Evaluation of Three Provisional Harvest Strategies and the Development of a Roadmap for Formal Harvest Strategy (Project Code: SER2021-05)

Report on TOR1 – Evaluation of three Provisional Harvest Strategies

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History

- There have been plans to develop a framework for Harvest Strategies (HS) for alfonsino, orange roughy and toothfish.
- A previous consultancy suggested three types of provisional HS:

1) **Maintain catches at present levels (unless there is evidence of a marked downward trend in the resource)**
2) **Implement a $F_{status\text{-}quo}$ harvesting strategy, which varies catches up or down in proportion to the results from the continued collection of some measure or index of abundance**
3) **Implement a HS based on some multiple of a proxy value of F_{msy}, whose value is informed by the most recent assessment of the resource.**

Analysis sought

- Determine the applicability and trade-offs between the three proposed HS approaches for each of alfonsino, orange roughy and toothfish, to provide an objective basis to underpin final decision making
- TOR:
  1) **Review the three provisional HS**
  2) **Review background information (e.g., data) available for each species**
  3) **Evaluate the pros and cons of the three HS**
  4) **Consider the possible application of some TRPs and LRPs**
  5) **Evaluate the stability of TAC and effort likely under each HS**

General approach

- Generic approach using simulation
- Consider a selected subcomponent of each resource
  1) **Alfonsino – west area considering fleet S2 (CPUE)**
  2) **Orange roughy – Feature 4 (acoustic estimates of abundance)**
  3) **Toothfish – Del Cano Rise (CPUE)**
- This investigation is **not** intended to provide an optimal proposal for each of these stocks, but rather to use these stocks as typical examples of major stocks in the SIOFA region

Simulation details

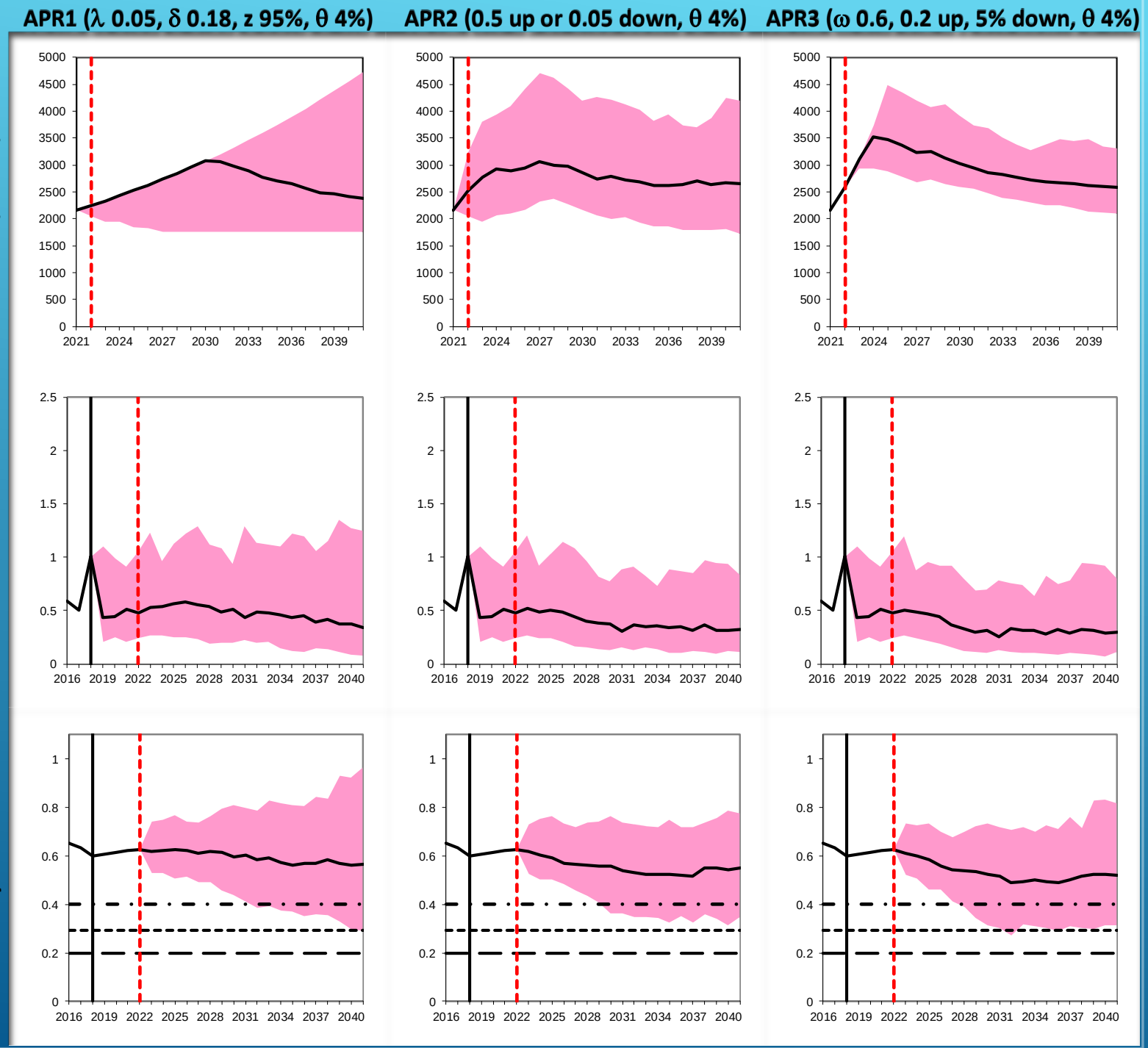
- Alfonsino
  - OM – Age-structured production model fitted to past catch and CPUE data
  - New CPUE value each year
- Orange roughy
  - OM – Age-structured production model fitted to past catch and acoustic estimates of abundance
  - New acoustic survey estimate every five years
- Toothfish
  - Initial stages of harvesting stock, yet concurrent increasing trends in both catch and CPUE
  - This is not compatible with standard population dynamics assumptions and/or CPUE being proportional to abundance
  - Hence no basis to develop an OM to underpin the simulation testing needed

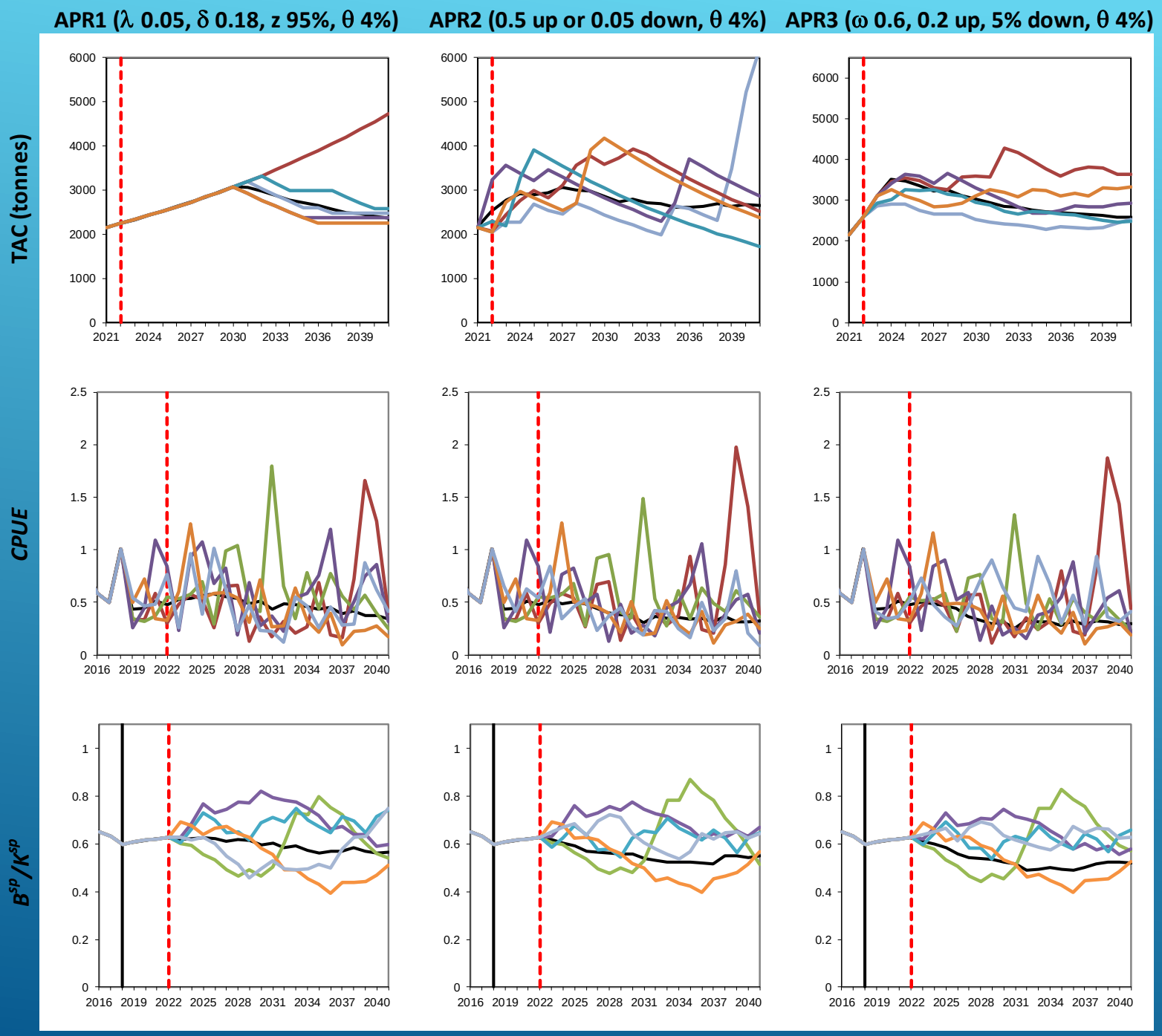
Alfonsino – HS approaches

- **APR1**
  - TAC increases annually at a constant rate, however
  - TAC is decreased by a proportion if the lower CI of the slope of recent CPUE vs time drops below a threshold value
- **APR2**
  - TAC increases annually at a constant rate, but
  - Is then adjusted by the ratio of recent to historical CPUE
- **APR3**
  - TAC first increases at a constant rate for 5 years, then
  - A population model is fit each year, and TACs are set proportional to an updated estimated F_{msy} value multiplied by the biomass estimate

ALFONSINO – RESULTS

Comparison of summary median trajectories for TAC, CPUE and depletion for APR1 (left), APR2 (middle) and APR3 (right)





ALFONSINO – RESULTS

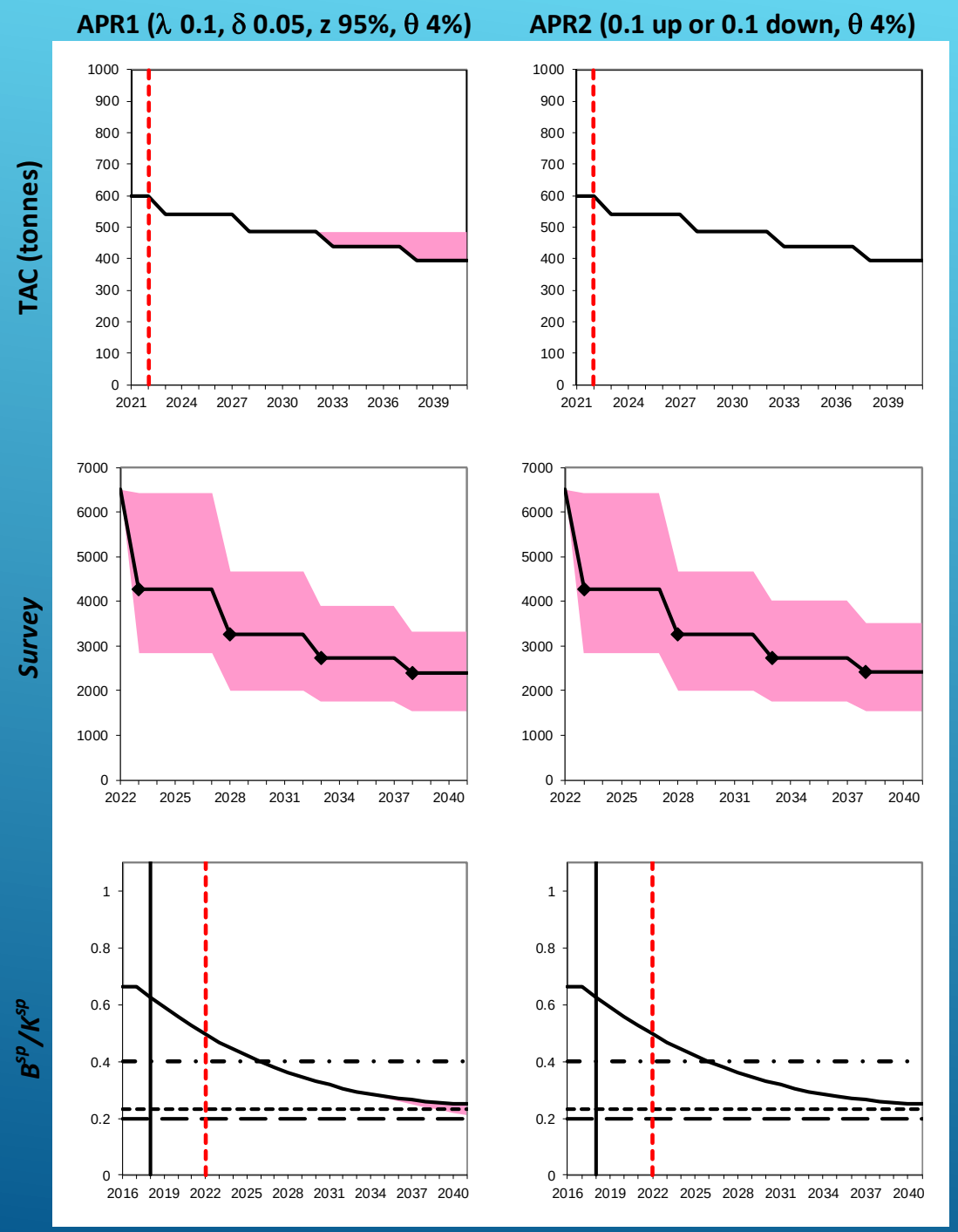
Median trajectories (thick black lines) and a random selection of worm plots (coloured lines) for TAC, CPUE and depletion for APR1 (left), APR2 (middle) and APR3 (right)

Alfonsino – Results summary

- All three approaches were tuned for similar depletions (somewhat above B_{msy}) after 20 years
- This required an initial steady increase in the TAC
- The primary basis to compare performance are the worm plots of TAC trajectories
- APR1 is clearly preferable to APR2 from the perspective of the fishery because of less variable trends in TAC over time
- APR3 could provide more certainty than APR1 about longer term TAC levels
- However this comparison is misleading because APR3 has an unrealistic advantage from using the identical population model in the OM and the HS – further robustness tests would be needed to check how they impact performance.

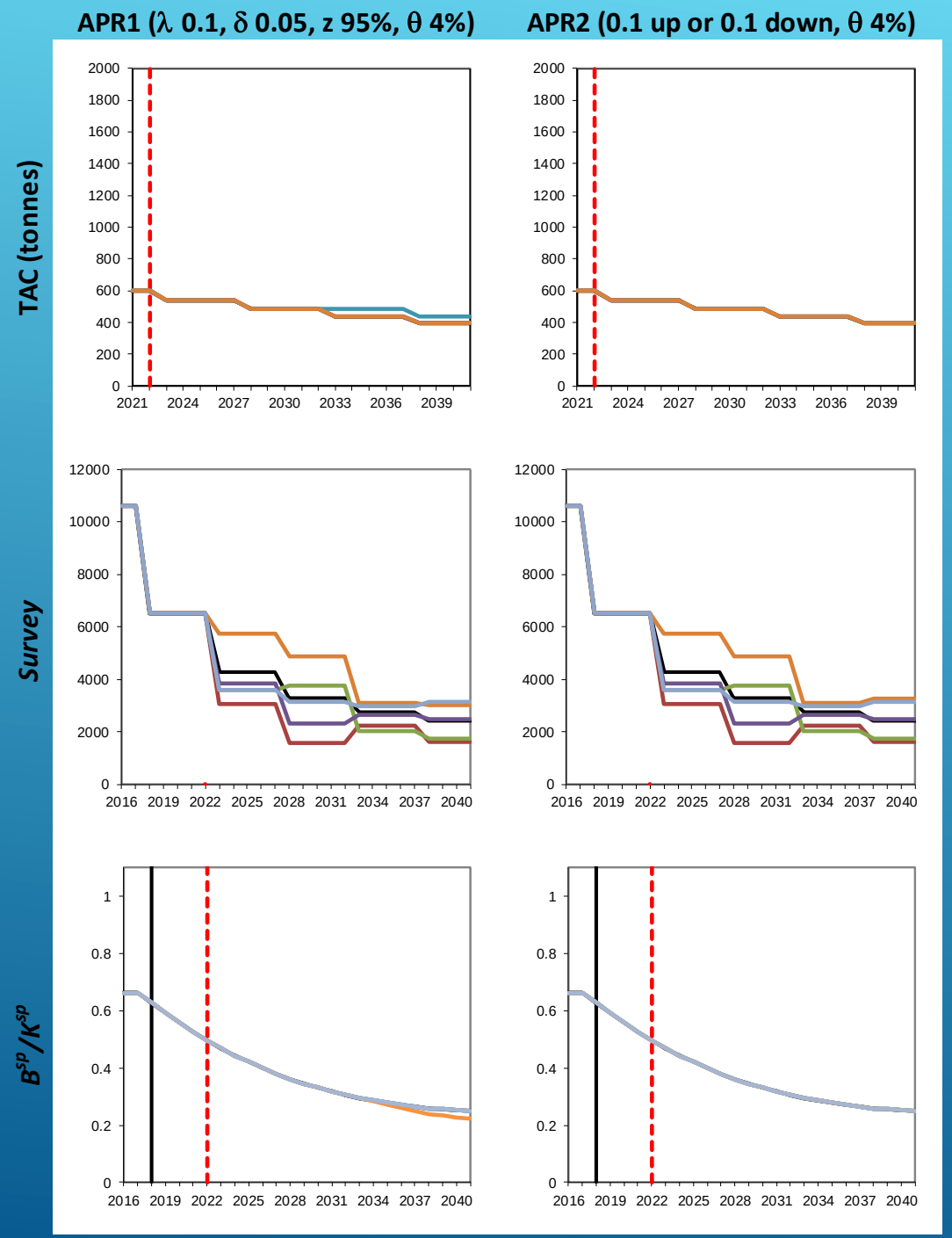
Orange roughy – HS approaches

- **APR1**
  - TAC increases annually at a constant rate (though this does not come into play in this example), however
  - TAC is decreased by a proportion if the lower CI of the slope of the acoustic survey estimates vs time drops below a threshold value
- **APR2**
  - TAC increases annually at a constant rate, but
  - TAC is then adjusted by the ratio of recent to historical acoustic survey abundance indices
- **APR3**
  - Not yet attempted



ORANGE ROUGHY – RESULTS

Comparison of summary median trajectories for TAC, CPUE and depletion for APR1 (left) and APR2 (right)



ORANGE ROUGHY – RESULTS

Median trajectories (thick black lines) and a random selection of worm plots (coloured lines) for TAC, CPUE and depletion for APR1 (left) and APR2 (right)

Orange Roughy – Results summary

- There is insufficient contrast between the results for APR1 and APR2 to make any strategic choice
- This is partly a result of the fact that recent catches from this resource are unsustainable, so that the immediate priority is for these to be reduced.

Results in overview

The combination of the nature of the statuses of the three stocks investigated, and the limited data available for them, leads to limitations in what can be achieved in terms of the original objectives for this work:

- **The Operating Models required for testing cannot be (straightforwardly) developed for the toothfish stock**
- **Results for the orange roughy stock are dominated by the need to reduce current catches substantially to achieve sustainability**
- **For alfonsino, more work on robustness tests would be needed before initial comments could be made by way of a comparison between the performance of the population model-based APR3 approach, and the other two empirical approaches: APR1 and APR2.**

Conclusions

- The only firm-ish conclusion, drawn from the alfonsino analyses alone, is a preference for APR1 – maintain a slow steady increase in catch until the CPUE index might indicate a marked downward trend, rather than for APR2 - vary catches up and down in response to shorter-term CPUE changes.

- But even that is not very satisfactory as a result to provide a basis for generic implementation, as certain control parameter value choices (especially the size of the initial upward trend in TACs) would probably need to vary substantially from stock to stock, thus requiring stock-specific as well as generic analyses to proceed further.

Conclusions

- The current prospects for developing entirely generic approaches/harvest strategies able to cover the major resources in the SIOFA region do not appear promising.
- A roadmap with suggestions about how SIOFA might best move forward towards adopting such harvest strategies in these circumstances is put forward in the Report for the second part of this project.

Thank you for your attention