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Recreational fishing objectives in NSW

An interim report on the outcomes of stakeholder workshops for Mulloway, Yellowtail Kingfish and Snapper

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Executive Summary

This interim report provides an update on workshops with recreational fishers, scientists and managers to investigate recreational fishing objectives for three stocks of recreational importance in NSW – Mulloway, Yellowtail Kingfish, and Snapper. The study forms part of a broader research project investigating the integration of recreational fishing (RF) into harvest strategies for multi-sector fisheries.

Background

Harvest strategies are a formal framework that specify the data collection, performance indicators, and fisheries management actions (via harvest control rules) needed to achieve stakeholder objectives. Harvest strategies must therefore integrate the objectives of all fishing sectors to ensure success, yet the objectives of RF are not well understood. Knowledge of RF objectives will be necessary for ensuring fishery performance for the sector as NSW develops harvest strategies for stocks with a recreational interest.

Aims

1) Obtain information on RF objectives for Mulloway, Yellowtail Kingfish, and Snapper stocks in NSW;
2) Build understanding of harvest strategies among recreational fishers.

Methods

Workshops between RF stakeholders, scientists and resource managers were held by NSW DPI – Fisheries during March 2021. Workshop sessions were run online and consisted of background presentations on harvest strategies and fishing objectives, along with group discussions to develop a detailed understanding of RF objectives for each stock. A generic list of RF objectives obtained from the scientific literature was provided as a base. RF stakeholders were invited to participate based on their knowledge and experience targeting the selected species within NSW. Workshops were chaired and facilitated by an independent scientist, and attended by scientists and managers from NSW DPI Fisheries, as well as scientists from external research institutions.

Results

A shortlist of RF objectives suitable for inclusion in harvest strategies was produced for each stock, along with a comprehensive list that included all RF objectives developed during the workshops. A broad range of objectives were identified, spanning all four major areas of fisheries sustainability – ecological, economic, social and management-related. Ecological objectives and most economic objectives were considered achievable within a harvest strategy; however, many social and management objectives were considered to be outside the scope of harvest control rules and were therefore not included in the shortlist. Objectives were similar among stocks, although some differences based on unique biological characteristics were noted. Participants also suggested management measures for each stock, which were primarily related to limiting harvest. Some of these measures are dynamic, such that their implementation would vary depending on fishery performance (e.g. bag limits), while others were static (e.g. mandatory use of release weights).

Implications

Harvest strategies have the potential to deliver considerable change in fishery performance for the RF sector in NSW, given that all ecological objectives and most economic objectives identified during workshops were considered suitable for inclusion in harvest strategies. Many RF objectives identified in the workshops are likely shared with other fishing sectors, providing opportunities for development of mutually beneficial harvest strategies in NSW. However, if social and management objectives that are not linked to harvest are considered priorities for recreational fishers, harvest strategies are unlikely to provide the appropriate mechanism to achieve them and a broader management regime would likely be required.

Keywords

Harvest strategies, fishing objectives, recreational fishing, Mulloway, Yellowtail Kingfish, Snapper

Introduction

Harvest strategies are a formal and pro-active method for sustainable fisheries management. They specify the management actions needed to achieve stakeholder objectives, as well as the stock monitoring and assessment required to measure fishery performance against those objectives (Sloan et al. 2014). Harvest strategies must therefore consider the objectives of all stakeholder groups, including fishing sectors, to ensure equitable management outcomes.

While the objectives of commercial fishing are relatively well-understood, recreational fishing (RF) objectives are much less so. This is due to the diversity of motivations for RF and the large number of individual fishers, which complicates efforts to understand these motivations (Pascoe et al., 2009). Objectives for RF often differ to those of other sectors. Commercial fishers, for example, are primarily motivated by the monetary value and profitability of their business operation, while recreational objectives are often social in nature and relate to the quality of the fishing experience; for example, the probability of encountering trophy-sized fish, enhancing social capital, and the aesthetic appeal of the fishing location.

Workshops are an effective method for obtaining detailed fishery information from stakeholders. While stakeholder workshops are typically undertaken for management purposes, they can also be effective for collecting fishery data, particularly where variables of interest are related to stakeholder interests and experiences (Yochum et al. 2011). Workshops ideally include stakeholders, managers, and scientists within a fishery, to ensure a holistic and balanced process. While harvest strategy workshops typically include all stakeholder groups within a fishery, preliminary workshops with individual groups can be useful for identifying sector-specific objectives and priorities.

Harvest strategy development has recently commenced in New South Wales (NSW) and will include fisheries with a substantial RF component, both in terms of fisher participation and total catch. The *NSW Fisheries Management Act 1994* ("The Act") includes the object, "...to promote quality recreational fishing opportunities", and the draft NSW Harvest Strategy Policy (HSP) states, "Where stocks are shared among sectors (e.g. commercial, recreational, Aboriginal cultural fishing) this should be explicitly recognised in the management approach". To meet the requirements of The Act and the HSP, harvest strategies in NSW will need to include RF for stocks where the sector has a substantial interest.

A research project was developed to address knowledge gaps regarding RF objectives and their inclusion in harvest strategies – "Integrating recreational fishing into harvest strategies for multi-sector fisheries" (FRDC2019-021). The project includes a review of RF objectives from the scientific literature, a review of NSW data sources available to monitor those objectives in harvest strategies, and a statewide survey to understand what objectives are considered most important to recreational fishers in NSW. Detailed information from experienced recreational fishers in NSW is required to refine RF objectives from the literature, to ensure they are relevant for specific stocks in NSW, and to develop the statewide survey.

Objectives

This component of the project aims to:

1) Obtain information on RF objectives for Mulloway, Yellowtail Kingfish, and Snapper in NSW;

2) Build understanding of harvest strategies among recreational fishers.

Method

Selection of stocks

Fishing objectives may differ among stocks, due to their inherent characteristics and the interests of fishers that target them. Objectives are therefore best developed at the stock level.

Three fin-fish stocks were identified as both important to recreational fishers in NSW and of interest for harvest strategy development in the near-term: Mulloway (*Argyrosomus japonicus*), Yellowtail Kingfish (*Seriola lalandi*), and Snapper (*Chrysophrys auratus*).

All three stocks are distributed throughout coastal NSW. They inhabit all saline waters, from estuaries through to coastal offshore, depending on season and life-cycle stage. Mulloway in NSW has declined since the mid-1970s and is currently classified as depleted (Hughes et al. 2020a). Yellowtail Kingfish are highly mobile and move between NSW and multiple other jurisdictions in Eastern Australia. Fish in this region are therefore considered a single biological stock which was classified as sustainable in the most recent assessment (Hughes et al. 2020b). Stock assessment for Snapper is conducted at the jurisdictional level, with the most recent NSW assessment indicating the NSW component of the stock is sustainable (Stewart et al. 2020).

All three species are prized sportfish with excellent eating qualities. Mulloway are often targeted in estuaries in NSW, where large individuals can be accessed using small boats or from shore. Yellowtail Kingfish and Snapper are primarily targeted on coastal reefs, with larger Yellowtail Kingfish typically found offshore. During the most recent statewide RF survey (2017/18), the recreational harvest of Mulloway, Yellowtail Kingfish and Snapper in NSW was estimated at 90 t, 129 t, and 106 t, respectively (Murphy et al. 2020). The recreational harvest of both Mulloway and Yellowtail Kingfish exceeded the commercial harvest in that time period (56 and 58%, respectively), with the recreational harvest of Snapper comprising 38% of total harvest.

Ethics

This study was approved through the NSW DPI Fisheries Research Human Ethics process in accordance with the National Statement on Ethical Conduct in Human Research 2007 (“National Statement”, updated 2018, www.nhmrc.gov.au). Participation in this study was voluntary and participants could opt out at any time. The identities of participants are kept confidential, consistent with the National Statement.

Workshops

Participation

Fishing objectives were elicited from RF stakeholders in NSW during workshops held by NSW DPI Fisheries in March, 2021. Workshops were held online, after normal working hours, to increase participation of fishers located throughout the state, and to comply with COVID-19 restrictions. Twenty active RF stakeholders were invited to attend the workshops based on their knowledge and experience targeting the selected stocks in NSW. Some RF attendees had expertise across all three stocks while others specialised in one of the three. Other attendees included fisheries scientists and managers from NSW DPI Fisheries, and fisheries scientists from CSIRO, University of Wollongong, and University of Tasmania. Workshops were facilitated by an independent scientist specialising in recreational fisheries.

Sessions

Workshops consisted of a series of short (1.5-2 hours) sessions designed to accommodate personal schedules and minimise stakeholder fatigue (Figure 1). They involved a combination of presentations from scientists and managers, and group discussions. Sessions commenced with an Information Session for all stocks combined, which included: 1) an outline of the project and purpose of the workshops, 2) a presentation on harvest strategies, and 3) presentations on current stock status, assessment and

management for each of the three stocks. RF stakeholders were then asked to consider their preliminary objectives for each stock in preparation for the next session.

Objectives Sessions were held separately for each of the three stocks (Figure 1). In Objectives Session 1, facilitated group discussions were used to build a preliminary list of objectives for each stock. A generic list of RF objectives sourced from the scientific literature was provided as a guide (Table 1). Generic objectives were organised into three tiers – broad, sub-, and specific. The broad tier reflected the four major categories of fishing objectives – ecological/biological, economic, social, and managerial (Stephenson et al. 2018). Objectives then became increasingly specific through the lower two tiers. Not all sub-objectives required further specification.

RF stakeholders were first divided into small separate groups online (2-4 person) to consider which of the generic objectives were appropriate for the particular stock under consideration and which were not, while also adding objectives required for the specific stock. Findings from the small groups were then reported to all workshop participants by a spokesperson, discussed and combined. Between sessions, scientists and managers consolidated objectives that were similar and classified them according to whether they were suitable for inclusion in a harvest strategy. This decision was purely technical and based on whether the objective could be achieved through control of harvest. Three categories of suitability were used – "in scope", "in scope but difficult to measure", and "out of scope". Wording of objectives was also refined, to ensure consistency, brevity and precision.

In Objectives Session 2, the refined objectives and suitability classifications were presented to RF stakeholders and further refinements were made through group discussion. Potential management measures and considerations suggested by RF stakeholders were also discussed, including the fishing sectors that might be involved. Following the session, scientists translated objectives in the harvest strategy shortlist (see below) into non-technical language, to increase comprehension within the statewide survey component of the project.

The final Prioritisation Session was combined across all stocks. It included presentations on prioritising fishing objectives using stakeholder preferences and a survey designed to elicit those preferences from RF stakeholders attending the workshops. The survey was anonymous and completed online following the workshops. Survey results from workshop participants will be compared to those from a broader survey of RF objectives throughout NSW (a later component of this project) and are therefore not reported in this document.

Results

Eight workshop sessions were completed, involving a total of 14 hours contact time with participants. Workshops were generally well-attended, with more than 10 RF stakeholders participating in most sessions. Objectives sessions for Snapper were attended by six RF stakeholders.

The shortlists of objectives considered suitable for inclusion in harvest strategies, based on whether they could be achieved via harvest control, are presented in Tables 2-4 and outlined in the section "Harvest strategy objectives" below. The objectives are phrased in non-technical language, to ensure comprehension by a wider audience potentially involved with harvest strategy development and the broader group of recreational fishers involved in future surveys of objectives preferences. The complete lists of all objectives developed within the workshops, including those not considered addressable within a harvest strategy, are presented in Tables 5-7 and outlined in the section "Complete list of objectives". Note that the complete lists include the technical language originally used for harvest strategy objectives (in bold).

Harvest strategy objectives

Harvest strategy objectives were similar among stocks and included 20-21 sub- or specific objectives. They spanned three of the four broad categories - ecological, economic, and social (Tables 2-4); none of the managerial objectives were considered suitable for inclusion in a harvest strategy because they were unlikely to be achieved by controlling harvest. Ecological objectives primarily related to aspects of

sustainability, such as maintaining healthy stocks and ensuring a reasonable proportion of fish reached legal size. Economic objectives included maximising the value of the RF experience, generating revenue for RF industries and promoting quality regional fisheries. Social objectives included growing the sport, increasing time spent with friends and family, and improving recreational experiences. Numerous social objectives were related to ecological objectives, for example, the social objective "Ensure a decent proportion of the stock can reach trophy size" relates directly to the ecological objective "Ensure a decent proportion of the stock can reach maximum size". Maintaining stock biomass was considered an ecological objective in the context of stock sustainability, but also a social objective from the perspective of ensuring quality fishing.

Minor differences in ecological and social objectives were observed among stocks (Table 2-4). Concern regarding post-release mortality of Mulloway led to the inclusion of an additional sustainability objective, "Ensure released fish have a high chance of survival". Tournament fishing was also not considered an objective for this stock, hence the social objective "Increase opportunities to compete in fishing tournaments" was omitted. A desire to recover localised populations of Snapper led to the inclusion of the ecological objective "Rebuild stocks in habitats previously known to support fish".

Complete list of objectives

An additional 20-26 objectives were included in the complete list for each stock (Tables 5-7). While considered worthy of retention by workshop participants, the additional objectives were deemed to be outside of the scope of a harvest strategy, because they were unlikely to be achieved by controlling harvest.

The additional objectives were primarily social and managerial, and were similar among stocks. Differences included: 1) increasing knowledge of the benefits of releasing large fish for Yellowtail Kingfish (Social, Table 6), 2) improving public education regarding the use of whole fish, to avoid waste and more generally respecting and valuing the fish, for Snapper (Social, Table 7), and 3) ensuring clarity of regulations for a Snapper harvest strategy (Management, Table 7).

Objectives considered during the workshop mostly require dynamic harvest control, where the amount of harvest is set in response to the performance of the fishery relative to the objective. However, numerous objectives were identified that could be achieved using fixed (static) management measures (Tables 5-7). These included the ecological objectives of coordinating with other sectors to minimise bycatch mortality of juvenile fish, particularly when setting catch and effort quotas in other fisheries, and protecting larger Snapper while retaining smaller fish for consumption. Ensuring protection of spawning aggregations for Snapper and Yellowtail Kingfish could be achieved via both dynamic controls and fixed measures, depending on whether spawning aggregations differ through time and space or remain in the same locations, respectively.

Social objectives potentially achieved using fixed management measures included minimising negative interactions with other aquatic users and avoiding interactions with other people generally. Management objectives focused on the development and review of harvest strategies, specifically, broadening the range of RF-specific harvest strategy components, optimising the frequency of harvest strategy reviews, and including breakout rules for RF (Tables 5-7).

Potential management measures and considerations suggested by participants

Numerous measures and considerations were suggested for each stock (Table 8). These primarily related to limiting harvest, either through reductions in bag limits for the recreational sector or introducing catch quotas for the commercial sector. Harvest controls for particular size classes were also suggested, including slot limits and increasing the minimum legal length for both Yellowtail Kingfish and Snapper for all sectors. Increased enforcement and penalties were also suggested for Mulloway and Snapper for all sectors.

Suggested measures for Mulloway were more numerous and more substantial (Table 8), because participants identified that immediate and drastic management action is required for this stock until rebuilding has been achieved. Suggestions included a zero bag limit for the recreational sector, line-only

status, and a closed fishery for the commercial sector, including ceasing commercial mesh netting and beach hauling for that species. The line-only measure reflects the fact that this method can be conducted with minimal mortality through catch-and-release, which is not possible with other methods. Suggestions were also provided for other harvest strategy components, including the use of trigger reference points during both increases and decreases in biomass. Setting the limit reference point higher than 20% of unfished biomass, setting a target biomass of 50-60% unfished biomass, and determining sectoral catch allocation on financial return were all suggested for this stock.

Discussion and conclusions

Recreational fishers identified a broad range of objectives for stocks of Mulloway, Yellowtail Kingfish and Snapper in NSW, indicating the sector has diverse interests in these stocks. While numerous ecological and economic objectives were identified, including those often associated with maintaining viable stocks and generating revenue for RF-related industry, many social and managerial objectives were also retained from the generic list provided to participants. This finding suggests that maximising fishery performance for the NSW RF sector will require consideration of objectives that extend beyond the objectives typically addressed in harvest strategies. The finding in NSW is consistent with investigations into RF motivations globally, which have shown that satisfaction of recreational fishers is linked to both catch- and non-catch-related motivations (Arlinghaus 2006).

Harvest strategies have the potential to deliver considerable improvements in fishery performance for the RF sector in NSW, given that all ecological objectives and most economic objectives identified during workshops were considered suitable for inclusion in harvest strategies. Decisions regarding suitability for inclusion were based on whether objectives were likely to be influenced by harvest – a prerequisite for achieving an objective through harvest control (Deroba and Bence, 2008). The effect of this control was expected to be indirect for some objectives, for example, it was still considered possible for harvest control to promote tourism, by assisting the development of quality regional fisheries through increases in fish abundance.

Many objectives identified in the workshops are likely shared with other fishing sectors, providing opportunities for development of mutually beneficial harvest strategies in NSW. Examples include maintaining stock biomass, rebuilding depleted stocks and increasing investment in fisheries management. However, while the objectives themselves may be similar among sectors, the degree of fishery performance considered acceptable to meet these objectives may differ considerably. For example, harvest strategies for commercial fisheries often aim for a stock biomass that provides maximum sustainable yield (B_{MSY}), yet this biomass is likely to be considerably lower than the 50-60% biomass target suggested for Mulloway by recreational fishers during the workshops (Table 2). Determining levels of fishery performance that are acceptable to all sectors, or at least optimising the trade-offs for conflicting objectives, is essential for development of equitable harvest strategies.

The similarity of objectives among the stocks examined suggests that RF objectives, while broad, may be relatively uniform across fin-fish stocks subject to similar fisheries activity in NSW. Similarity likely also arose from the fundamental nature of many objectives, for example, the need for sustainability. Other objectives lie at the sector or fishery level, rather than at the stock level, and lie outside the scope of harvest strategies; for example, maintaining catch allocation among sectors and providing opportunities for co-management. Numerous social objectives relate to the fishers themselves, not the stock, for example, spending time with friends and family. The few differences that were observed among stocks tended to relate to stock-specific biological traits or requirements. For example, potentially high mortality of Mulloway following release (largely related to barotrauma effects) prompted the inclusion of an objective regarding ensuring survival of released individuals. The similarity of most objectives among the three stocks suggests that the lists generated in the current study may provide a useful base for development of objectives for other stocks.

Although ecological and economic objectives of recreational fishers are potentially achievable using harvest strategies, many social and all management objectives from the workshops were not considered suitable

for inclusion. The links identified between social and ecological objectives suggest that some additional social performance may be achieved via ecological objectives that are included. Use of a subset of objectives would also reduce the complexity of harvest strategies and the resources required to service them. However, if social and management objectives are considered priorities for recreational fishers (see below), harvest strategies may not achieve adequate fishery performance for the sector. In such circumstances, social and management objectives should be considered within the broader management regime, along with methods of monitoring and assessing success.

Objectives developed in the current study must be reduced in number for effective harvest strategy development, either by prioritisation or combination. While numerous objectives can simultaneously be included within harvest strategies, each additional objective increases the complexity of the harvest control response (Dowling et al. 2020). It is extremely challenging to accommodate the sheer number of objectives developed in the workshops (even at the sub-objective level) within a harvest strategy framework, particularly given that other sectors will likely contribute separate and potentially competing objectives. Each objective also requires monitoring and assessment to evaluate its performance, increasing the resourcing required to maintain the harvest strategy. Prioritising RF objectives will focus harvest strategy development on the most important goals of the sector and increase the likelihood that each will be achieved. Workshop participants were surveyed to elicit their preferences among objectives developed in the workshop. Results from this elicitation will be compared to those from a broader survey of recreational fishers in NSW, under development as part of this project, and will be reported at a later date. If a small number of priority objectives are identified from the surveys, this will provide an objective base for selection of RF objectives. If not, consideration should be given to combining objectives of a similar nature where possible.

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Tables

Table 1 Generic list of RF objectives developed from a review of the scientific literature and provided to workshop participants as a base to assist their development of objectives specific to Mulloway, Yellowtail Kingfish, and Snapper in NSW. Objectives are organised into three tiers of specificity; broad objectives (bold headings), sub-objectives (left column), and specific objectives (right column).

Ensure ecological sustainability	
Catch fish	Reduce the number of fishless trips
	Maximise the number of fish caught per fisher day
Receive bites or strikes	Maximise the number of strikes or bites per fisher day
Obtain food	Maximise the number of legal-sized fish caught per fisher day
Catch large or 'trophy' fish	Ensure 'trophy' fish are available in the fishery
	Increase the chance of catching large fish
Ensure a sustainable fishery	Maintain sustainable stock biomass
	Increase fisher awareness of sustainable fishing practices
	Increase RF understanding of population biology and stock assessment
	Reduce fishing infringements
Avoid environmental impacts of fishing	Minimise mortality of bycatch species
	Minimise mortality of undersized fish
	Minimise interactions with Threatened, Endangered, Protected (TEP) species
	Minimise pollution generated by RF
	Reduce habitat damage
	Limit the transfer of aquatic pest species
Enhance economic performance	
Maximise the value of the recreational experience	Maximise the value of the recreational experience
Generate economic value for the RF industry	Maximise profit for RF charter industry
	Maximise profit for RF tackle industry
Generate economic value for communities	Maximise flow-on economic benefits to local communities
Minimise financial costs	Minimise cost of managing the fishery
	Minimise cost of compliance for charter industry

Maximise social outcomes	
Easy access to fishing locations	Improve physical access to fishing locations Optimise the number, size and quality of boat ramps
Improve participation in RF ('grow the sport')	Increase the number of individuals participating in RF each year Increase time spent fishing
Compete against other fishers	Increase opportunities to compete in fishing tournaments
Equitable access to fish stocks	Maintain equitable allocation of catch among fishing sectors
Enhance social networks, or social capital	Increase networking opportunities within the RF community
Foster a positive public image of RF	Minimise negative public perception of environmental impacts Improve public understanding of socio-economic benefits of RF Minimise negative interactions with other aquatic users
Improve fishing knowledge	Increase knowledge of fishing techniques Increase knowledge of fishing locations Increase knowledge of target species
Enjoy the outdoors/nature	Maintain/improve the aesthetic beauty of fishing locations
Spend time with friends and family	Increase the time spent fishing with friends and family
Relaxation, or to reduce stress	Enhance the relaxative effect of fishing
To be on your own	Avoid interactions with other people
Enhance management performance	
Flexible management to meet RF needs	Broaden the range of rec-specific harvest strategy components used Optimise the period between harvest strategy reviews Include 'breakout' rules for RF in harvest strategies
Transparent management	Increase consultation periods on management changes Improve the clarity of fisheries management documentation Improve the distribution of fisheries management information

	Simplify fishing regulations
Involvement in fisheries management processes	Increase recreational representation in fisheries management advisory processes Improve partnerships between recreational fishers and fisheries management Provide opportunities for co-management

Table 2 Recreational fishing objectives hierarchy for Mulloway (*Argyrosomus japonicus*) in NSW. Objectives here are considered suitable for inclusion in a harvest strategy and represent a subset of the full list (see Table 5). Bold indicates differences with other species.

Broad objective	Sub-objectives	Specific objectives
Ensure ecological sustainability	Ensure a sustainable fishery	Maintain enough fish overall to ensure a healthy stock
		Maintain enough fish regionally to avoid local declines in numbers
		Ensure a decent proportion of the stock can reach maximum size
		Ensure a decent proportion of the stock can reach legal size
		Ensure protection of spawning aggregations
		Ensure released fish have a high chance of survival
	Minimise lost fishing gear and other waste	
Enhance economic performance	Maximise the dollar value of your recreational fishing experience	
	Generate economic value for the recreational fishing industry	Maximise the dollar return for the charter fishing industry
		Maximise the dollar return for the fishing tackle industry
	Increase development of quality regional fisheries to promote tourism	
	Minimise the cost of adhering to management regulations for the charter fishery	
	Increase investment in the fishery to obtain best management outcomes	
Ensure social outcomes	Increase the number of individuals participating in recreational fishing each year	
	Increase time spent fishing (with family and friends)	
	Ensure that the share of catch between sectors is fair, according to pre-agreed proportions	
	Improve recreational fishing experiences	Ensure a decent proportion of the stock can reach a trophy size
		Maintain enough fish overall to ensure quality fishing
		Maintain enough fish regionally to ensure quality fishing in local areas
		Ensure a good chance of encountering fish

Table 3 Recreational fishing objectives hierarchy for Yellowtail Kingfish (*Seriola lalandi*) in NSW. Objectives here are considered suitable for inclusion in a harvest strategy and represent a subset of the full list (see Table 6). Bold indicates differences with other species.

Broad objective	Sub-objectives	Specific objectives
Ensure ecological sustainability	Ensure a sustainable fishery	Maintain enough fish overall to ensure a healthy stock
		Maintain enough fish regionally to avoid local declines in numbers
		Ensure a decent proportion of the stock can reach maximum size
		Ensure a decent proportion of the stock can reach legal size
		Ensure protection of spawning aggregations
	Minimise lost fishing gear and other waste	
Enhance economic performance	Maximise the dollar value of your recreational fishing experience	
	Generate economic value for the recreational fishing industry	Maximise the dollar return for the charter fishing industry
		Maximise the dollar return for the fishing tackle industry
	Increase development of quality regional fisheries to promote tourism	
	Minimise the cost of adhering to management regulations for the charter fishery	
	Increase investment in the fishery to obtain best management outcomes	
Ensure social outcomes	Increase the number of individuals participating in recreational fishing each year	
	Increase time spent fishing (with family and friends)	
	Increase opportunities to compete in fishing tournaments	
	Ensure that the share of catch between sectors is fair, according to pre-agreed proportions	
	Improve recreational fishing experiences	Ensure a decent proportion of the stock can reach a trophy size
		Maintain enough fish overall to ensure quality fishing
		Maintain enough fish regionally to ensure quality fishing in local areas
		Ensure a good chance of encountering fish

Table 4 Recreational fishing objectives hierarchy for Snapper (*Chyrsophrys auratus*) in NSW. Objectives here are considered suitable for inclusion in a harvest strategy and represent a subset of the full list (see Table 7). Bold indicates differences with other species.

Broad objective	Sub-objectives	Specific objectives
Ensure ecological sustainability	Ensure a sustainable fishery	Maintain enough fish overall to ensure a healthy stock
		Maintain enough fish regionally to avoid local declines in numbers
		Ensure a decent proportion of the stock can reach maximum size
		Ensure a decent proportion of the stock can reach legal size
		Ensure protection of spawning aggregations
		Rebuild stocks in habitats previously known to support fish
	Minimise lost fishing gear and other waste	
Enhance economic performance	Maximise the dollar value of your recreational fishing experience	
	Generate economic value for the recreational fishing industry	Maximise the dollar return for the charter fishing industry
		Maximise the dollar return for the fishing tackle industry
	Increase development of quality regional fisheries to promote tourism	
	Minimise the cost of adhering to management regulations for the charter fishery	
	Increase investment in the fishery to obtain best management outcomes	
Ensure social outcomes	Increase the number of individuals participating in recreational fishing each year	
	Increase time spent fishing (with family and friends)	
	Increase opportunities to compete in fishing tournaments	
	Ensure that the share of catch between sectors is fair, according to pre-agreed proportions	
	Improve recreational fishing experiences	Ensure a decent proportion of the stock can reach a trophy size
		Maintain enough fish overall to ensure quality fishing
		Maintain enough fish regionally to ensure quality fishing in local areas
		Ensure a good chance of encountering fish

Table 5 Complete list of recreational fishing objectives developed for Mulloway (*Argyrosomus japonicus*) in NSW. Bold indicates those objectives considered suitable for inclusion in a harvest strategy. Note: language here differs to the non-technical language used for objectives in Table 2.

	Specific objectives (or sub-level objectives where no further specification occurred)	**Further detail**	**Objectives addressed by fixed management measures**
ECOLOGICAL/BIOLOGICAL	**Maintain stock biomass at target level**	To provide resilience	Coordinate with other sectors to minimise bycatch mortality of juvenile mulloway in other fisheries
	Maintain regional biomass at target levels per region	To avoid localised depletion	Acknowledge mortality of juvenile mulloway when setting catch or effort quotas in other fisheries
	Maintain the encounter rate at a target level	This is an abundance proxy	
	Maintain a target proportion of the stock that reaches maximum size		
	Maintain a target proportion of the stock that reaches legal size		
	Ensure protection of spawning aggregations		
	Minimise mortality of released fish	Also influenced by extent of education	
	Minimise impacts of lost fishing gear and other discarded waste	To avoid environmental impacts of fishing	
ECONOMIC	**Maximise the financial value of the recreational experience**	What the fishing experience is worth to the participant	
	Increase investment in the fishery to obtain best management outcomes		
	Minimise cost of compliance for charter industry	E.g. licence fees	
	Maximise revenue for RF charter industry	Helps maximise flow-on economic benefits to local and regional communities	
	Maximise revenue for RF tackle industry	Helps maximise flow-on economic benefits to local and regional communities)	
	Increase development of quality regional fisheries to promote tourism	The component of fishing quality linked to harvest control	
	Optimise efficiency of RFL spending through consultation with RF		
	Improve methods for evaluation of RF experience		
SOCIAL	**Increase the number of individuals participating in RF each year**	To 'grow the sport'	Avoid interactions with other people
	Maintain equitable share of catch among fishing sectors, according to allocation policy	Sectoral allocation policy does not currently exist	Minimise negative interactions with other aquatic users
	Increase time spent fishing (with family and friends)		
	Maintain stock biomass at target level	To ensure a good fishing experience and catch sufficient to feed family	
	Maintain regional biomass at target levels per region	To ensure good catches and strike rates	
	Maintain the encounter rate at a target level	To ensure a good fishing experience and strike rate for fishers of all skill levels	
	Maintain a target proportion of the stock that reaches trophy size		
	Improve physical access to fishing locations		
	Optimise the number, size and quality of boat ramps		
	Increase networking opportunities within the RF community		
	Increase knowledge of fishing techniques		
	Increase knowledge of fishing locations		
	Increase knowledge of target species		
	Maintain/improve the aesthetic beauty of fishing locations		
	Enhance relaxative effect of fishing		
	Contribute to sense of wellbeing through education to improve handling practices and minimise mortality of released fish	Both target and bycatch species	
	Improve public understanding of socio-economic benefits of RF	By improved public education, encourage efficiency of yield by taking fewer fish of a larger size, rather than many fish of smaller size	
MANAGEMENT	Avoid undue complexity and redundancy in regulations		Broaden the range of rec-specific harvest strategy components used
	Increase consultation periods on management changes		Optimise the period between harvest strategy reviews
	Increase transparency of public information regarding catch and stock status		Include 'breakout' rules for RF in harvest strategies
	Improve the clarity of fisheries management documentation		
	Improve the distribution of fisheries management information		
	Increase recreational representation in fisheries management advisory processes		
	Improve partnerships between recreational fishers and fisheries management		
	Provide opportunities for co-management		
	Increase penalties for infringement		
	Increase financial investment in management of the fishery		
	Increase fisher awareness of sustainable fishing practices	Including knowledge of population biology and stock assessment, the benefits of releasing large fish, best-practise fish handling, and catch-and-release)	

Table 6 Complete list of recreational fishing objectives developed for Yellowtail Kingfish (*Seriola lalandi*) in NSW. Bold indicates those objectives considered suitable for inclusion in a harvest strategy. Note: language here differs to the non-technical language used for objectives in Table 3.

	Specific objectives (or sub-level objectives where no further specification occurred)	**Further detail**	**Objectives addressed by fixed management measures**
ECOLOGICAL/BIOLOGICAL	**Maintain stock biomass at target level**	To provide resilience	Increase protection of spawning aggregations
	Maintain regional biomass at target levels per region	To avoid localised depletion	
	Maintain the encounter rate at a target level	This is an abundance proxy	
	Maintain a target proportion of the stock that reaches maximum size		
	Maintain a target proportion of the stock that reaches legal size		
	Ensure protection of spawning aggregations		
	Minimise impacts of lost fishing gear and other discarded waste	To avoid environmental impacts of fishing	
ECONOMIC	**Maximise the financial value of the recreational experience**	What the fishing experience is worth to the participant	
	Increase investment in the fishery to obtain best management outcomes		
	Minimise cost of compliance for charter industry	E.g. licence fees	
	Maximise revenue for RF charter industry	Helps maximise flow-on economic benefits to local and regional communities	
	Maximise revenue for RF tackle industry	Helps maximise flow-on economic benefits to local and regional communities)	
	Optimise efficiency of RFL spending through consultation with RF		
SOCIAL	**Increase the number of individuals participating in RF each year**	To 'grow the sport'	Avoid interactions with other people
	Maintain equitable share of catch among fishing sectors, according to allocation policy	Sectoral allocation policy does not currently exist	Minimise negative interactions with other aquatic users
	Increase time spent fishing (with family and friends)		
	Increase opportunties to compete in fishing tournaments		
	Maintain stock biomass at target level	To ensure a good fishing experience	
	Maintain regional biomass at target levels per region	To ensure good catches and strike rates	
	Maintain the encounter rate at a target level	To ensure a good fishing experience	
	Maintain a target proportion of the stock that reaches trophy size		
	Improve physical access to fishing locations		
	Optimise the number, size and quality of boat ramps		
	Increase networking opportunities within the RF community		
	Increase knowledge of fishing techniques		
	Increase knowledge of fishing locations		
	Increase knowledge of target species		
	Maintain/improve the aesthetic beauty of fishing locations		
	Enhance relaxative effect of fishing		
	Contribute to sense of wellbeing through education to improve handling practices and minimise mortality of released fish	Both target and bycatch species	
	Improve public understanding of socio-economic benefits of RF	By improved public education, encourage efficiency of yield by taking fewer fish of a larger size, rather than many fish of smaller size	
	Increase knowledge of benefits of releasing large fish		
MANAGEMENT	Avoid undue complexity and redundancy in regulations		Broaden the range of rec-specific harvest strategy components used
	Ensure clarity of regulations for kingfish HS		Optimise the period between harvest strategy reviews
	Increase consultation periods on management changes		Include 'breakout' rules for RF in harvest strategies
	Improve the clarity of fisheries management documentation		
	Improve the distribution of fisheries management information		
	Increase recreational representation in fisheries management advisory processes		
	Improve partnerships between recreational fishers and fisheries management		
	Provide opportunities for co-management		
	Maximise penalties for infringement		

Table 7 Complete list of recreational fishing objectives developed for Snapper (*Chyrsophrys auratus*) in NSW. Bold indicates those objectives considered suitable for inclusion in a harvest strategy. Note: language here differs to the non-technical language used for objectives in Table 4.

	Specific objectives (or sub-level objectives where no further specification occurred)	**Further detail**	**Objectives addressed by fixed management measures**
ECOLOGICAL/BIOLOGICAL	**Maintain stock biomass at target level**	To provide resilience	Coordinate with other sectors to minimise bycatch mortality of juveniles in other fisheries
	Maintain regional biomass at target levels per region	To avoid localised depletion	Acknowledge mortality of juveniles when setting catch or effort quotas in other fisheries
	Maintain the encounter rate at a target level	This is an abundance proxy	Increase protection of spawning aggregations
	Maintain a target proportion of the stock that reaches maximum size		Protect larger fish and maintain best eating Snapper in catch
	Maintain a target proportion of the stock that reaches legal size		
	Ensure protection of spawning aggregations		
	Rebuild stocks in habitats previously known to support fish		
	Minimise impacts of lost fishing gear and other discarded waste	To avoid environmental impacts of fishing	
ECONOMIC	**Maximise the financial value of the recreational experience**	What the fishing experience is worth to the participant	
	Increase investment in the fishery to obtain best management outcomes		
	Minimise cost of compliance for charter industry	E.g. licence fees	
	Maximise revenue for RF charter industry	Helps maximise flow-on economic benefits to local and regional communities	
	Maximise revenue for RF tackle industry	Helps maximise flow-on economic benefits to local and regional communities	
	Increase development of quality regional fisheries to promote tourism	The component of fishing quality linked to harvest control	
	Optimise efficiency of RFL spending through consultation with RF		
	Improve methods for evaluation of RF experience		
SOCIAL	**Increase the number of individuals participating in RF each year**	To 'grow the sport'	Avoid interactions with other people (i.e. recreational fishers)
	Maintain equitable share of catch among fishing sectors, according to allocation policy	Sectoral allocation policy does not currently exist	Minimise negative interactions with other aquatic users (i.e. other sectors/users)
	Increase time spent fishing (with family and friends)		
	Increase opportunties to compete in fishing tournaments		
	Maintain stock biomass at target level	To ensure a good fishing experience and catch sufficient to feed family	
	Maintain regional biomass at target levels per region	To ensure good catches and strike rates	
	Maintain the encounter rate at a target level	To ensure a good fishing experience and strike rate for fishers of all skill levels	
	Maintain a target proportion of the stock that reaches trophy size		
	Improve physical access to fishing locations		
	Optimise the number, size and quality of boat ramps		
	Increase networking opportunities within the RF community		
	Increase knowledge of fishing techniques		
	Increase knowledge of fishing locations		
	Increase knowledge of target species		
	Maintain/improve the aesthetic beauty of fishing locations		
	Enhance relaxative effect of fishing		
	Contribute to sense of wellbeing through education to improve handling practices and minimise mortality of released fish	Both target and bycatch species	
	By improved public education, encourage efficiency of yield	By only taking enough plate size fish to feed a family - fewer fish of a larger size, rather than many fish of smaller size	
	Improve public education to use whole fish to avoid waste and more generally respecting and valuing the fish.	e.g. use of head and frames	
MANAGEMENT	Avoid undue complexity and redundancy in regulations		Broaden the range of rec-specific harvest strategy components used by explicitly capturing recreational objectives in development of a harvest strategy
	Ensure clarity of regulations for Snapper HS		Optimise the period between harvest strategy reviews
	Increase consultation periods on management changes		Include 'breakout' rules for RF in harvest strategies
	Increase transparency of public information regarding catch and stock status		
	Improve the clarity of fisheries management documentation		
	Improve the distribution of fisheries management information		
	Increase recreational representation in fisheries management advisory processes		
	Improve partnerships between recreational fishers and fisheries management		
	Provide opportunities for co-management		
	Increase penalties for infringement		
	Increase financial investment in management of the fishery		
	Increase fisher awareness of sustainable fishing practices	Including knowledge of population biology and stock assessment, the benefits of releasing large fish, best-practise fish handling, and catch-and-release)	

Table 8 Management measures or considerations suggested by workshop participants for each stock. The sector(s) that would be affected by each proposed measure are indicated. C: commercial, R: recreational. 'All' refers to commercial, recreational and Aboriginal customary fishers.

Mulloway	
Measure or consideration	*Sector*
Catch quota	C
Zero bag limit/close fishery (regular review)	R and C
Use recreational licence fees to compensate commercial fishers for loss of catch during recovery period	C
Designate mulloway a line-only species:	All
- Stop beach hauling for mulloway	C
- Buy out estuary mesh net fishers	C
- Stop prawn trawling near estuary mouths	C
Increase enforcement and penalties	All
Harvest strategy related:	
- Include trigger points during increases and decreases in biomass	All
- Set the limit reference point for biomass higher than 20% and have a high target biomass (50-60%)	All
- Determine sectoral catch allocation on financial return, not an even division	C, R
Yellowtail Kingfish	
Measure or consideration	*Sector*
Decrease the daily bag limit	R
Further restrict the daily bag limit of large individuals	R
Increase the minimum legal length in accordance with size-at-maturity	All
Introduce a slot limit	All
Prohibit the use of lead lines	R
Spatial closure during spawning period	All
Trip limits	C
Quota	C
Snapper	
Measure or consideration	*Sector*
Mandatory use of release weights	R
Increase size limit to 35 cm (bring in line with other jurisdictions)	All
Slot limit	R
Decreased bag limit for large fish	R
Increase enforcement and penalties	All
Modify escape panels in fish traps	C
Regular management reviews to account for environmental changes and stock impacts	All

Figures

Figure 1 Arrangement of workshop sessions.