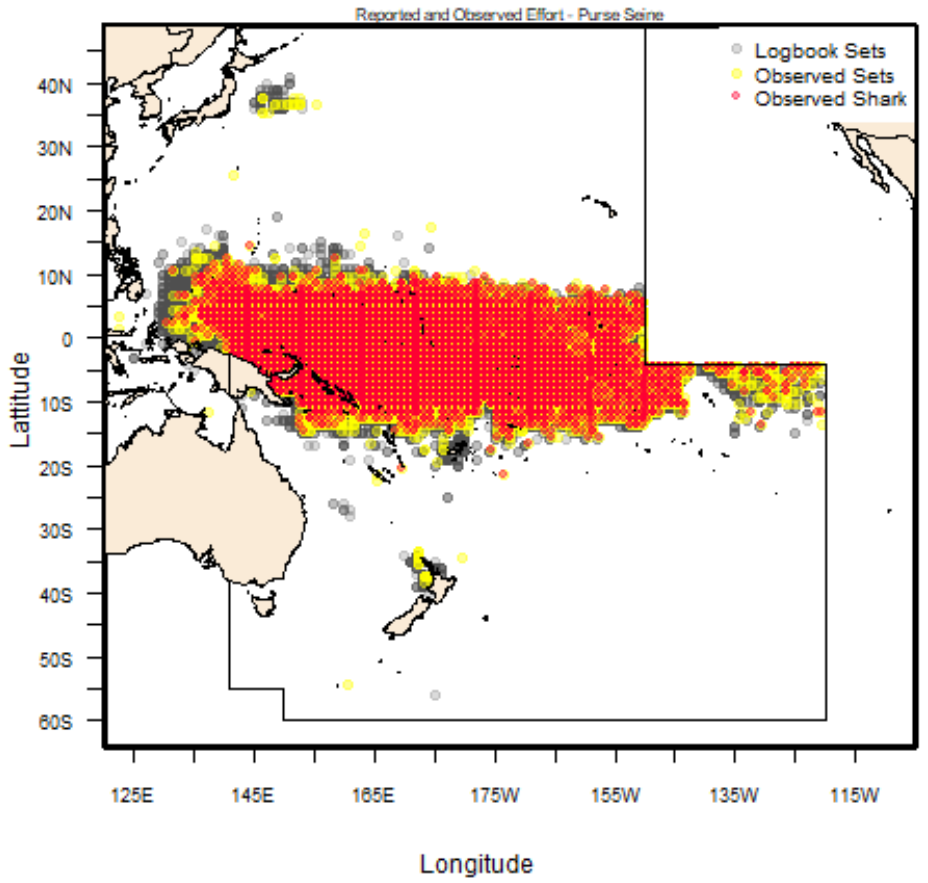


Since 2015/2016 full operational data have been provided by major distant water fleets, however this data was not available for this project.

Summary of longline data holdings.

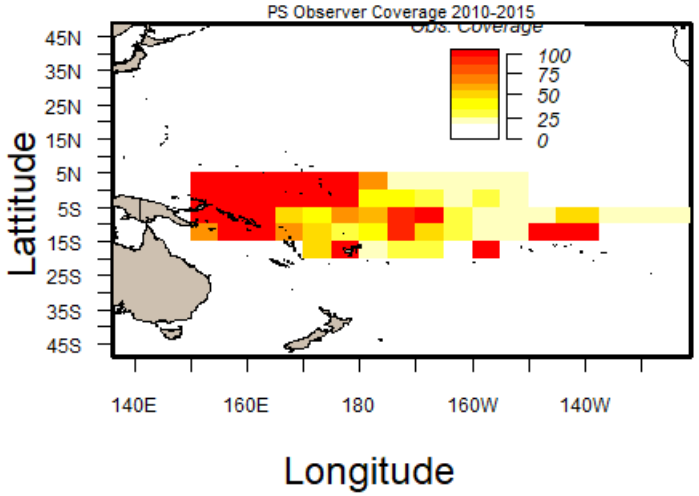
- Longline observer data coverage is low, ranging between 4% and 6% over the years 2010-2015
  - Fleet by fleet coverage is highly variable.
- Longline observer data is clustered in EEZ's and low in certain high seas areas (NW and SE areas of WCPO)
- The relative distribution of the observer data is similar to the relative distribution of the logbook data.
- Logbook coverage is higher than observer coverage but is less than 50% by catch and by effort.

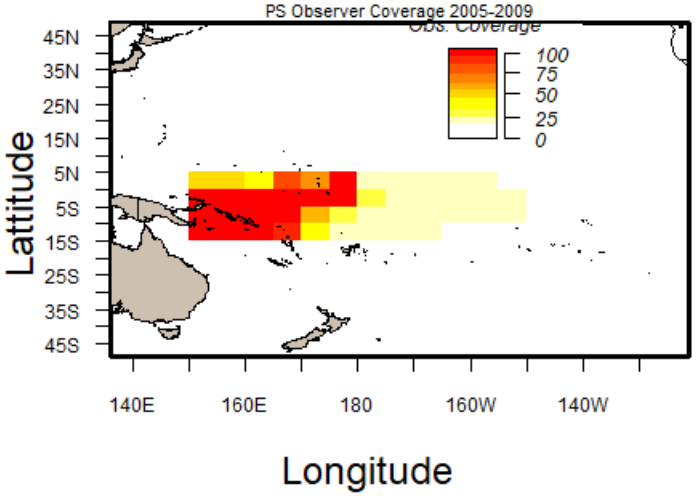
Reported and Observed purse seine sets

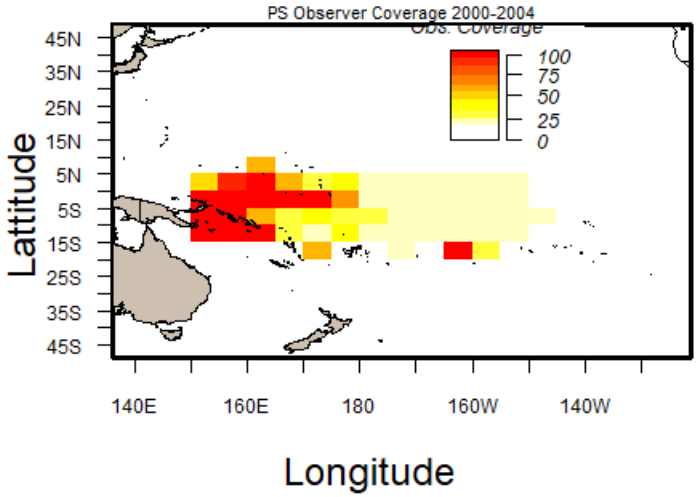


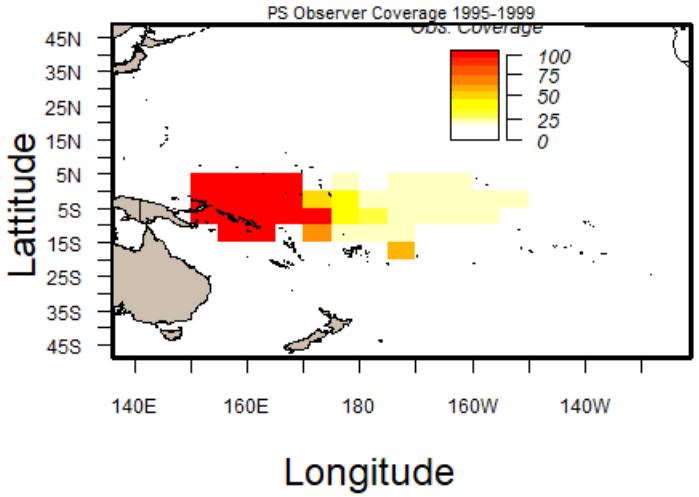
- Reported effort occurs throughout the WCPFC convention area
- Observer coverage is high throughout the range of the purse seine fishery
- Sets with observed sharks occur throughout the range of the observer data.
- Timeframe of the study was 1995-2015

Spatial distribution of observer coverage. Purse seine fishery.







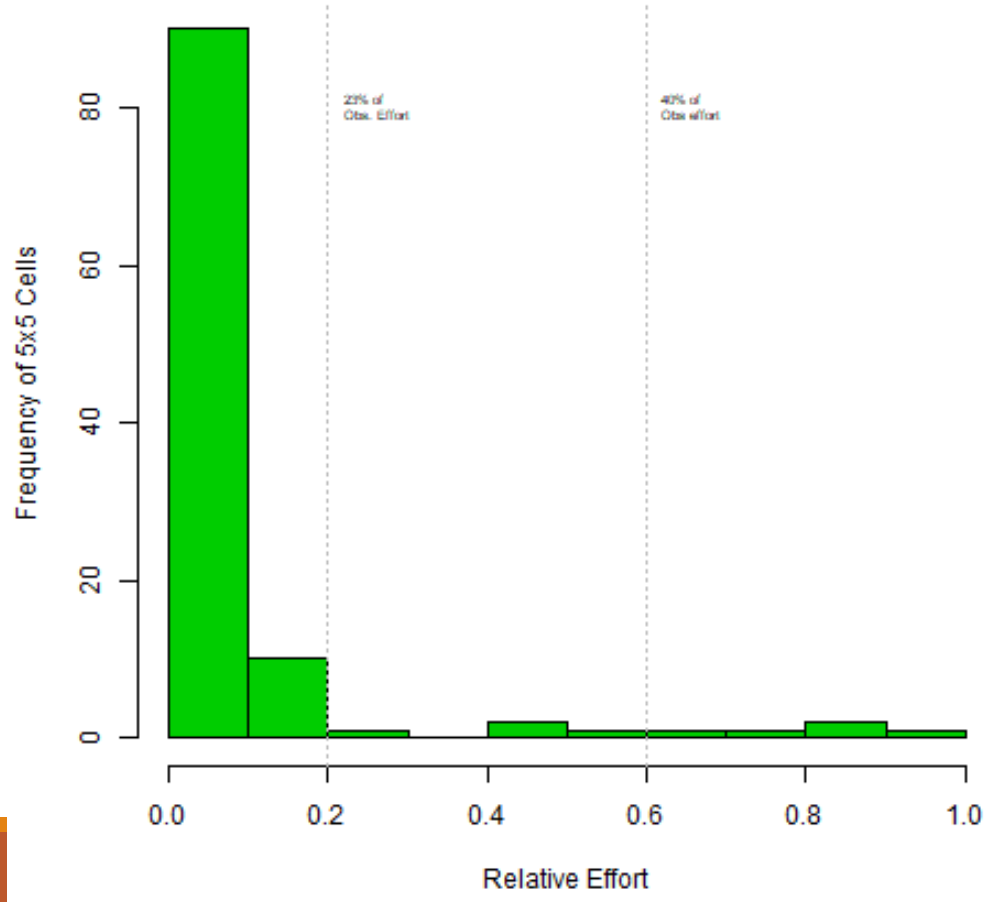


Observer coverage in the purse seine fishery is **variable** by fleet, averages 72-90% from 2010-2015

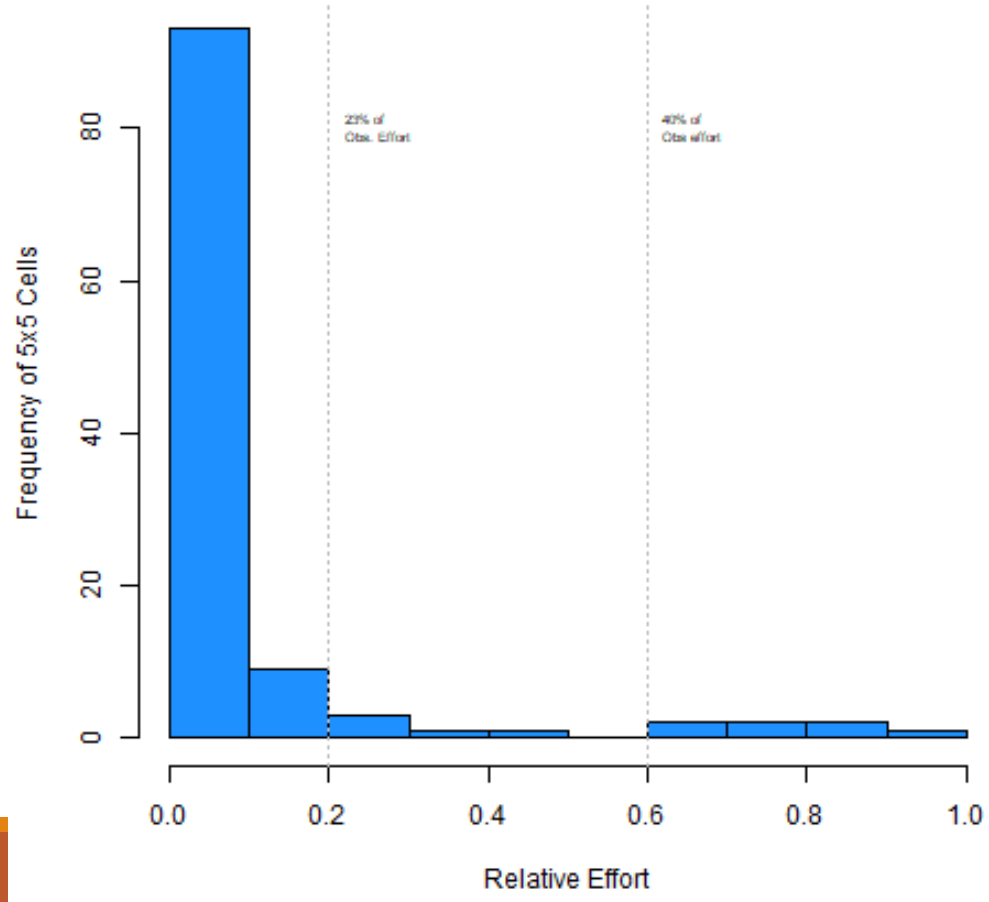
Observed purse seine sets are **clustered** in the Western part of the convention area near PNG and the Solomon Islands.

Distribution of the relative effort of Logsheet and Observer data. Purse Seine 2010-2015.

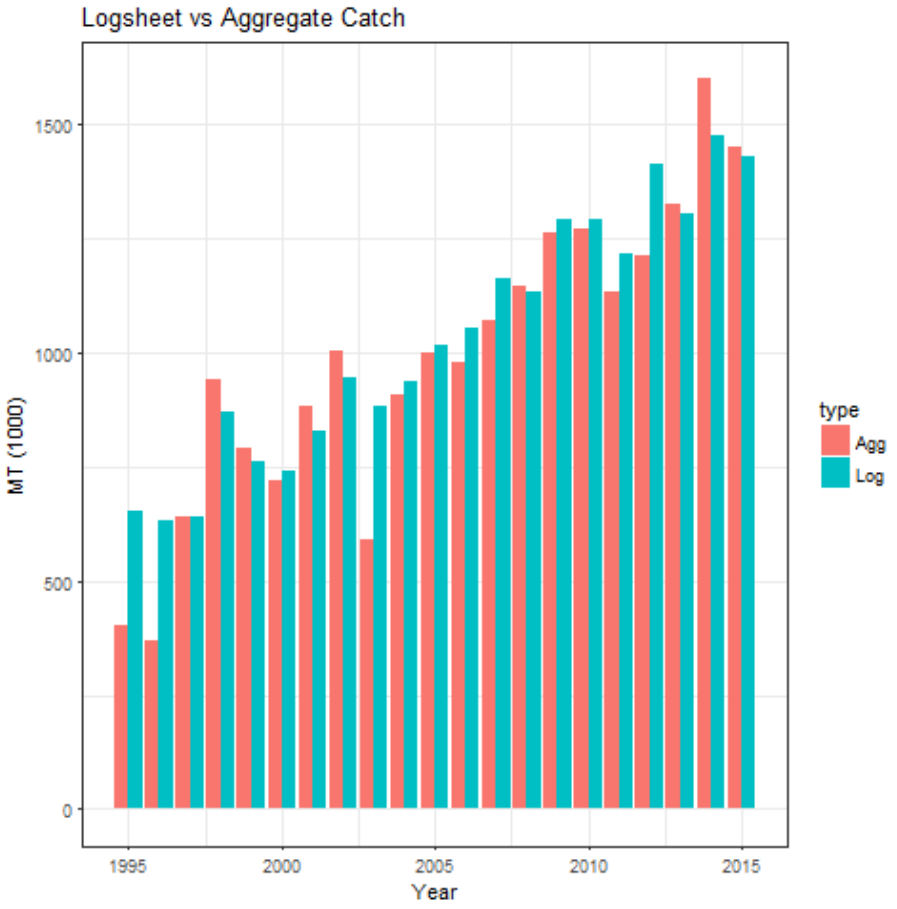
Observer data

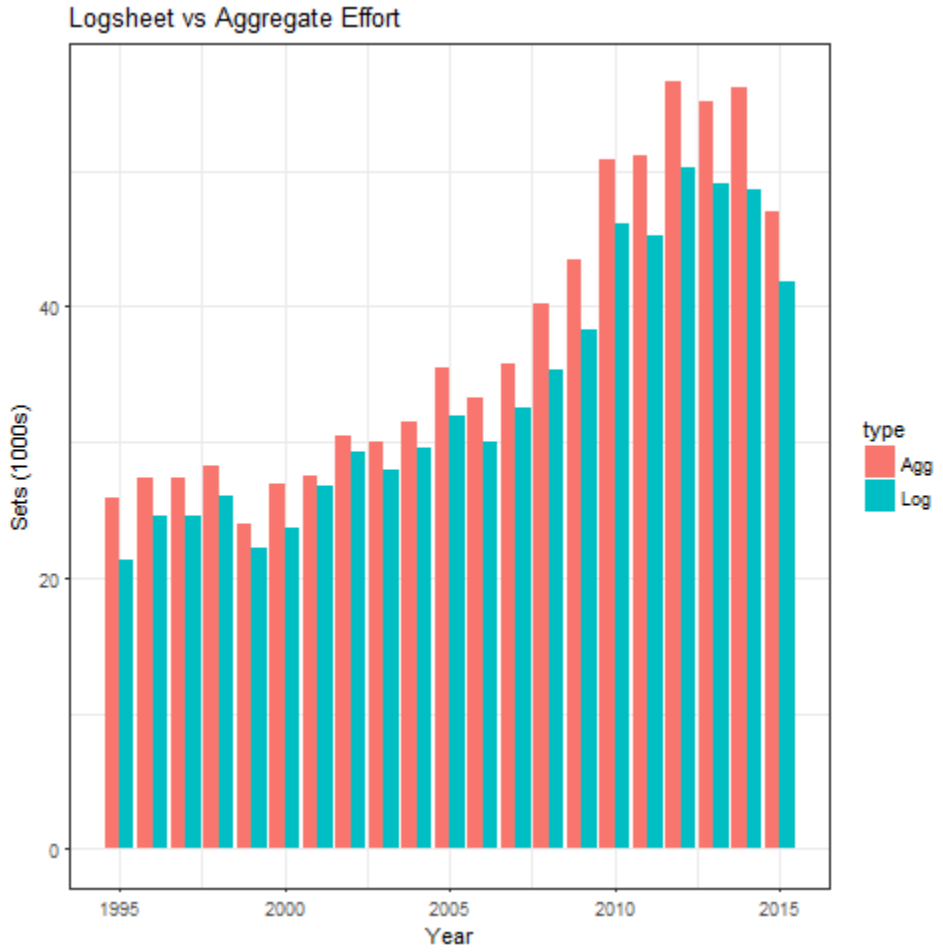


Logsheet Data



Coverage – Logsheet to Aggregate Catch and Effort. Purse Seine Fishery.

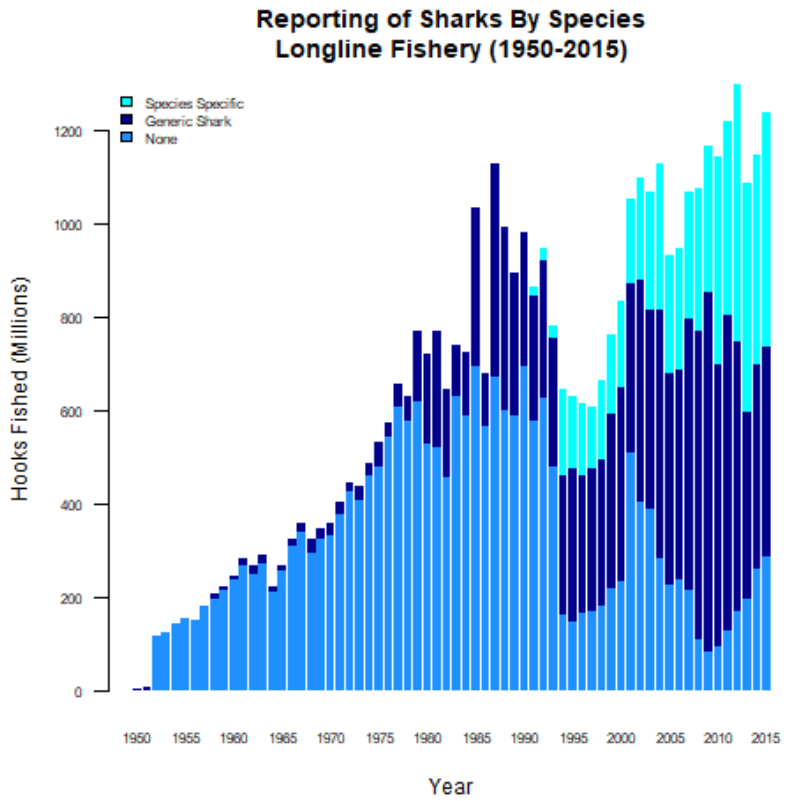


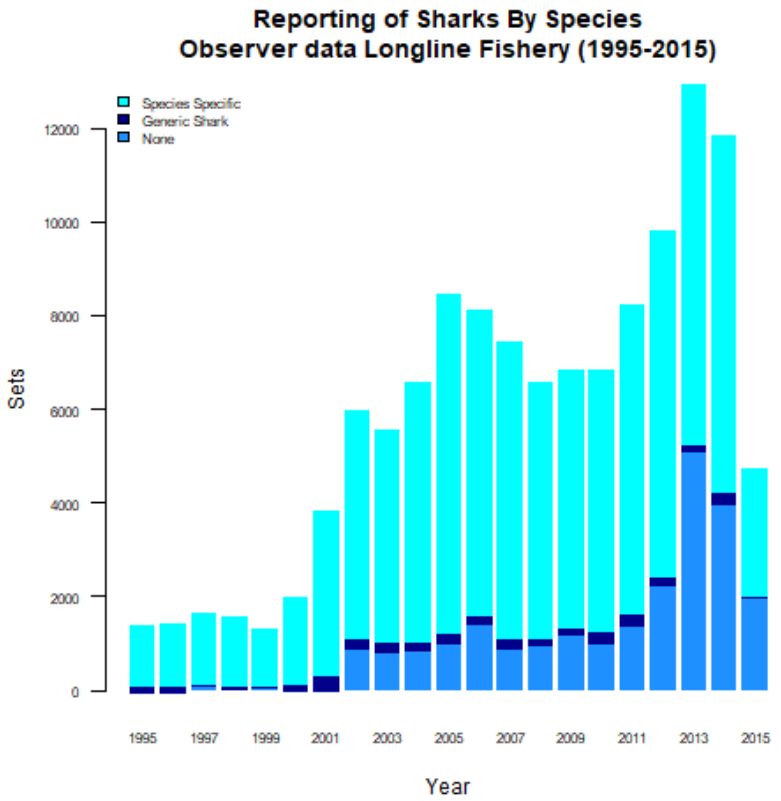


Summary of Purse Seine Data Holdings.

- Purse seine observer data coverage is relatively high, ranging between 72% to 90% over the years 2010-2015
  - Fleet by fleet coverage is highly variable.
- Purse seine observer data is higher in the Western equatorial area, lower in the central and Eastern pacific.
- The relative distribution of the observer data is similar to the relative distribution of the logbook data.
- Logbook coverage is nearly at parity with the aggregate data by catch but slightly less when considering effort.

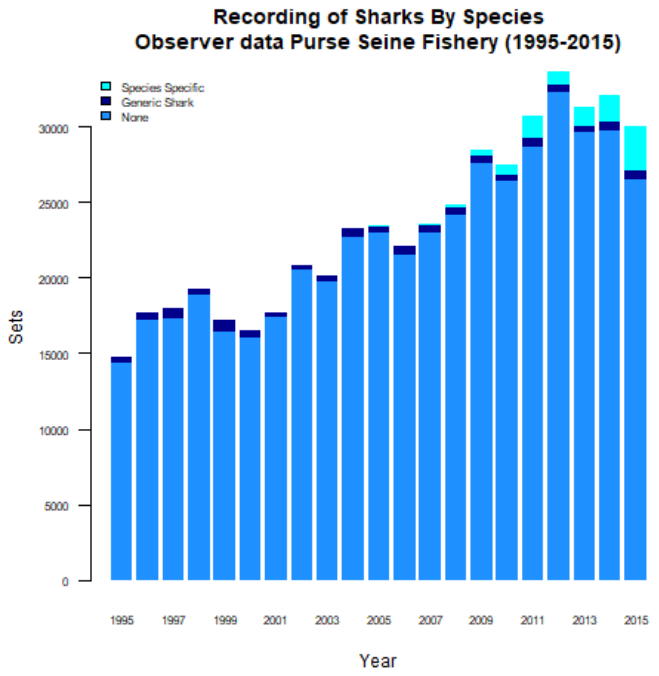
Reporting of sharks; by species, generically, or not at all. Longline vessels.



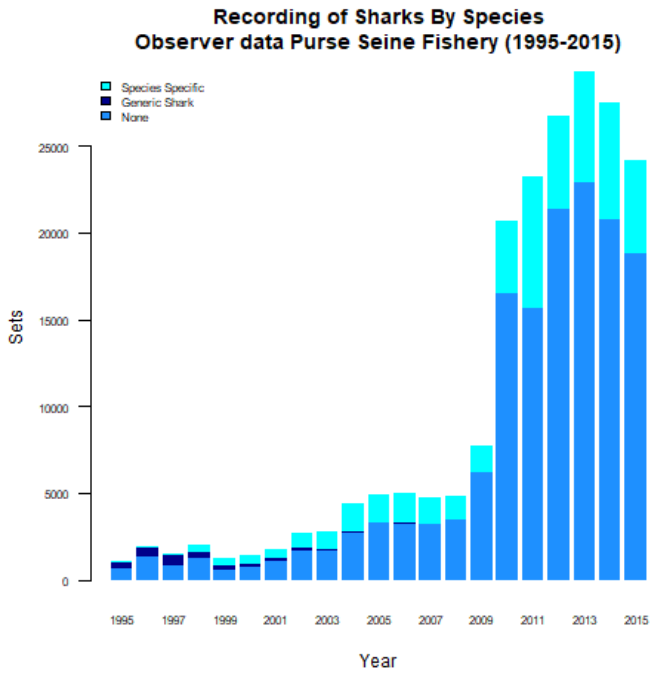


Reporting of sharks; by species, generically, or not at all. Purse seine vessels.

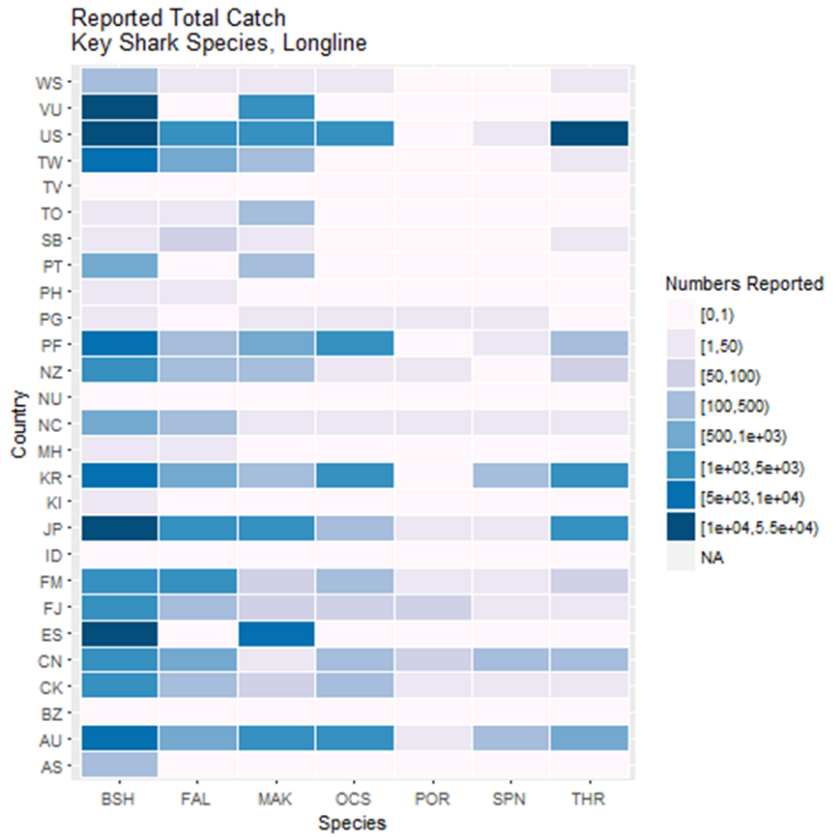
LOGBOOK



OBSERVER RECORDS



Reported Total Catch (retained catch &discards) of Key Shark Species By Flag Longline fishery, 2010-2015

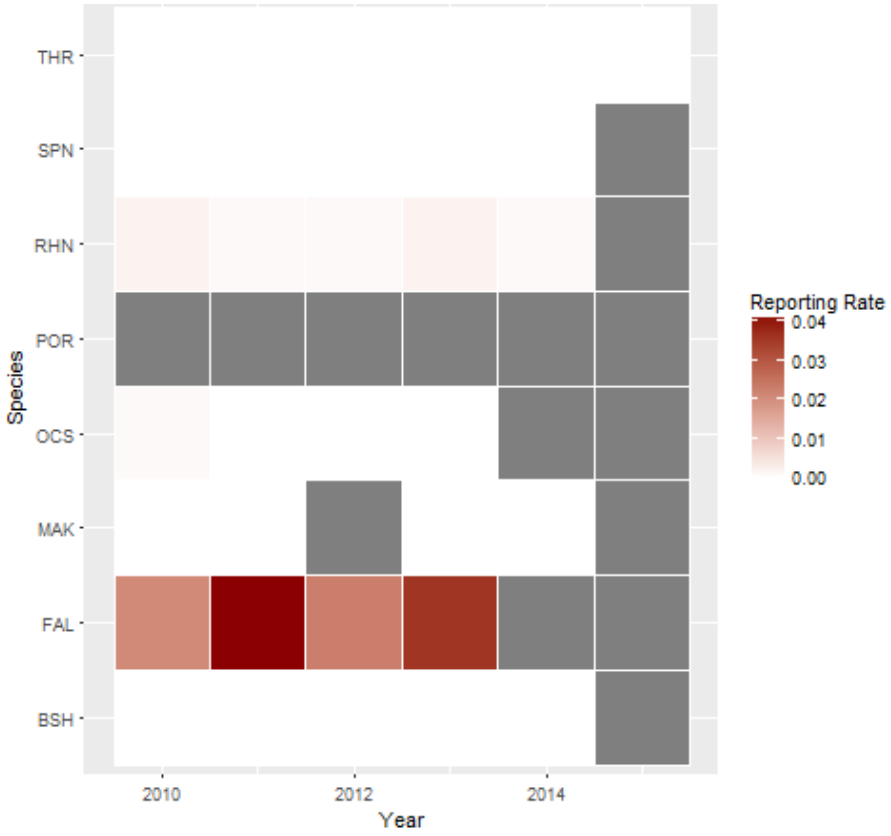


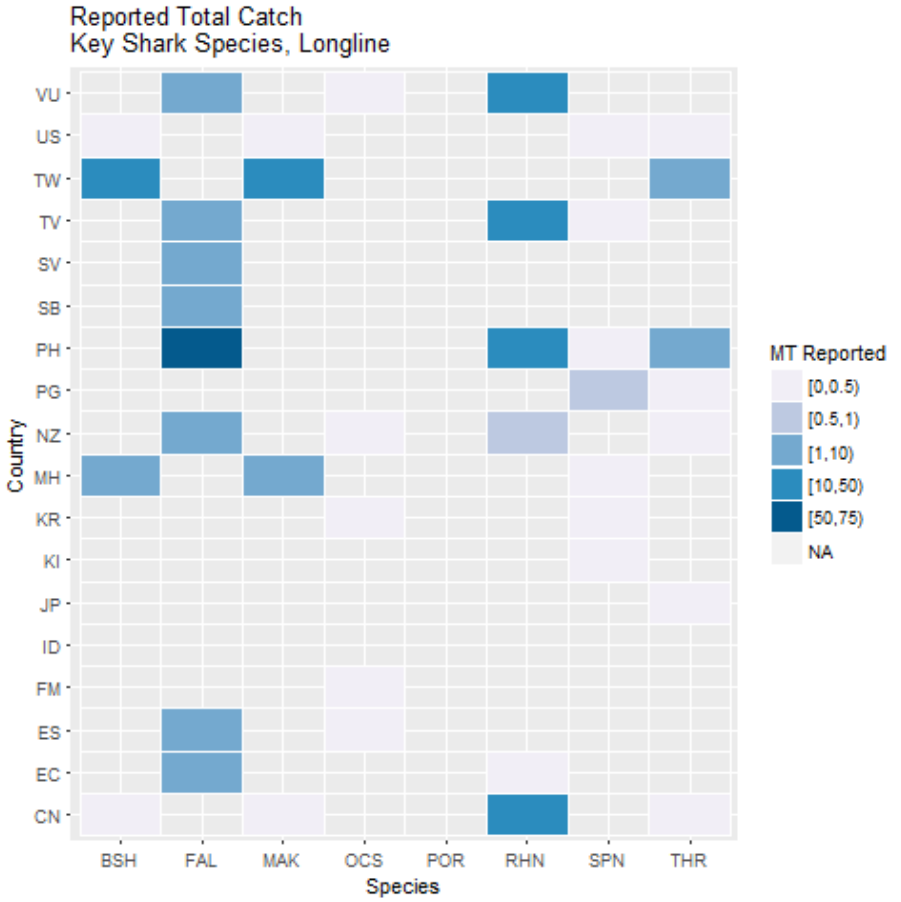
Fishery specific differences (i.e. temperate vs tropical) result in the majority of the differences in reporting by flag

BSH are the most commonly reported shark, with FAL as the second most commonly reported.

Reported catch for the period 2010-2015. Purse seine vessels

REPORTED CATCH





FAL are the most commonly reported shark in the purse seine logsheet data. No reports since 2014

Small numbers of RHN, OCS reported until 2014 and 2013 respectively.

Occasional reports of THR, BSH, SPN, and MAK reported.

Summary of reporting by species - general

- Longline logsheet reporting by species has increased over time
  - The majority of the sets report either generic shark or zero sharks
- Recording of sharks by observers shows mainly sharks by species.
- Purse seine logsheet data consists mostly of zero shark catches.
- Purse seine observer data shows a higher percentage of sets with sharks, yet a majority of reported sets contain no shark catch.

Summary of reporting by species - general

There has been an increase in reporting of catch and discards for all key sharks in the longline fishery, especially THR and BSH.

Reported catch and discard rates of FAL and OCS (LL) are higher in 2014 & 2015 than previously.

- May indicate a trend in reporting not a change in catch

Reported catch rates of key sharks in the purse seine fishery is low

- Generally consistent with observer data showing the majority of sets with zero sharks

No catch reporting for OCS and FAL since 2014

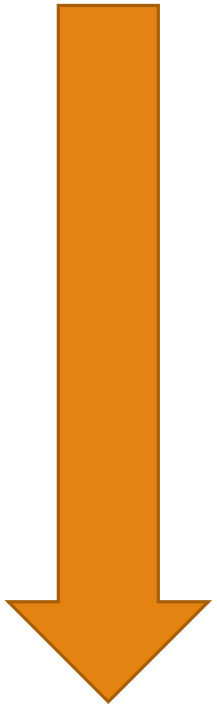
Impact of WCPFC CMM's on data quality

Four main CMMs govern the catch of sharks in the WCPO;

- **CMM 2010-07**. Reporting of key shark species and ' 5% rule'.
  - Increase in logsheet reporting of sharks to species (however reporting also increased in the 2000's relative to the 1990s)
- **CMM 2011-04**, non-retention for OCS, effective January 1, 2013
  - Absence in reporting of OCS in the purse seine fleet. An increase in reporting of discards in the longline fleet.
  - Observed catch (not discard) rates are similar to the years 2012-2013
- **CMM 2013-08**, non-retention for FAL, effective from 1 July 2014.
  - Reporting of discards in the longline fishery increased in 2014 and 2015 relative to 2013,
  - Reported catch rates in 2014 and 2015 higher than 2013, possibly due to change in reporting rates
  - No data from 2014 and 2015 in the purse seine logbook data for FAL
- **CMM 2014-05** bycatch mitigation via no wire trace or no shark lines, effective from 1 July 2015.
  - entered into force on July 1st 2015 and as such there is not enough data to quantify the effect

Methods and Assumptions for Estimating Unreported Shark Catch.

Simple



More Complex

Target Species Ratio Based Estimates.

- Estimates based on the annual target species catch and the ratio of shark to target catch . Useful when only part of the fleet reports any sharks to species.

Dis-Aggregated Estimates.

- Uses substitution rules to define the species composition based on the most similar record of species specific shark catch
- Assumes that fleets or vessels operating in similar areas with the same gear would have similar catch rates across target and bycatch species.

Model based approaches using reported landings.

- Reported species specific shark catch to parameterize a model (typically a GLM or GAM), then uses that model to predict the catch for those records that contain no reports of shark catch.
- Assumes that fishing operations in the same area/time/gear strata would, catch a similar combination of species,

Effort and CPUE based Estimates.

- Estimates based on the assumption that *CATCH = CPUE/EFFORT*. CPUE and EFFORT can be nominal or model based, usually stratified to the representative.
- Assumes that effort data is complete, and that CPUE rates are representative of the population as a whole. CPUE data are typically predicted based on models fit to observer data, this can be biased when coverage is low or spatially clustered.

Trade Based Estimates.

- Bayesian statistical methods, trade data and genetic analyses to estimate the the annual number of globally traded shark fins, the

Integrated model based estimates.

- Usually used to estimate unreported discards, can be used to estimate unreported catch as well. -Assumes that the other model inputs (age, growth, CPUE) are available

Modeling approach based on Babcock et al. 2003 to asses the impact of data gaps.

1. Simulate a fishery (the sampling universe)

2. Simulate the observer sampling process, and repeat many times for various levels of observer coverage

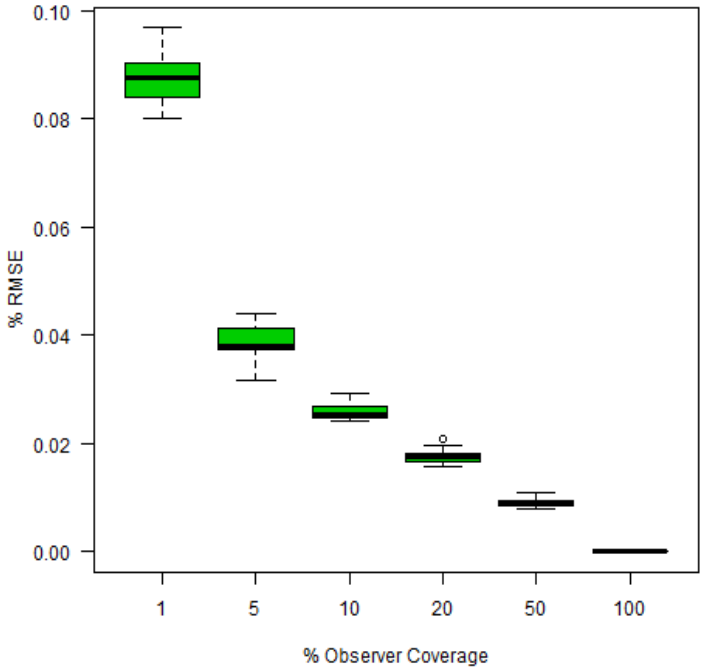
3. Calculate the CPUE

3. Estimate the total bycatch for each sample at each level of coverage

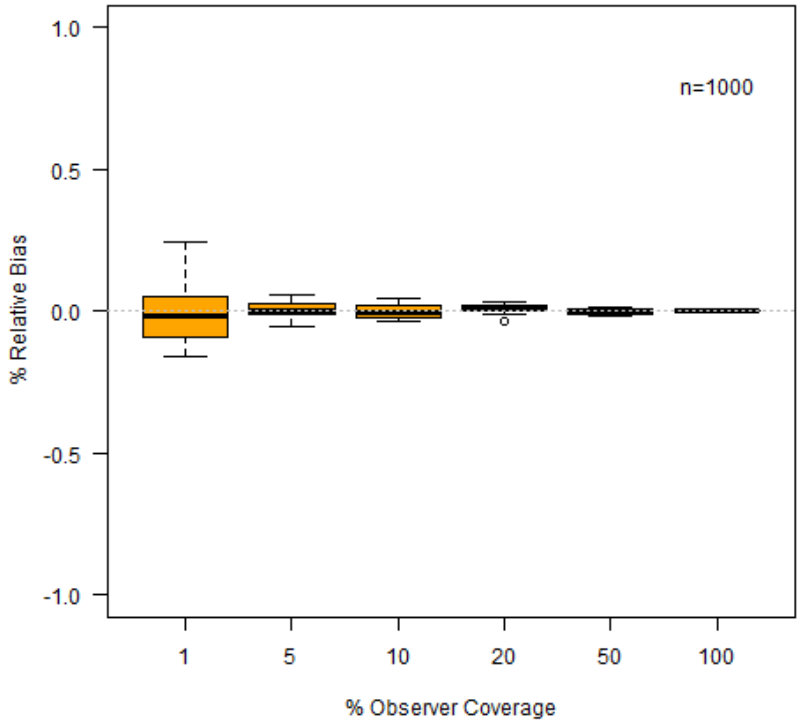
4. Compare the estimated total CPUE bycatch at each coverage level to the "true" values from the simulated fishery

General Results Effect of Observer Coverage

%RMSE

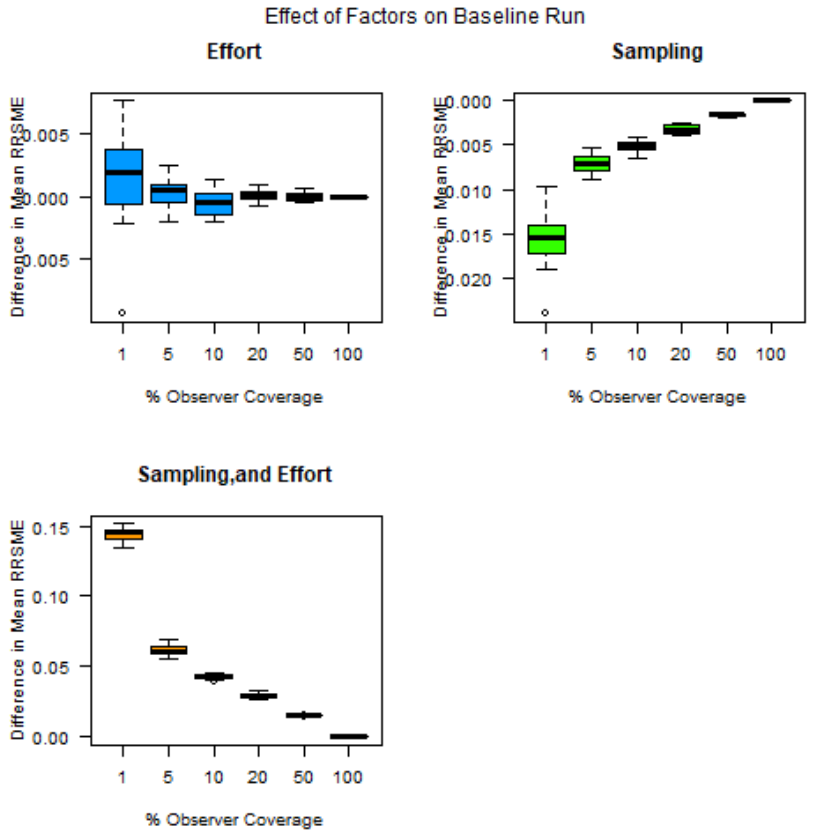


Percent Bias



- RRMSE was highest for low levels of observer coverage
- Relative bias was slightly negative at low levels of observer coverage and converging on zero by 5%

Random vs. 'Actual' Effort and Observer Sampling Distribution in the Estimation of catch.



Compares the differences in catch estimation (using the RRMSE) based on a random and simulated actual distribution of Effort and Observer data.

Individually the distribution of effort and sampling have smaller effects

Including both effort and sampling in the simulations greatly increased the error

Increased observer coverage (from 1%-5%) significantly decreased the error

So what does this all mean?

- Gaps in space and time exist for between observer and logsheet data, as well as between logsheet and aggregate data.
  - Most notably in the longline fishery.
- Most methods for estimating catch rely on scaling or modeling data rich components (e.g. observer data) to a region wide data set (aggregate effort).
- Increase in observer coverage and spatial representation of the data can reduce bias, and overall error in the CPUE estimation, and resulting catch estimates.

Species Assessment Decision Tree (*Silky Shark -Carcharhinus falciformis*)

Silky Shark (Carcharhinus falciformis)						
Assessment type	Inputs		Data needs	Do we have it (may need to provide detail)	Can we get it or estimate it? (may need to provide detail)	Can we do it?* (if NO, should we work towards this, if YES should we do it)
Data Rich Assessment. Integrated or other analytic assessment - e.g. Rice et al. Ref Pt F&B based	Biology	Age and growth	Reliable length-at-age estimates	Yes		Yes. WCPO assessment has been completed, a Pacific wide assessment is planned as part of the Common Oceans Program.
		Maturity	Reliable maturity schedule	Yes		
		Stock structure	Some understanding of stock structure	Yes		
		M	Reliable M estimate	Yes		
	Fisheries	Catch	Catch history (more than 20 years)	No	Yes	
		Effort	Effort data	Yes		
		Length	Length samples from some fisheries	Yes		
		Weight	Weight samples from some fisheries	Yes		
Medium Data Assessment Indicator based assessment (e.g. Rice et al) or SRA - e.g. MIST (Fu et al.) Ref Pt F based	Biology	Age and growth				
		Maturity				
		Stock structure				
	Fisheries	Catch				
		Effort				
		Length				
		Weight				
Data Poor Assessment, SPR or ERA- eg PSA (Kirby and Hobday) Or Risk indicator Risk H, M, L	PSA score	PSA1	PSA2	PSA3		Kirby and Hobday 2007. WCPFC-SC3-EB SWG/WP-1
	Deep Risk	MEDIUM	MEDIUM	MEDIUM		
	Shallow Risk	MEDIUM	MEDIUM	MEDIUM		

Annex 4 of the report

Summary of Species Assessment Decision Tree

Species	Species Code	Scientific Name	Stock	Last assessment, assessment type	Data Quality/assessment type possible	Proximate analysis if NOT assessed.
Silky shark	FAL	*Carcharhinus falciformis*	WCPO	2013 (Integrated)	Data rich	Analytic assessment, possibly Pacific wide
Blue Shark	BSH	*Prionace glauca*	Southwest Pacific North Pacific	2016 (Integrated) 2017 (Integrated)	Data rich Data rich	Analytic assessment Analytic assessment
Thresher Sharks						
Pelagic thresher	ALP	*Alopias pelagicus*	WCPO	Not Assessed	Data poor	Update PSA, Possibly estimate catch
Common thresher	ALV	*Alopias vulpinus*	WCPO	Not Assessed	Data poor	Update PSA, Possibly estimate catch
Bigeye thresher	BTH	*Alopias supercillious*	WCPO	2017 (MIST Analysis)	Data Medium	Update of the recent (MIST) analysis in 3-4 years
Oceanic Whitetip Shark	OCS	*Carcharhinus longimanus*	WCPO	2012 (Integrated Assessment)	Data Medium	Analytic assessment, possibly integrated
Porbeagle Shark	POR	*Lamna nasus*	Pacific-wide (southern hemisphere)	2017 (MIST analysis)	Data Medium	Update of the recent (MIST) analysis in 3-4 years

Silky Shark – SA-WP-08

Blue Shark – Analytic assessment

Pelagic and Common Thresher – update PSA, estimate catch

Bigeye Thresher – update MIST analysis

Oceanic Whitetip – analytic assessment

Porbeagle – update MIST analysis

Summary of Species Assessment Decision Tree, continued

Species	Species Code	Scientific Name	Stock	Last assessment, assessment type	Data Quality/assessment type possible	Proximate analysis if NOT assessed.
Mako Sharks						
Longfin mako	LMA	*Isurus paucus*	WCPO	Not Assessed	Data poor	Update PSA, Possibly estimate catch
Shortfin mako	SMA	*Isurus oxyrinchus*	North Pacific	2015 (Indicator Analysis)	Medium data	Estimate Catch, develop indices of abundance
			Southwest Pacific	Not assessed	Medium data	Estimate Catch, develop indices of abundance
Hammerhead Sharks						
Great hammerhead	SPK	*Sphyrna mokarran*	WCPO	Not Assessed	Data poor	Update PSA, Possibly estimate catch
Scalloped hammerhead	SPL	*Sphyrna lewini*	WCPO	Not Assessed	Data poor	Update PSA, Possibly estimate catch
Smooth hammerhead	SPZ	*Sphyrna zygaena*	WCPO	Not Assessed	Data poor	Update PSA, Possibly estimate catch
Winghead shark	EUS	*Eusphyra blochii*	WCPO	Not Assessed	Data poor	Update PSA, Possibly estimate catch
Whale shark	RHN	*Rhincodon typus*	WCPO/Pacific-wide	Not Assessed	Data poor	Update PSA, characterize PS interactions. Stock structure research.
Manta and Mobulid Rays	MOB	*Mobulidae*	WPCO	Not Assessed	Data poor	Update PSA, Gather more data

Mako & Hammerhead - Estimate Catch, develop indices of abundance, update PSA (note SA-WP-11 SMA in N. Pacific)

Whale Shark – characterize interactions and stock structure (note SA-WP-12)

Manta and Mobulid Rays- Update PSA, gather more data

Summary TOR #1 findings

- *Data quality has been increasing over time*
- *Logbook data (PS & LL) has been increasing spatial coverage and higher levels of reporting to species.*
- *However many species (i.e. mako, hammerhead, thresher, manta and Mobula rays) are still reported at the generic species level*
- *There are substantial historic logbook data that SPC does not hold and may have been useful for this study, noting that historic operational logbook data may be subject to similar non reporting of sharks that is in the available data.*

Summary TOR #2 Findings

- *The current data gaps include*
  - *Catch Rate*
  - *Total catch data,*
  - *Low observer coverage in the longline fishery,*
  - *Lack of reporting to species and misidentification of species*
- *These gaps imply uncertainty with respect to fishery impacts on the population and the overall trajectory of the stock.*
- *Stock status determinations based on uncertain or largely extrapolated data are less reliable (due consideration of uncertainty is necessary, i.e. structural uncertainty grid).*

Summary TOR #3 findings

- *The major data gaps can be filled by:*
  - *Expanding observer coverage (especially for LL vessels, to reach 5% by hooks)*
  - *Structuring observer programs so that they match the spatial / temporal distribution of fishing effort*
  - *Observers to receive further identification training for species commonly identified to the generic level only*
  - *For logbooks to report sharks to species level where these sharks are WCPFC key shark species.*
- *Include a universal unique ID number for logbook or observer so that direct comparison of observer and logbook data on a set by set basis can be made.*

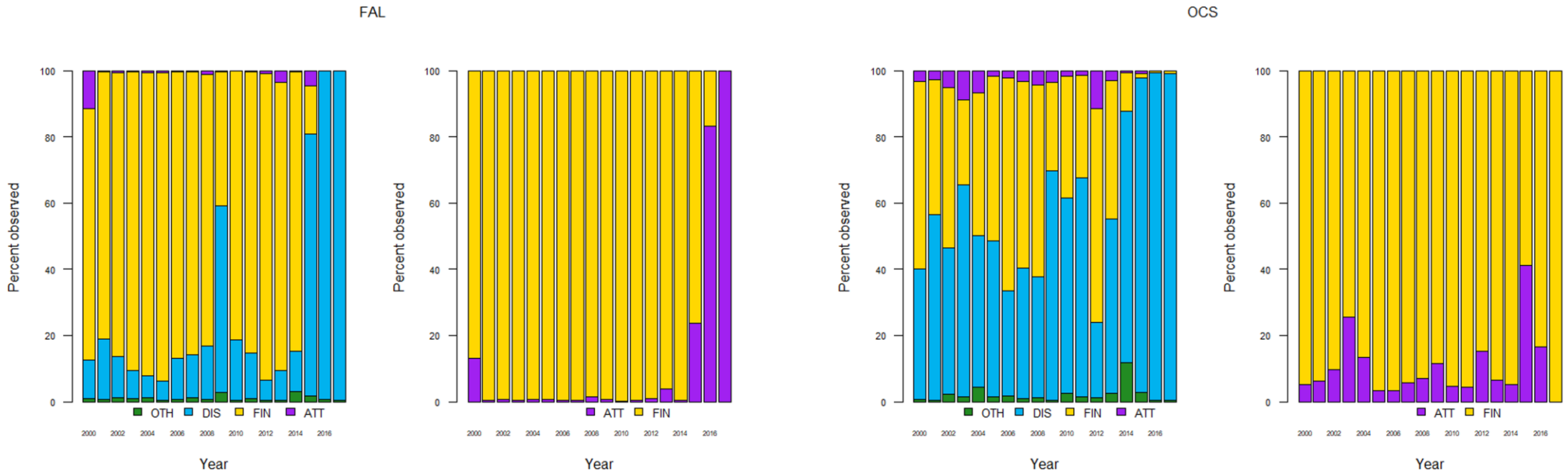
Summary TOR #4

- *In practice, the choice of estimation methodology is often dictated by the data that are available.*
- *Given the data currently available methods that relate species specific catch rates by fleet, area and time to the overall effort appear to make the best use of the available data.*
- *Model-based methods that can account for gaps in the operational or observer data are appropriate for species with low catch rates.*
  - *Catch rates should be based on survey or observer data from fisheries similar to the main fisheries.*
  - *Ideally alternative catch histories should be developed using different methodologies and sources of data.*
  - *At a minimum, estimates of catch should be carried out based on a standardized CPUE (from observer data that is proportioned by fleet, area and target species catch) raised to total effort that is stratified by the same factors as the CPUE.*

Summary TOR #5

- *There has been an **increase in logsheet reporting of sharks to species** part attributable to impact of CMM 2010-07, species specific reporting also increased in the 2000's relative to the 1990s.*
- *The impact of the non-retention CMMs (CMM 2011-04 and 2013-08) has been **a decrease of reporting in the purse seine fishery for the years 2014 and 2015** despite observed catch rates that are similar to the years 2012-2013.*
- *CMM 2014-05 entered into force on July 1st 2015 and as such there is **not enough data to quantify the effect of the bycatch mitigation** via the implementation of this CMM (either no wire trace use or no shark line use).*
- *Reporting of silky shark and oceanic whitetip in the longline fishery occurred in 2014 and 2015 at a similar rate to 2013, indicating that the CMM is not adopted over the entire fleet.**
- *As the CMMs that specify non-retention for oceanic whitetip and silky shark continue to be implemented **the importance of the observer data in both purse seine and longline fisheries will increase.***

Recent Impact of Shark Related CMMs



Recent observer data show high levels of discards, indicating that CMM 2011-04 and 2013-08 are being adopted (at least in the observed fleet).

Overall Recommendations

- *Additional identification training to improve the provision of shark interaction information to the species level.*
- *The largest gap in the data is within the longline fishery. The key mechanism to address the current data gaps would be an increase in observer coverage to at least **5% by hooks***
- *Reporting of logbook and observer data be done in such a way that direct comparison of observer and logbook data on a set by set basis can be made.*
- *A final general recommendation is that a PSA be completed for just the sharks and rays commonly found in the WCPO to help prioritize and inform future research efforts.*

Thank You

Questions or Comments?