UNIVERSITY of TASMANIA

IMAS

Institute for Marine and Antarctic Studies

1 March 2023

Dr Ian Dutton
General Manager – Marine Resources
Department of Natural Resources and Environment Tasmania
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Dear Ian,

I am writing in response to your letter dated 23rd February 2023 requesting scientific advice on a range of management scenarios to aid the recovery of the Sand Flathead (*Platycephalus bassensis*) stocks in Tasmania that were reported as 'depleted' in the Tasmanian Scalefish Fishery Assessment 2020/21 (Fraser et. al., 2022). I have attached the rationale for applying a 'depleted' status to Sand Flathead.

The rationale for assessing the Tasmanian Sand Flathead population as 'depleted' was based on three key factors:

- **Unsustainably high fishing mortality (> 2 x natural mortality)**
- **Population biomass below critical levels (< 20%)**
- **Spawning potential below sustainable limits (< 0.2)**

These factors are further explained in the attachment.

As such there is an **urgent need to increase the biomass above 20% of the estimated unfished biomass** and then manage the fishery towards a target of at least 40% of unfished biomass.

This species is predominantly harvested by the recreational fishery (~ 98%) and, as such, economic considerations are different to those that would factor into management of a species with a greater proportion of commercial harvest.

IMAS (and its precursors) have been conducting recreational fishing surveys for over 20 years that clearly show the benefit and values from recreational fisheries relate not only to the harvest of fish for consumption, but also to the quality of the fishing experience. Importantly, a high-quality recreational fishing experience is not just related to the catch, but satisfaction from time spent with friends and family in nature. These factors highlight that a recreationally dominated fishery is likely to have greater resilience to experiencing short term losses of benefits if these losses produce benefits over the long term. It is also known that recreational fishers do not experience high satisfaction levels when fish stocks are in a poor condition.

Therefore, it is suggested that applying a management strategy that aims to recover biomass to at least 40% of unfished levels in the medium term (i.e., 4 - 6 years) rather than longer term (i.e., > 6 years).

A longer-term solution may also exacerbate the recently identified issue of changing growth characteristics in some regions (particularly the south & Georges Bay) which promotes the survival of older fish with slower growth characteristics and smaller maximum sizes (i.e. phenotypic population stunting as a result of fishing-induced evolution). This phenomenon not only risks

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significant impairment of Sand Flathead stock recovery but also risks altering the functioning of the ecosystems this species inhabits.

To recover the biomass to above 20% and above a target of at least 40% **will require a significant reduction in fishing mortality**. We suggest that a significant reduction in catch would rely primarily on reduced bag limits. The multiple model assessment approach applied suggests that **this bag limit would need to be less than two fish per person per day, particularly in southeast Tasmania where stocks are most overfished**. Furthermore, there is a need to provide greater protection for larger, female fish which are now almost absent from most southeast regions in the state, with evidence of phenotypic alterations to the populations as described above.

In your request you have asked for, at point 1, the probabilities of specific scenarios reaching different biomass levels in given time frames. Unfortunately, at this stage, it is not possible to provide this level of detailed quantitative information. Our modelling team are progressing rapidly to advance assessment capacity for Sand Flathead but, at this stage, the models are equilibrium based and do not provide temporal projections.

As such, the advice below is based on best scientific information from the available models, the known biological and ecological traits of the species, and consensus discussions amongst several of our scientists who work on fisheries biology and population dynamics. At this stage however, our advice is based partly on qualitative assessments and provided in line with ‘a precautionary approach’ to achieve what would be expected to produce a recovery to at least 40% in the medium term (four to six years, as per your letter). The strategy is designed to rapidly see a recovery trajectory that can then be integrated into our models to assess the effectiveness of the strategy. At this point a review period where management changes can be altered based on predictive modeling would be prudent.

It is also important to note that with the rapid development of new models, and as additional data is gathered, that the scientific advice can change.

Advice to the scenarios as presented in point 2 of your letter are outlined below. Further to this it is advised on a holistic strategy for recovery using an ensemble of traditional fisheries management levers, a stewardship, engagement and education program, and a feasibility assessment of re-stocking.

The advice is based on a priority of recovering the stock and secondarily minimising the impact to the fishery based on the assumption that **a rapid recovery will provide greater satisfaction to the values of the recreational sector in the short to medium term.**

A critical component of the strategy is ongoing fishery independent monitoring, ongoing fishery dependent monitoring through frame collection, continuing development of predictive models and periodic review of the effects of management with a precursive intention to relax measures once targets are achieved, or at least the trajectory to recovery can be assessed.

Our general response to your scenarios are:

- **Closing the fishery** – maximises the chances of recovery in a shorter period; however, will impact more on fishers. There would still be a need for significant management change upon reopening of the fishery, such as reduced bag limits and adjusted size limits.

- **Maintaining status quo (i.e., size limit 32 cm, bag limit 20 statewide)** – the biomass will continue to decline and diminish the value of the stock to the recreational sector (i.e., there will be very few fish available for fishers to retain above the size limit). Inaction risks the long-term

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availability of this species. Long-term depletion also creates significant risks to ecosystem health, by impacting the important ecosystem roles of Sand Flathead as predators and prey.

- **Bag limits cut to 4, 5 or 8 depending on region** – Current modelling suggests that the bag limits scenarios of 5 statewide or regional limits of 4 in the south/southeast and 8 in the north will not be sufficient to reduce fishing mortality to allow biomass recovery or continued phenotypic change. It is recommend, however, a bag limit of 5 on the east and north coast in combination with other management measures in our advice below, although there are some local areas of concern such as Georges Bay that a bag limit of 5 may impair local stock biomass recovery.

- **Increasing size minimum size limit to 35 cm** – Modelling suggests that by increasing the minimum size limit (MLS) to 35 cm would protect a significant increase in spawning stock biomass of fast-growing fish, but without a significant reduction in bag limit further phenotypic change is still likely.

- **Maximum size limits of 36 or 40 cm depending on scenario –** A maximum size limit needs to be of a sufficiently low size to provide adequate protection. Current data suggests that a maximum size limit over 40 cm will be grossly ineffective in the south, as most fish are harvested by the fishery before being able to grow to be protected by this measure (see attachment). A maximum size limit of 40 cm, in combination with other significant management measures, will provide some protection to fish of a larger size on the east and north coasts in the immediate term. Importantly, however, maximum size limits will be a critical component of the longer-term recovery and management of the fishery. As a greater proportion of fish grow larger due to other management restrictions, a maximum size limit will be necessary to protect them to avoid repeating the significant absence of larger fish, which is the reason for the current depleted biomass status.

- **Boat limits –** If bag limits are set correctly, boat limits are not required. However, given that modeling suggests that current fishing mortality is greatly above the level required to allow for biomass recovery, a boat limit would provide additional protection and may be worth considering against the strategy of a rapid return to greater than 20% of unfished biomass and a medium-term return to 40% of unfished biomass. The proposed boat limits (three times the bag limit) will only effect boats that take more than 3 fishers, but it is worth noting that this is a common for charter operators.

- **Particular advice for the D'Entrecasteaux Channel, Fredrick Henry Bay and Norfolk Bay –** These three areas are the most impacted by overfishing. The management measures proposed below take these areas into account in the regional stratification.

It will be important that whichever scenario is implemented, that it will require a combination of both catch limits and size limits to be effective.

Current scientific advice suggest the following:

- A level of regionality to the management approach. Two regions on mainland Tasmania be considered and that King Island and the Furneaux group of islands be considered separately.
  - South (Cape Pillar to Whale Head)
  - Rest of mainland Tasmania
  - King Island and the Furneaux Island group

- For the South:

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  - a slot limit of 35 – 38 cm, bag limit of 2 boat limit of 6

- For the rest of mainland Tasmania:
  - a slot limit of 35 – 40 cm, bag limit of 5 and boat limit of 15

- For King Island and the Furneaux Island group:
  - a minimum size limit of 40 cm and a bag limit of 5, no boat limit (as a secondary benefit to population protection, this will align with current size limit regulations for blue spot and rock flathead.

It is emphasized the importance of implementing management settings that significantly reduce fishing mortality to contain the risks of continued or permanent decline in stock status, growth characteristics and ecosystem stability.

The stock response will be tracked annually through the annual stock assessment process; however, it is recommended that a formal evaluation should be done after two and four years. During this time IMAS aim to develop a temporally explicit population simulation model to better evaluate and predict the recovery trajectory. Relaxation of measures could then be considered based on the stock recovery trajectory, assessed biomass, and assessed fishing mortality. Conversely, if a recovering trajectory towards 40% is not occurring, further refinements may be needed.

As you are aware, IMAS are currently preparing an FRDC funding application to support the evidence- based management to recover sand flathead populations. This will involve filling biological and ecological knowledge gaps required to inform the assessment models to ensure that decisions can be assessed and adjusted based on the best possible scientific information. It will also include an engagement and communications program (focusing on a collaborative approach between IMAS, DNRET and TARFish) and a feasibility assessment of stock enhancement. We look forward to progressing this application with DNRET and stakeholders in the near future.

I would also be more than happy to discuss with you and or your team the proposals outlined in this response.

Yours Sincerely,

Assoc. Prof. Sean Tracey
On behalf of
Drs Nils Krueck, Klaas Hartmann, Alyssa Marshell and James Haddy

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In response to DNRET request for advice letter on sand flathead:

A summary of the analysis and factors that have led IMAS to define sand flathead as depleted and an integrated rationale for the management scenario proposed.

The rationale for applying a 'depleted' status to the Sand Flathead population in Tasmania was based on three key factors:

- **AN UNSUSTAINBLY HIGH DEGREE OF FISHING MORTALITY:** Multiple lines of evidence including a low proportion of fish larger than the minimum legal-size limit, the mean size of fish above legal size indicating high exploitation, age- and length-based catch curves, the LBB model, the LBSPR model (Fraser et. al., 2022) and a Population Simulation model, all concur that the level of fishing mortality (F) far exceeds sustainable levels. Across the state fishing was estimated to account for 72% of all mortality of female Sand Flathead, and in the southeast this estimate increased to 81% of female Sand Flathead mortalities. The inclusion of regional sampling in the northeast and north coasts is relatively new (since 2021) and more sampling years are required to provide greater certainty on fishing mortality. However, initial assessment estimates that fishing mortality and the ratio of fishing mortality to natural mortality are likely to exceed sustainable levels in all regions sampled to date.

- **BIOMASS BELOW SUSTAINABLE LEVELS:** an assessment of a spawning stock biomass relative to a virgin (unfished) spawning stock biomass (B/B_0) of below 20%. This estimate was corroborated by multiple assessment models, including the Length-based Bayesian Biomass (LBB) estimation approach (Fraser et. al., 2022) and and a Population Simulation model (Haddy et. al., *in development*). This level of 20% is widely regarded as a critically low level of biomass and is used as a limit reference point (ie fishery closure) in fisheries with harvest strategies.

- **SPAWNING POTENTIAL RATIO BELOW SUSTAINABLE LIMITS:** an assessment of the spawning potential ratio relative to the virgin (unfished) spawning potential ratio (SPR/SPR_0) below 20%, again corroborated by multiple assessment models including the Length-Based Spawning Potential Ratio (LBSPR) estimation approach (Fraser et. al., 2022) and a Population Simulation model (Haddy et al., *in development*).

This assessment is based on ongoing scientific assessment and monitoring of the sand flathead stock in Tasmania.

IMAS have been conducting annual fishery independent sampling on the east and southeast coast since 2012 (11 years). This sampling occurred at three regions (D'Entrecasteaux Channel, Norfolk and Fredrick Henry Bay and Great Oyster Bay). There are 43 sites fished each year within these 3 regions. In 2021, after receiving additional research funds from FRDC five additional regions were added to the annual sampling routine (Bridport, Mercury Passage, Stanley, St Helens and the Tamar River). This added 37 new sites across these regions. **So, in total, the current monitoring program covers eight regions and sampling (fishing) occurs at 80 sites.**

The experimental design is established to make the sampling comparable between years. This is a well-recognised method in marine science (and other sciences). In each region sampling (fishing) sites were selected in the first year of sampling (2012 or 2021 depending on region). The sites were selected based on the advice of expert recreational fishers in each region. The same sites are fished each year, from January – April, which are the best months for Sand Flathead catchability.

The time spent fishing at each site is standardised and the sites are picked haphazardly in regard to the order in which they are fished. Once on a site, the crew fish the same way as an average recreational fisher. Three hook paternoster rigs have been used since the project started (again kept consistent). There are three fishers on the one vessel, and they drift fish at each site. If they come across a good bite they will drive back up on it. If the bite is slow, they will fish bathymetric 'features' around the site if they are present. They then move onto the next site and repeat. This sampling protocol is conducted at a similar time each year (weather permitting). This timing was determined as the time when highest catch rates are observed in the recreational fishery (summer), which is determined by reference to the statewide survey of recreational fishers.

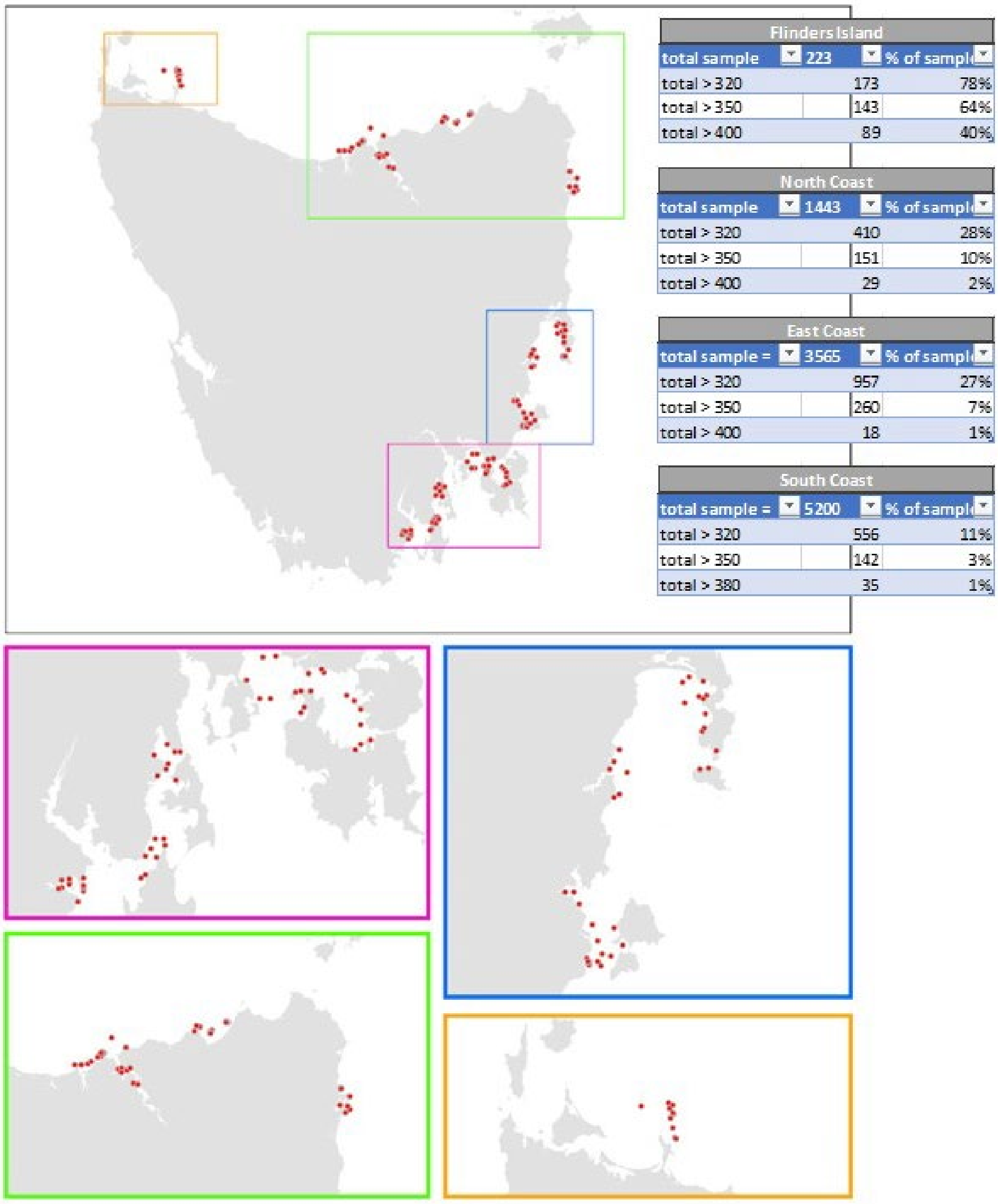
The sampling design and methods represent a standardised, repeatable experiment so we can precisely track changes through time.

An important note is that this method has been questioned by some experienced recreational fishers as ‘not the best way to find and catch the fish’. They note that fish move around or feed at different time dependent on a range of factors (moon, tides, etc). There are also comments about ‘old spots don't fish as good as my new secret spot’, and that IMAS would catch bigger fish if they tried some of these spots. Or, that if we changed to different fishing methods (soft lures rather than baits) that our catch rates might increase.

Changing our behaviour or location is the antithesis of a well-designed sampling protocol because the sampling needs to be standardised and repeatable. The need to chase fish around and use alternate gears and methods to optimise catch when these fish (of particular concern is large fish) were readily available in all areas of the state is not a standardised method and will provide a bias view on stock health as explained below.

Critique of the IMAS sampling protocol is leading to the perception that stock depletion is not as significant as the research suggests. However, changing our sampling protocol as suggested would lead to a phenomenon known as 'hyperstability' (i.e., maintaining high catches while stocks are continuing to deplete). In the case of Sand Flathead, hyperstability is likely to be caused by a change in the behaviour of fishers, who move on to new areas where they can still find ‘big’ fish, thereby masking the effect of ‘serial depletion'. Communicating this to the recreational fishing community would be of value to increase acceptability of management intervention to recover stocks.

Since 2012, over 4,100 Sand Flathead have been sampled for a full biological assessment (age, length, weight, sex, maturity status). A total of over 10,200 (inclusive of those sampled for full biological assessment) have been caught and their length measured using the experimental design described above. This data is used in the assessment figures below.



Flinders Island		
total sample	223	% of sampl
total > 320	173	78%
total > 350	143	64%
total > 400	89	40%

North Coast		
total sample	1443	% of sampl
total > 320	410	28%
total > 350	151	10%
total > 400	29	2%

East Coast		
total sample =	3565	% of sampl
total > 320	957	27%
total > 350	260	7%
total > 400	18	1%

South Coast		
total sample =	5200	% of sampl
total > 320	556	11%
total > 350	142	3%
total > 380	35	1%

Figure 1. The sampling regions (some are grouped relative to those described in this document) and research fishing sites around Tasmania. The summary tables show the proportion of fish caught above various minimum size limit scenarios. These tables report the fish caught in the regional grouping proposed by IMAS for management purposes. Sites are not shown for recent sampling at Flinders Island.

Due to the high fishing mortality, most fish are below the current size limit especially in the south (i.e., 89% of fish in the south are under this size limit). These tables also show the instantaneous relative effect on catches from increased minimum legal-size limits (MLS) (i.e., increasing the MLS from 32 cm to 35% in the south would increase protection of the current biomass from 89% to 97%). The number of fish above a larger possible MLS would increase through time from that shown here as they grow through the proposed slot limit under the protection of reduced catch rates provided by reduced bag limits.

The figure also shows the relative impact of maximum size limits (creation of slot limits). On the south, east and north coasts a maximum legal-size limit would only protect approximately 1-2% of the current biomass. Furthermore, maximum size limits can be counter-productive because there is displacement of catch onto smaller sizes – that is, if fishers keep taking their daily bag limit but can no longer take large fish, then they must increase fishing pressure on smaller sizes – so that even fewer fish grow through to the maximum size limit. This is why maximum size limits need to be combined with a significant reduction in catch (e.g. through daily bag limits). Reducing the fishing mortality through catch limits will allow fish to continue to grow through the slot to reach the protection of the maximum size limit.

The size composition of fish from Flinders Island, a lightly fished population of Sand Flathead is valuable for exploring management needs. Sand Flathead are highly resident so the fish off Flinders Island are not moving between areas with higher fishing mortality on mainland Tasmania.

At Flinders Island, 78% of the Sand Flathead sampled were greater than 32 cm (compared to just 11% in the south), 64% were above 35 cm (compared to just 3% in the south) and 40% were above 40 cm (compared to just 1% in the south). This observed data of this lightly fished population contrasts with the heavily fished, depleted state as sampled in most of mainland Tasmania.

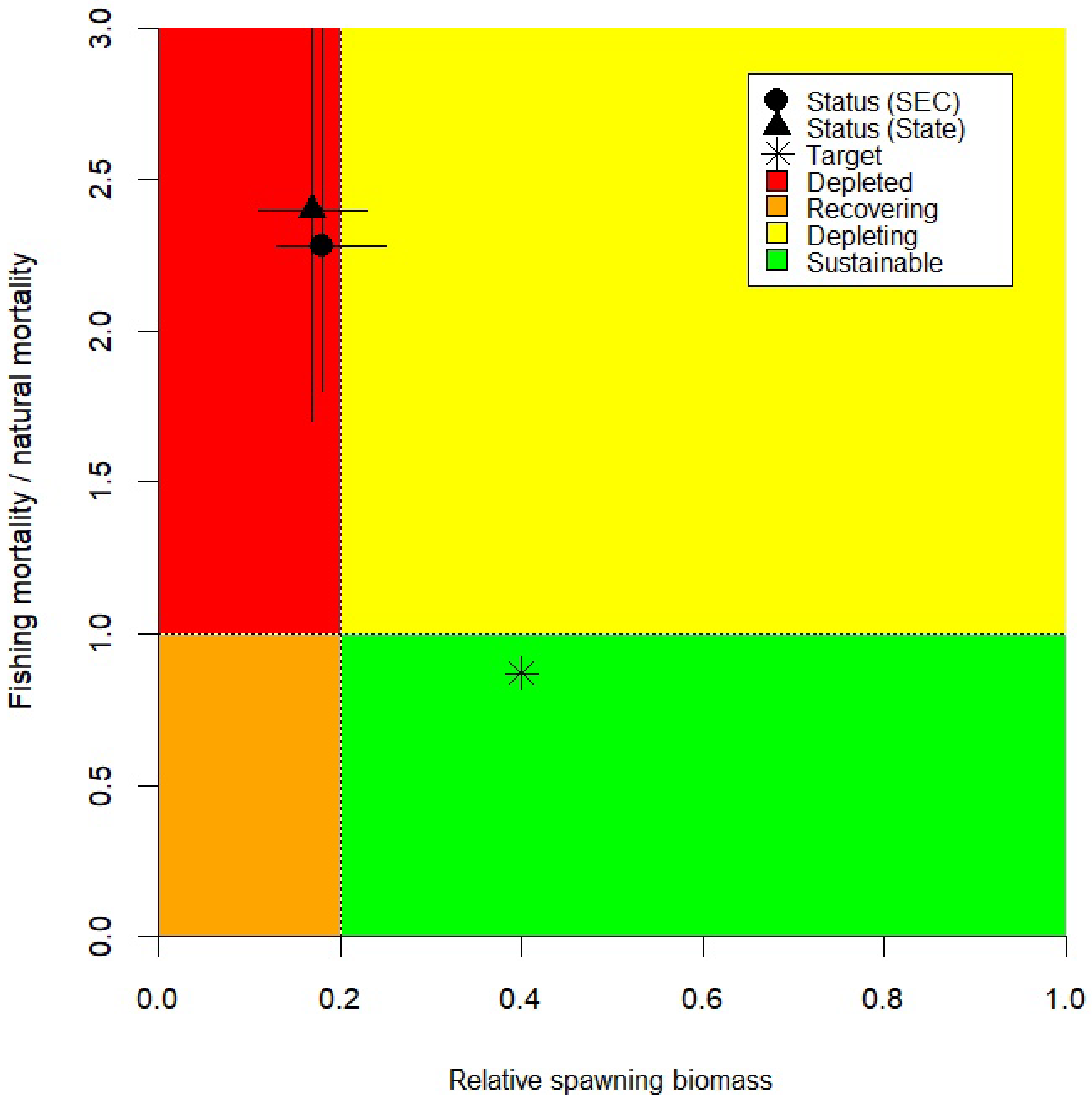


Figure 2. This is called a Kobe plot and shows both the biomass and fishing mortality combined. This is a standard representation of the status of a fishery. The colours show the status of the fishery based

on these two metrics with the colours (as described in the legend) indicating what state the fishery is in at a given level of estimated fishing mortality and estimated spawning biomass.

The relative spawning biomass (mature fish) is shown on the x-axis (horizontal axis). This is shown as relative to the unfished spawning biomass. So, a value of 1.0 is the relative biomass if no fishing was occurring. The target of 40% spawning biomass to unfished biomass is shown as a Star (∗) at 0.4 and the current estimate of female biomass for the southeast coast (SEC) is shown as a circle. The current estimate of female biomass for the whole of the state is shown as a triangle. The horizontal lines on these symbols indicate the modelled confidence intervals in these estimates. Both are currently below 20% of the unfished spawning biomass which is a standard limit reference point in fisheries management representing a potentially critically depleted population where the fishery is closed.

The y-axis (vertical axis) shows the amount of fishing mortality (the rate of deaths of fish from the population due to fishing) relative to natural mortality (the rate of fish removed from the population due to death by natural courses [old age, predation, etc]). When the rate of fishing mortality relative to natural mortality (estimated for the whole stock) is greater than a value of 1.0, the fishing mortality is exceeding the level where the biomass can start to recover. The position of the star on the y-axis shows where we fishing mortality relative to natural mortality (~0.87) should be managed towards because fish populations have been found to be most productive and support the highest catches under this level of exploitation. If it is lower than this recovery would likely be more rapid. If it is higher, recovery might be hindered or slower, but to reiterate, if it is above 1.0, any recovery is unlikely. The (circle) symbol, which is the estimate for the SEC, indicates that fishing mortality in this region is over twice the level of fishing mortality required for recovery, while the (triangle) which represents the whole of state suggests than fishing mortality is even higher. The vertical bars show the confidence intervals of the model estimates. In both cases, while there is significant uncertainty in the estimates (long lines), even at the minimum end of this variability that fishing mortality is still significantly over the level that will facilitate stock recover.

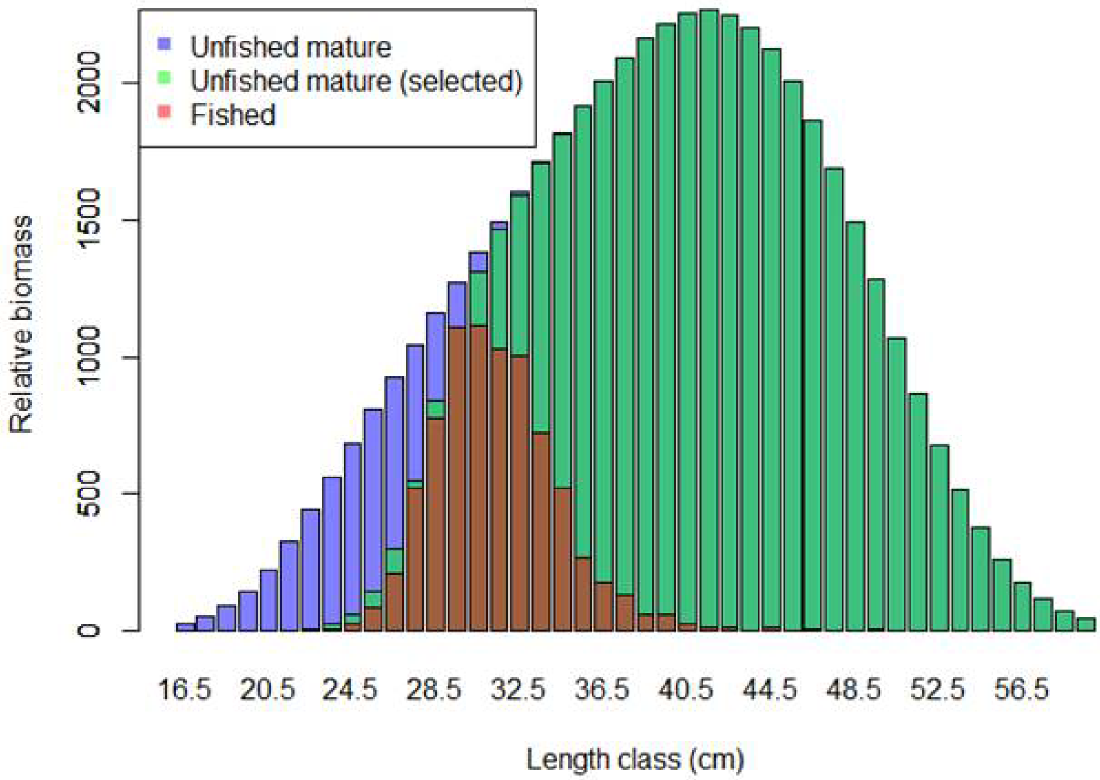


Figure 3. Shows the biomass of sexually mature female fish in each size class under different scenarios. The size (length of fish) is shown along the x-axis, while the relative biomass in each size class is shown on the y-axis. The higher the bar the greater the biomass in that size class.

The blue bars show what the modelled population size composition of sexually mature female fish would look like if it had never been exposed to fishing. This figure is a little deceptive as the blue bars become hidden behind the green bars, but, at that point, they are exactly the same, i.e. the blue bars are exactly the same height as the green bars.

The green bars show the modelled population size composition of mature fish that would be selected (available to fishery based on hook sizes commonly used and a range of other factors such as catchability) if fishing was to begin in the form it currently occurs on an unfished biomass.

The red bars show the recent size composition of female sand flathead in the south-east coast region in Tasmania, including survey data from 2012-2022. It shows the significant impact of fishing on the larger size classes. This is where the significant decline in female spawning biomass has occurred. The management strategies proposed by IMAS are focused on recovering the spawning biomass but particularly recovering and protecting a greater proportion of the larger fish that have been removed from the population because these fishes contribute the most to the population replenishment as a whole.

This figure also highlights one of the complexities of explaining the depletion in this fishery to the public. The red bars show that the number of fish relative to an unfished biomass between 32 and 35 cm is still high. So, people can still go out and catch fish with reasonable ease, but almost 90% of the time in the south-east coast region the fish will be below the minimum size limit. Catch rates of smaller fish will be similar to that of previous decades. A second problem of “shifting baselines” will be starting to emerge because the stock has now been depleted for several years. People coming into the fishery new (younger generations) will perceive what’s represented by the red bars as a ‘normal’ sand flathead fishery. People with longer experience will comment that ‘it is not like it used to be’. This figure shows both the ‘new normal’ and ‘what it used to be like’.