

Stock assessments (and harvest strategy stuff)

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Workshop: Identifying the spatial stock structure of tropical Pacific tuna stocks
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BACKGROUND



- Aims of stock assessment
- Considerations of spatial scale and structure in WCPO stock assessments
 - Impact on assessment results
- Harvest strategies and MSE in the WCPFC

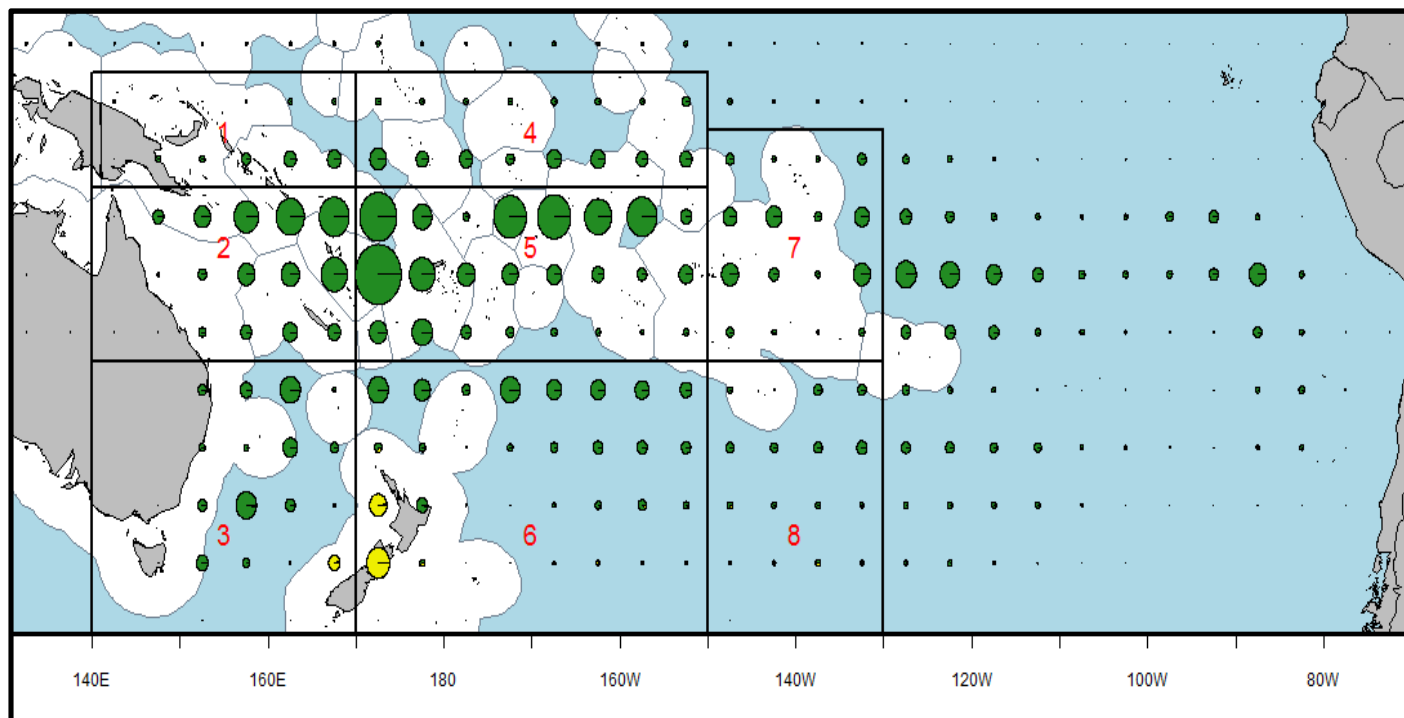
A(nother) definition of a “stock”

“A unit stock is an arbitrary collection [of a single species] of fish that is large enough to be essentially self reproducing (abundance changes are not dominated by immigration and emigration) with members of the collection showing similar patterns of growth, migration and dispersal.”

Hilborn and Walters (1992)

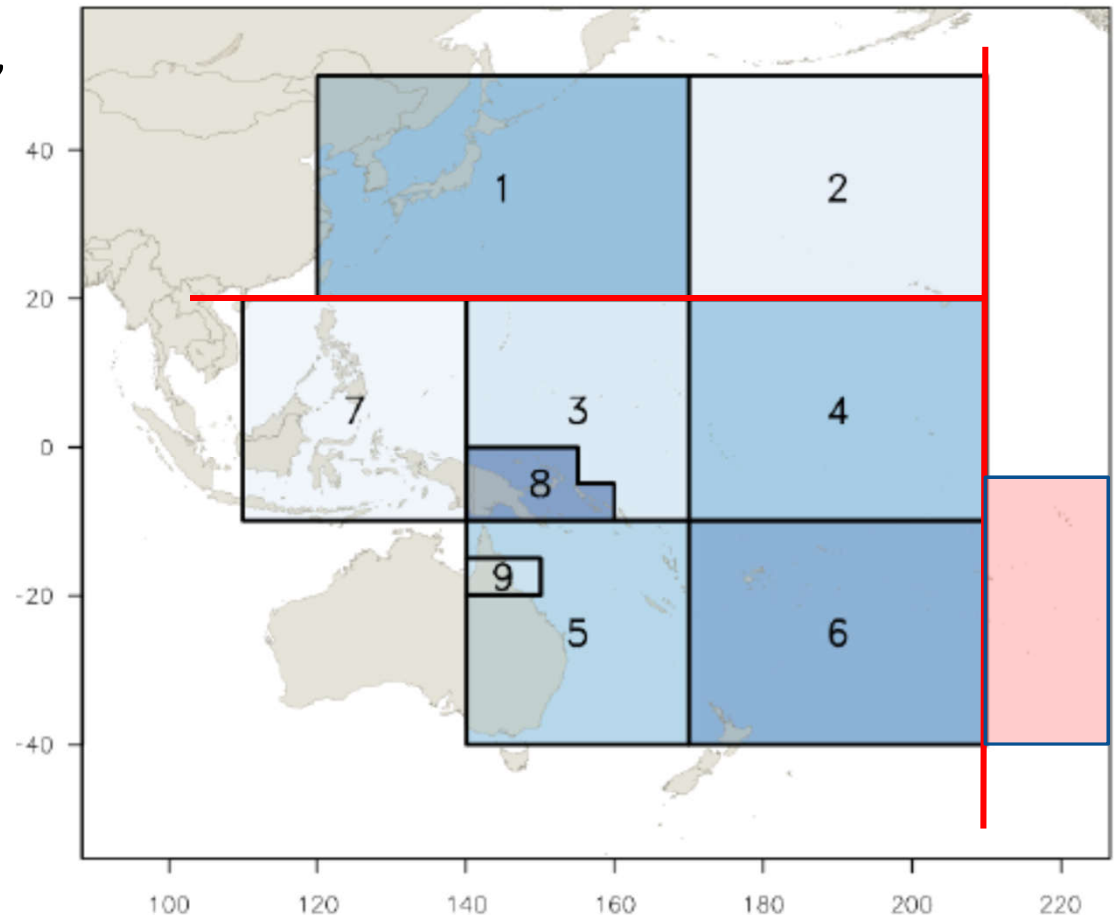
AIMS OF STOCK ASSESSMENT

- Scientific advice on stock status relative to reference points
- Provide information at the scale relevant for management actions
 - Relevant fisheries included
- In practice, 'stock' influenced by the management area and fisheries, not necessarily just biology
 - E.g. SP albacore (almost tropical!)

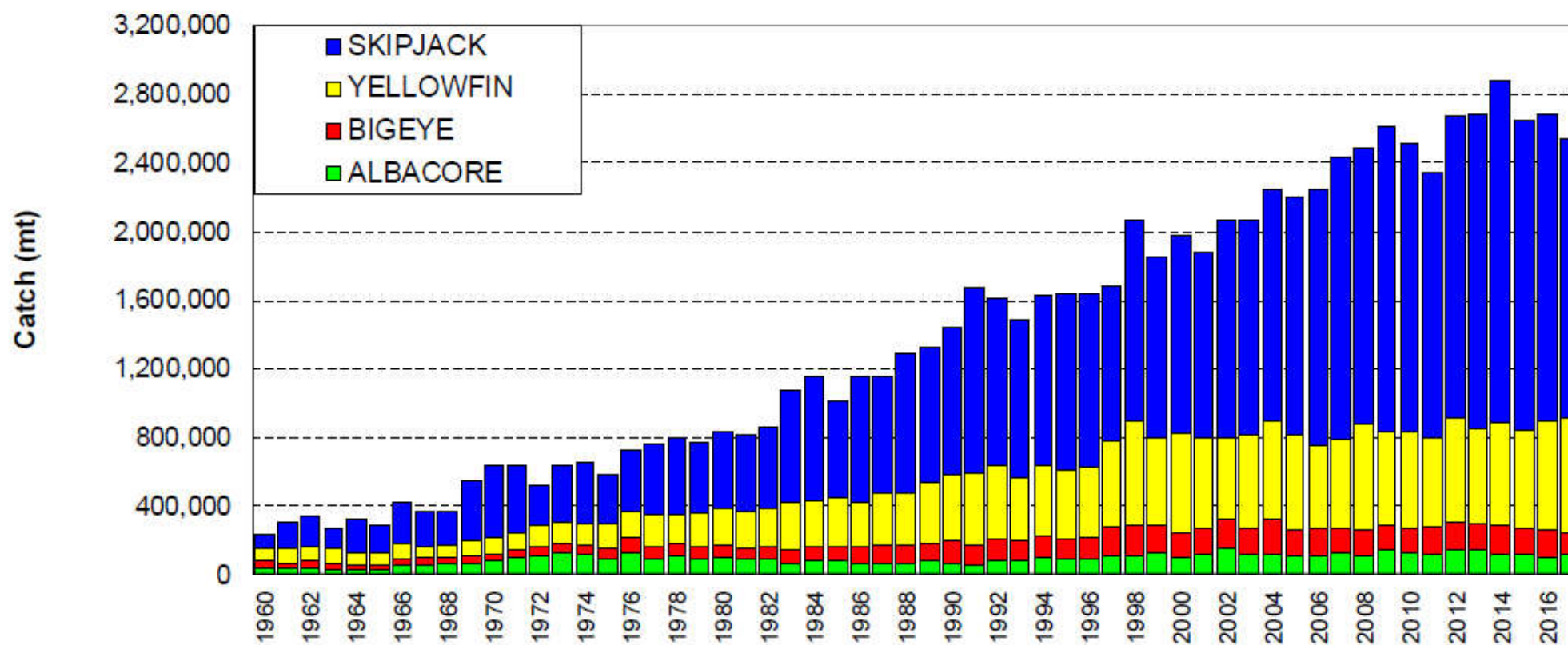


WCPFC APPROACH

- Software: MULTIFAN-CL
 - Spatially- and age-structured size-based assessment
- Usage: 'key' WCPO tuna stocks, billfish, ~sharks
- Optimised for WCPO tuna situation
 - In particular tagging data
- Time step generally quarterly
- Multiple fisheries/regions
- Spatial structure is stock-specific
 - Noting bio-economic analyses

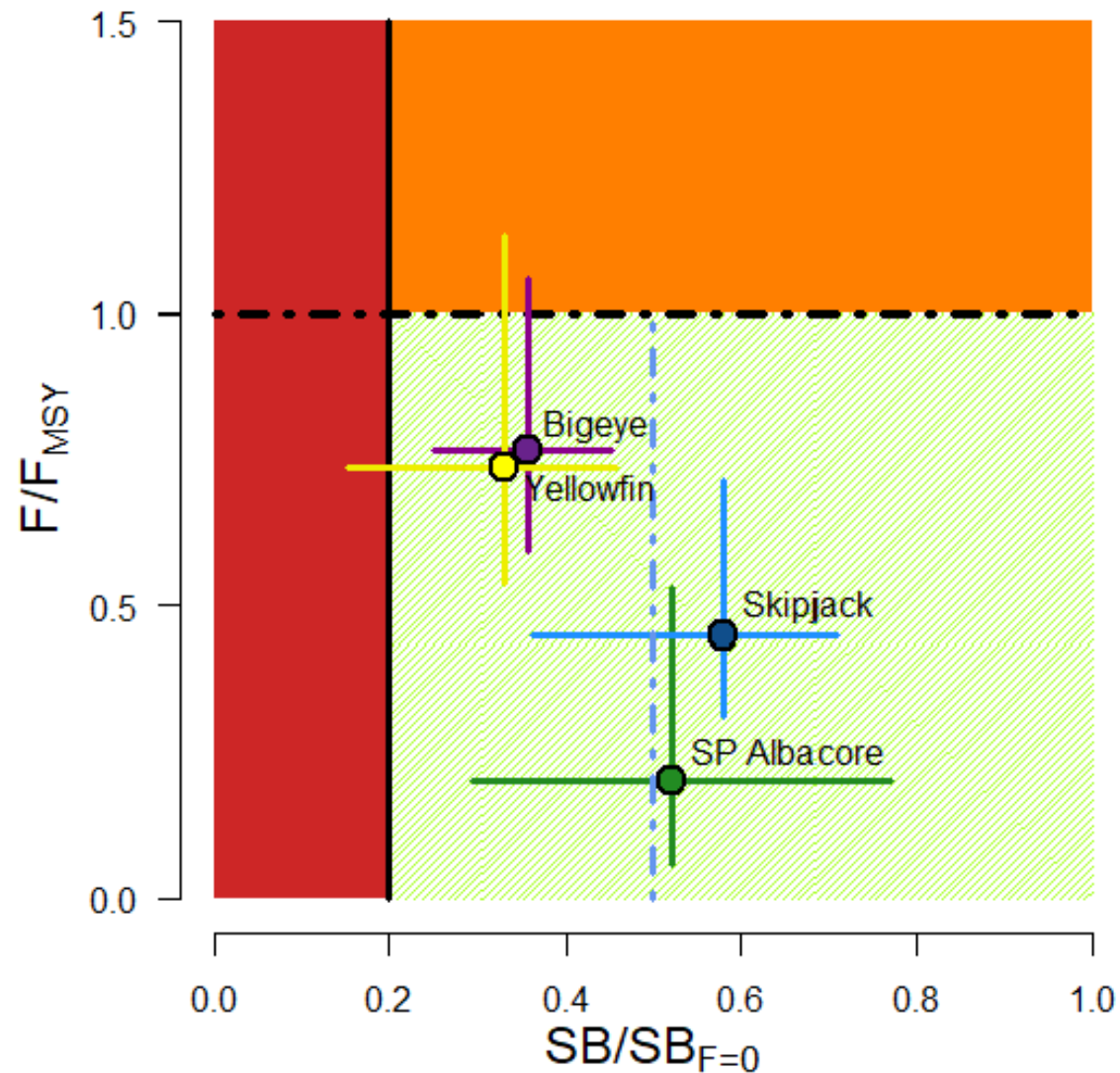


CURRENT STATUS OF STOCKS



- WCP-CA catch history by spp
- 2017 provisional total: 2,539,950 mt

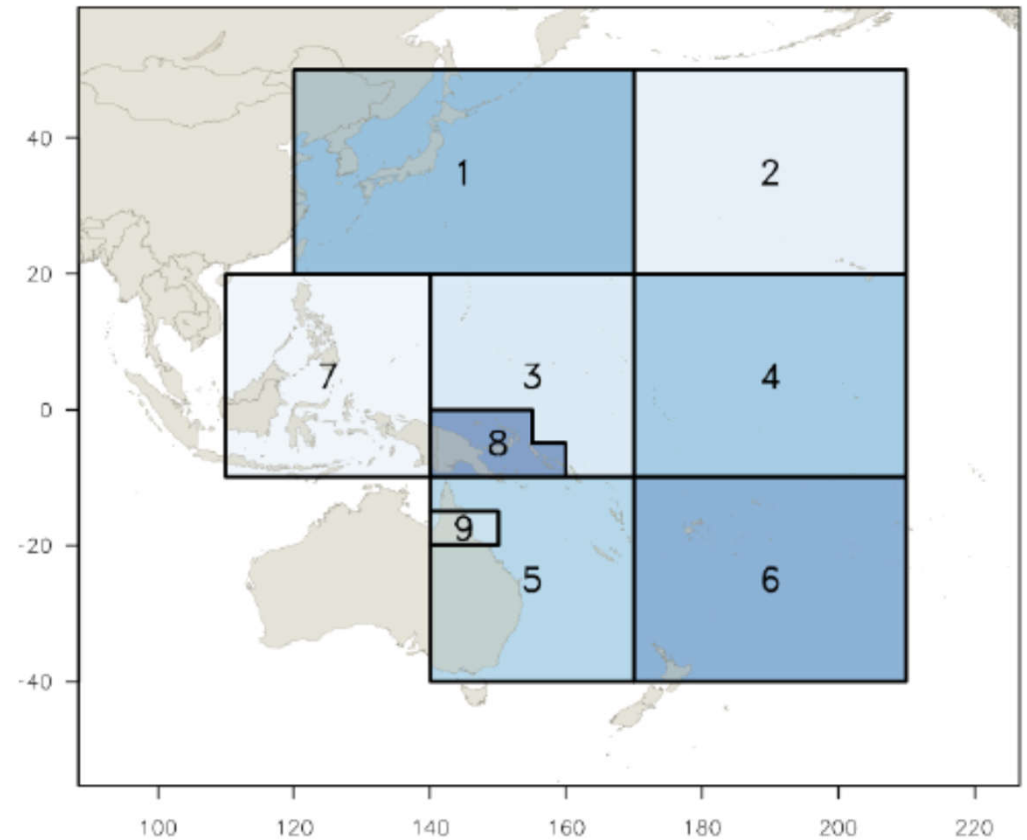
CURRENT STATUS OF STOCKS



- All 4 'key' tuna stocks 'in the green' of the Majuro plot
- On average, NOT overfished, overfishing NOT occurring

ASSUMPTIONS

- Population dynamics of the ‘stock’ are consistent(-ish)
- Recruitment related to overall ‘stock’ (sub-divided by region... moving toward spatially-explicit approaches)
- Movement occurs – spatially-structured models
 - Estimated seasonal movement ‘fixed’



WHAT INFLUENCES SPATIAL STRUCTURE?

- Fisheries
 - Selectivity of gears consistent in a region
- Biology
 - Movement - Tagging information – ‘000s fish tagged over time
 - Growth (not yet modelling spatially)
 - Size structure

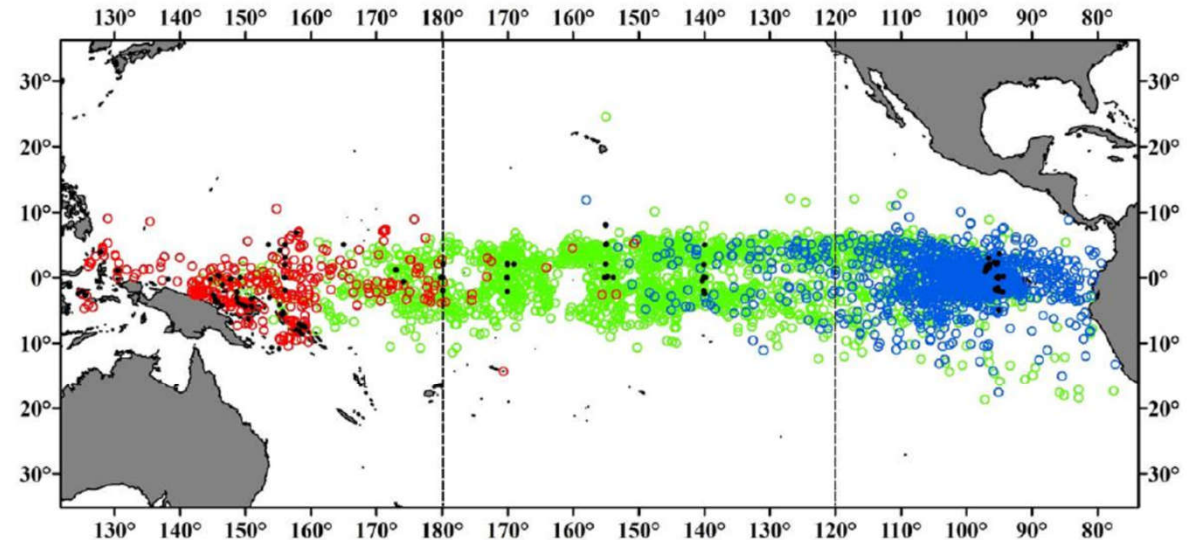
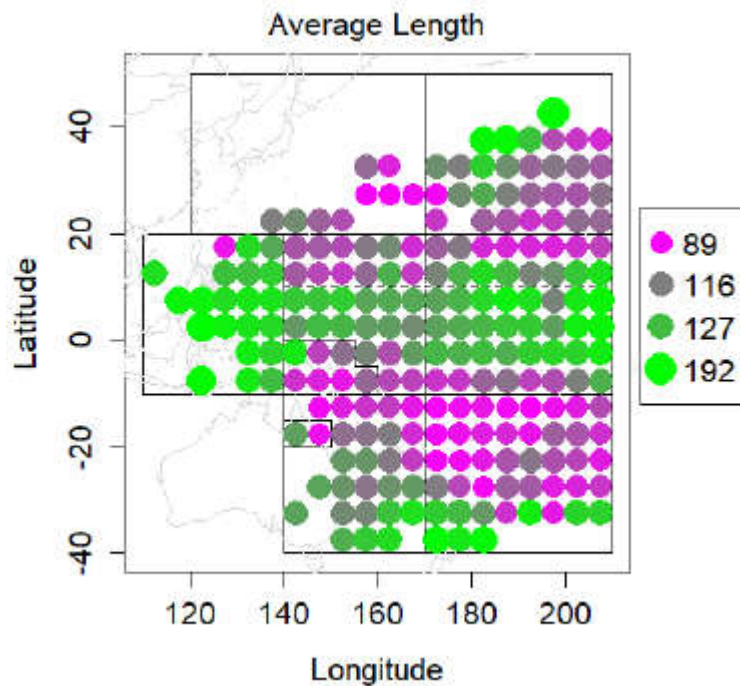
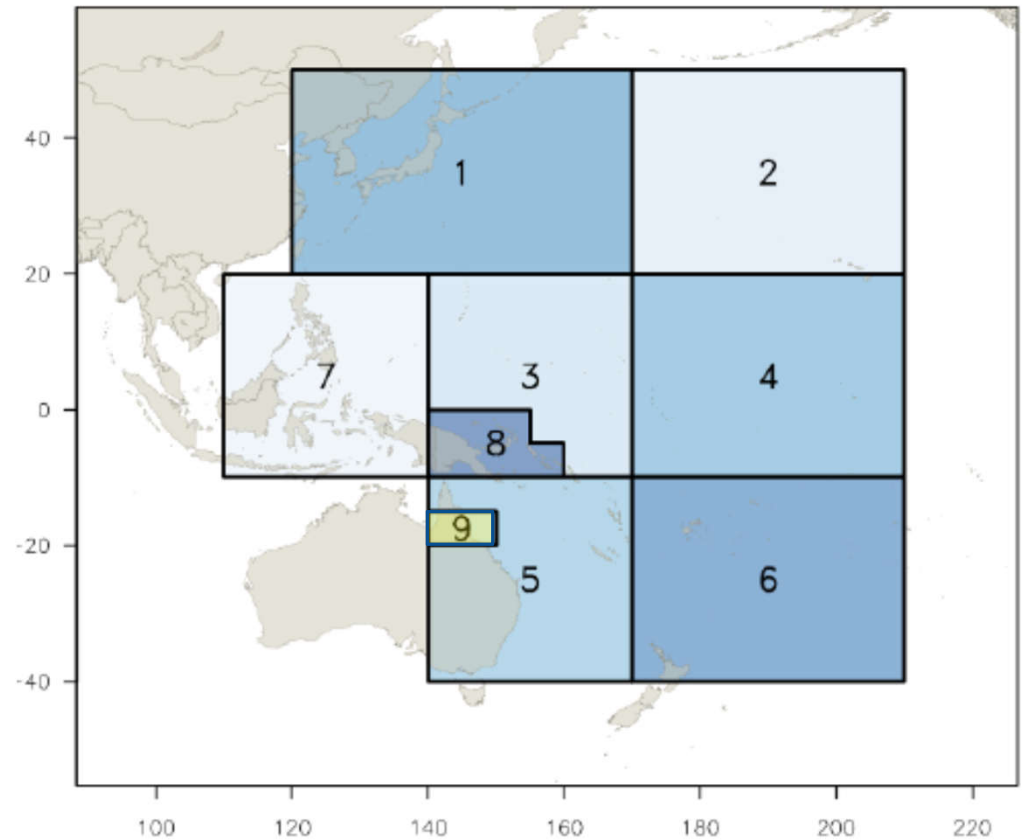


Figure 11: Map of the movements of tagged bigeye released in the Pacific Ocean and subsequently recaptured. The figure is sourced from Schaefer et al. (2015), and shows the three regions they split their data by. The small black points are the release locations, the red points are the recapture locations of fish released in the western region, the green points are the recapture locations of fish released in the central region and the blue points are the recapture locations of fish released in the eastern region.

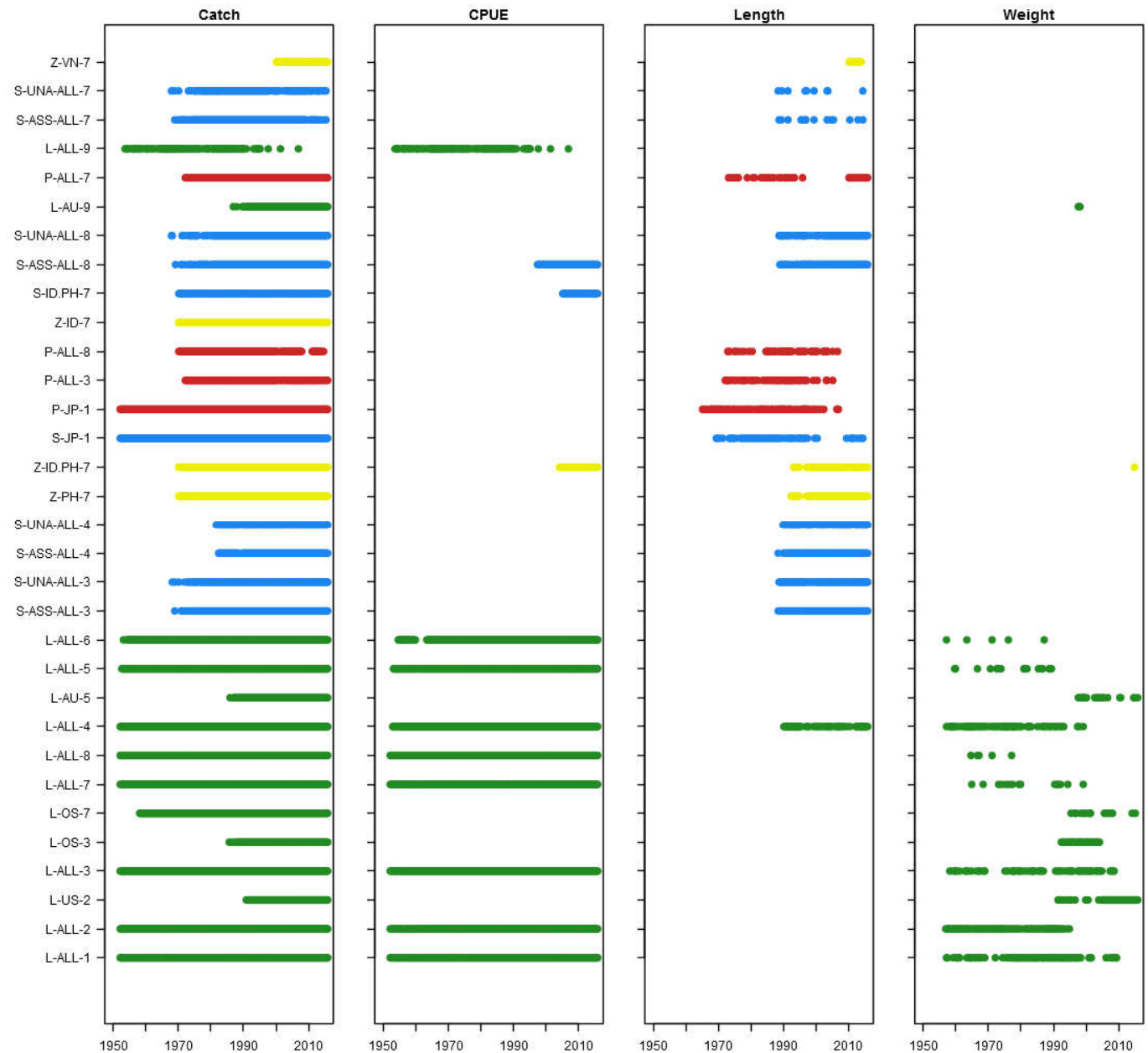
WHAT INFLUENCES SPATIAL STRUCTURE?

- Fisheries
 - Selectivity of gears consistent in a region
- Biology
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 - Growth (not yet modelling spatially)
 - Size structure
- Model functionality
 - E.g. Region 9 for tag mixing
- Pragmatism
 - More complex models = longer to fit



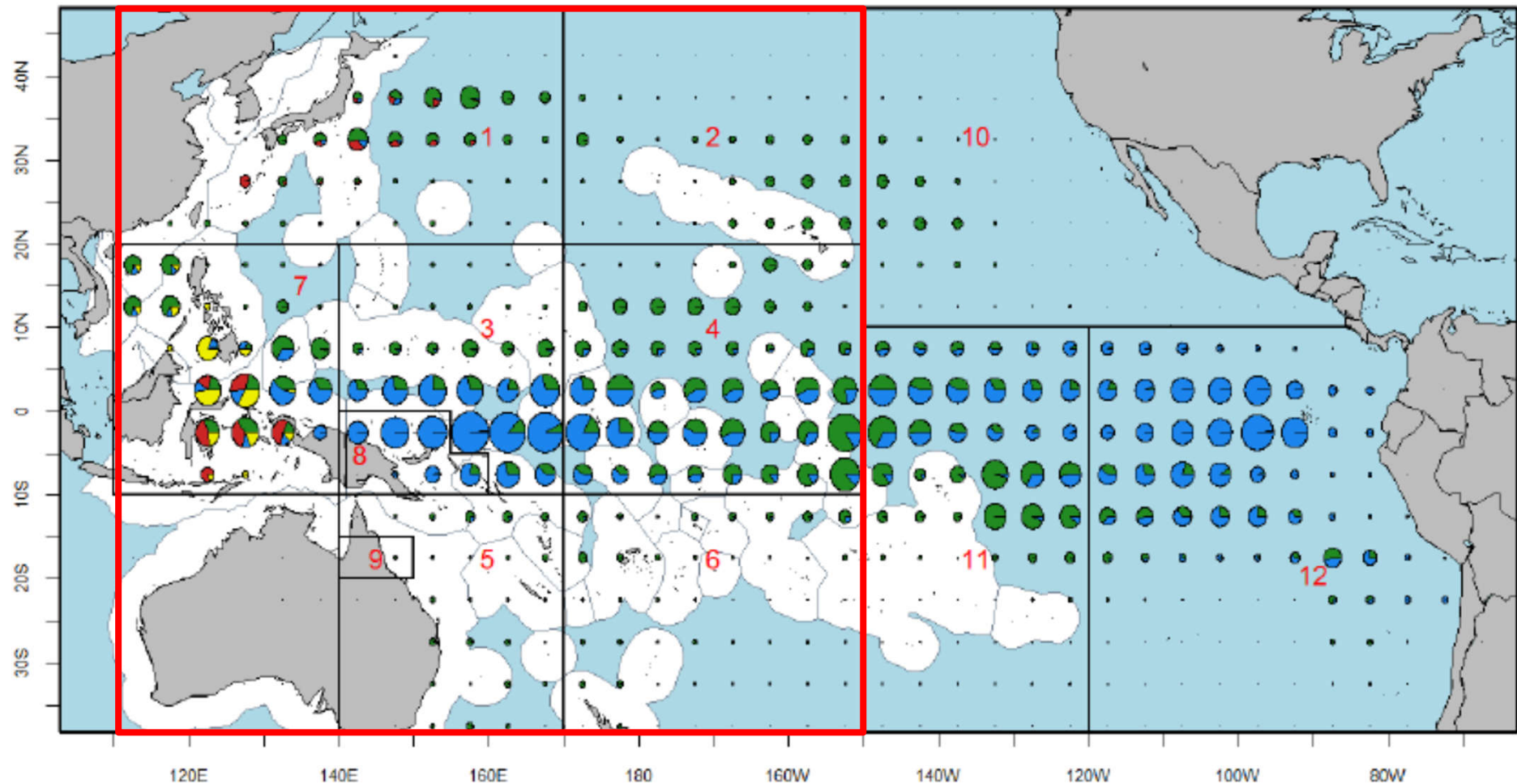
OTHER FACTORS: DATA AVAILABILITY

- Temporally
- Spatially
 - E.g. 5° by 5°



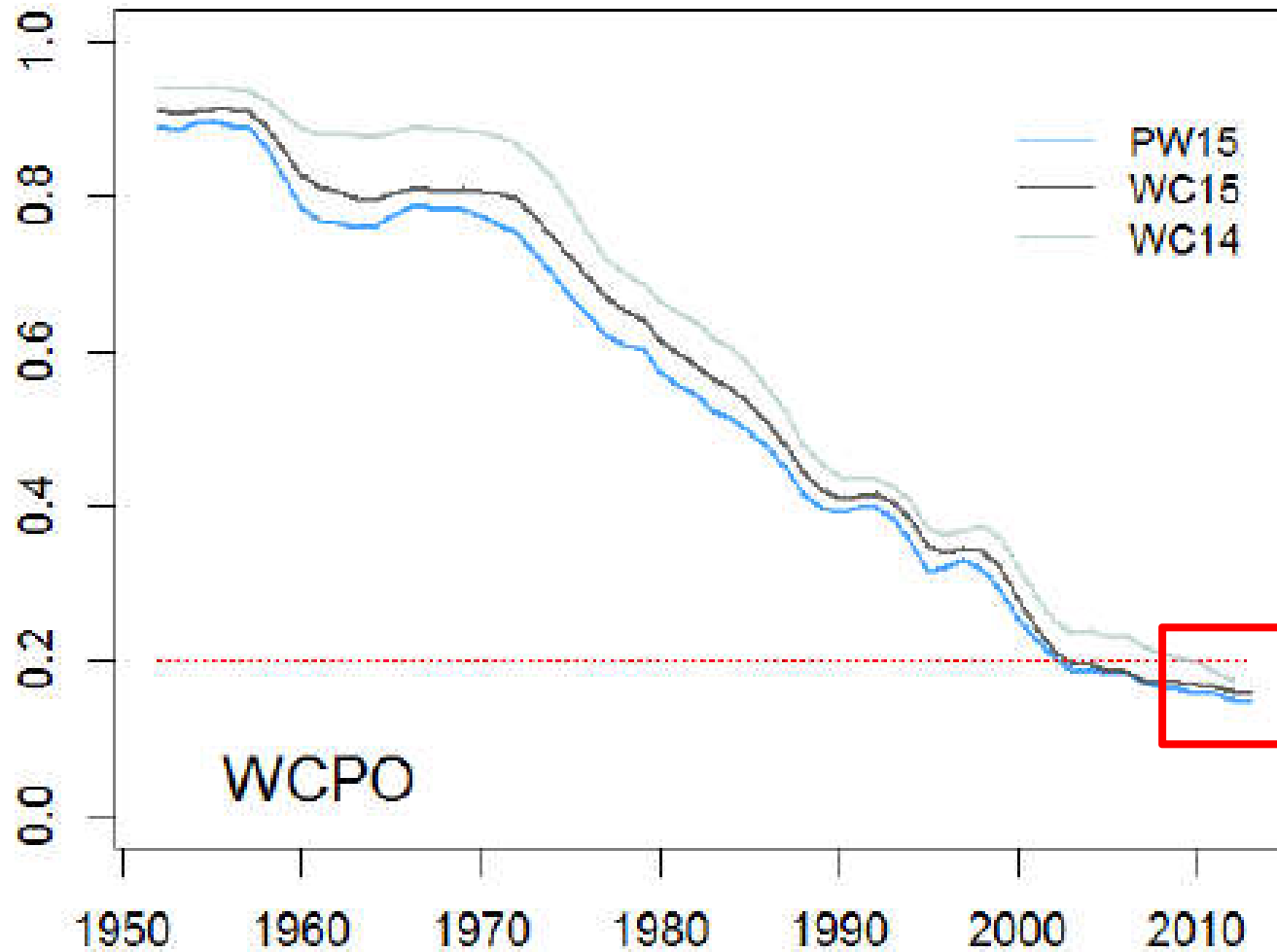
ALTERNATIVE WCPO SPATIAL STRUCTURES - BET

- Pacific-wide BET assessment (2015)
- Assumption that growth consistent across Pacific



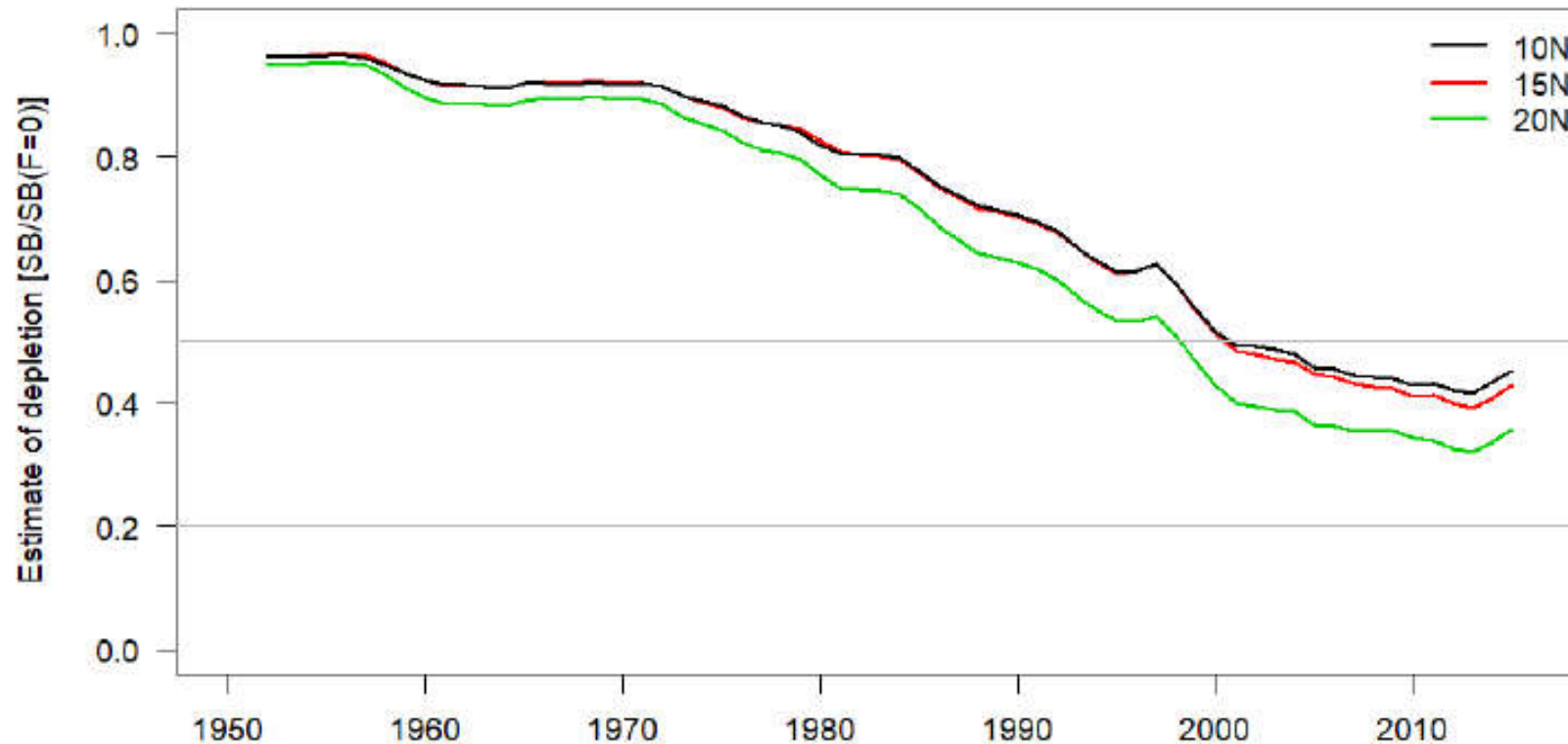
ALTERNATIVE WCPO SPATIAL STRUCTURES - BET

- Pacific-wide BET assessment (2015) – pretty robust for WCPO advice

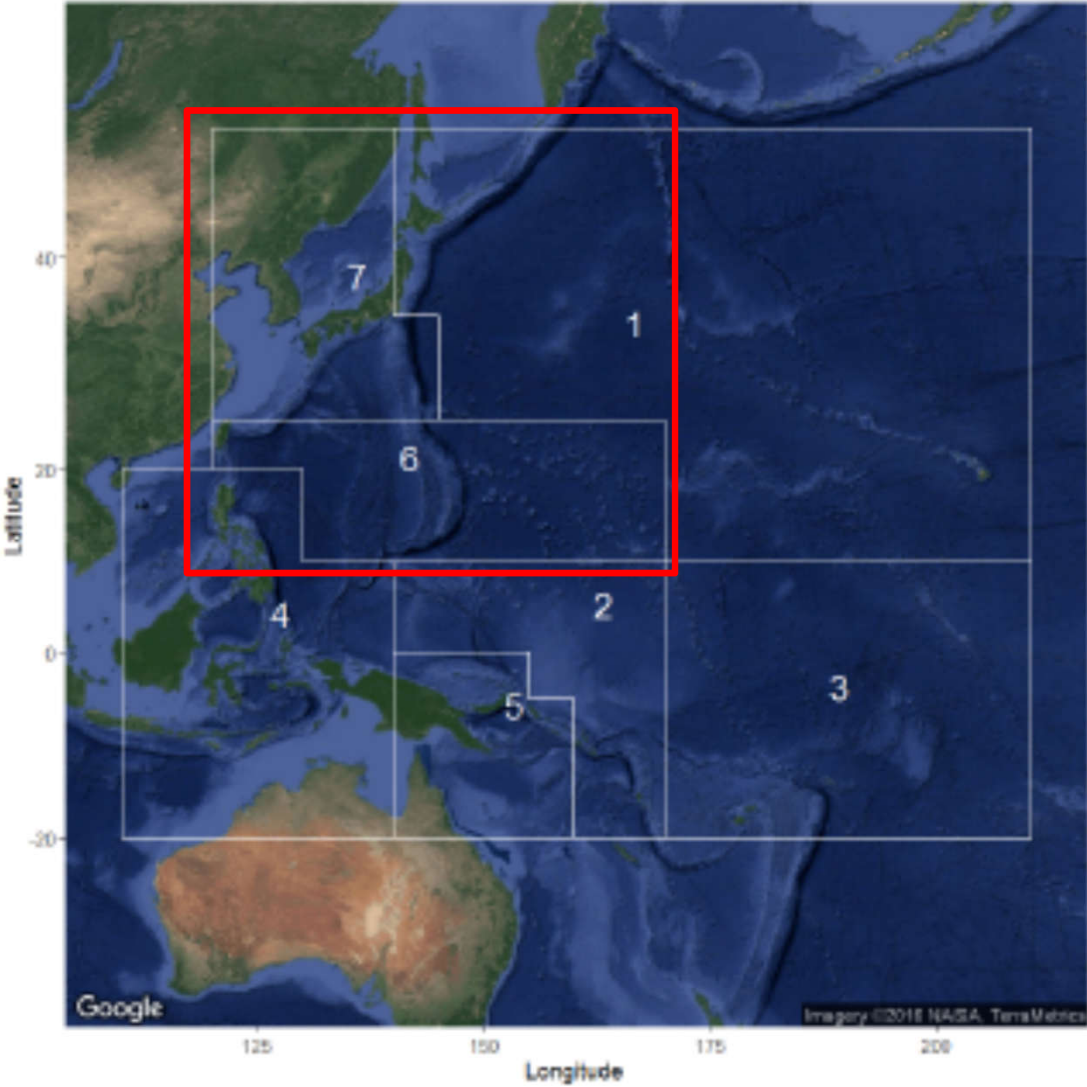


EVOLUTION OF WCPO SPATIAL STRUCTURES - BET

- Location of northern 'tropical' boundary (2017) – greater influence?
 - Not look at all combinations...

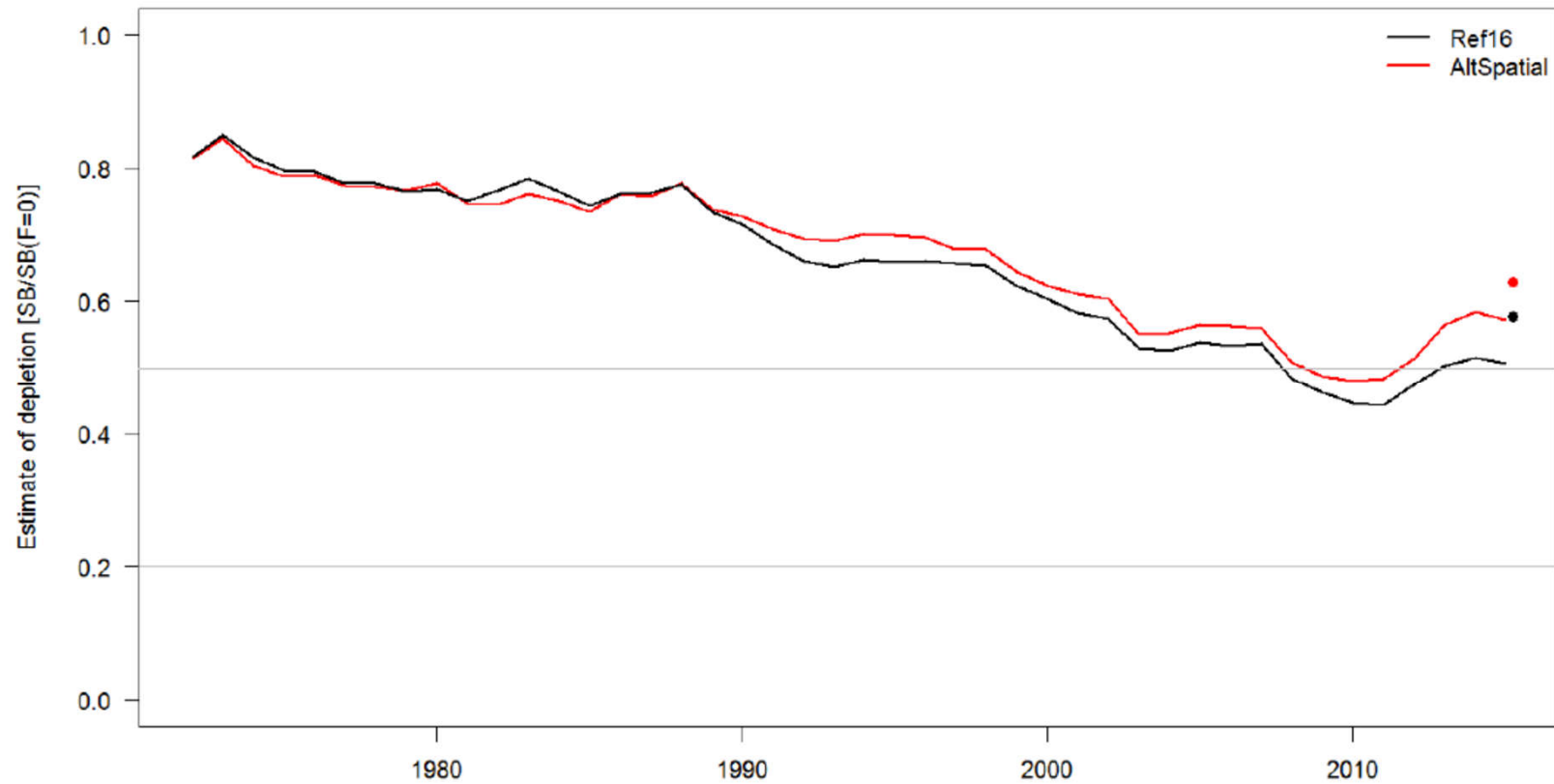


TESTING... SKIPJACK



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- Reasonably robust – stock at a level where impact minimal



HARVEST STRATEGIES AND THE WCPO



- Longer-term view in management decision making
- Pre-agreed management actions based upon stock assessment results defined through 'harvest control rules'
- Simulation tested before implementation using 'management strategy evaluation' (MSE)
- Looking at the 'future', not the historical (assessment) period

MSE

- Allows the robustness of harvest strategies to be tested against key uncertainties
 - Include the stock structure, reproductive patterns, connectivity, etc.
 - Is the proposed mgmt. system going to fail if our assumptions are wrong??
 - Overexploitation of less productive sub-populations?
- Can the workshop raise scenarios for testing?
 - Or the best approach to develop them?

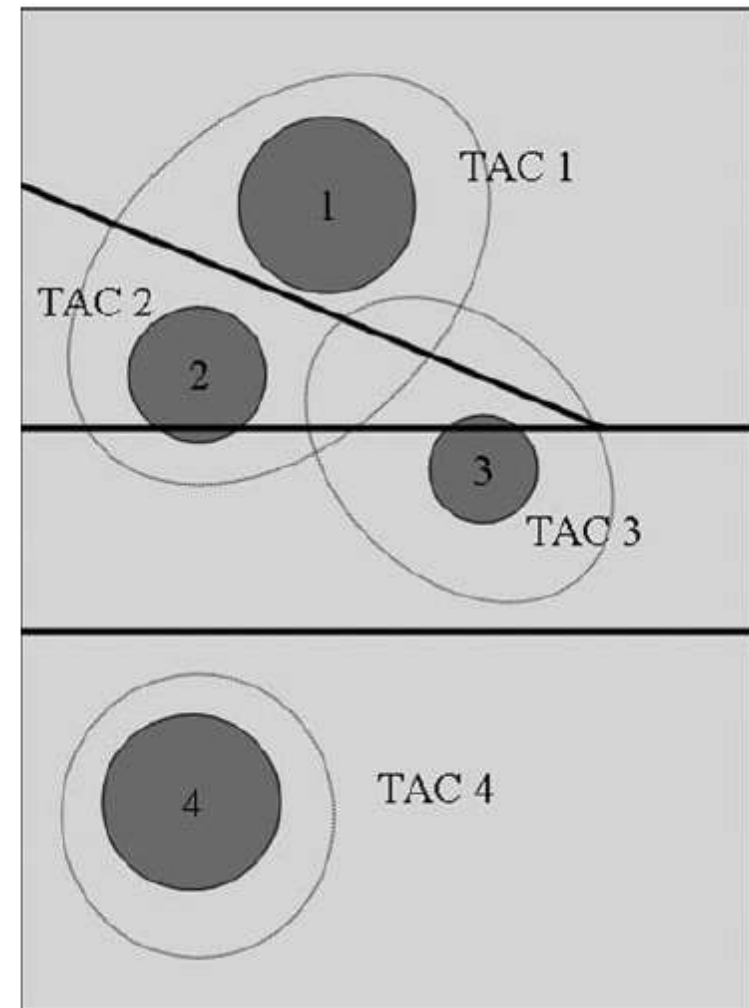


Figure 2. Diagrammatic representation of the mixing hypotheses (dark grey circles, spawning aggregations of the four “populations”; dotted circles, their distribution area during the feeding season; straight lines, the borders of the assessment/management units or “stocks”).

FURTHER MULTIFAN-CL DEVELOPMENTS

- Further development of existing assessment and MSE capability
 - Region-specific (local) SRR dynamics, then mixing
 - Spawning site fidelity?
 - ‘Stock’-based growth characteristics
 - E.g. population/genetic, less environmental drivers of stock characteristics
- Non-stationarity in biological characteristics



SUMMARY

- Do we need perfection?
- Assessment results and advice need to be robust to the uncertainties
 - Improvement of assessment structure
 - Improvement of biological/connectivity assumptions
- Moving toward HS – robustness of management system
- Improved scientific basis for stock structure v. important
 - Better advice
 - Scenarios for MSE testing – within the constraints of spatial data precision, MULTIFAN-CL functionality, etc. etc.