WORKSHOP TO IMPROVE THE LONGLINE INDICES OF ABUNDANCE OF BIGEYE AND YELLOWFIN TUNAS IN THE EASTERN PACIFIC OCEAN

La Jolla, February 11- 15 2019

Collaborative work in IOTC and ICCAT, and lessons learnt

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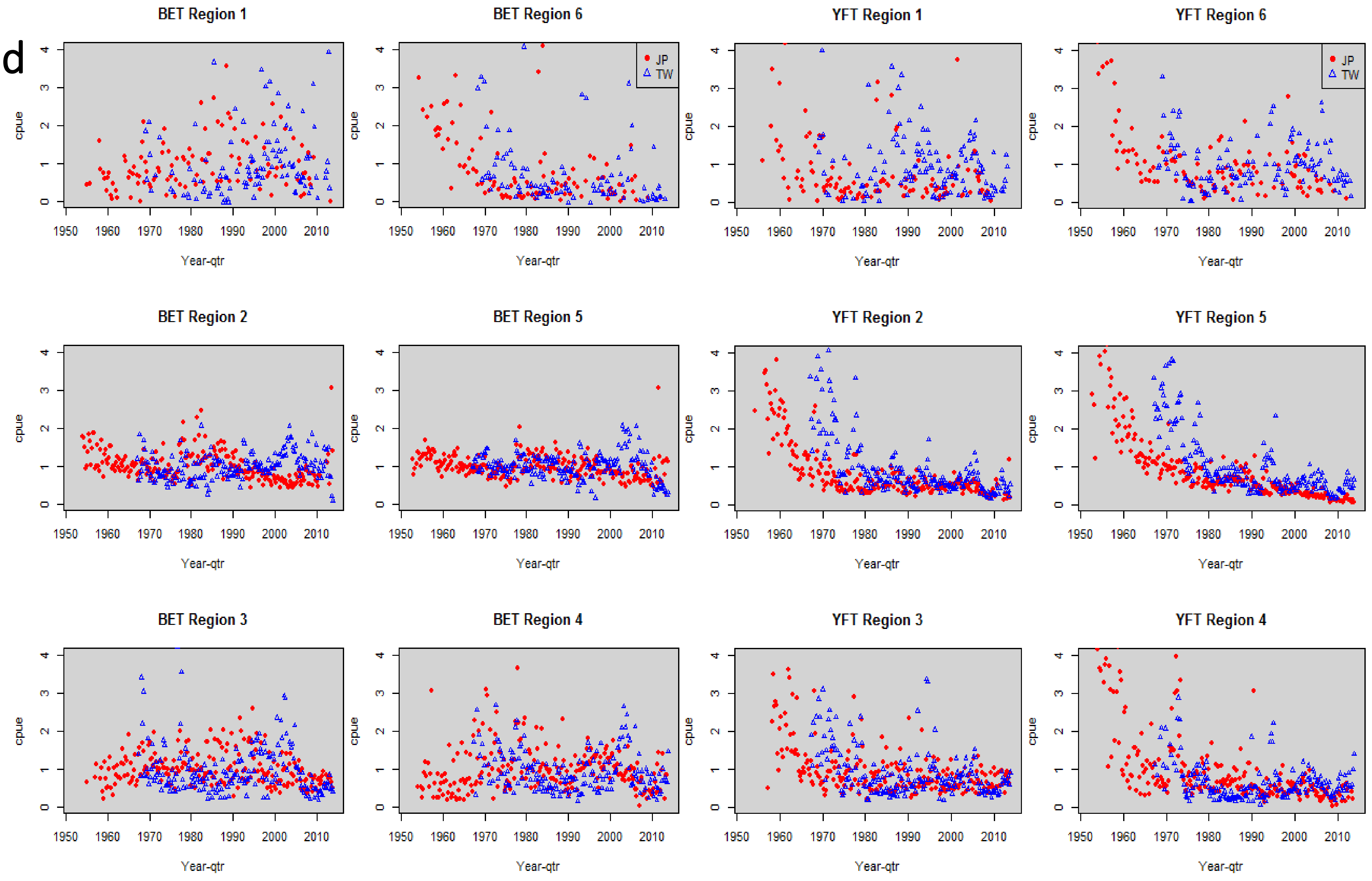
Introduction

- Experiences analysing operational DWFN tuna data
  - 2008-2012: US provided data collected at Pago Pago canneries. Joint analyses of ALB CPUE for JP, KR, TW, with cluster analysis for targeting.
  - 2009: SPC-held operational data submitted by fleets fishing in Pacific EEZs. JP CPUE for BET & YFT.
  - From 2010: Japan permitted analyses of their operational data for WPCO BET & YFT indices.
  - From 2015: Japan, Korea and Taiwan provided access to Indian Ocean data for collaborative BET, YFT and ALB CPUE. Seychelles joined in 2016.
  - From 2018: JP, KR, TW and US provided access to Atlantic Ocean data.

Background

Compare fleets 1



Analysis process

Load

Load data
- Import, clean, & create variables

Characterise

Characterise data
- Plot and summarize to identify unique characteristics of datasets, and any issues that should be addressed

Cluster

Cluster analysis, to separate fisheries by targeting strategy

Standardize

Standardize data, individually and jointly

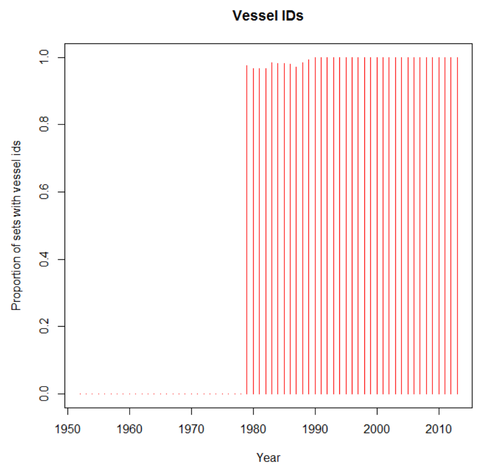
1. Loading data

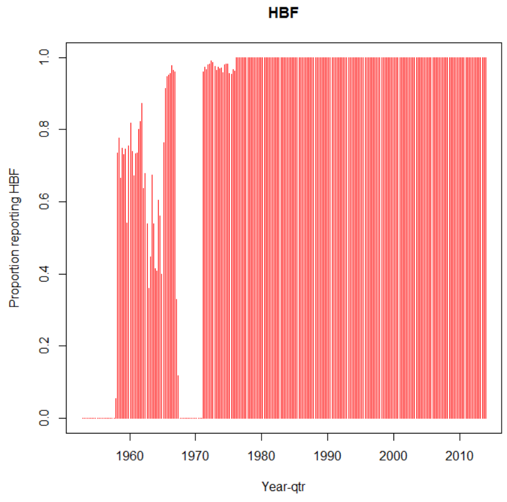
- Seems simple, right?
- But, very time-limited process, with multiple datasets.
  - Only have data access during the meeting, e.g. as little as 5 days for one person to load and analyse 4 datasets.
- Data formats sometimes (often) change from year to year, costing hours or days each time.
- Lesson:
  - National scientists must provide data in the same format every year!
  - National scientists should prepare, characterize, cluster and standardize their own data.

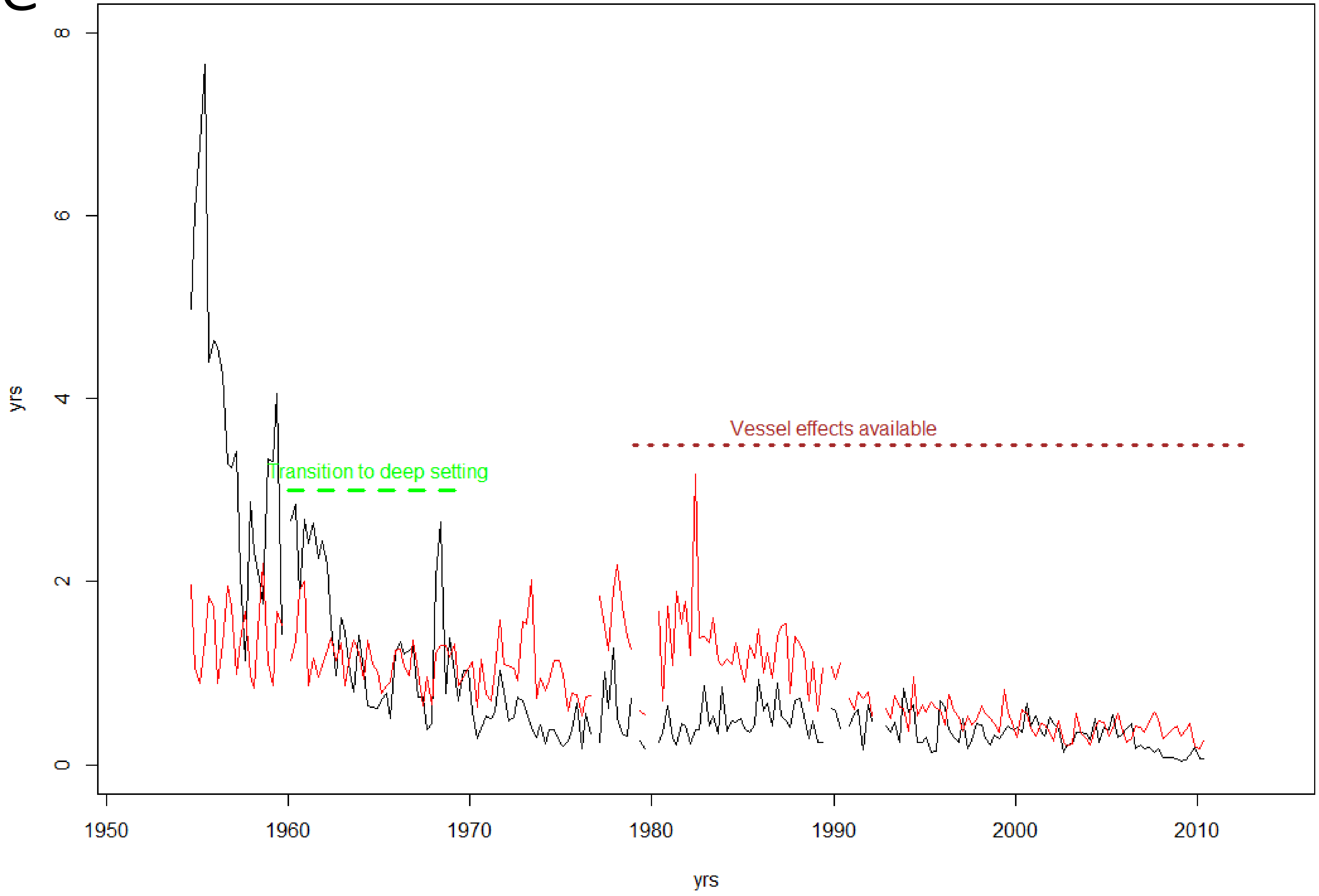
2. Data characterisation

- Lesson: Understanding the data and fisheries is more important than improving the standardization methods.
    - Characterization is a vitally important part of the process.
    - Share that understanding by providing detailed results in public documents for future reference.
        - IOTC-2015-WPTT17-INF07, IOTC-2015-WPTT17-INF08, and IOTC-2015-WPTT17-INF09
- Key changes in Indian Ocean data.
    - JP 1952 - present. Vessel ids start in 1979. Sparse data before 1955 and since 2010.
        - Project currently under way to provide vessel ids before 1979.
        - Albacore targeting increasingly important in recent years – re SBT quotas?
    - TW 1979 – present. HBF since 1995. Low coverage before 2000. Data problems 2003-05.
        - ‘Other’ fishery (oilfish) in south since 2005. Important for all TW indices in southern Indian Ocean.
    - KR 1978 – present. HBF & vessel id throughout. Data sparse, mostly SBT fishery.
    - Somali piracy excluded effort

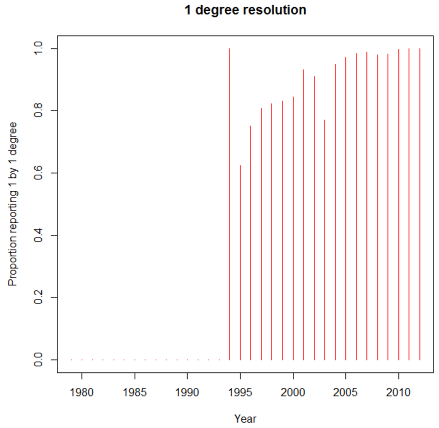
Japanese time series

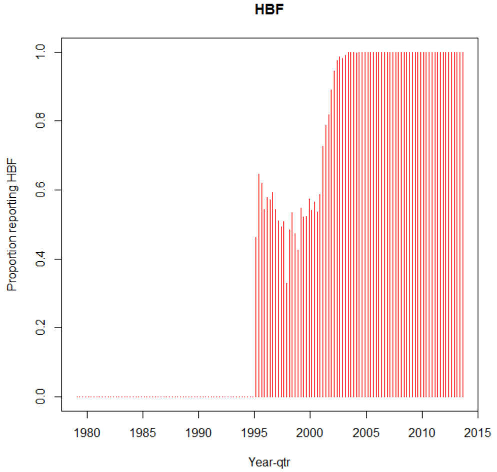


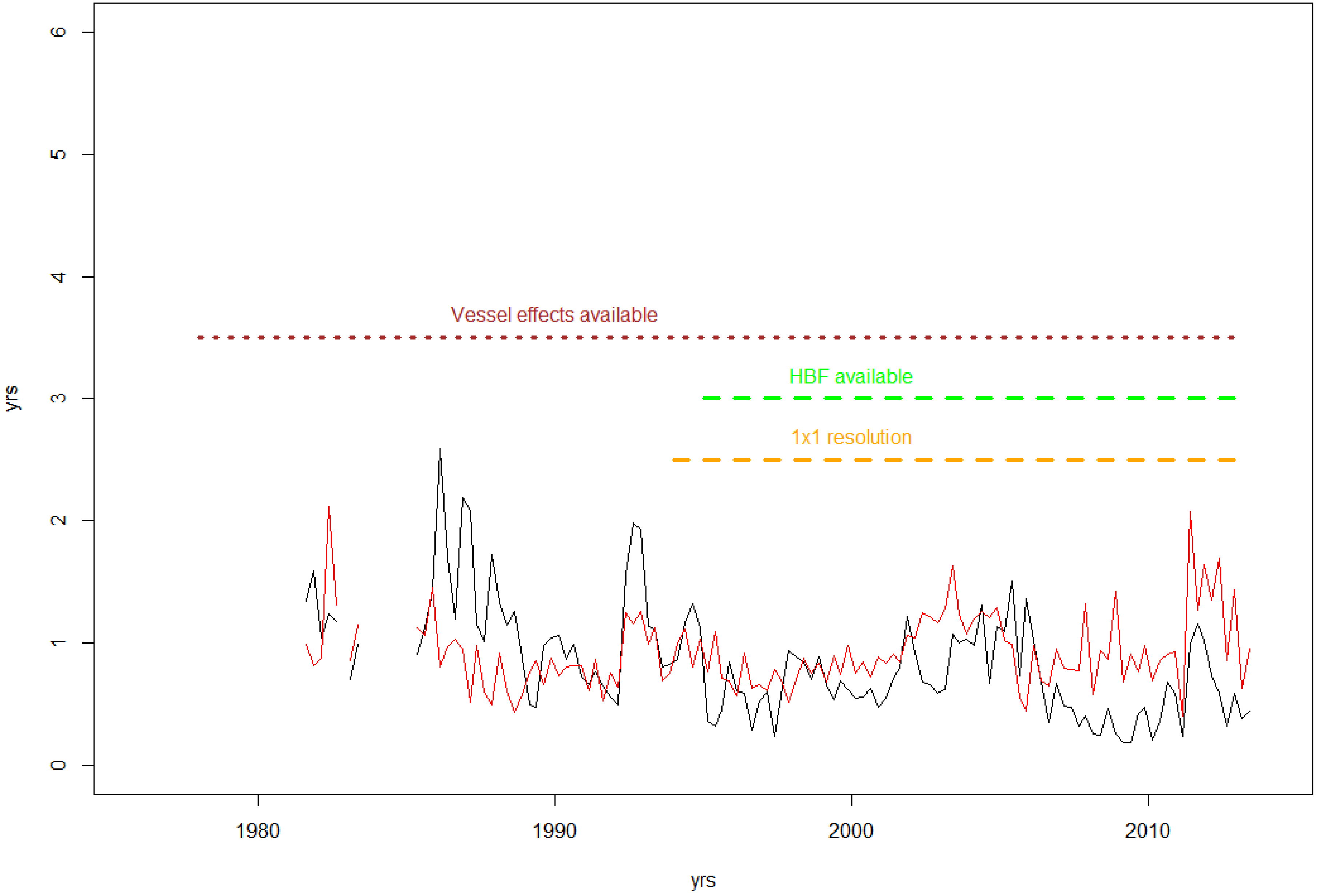




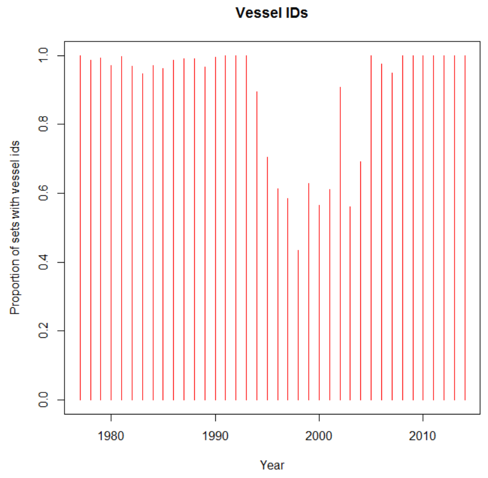
Taiwanese time series

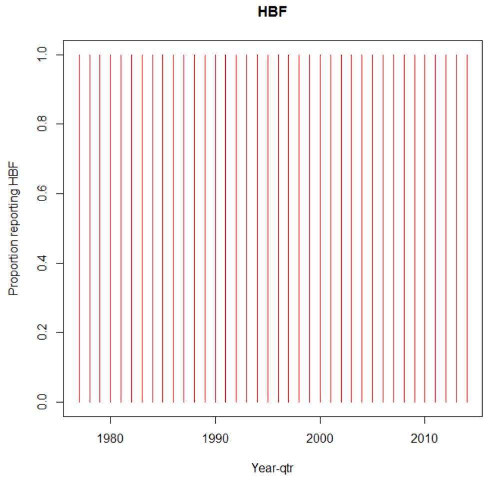


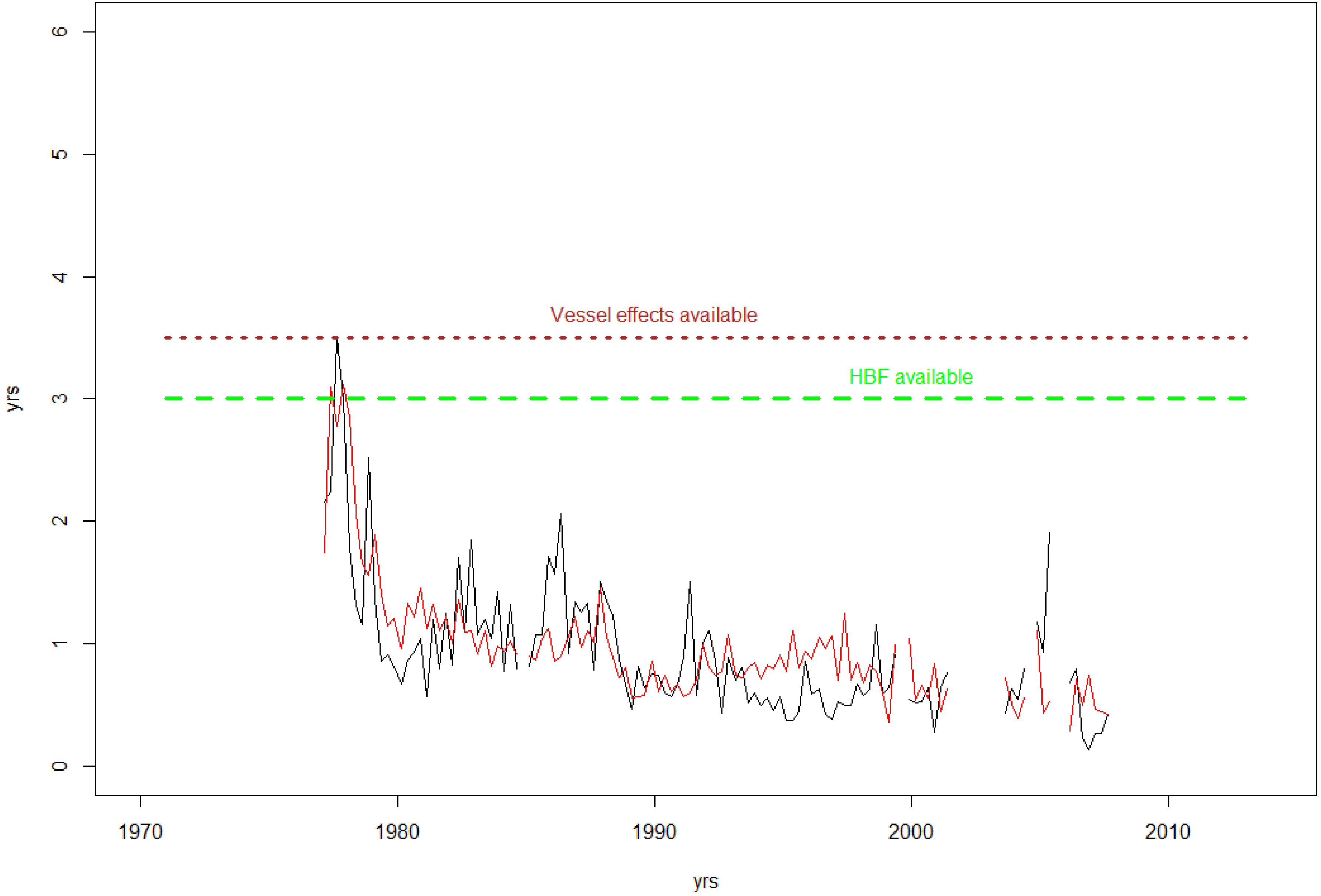




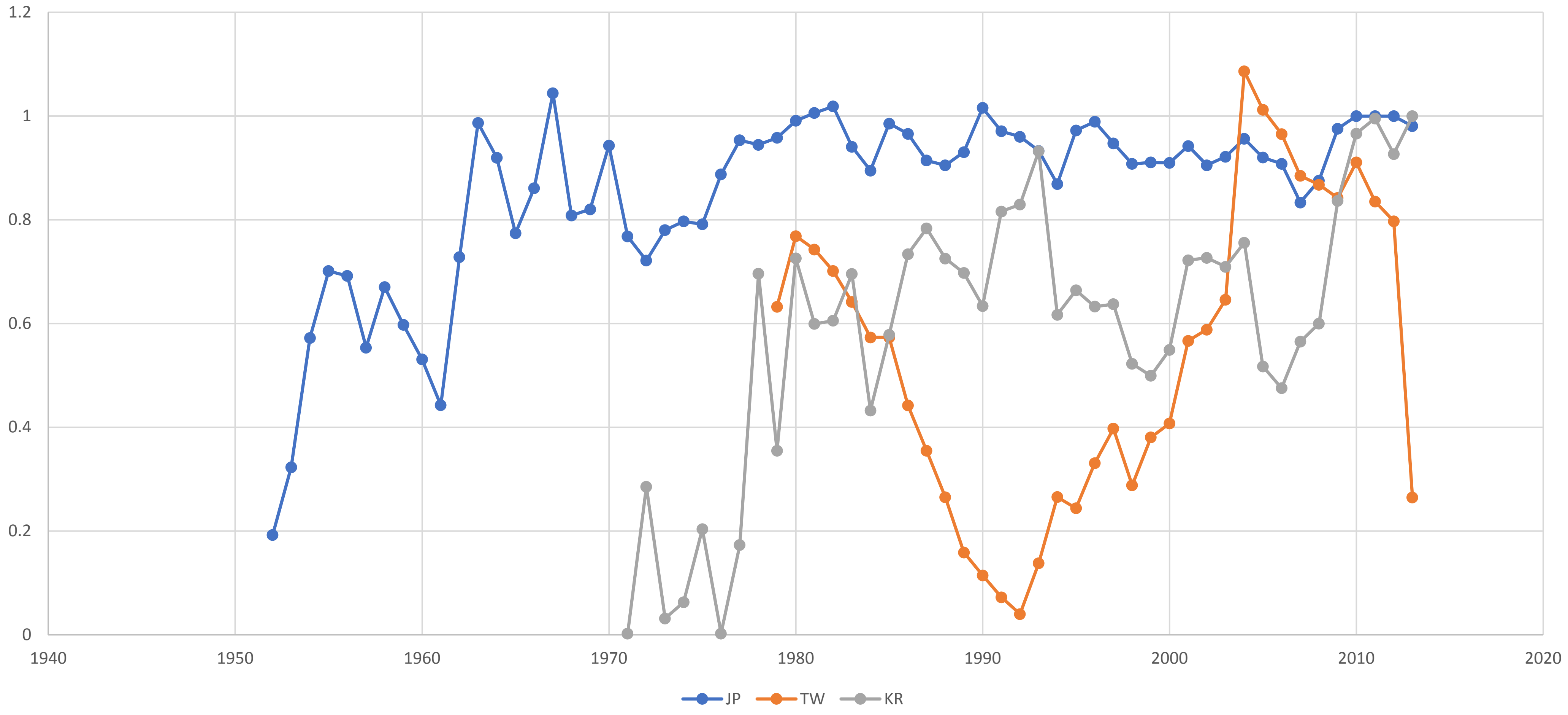
Korean time series







Data coverage by flag (Indian Ocean)



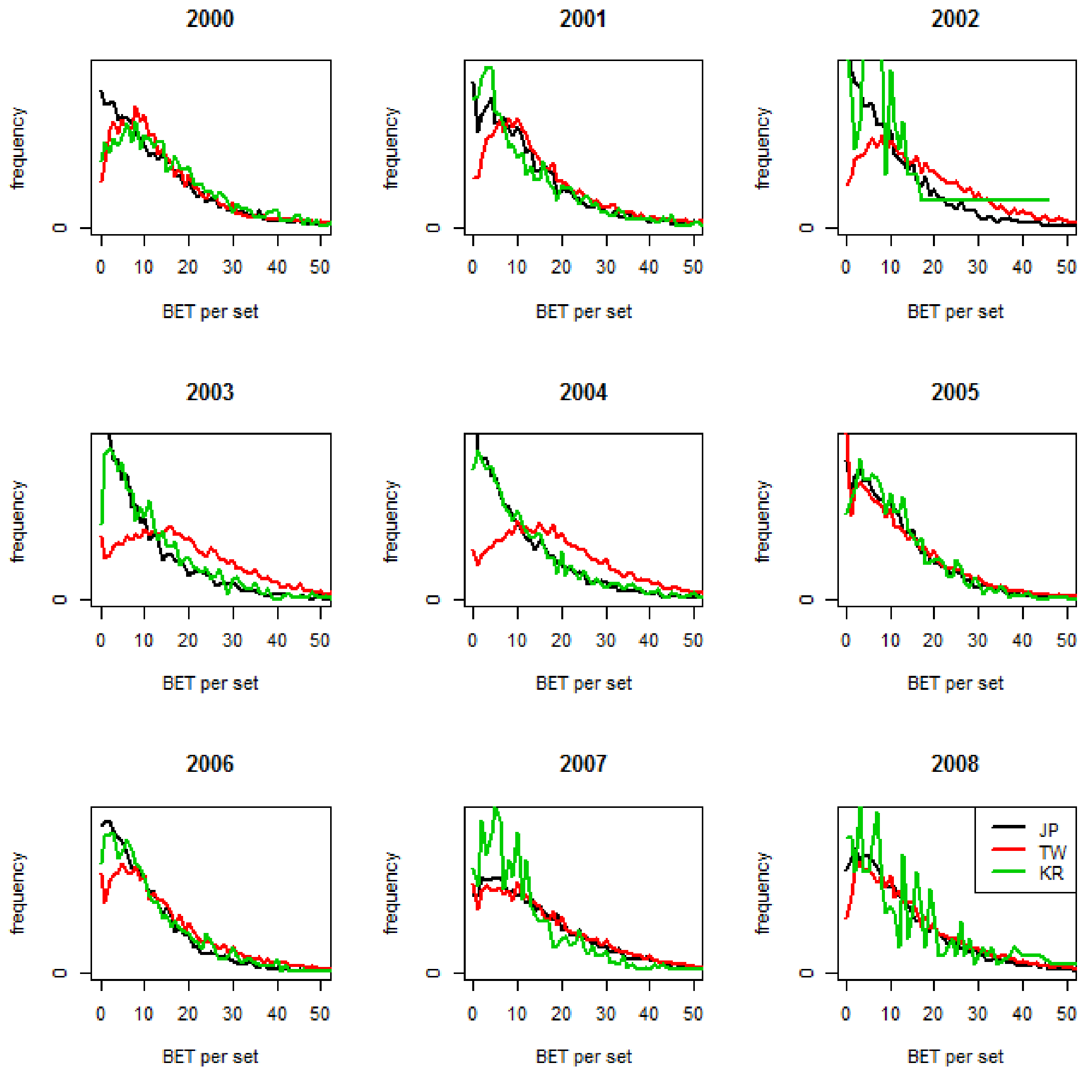
Data coverage

- Logbook coverage < 40% for the Taiwanese fleet 1987 - 1996.
- During this period the Taiwanese bigeye and yellowfin indices are very variable and appear to be less consistent with the Japanese indices.
- Indices may be affected by both lower sample sizes, and varying motives for data submission across the fleet.
  - Cancellation of foreign exchange controls in 1987 broke link between logbook submission and fish trade. Fishers could directly sell their catch, bypassing government controls, and not provide log-book catches for this period.
- Data from this period may be less representative of the fleet than at times when coverage rates are higher.

2002-2004 period in TW data

- Sharp increase in BET catch rates
- Frequency distributions differ between fleets.
  - Averages by vessel also differ
  - JP and KR consistent, TW differ
- Spatial distributions – no major differences, changes
- Fish ‘laundering’ from Atlantic ocean (associated with Atlantic BET TAC) discussed in ICCAT and IOTC reports.
  - IO frequency distributions are consistent with TW fish transfer.

BET frequency distributions by fleet



1971-2000 period

- Pre-1979 operational data unavailable for TW. Aggregated data based on operational data now lost.
- Coverage 1987-2000 < 40%, and at times as low as 4%.
  - Representative data?
- KR and JP indices are similar, and differ from TW indices

Data preparation

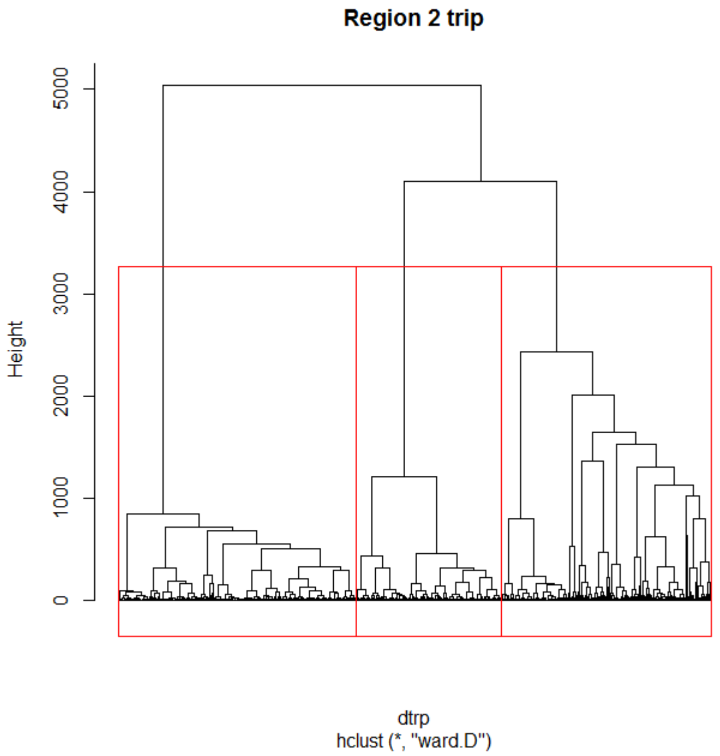
- Other issues identified in TW data
  - Operational data not provided to analysts if submitted after ‘finalization’
  - Some data cleaning variables inconsistently defined (outlier flags)
  - Data cleaning rules may have affected CPUE particularly outside equatorial areas

4. Targeting analyses

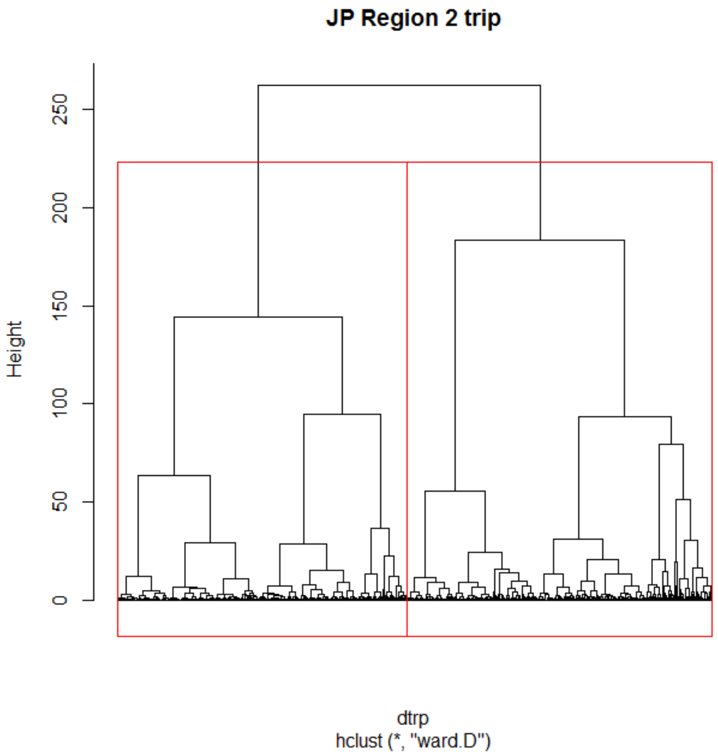
- Aim to:
  - Identify whether methods could identify distinct fishing strategies
  - Identify fishing strategies in the data for each fleet and region
  - Assign effort to fishing strategies, and use clusters in standardization.
- Methods
  - Targeting analyses by flag, and also by flag-decade
    - Cluster analyses on species composition
      - Multiple methods (Ward hclust, kmeans, clara) by a) set and b) aggregated by vessel-month
    - PCA on species composition
- Results
  - Some methods (Ward hclust, clara & some PCA) effective, esp in subtropical areas.
    - E.g. TW oilfish fishery.
  - In tropics, fishing strategies appear less diverse. Clusters in glm may not be appropriate.
  - Current approach not always sufficient to remove effects of target change

R2 hierarchical clusters for TW, JP and KR

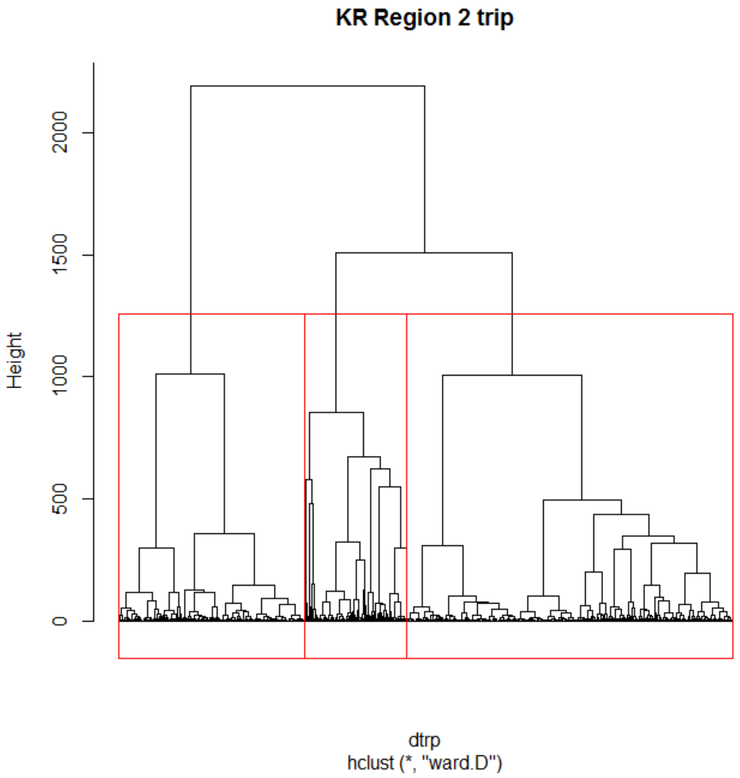
TW



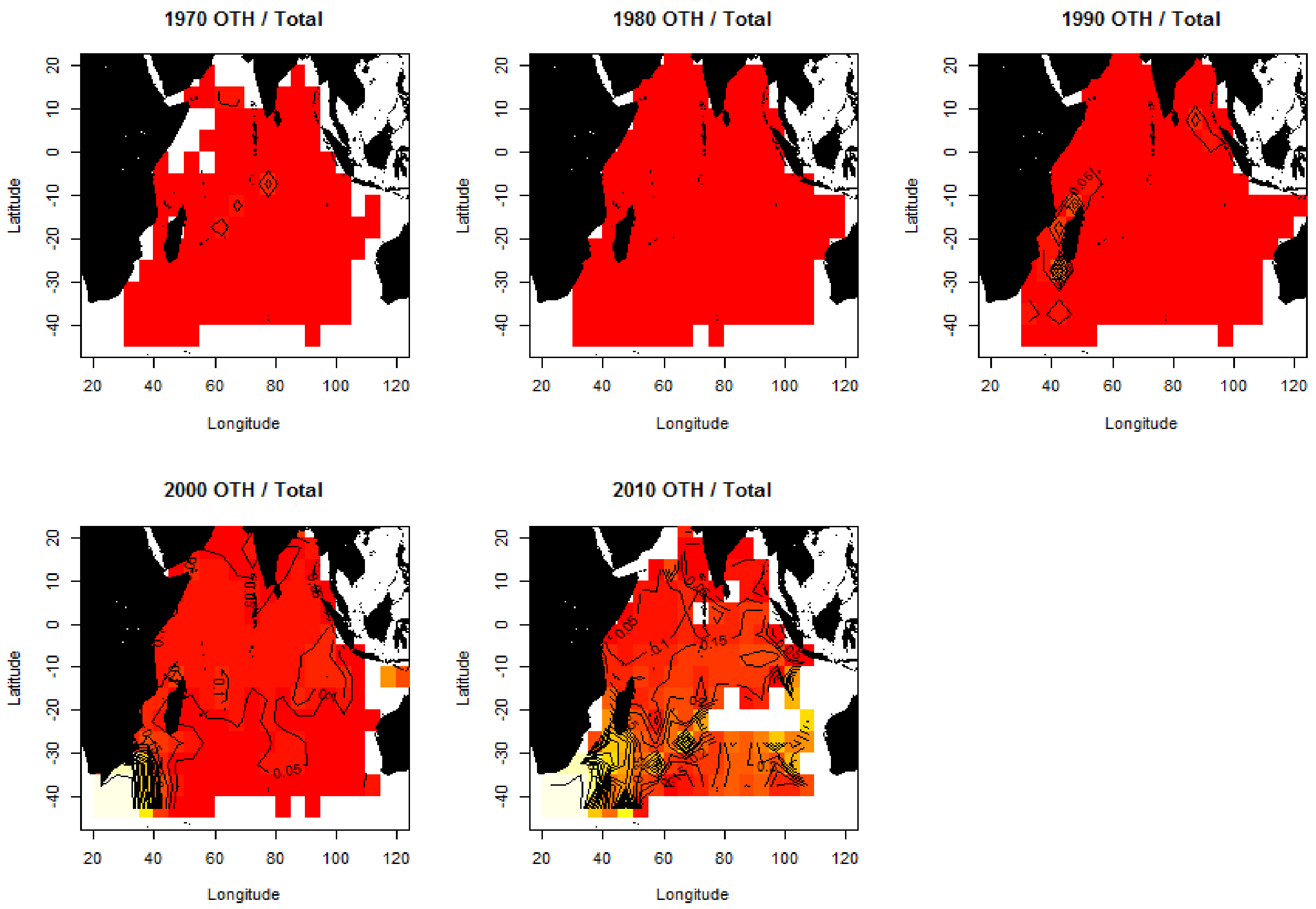
JP



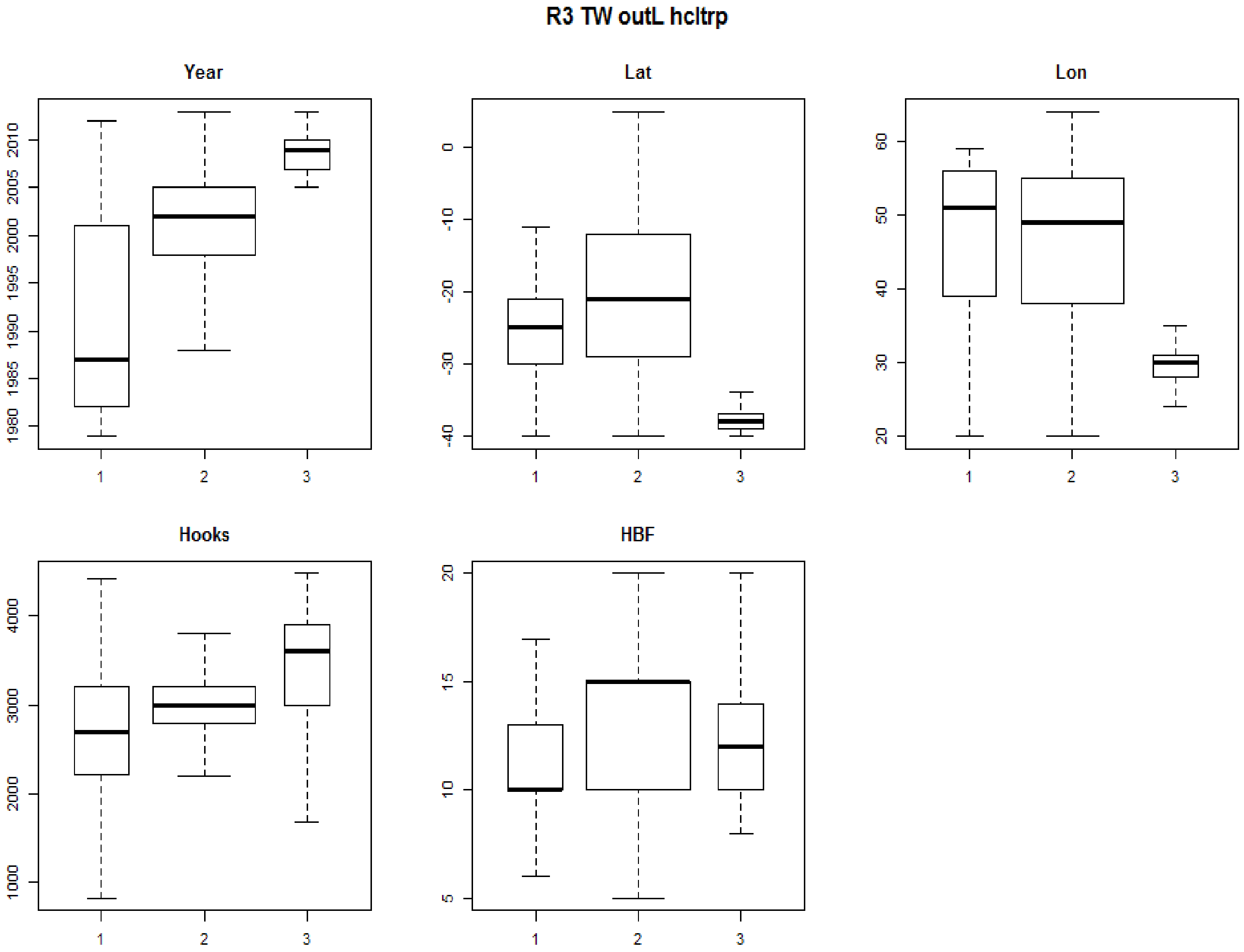
KR



Species composition – TW ‘other’ species (mostly oilfish and escolar)



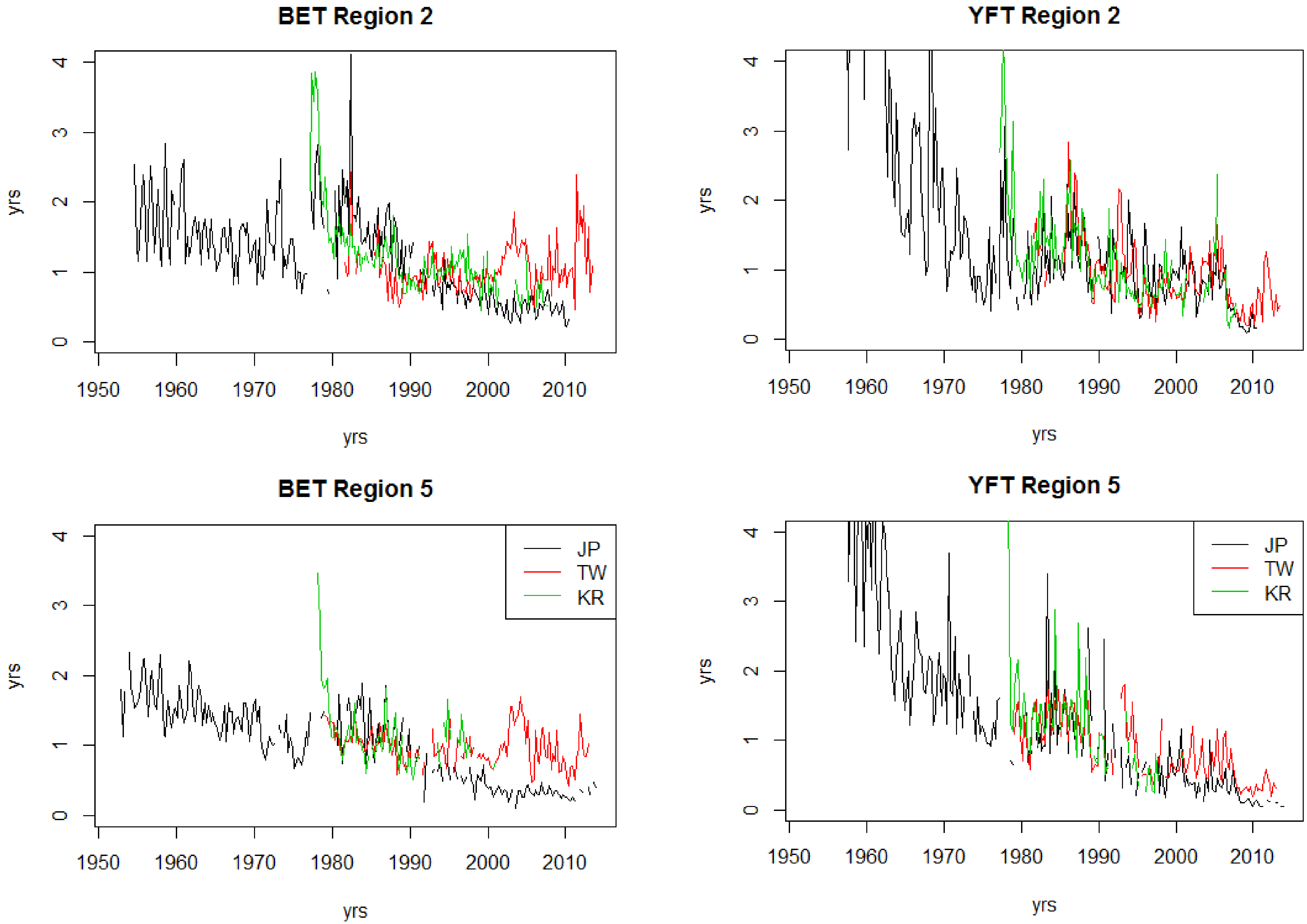
TW variables by cluster, R3



6. Joint analyses of all 3 fleets

- Carried out for R2 and R5, BET and YFT
- Used all JP and KR data, and TW data from 2005.
- Aim was not conclusive indices, but to consider feasibility, to identify issues, and to apply improved methods
- Availability of variables differs among fleets
  - HBF (JP variable but long term, TW since 1994, KR throughout)
  - Vessel ID (JP since 1979, TW & KR throughout)
  - Time series (JP 1952, TW 1979, KR 1971)
  - Area coverage
  - Bait (TW only)
- Analyses use delta lognormal approach and include vessel effects, 5 degree squares and HBF, and adjust for changing effort concentration.

Comparison of indices among fleets



Outcomes

- Indices from operational data are better
  - Analyses can take more factors into account.
  - Analysts can check the data for inconsistencies and errors.
- Important to identify target changes, and either remove relevant effort or include a categorical variable (e.g. TW oilfish).
- Exploring data coverage, and the reasons for changes, is important (i.e. TW low coverage).
- Differences between trends in different fleets are useful indicators of potential problems in one dataset or the other.
  - Differences in CPUE between Taiwanese fleet and other fleets were identified as due to either low sampling coverage (between 1982-2000) or misreporting across oceans for BET catches between 2002-2004.

Data cleaning and availability

- Ongoing needs

  Recommended that Taiwanese fleets provide all available logbook data to data analysts. The dataset currently used by Taiwanese scientists is incomplete and not updated with logbooks that arrive after ‘finalization’.

  - Vessel identity information for the Japanese fleets for the period prior to 1979 should be obtained either from the original logbooks or from some other source, to allow better understanding of fishing behavior, and estimation of catchability change. During this period there was significant technological change (e.g. deep freezers) and target change.

Recommended Analysis and Covariates

- The WG **RECOMMENDED** that examining operation level data across all LL fleets (Korea, Japan, and Taiwanese) will give us a better idea of what is going on with the fishery and stock, especially if some datasets have low sample sizes or effort in some years, and others have higher sample sizes and effort, so we have a representative sample covering the broadest areas in the Indian Ocean. This will also avoid having no information in certain strata if a fleet were not operating there, and avoid combining two indices in that case.
- The WG **NOTED** that using filtered operational data from different fleets is generally appropriate as long as different catchability of the fleets is accounted for (e.g. using vessel id), rather than computing indices separately across fleets and then averaging them after the standardization process.

FUTURE STEPS FOR FURTHER ANALYSIS

- It was **NOTED** that clustering approaches and other ways to define targeting should be further explored. The effect of these analyses in defining a subset of operational data (sets/hauls) and its effects on the standardization be tested.
- It was **NOTED** that time-area interactions within regions need further examination.
- It was **NOTED** that using a subset of vessels to examine Vessel-Year interactions over time would be important to understand vessel-dynamics, and their reasons for their change in efficiency over time.

ICCAT review of 2018 AO bigeye assessment

- It is crucial to ensure that the newly developed abundance index from LL CPUE is reliable and represents a step in the correct direction for the stock assessment.
- I strongly encourage efforts to continue to develop and improve this index in coming years, focusing among other things in demonstrating the ability of the clustering method to differentiate between changes in targeting strategy and changes in relative abundance of the different species (simulation studies could aid in this regard) and further considering how best to represent the selectivity of the index.

Conclusions

- Benefits from combining datasets
- Benefits from using operational data
- Benefits from collaborating with scientists from multiple CPCs
- Current collaborative approach is simple. Not much time for considering complications such as spatio-temporal interactions.
  - Provides a starting point for further exploration

Acknowledgments

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