



Australian Government

Australian Fisheries Management Authority



Blue warehou (*Seriolella brama*) Stock Rebuilding Strategy



Revised 2014

Executive Summary

This *Blue Warehou Stock Rebuilding Strategy 2014* (the Strategy) is a revision of the *Blue Warehou Stock Rebuilding Strategy 2008* (the 2008 Strategy). The 2008 Strategy was implemented as required by the *Commonwealth Fisheries Harvest Strategy Policy 2007* to support the recovery of eastern and western stocks of blue warehou to above 20 per cent of their unfished spawning biomass, the biomass limit reference point that has been adopted for the stocks.

In 2013, assessments indicated that both the eastern and western stocks of blue warehou are likely to have remained below 20 per cent of their unfished spawning biomass and require rebuilding. This Strategy aims to rebuild the stocks to their biomass limit reference point within a biologically reasonable timeframe of 16 years. To achieve this, the Strategy:

- prevents targeted fishing for blue warehou by setting low TACs to cover incidental catches only
- ensures that incidental catch of the species is kept to a minimum
- aims to improve knowledge of stock status, including improved data collection and monitoring that will inform future management responses.

Improved data collection will provide a better understanding of the status of the stocks and their recovery projection. This will in turn inform future management measures to ensure the objectives of this Strategy are achieved.

An annual review of blue warehou catches and biological information is conducted by the Shelf Resource Assessment Group (ShelfRAG). This process forms the main tool for monitoring the performance of the Strategy in meeting its objectives. The Southern and Eastern Scalefish and Shark Fishery (SESSF) Resource Assessment Group (SESSF-RAG) annually reviews data for assessments and the South East Management Advisory Committee (SEMAC) review triggers for blue warehou catches. AFMA reports annually to the Department of the Environment on progress made under the Strategy. The management arrangements contained in this Strategy may be amended as required in response to changes in stock status or the ongoing monitoring by ShelfRAG.

Table of contents

Introduction	4
Rebuilding timeframes	4
Objectives	5
Background	5
Life history	5
Key threats	5
Status of resource	6
Catches, targeting and discards	7
Management actions to achieve the objectives.....	8
No targeting and an incidental catch limit	8
Limited entry.....	9
Gear requirements.....	9
Fishery closures	9
Triggers for east and west	9
Possible future management	9
Industry code of practice	10
Monitoring and evaluation.....	10
Stock assessments and data collection	10
Evaluation	12
Integrated Scientific Monitoring Program and monitoring.....	12
Fishery Independent Surveys	13
Industry data collection.....	13
EPBC Act listing and reporting to the Department of the Environment.....	13
Reviewing the Strategy.....	13
Impacts of the strategy	14
Economic impact	14
Consultation	14
Environmental impacts	14
References.....	15
Appendix A – ShelfRAG annual reporting template	17
Appendix B – East and west catch triggers.....	18

Introduction

Under the *Commonwealth Fisheries Harvest Strategy Policy 2007* (HSP), rebuilding strategies must be developed for all species which are below their biomass limit reference point. For blue warehou, the proxy of 20 per cent of the unfished spawning biomass is used as the limit reference point.

In 2008, the blue warehou Stock Rebuilding Strategy (the 2008 Strategy) was implemented because the eastern and western stocks were assessed to be below their limit reference points. The development and implementation of the 2008 strategy was also a condition of the Southern and Eastern Scalefish and Shark Fishery (SESSF) Wildlife Trade Operation accreditation (WTO) (2007 variation to conditions) under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The 2008 Strategy was updated in 2012 to modify reporting requirements and to include the non-trawl sectors of the SESSF. At the time of the 2012 update AFMA committed to undertake a more complete review of the Strategy in 2014. This *Blue Warehou Stock Rebuilding Strategy 2014* (the Strategy) is the outcome of that review and applies the 2013 WTO accreditation condition to ensure that management measures are in place to meet the objectives of the rebuilding strategies for species listed as conservation dependent under the EPBC Act.

No targeting of blue warehou is permitted. Targeting is prevented by setting a low incidental total allowable catch (TAC) based on the estimated incidental catch while targeting other species.

Historically, blue warehou has been caught by both trawl and non-trawl methods while fishing within the SESSF. As such, the Strategy applies to both trawl and non-trawl fishing concessions.

Rebuilding timeframes

The 2008 Strategy implemented a timeframe for stocks to rebuild to the limit reference point of one mean generation time (being approximately six years to 2014). However, when assessed by ShelfRAG in 2013, the standardised catch rates for eastern and western stocks of blue warehou were below their limit reference points suggesting that the stock had not rebuilt. It should be noted that ShelfRAG considered that catch rates did not provide a good index of abundance (see below under 'Stock assessments and data collection').

The HSP has provided further guidance that the rebuilding timeframe to the limit reference point should be within a biologically reasonable timeframe. Examples of a biological reasonable timeframe given in the HSP are the shorter of:

- a period equal to a mean generation time plus 10 years (16 years for blue warehou);
or
- three times the mean generation time (18 years for blue warehou).

This 2014 Strategy adopts the HSP example biologically reasonable rebuilding timeframe to the limit reference point of one mean generation time plus 10 years (being approximately 16 years) from the date of the 2008 Strategy. This means that blue warehou stocks should be rebuilt to the limit reference point by or before 2024. This is biologically possible given blue warehou's biological characteristics (see below under 'life history') however whether this

occurs depends largely on recruitment levels. This timeframe enables the management measures outlined below to take effect and negate any short term environmental fluctuations.

Objectives

1. To rebuild blue warehou (east and west) stocks in the area of the SESSF to or above the default limit reference biomass point (B_{LIM}) of 20 per cent of the unfished spawning biomass within a biologically reasonable time frame; one mean generation time plus 10 years (approximately 16 years). That is, to reach or exceed B_{LIM} by no later than 2024.
2. Having reached B_{LIM} , rebuild blue warehou (east and west) stocks in the area of the SESSF to the default maximum sustainable yield biomass level of 40 per cent of the unfished spawning biomass (B_{MSY}) using the harvest control rules outlined in the *SESSF Harvest Strategy Framework*.
3. Once B_{MSY} is reached, pursue the biomass level which aims to maximise net economic returns, currently 48 per cent of unfished spawning biomass (B_{MEY}).

Background

Life history

Blue warehou are found in continental shelf and upper slope waters throughout south-eastern Australia (New South Wales, Victoria, Tasmania and South Australia), both in Commonwealth and State managed waters. The species is also found in New Zealand waters. Adults are caught in depths to 500 m, although most commercial catches occur from 50 m to 300 m (Smith 1994). Blue warehou reach maturity after two to three years at a size of approximately 32 cm, and are recruited into the fishery at 35–45 cm. Maximum size and age are reported as 76–90 cm and 10–15 years respectively (Talman *et. al.* 2003, Wilson *et. al.* 2010), although higher maximum ages have been recorded for blue warehou in New Zealand.

Spawning occurs during winter and spring in various locations (Knuckey and Sivakumaran 1999), and larvae are widely distributed. Juveniles are pelagic, commonly occurring in association with jellyfish in open coastal waters. Sub-adults often occur in the sheltered waters of large marine embayments. Growth is rapid, with a mean caudal fork length of about 20 cm being attained after one year.

Blue warehou feed mainly on salps but also euphausiids, krill, crabs and small squid. They are schooling species, usually aggregating close to the sea bed although there is some evidence that they move into the middle water column at night. Schools often contain fish of a similar size. Fishbase (www.fishbase.org) records them as having a trophic level of 3.3 (± 0.4 se) (based on diet studies), a minimum population doubling time 1.4 - 4.4 years and a medium level of intrinsic resilience (based on a growth coefficient, $K = 0.19$). Given the accepted value of K is 0.37 (Klaer 2012), much higher than that used by Fishbase, and that fecundity is estimated to be 0.43–1.33 million eggs/year (Knuckey and Sivakumaran 2001), blue warehou is likely to have medium to high resilience.

Key threats

Blue warehou were historically taken as a target and incidental catch species of the trawl and the non-trawl (principally gillnet) sectors. The non-trawl sector tended to catch larger blue warehou than the trawl sector.

Total landed catch (Commonwealth and State) of blue warehou across southern and eastern Australia peaked in 1991 at approximately 2 500 t and declined to about 48 t in the 2012-13 fishing season.

Fishing mortality is considered to have had a significant impact on blue warehou stocks and if it approached the levels seen in the early years of the fishery, it could be a key threat to the species in the future. However, it has been difficult to accurately estimate current biomass and biomass depletion levels due to spatial and temporal patchiness of the species and significant uncertainties in the current and earlier stock assessment models which have relied on catch per unit effort (CPUE) trends in the Commonwealth Trawl fishery for an index of abundance. Advice from ShelfRAG, however, is that current catch levels are not a key threat to the recovery of the species. The management arrangements outlined in this Strategy are intended to reduce the threat to blue warehou posed by Commonwealth commercial fishing mortality.

The impacts on blue warehou from recreational fishers are not well known nationally, and better mortality estimates from the recreational sector could be improved to give a better picture of total fishing mortality. There are good estimates of Tasmanian recreational catch of blue warehou through recreational fishing surveys. Lyle (2000) estimated that 191.3 t of blue warehou were taken recreationally from December 1996 to April 1998. Henry & Lyle (2003) provided an estimate of 14.6 t from May 2000 to April 2001. Lyle, Tracey, Stark & Wotherspoon (2009) estimated 7 t from December 2007 to November 2008, and Lyle & Tracey (2012) estimated that 35.7 t were taken from January to December 2010.

While fishing is considered to have had a significant impact on blue warehou stocks, long term and short term environmental variability, including climate change, can also affect fish population dynamics and may also limit the recovery of blue warehou. Cai et al. (2005) through oceanographic modelling predict that the Eastern Australian Current (EAC) flow through the Tasman Sea will intensify and generate a warming rate in the Tasman Sea that is the greatest in the Southern Hemisphere. The potential impacts of environmental variability on fish stocks, including blue warehou, are not well known and further work in this area would provide a greater understanding of the species and threats to its recovery.

Status of resource

Blue warehou stocks are currently managed under the *SESSF Harvest Strategy Framework* and are assessed by ShelfRAG using standardised CPUE to determine recommended biological catches (RBCs). Standardised CPUE of both the eastern and western stocks show substantial declines after the 1986 to 1995 reference period (Haddon 2013). CPUE has shown the eastern stock to have been below the limit reference point since 1998 and the western stock for most years since 1995. Consequently, ShelfRAG has continued to recommend an RBC of 0 t with no targeted fishing.

The ABARES Fishery Status Reports 2013-14 classified blue warehou stocks as overfished and uncertain with respect to the level of fishing mortality. An overfished status was given because the indicators of biomass (recent average standardised CPUE) for both the eastern and western stocks were below their limit reference points. An uncertain status with regard to the level of fishing mortality was given because the standardised CPUE series does not yet indicate that the stocks will recover at current catch levels in the timeframe specified in the rebuilding strategy (Georgeson *et. al.* 2014).

Although the status of blue warehou is uncertain, observer sampling shows regular recruitment into the fishery and catch and effort distribution shows no apparent contraction of

the species range. Despite this, available indicators suggest that the stock is depleted with few signs of biomass rebuilding.

Catches, targeting and discards

Landings of blue warehou peaked in 1991 at nearly 2500 t. Catch has since declined (Figure 1). The TAC decreased from 365 t in 2008-09 to 183 t in 2009-10 and 2010-11, 133 t in 2011-12, and 118 t in 2012-13, 2013-14 and 2014-15 and the 2008 Strategy further reduced landings.

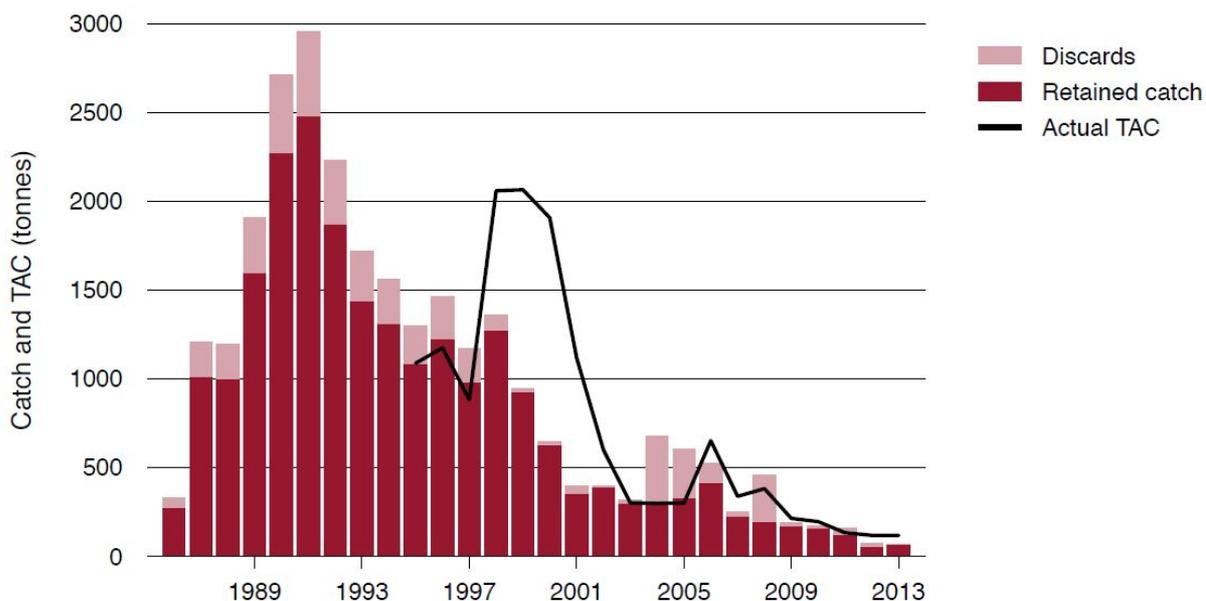


Figure 1: blue warehou annual catches (CTS, GHAT and state combined) and fishing season TACs, 1986 to 2013. Note: 2013 excludes discards and state catch (Georgeson *et. al.* 2014).

Monthly catch information for all SESSF quota species, including blue warehou, can be accessed through AFMA’s ‘catchwatch’ reports at <http://www.afma.gov.au/managing-our-fisheries/fisheries-a-to-z-index/southern-and-eastern-scalefish-and-shark-fishery/publications-and-forms/catchwatch/>.

In 2012, according to companion species analysis, the level of catch that may have been targeted was around 4-8 t in the east and 12 t in the west. However, the RAG noted that total catches had reduced significantly and therefore the analysis may have become less reliable and highly sensitive to catches by a small number of boats.

Estimates of the quantities of discarded catch, based on data recorded by onboard observers, is used in the blue warehou stock assessment and in calculating the blue warehou incidental catch limit.

These observer data suggest that there has been more active avoidance and less discarding of blue warehou in recent years. Discards decreased from 265 t in 2008, to 40 t in 2011 (Upston and Klaer 2013). No discard estimate from observed trips was available for 2012 of 2013 because of a lack of representative observer data. This reflects the difficulty for observers in predicting which trips will encounter blue warehou when operators are avoiding them. For this reason, AFMA and SETFIA have been working to encourage the collection of data by fishing crews when blue warehou are encountered.

AFMA will continue to monitor discarding through the AFMA observer program, and will work with industry to further reduce discarding. AFMA is assessing ways to improve the precision of discard information recorded by operators in catch and effort logbooks.

Management actions to achieve the objectives

There is currently no reliable index of abundance for blue warehou. The lack of a robust assessment means that it is not clear what level of catch will allow rebuilding to the limit reference point within the target timeframe. For this reason, management is focused on preventing targeting and limiting bycatch of blue warehou. Management arrangements for the current fishing season across the SESSF can be accessed in the 'SESSF management arrangements booklet' which is sent out to all concession holders before the start of each fishing season. A copy of the booklet is available at <http://www.afma.gov.au/managing-our-fisheries/fisheries-a-to-z-index/southern-and-eastern-scalefish-and-shark-fishery/publications-and-forms/>.

No targeting and an incidental catch limit

The HSP and this Strategy provide for zero targeted catch for blue warehou. As such, only an incidental catch TAC may be set after considering:

- the ability of the stocks to rebuild by 2024 under current levels of fishing mortality
- non-targeted catch based on:
 - landed catch
 - discards recorded in logbooks
 - Integrated Scientific Monitoring Program (ISMP) observer estimates of discards
- ShelfRAG or South East Management Advisory Committee (SEMAC) advice on the level of targeting and the ability of operators to avoid catching the species
- whether management arrangements (including those in this Strategy) have been, or are proposed to be, implemented to prevent targeting
- any ShelfRAG or SEMAC advice on whether the incidental catch TAC should be adjusted to account for any inefficiency in the quota market.

The TAC has decreased from 365 t in 2008-09 to 183 t in 2009-10 and 2010-11, 133 t in 2011-12, and 118 t in 2012-13, 2013-14 and 2014-15. Catch levels have been well below these limits. Statistical analyses by CSIRO indicated that of the 154 t of blue warehou catch in 2010, 118 t was unavoidable. This level of unavoidable catch has provided the basis for subsequent incidental catch TACs however this may change depending on available data (see Appendix A).

While recent catches have been below the incidental catch TAC, in 2013 ShelfRAG advised against reducing the TAC further. This was because reducing the TAC was unlikely to further reduce the amount of incidental catch and hence fishing mortality as there appears to be little targeting. It would also increase the risk of discarding and unreported catches due to restricted available quota.

If an increase in targeting behaviour is identified, AFMA, in consultation with ShelfRAG and SEMAC, may reduce the incidental TAC, introduce move on provisions into concession conditions or implement spatial closures.

Limited entry

Under the *SESSF Management Plan 2003*, access to the SESSF is limited to the number of concessions that currently exist. New operators can access the fishery only by purchasing an existing concession. This restricts any future expansion of incidental catch of blue warehou within the TAC limit.

A structural adjustment package in 2006 resulted in the removal of 59 boat Statutory Fishing Rights (approximately a 50 per cent reduction) and 32 vessels from the Commonwealth trawl sector (CTS) of the SESSF. This structural adjustment led to an immediate and significant reduction of total shots and effort (trawl hours) in the CTS, and resulted in a 24 per cent decline in total catch from 2005-06 to 2007-08 (Viera *et al* 2010).

Gear requirements

Commonwealth Trawl Sector operators are required to use gear designed to reduce the mortality (catch and discards) of juvenile fish. For demersal trawl, net mesh must not be less than 90 mm in any part of the net and in most cases a bycatch reduction device must be used.

For gillnets the mesh size must be between 15cm and 16.5cm.

Fishery closures

Fishery closures in the SESSF, while not specifically implemented for the purpose of protecting blue warehou, overlap with the distribution of blue warehou and provide some protection to stocks.

The area of the CTS that is closed to trawling adds up to approximately 86 per cent of the fishery. Closures in the Gillnet, Hook and Trap sector of the SESSF of waters deeper than approximately 183m prevent fishing in areas where blue warehou historically were targeted by gillnet fishers.

Triggers for east and west

The incidental catch TAC for blue warehou is applied to both eastern and western stocks. To ensure catches in each zone are monitored, AFMA and SEMAC review catches against triggers during the season with limits of:

- 27 t in the east
- 91 t in the west.

The percentage split is reviewed by ShelfRAG annually (see Appendix A) and may be recalculated each fishing year depending on fishing effort and the requirements of protecting and rebuilding eastern and western stocks.

The implementation of the catch triggers and reporting requirements are outlined at Appendix B.

Possible future management

With increased data becoming available, adaptive management measures may be adopted to achieve the objectives of this Strategy. These may include:

- management of the eastern and western stocks of blue warehou under separate TACs

- implementation of trigger and move-on provisions for vessels reporting large catches if annual analysis by ShelfRAG indicates that some boats are targeting blue warehou
- spatial and temporal closures of areas of likely high blue warehou abundance or believed to be spawning grounds. A voluntary industry closure was implemented from 2008 to 2012 for the eastern stock based on a historical understanding of blue warehou spawning grounds. These grounds were closed to all trawl fishing for a six week period beginning in mid-August through to the end of September, covering two full moons. The closure dates changed according to the moons. Voluntary closures were recommended in place of closures set by legislative direction as they were more cost effective and provided flexibility in setting and or changing closures. Compliance with the closures was monitored through AFMA's Vessel Monitoring System (VMS).

The voluntary closure was in place for five years, however following review in 2013 it was not continued. This was because the patchiness and unpredictability of the species, as identified in the 2005 and 2011 Fishery Independent Surveys for blue warehou (Hudson and Knuckey (2006) and Knuckey et al. (2012)) meant that the closure was not providing the stock with significant protection. A summary report by Knuckey (2012) stated that 'the large changes in variance and abundance from year to year are of concern, but may represent the real dynamics of a spatially and temporally patchy stock distribution or availability'.

ShelfRAG will continue to monitor the location and time of blue warehou catches. AFMA will reintroduce closures if appropriate areas, such as those with high concentrations of blue warehou, are identified to help achieve the objectives of this Strategy.

Industry code of practice

In early 2012 the South East Trawl Fishing Industry Association (SETFIA) with support from AFMA, developed a code of practice and an education and awareness program to actively avoid catching blue warehou and highlighting the importance of accurately recording data.

This code captures operator requirements set down by the Strategy and involves additional measures in which fishermen communicate the location of blue warehou schools in an effort to increase avoidance and reduce incidental catches. As a further initiative SETFIA and AFMA are developing online learning modules designed to educate fishers about the Industry and management, including arrangements for blue warehou.

Monitoring and evaluation

Stock assessments and data collection

Since 2005, because the Tier 1 assessment was not considered robust, blue warehou has been assessed under a Tier 4 assessment model which relies on CPUE to indicate stock abundance. The standardised CPUE for both stocks continued to be low and declining in 2013, resulting in a RBC of 0 t and an incidental catch TAC. At its November 2013 meeting, ShelfRAG considered that Tier 4 assessments for blue warehou were not reliable because avoidance of the species meant that CPUE is not reflective of abundance. As such, there continues to be uncertainties regarding the stock status and other indicators of abundance are required. The RAG also noted that there was little evidence of rebuilding.

Assessing the status of blue warehou is difficult because of the lack of reliable and representative data for the stocks. The problem has persisted because:

- fishers now avoid catching blue warehou so catch rates do not reliably reflect abundance
- length and age samples, which can be used to assess stock status, do not reflect the stocks because:
 - blue warehou tend to school in the same size classes
 - distribution of the stocks are patchy and unpredictable
 - in some years sampling is poor reflecting the unpredictable distribution of the stocks and the difficulty for AFMA observers to collect samples.

Industry has also reported that during the earlier years of the fishery when vessel numbers and catches were higher, they were able to overcome the patchiness of aggregations by working as a fleet. One vessel would find the fish, others would join and as a group they would be able to stay 'on the fish'. This search efficiency is lost due to the reduction of the fleet and the prevention of targeting of blue warehou.

Stock assessments before 2000 assumed that blue warehou formed a single stock off south east Australia. In 2003 several techniques, including DNA testing, otolith microchemistry and otolith shape analysis, indicated significant differences in the populations east and west of Bass Strait (Talman *et. al.* 2003, Robinson *et. al.* 2008). Given this strong evidence for separate stocks, recent stock assessments have been based on the assumption of two distinct stocks.

A workshop on blue warehou was held in February 2011 with the aim of determining whether there was a better approach to assessing and managing the stocks. It was agreed that an alternative index to the CPUE is required to properly assess the stock status, and that more data on the age structure of the stock and representative samples are required.

Workshop participants decided that the collection of lengths during a specific blue warehou survey could be useful for obtaining more size and age data. It was also recommended to broaden the sampling of size structure data by having operators measure length frequencies from commercial catches of blue warehou, which can be correlated with catch weight estimates. However, it was noted that the low TAC and catches in the east would constrain industry sampling for that stock.

AFMA held a further workshop in April 2013 to assist in determining a suitable index of abundance for blue warehou and ensure the best possible recovery estimates. The main recommendations of the workshop were to:

- further investigate the use of catch rates to use as an indicator of abundance. This work was considered by CSIRO in 2013 however significant uncertainties remain including because operators are actively avoiding blue warehou
- consider applying Tier 3 or Spawning Potential Ratio (SPR) assessments to existing data.

Preliminary results of the SPR analysis applied to blue warehou were presented to ShelfRAG in September 2013. ShelfRAG noted that with the currently available data the SPR analysis and any length based Tier 3 assessment are likely to be unreliable due to the data not being representative of the stock (a number of issues were identified including bimodal distribution, dome shaped selectivity, episodic recruitment, potentially unrepresentative sampling, and the spatially and temporally patchy nature of the species). Further:

- the Tier 4 assessment, which uses catch rates, would not be reliable because fishers were avoiding catching blue warehou

- a Tier 1 assessment will not be reliable given the potentially unrepresentative data.

As such, an increase in data collection is a priority for this Strategy and will be achieved through fishery independent surveys (although to date the FIS data collected for blue warehou has not shown any consistent trend), integrated scientific monitoring program (ISMP) data collection and industry collected data.

New assessment methods that are currently being evaluated for data poor situations may be suitable for application to blue warehou. Results of these methods, and methodological developments elsewhere, will be monitored and used to expand the options currently provided in the SESSF Harvest Strategy Framework. AFMA is also considering the potential for new genetic approaches (such as Close Kin Genetics) to provide improved estimates of population size that are not dependent on CPUE or surveys.

Evaluation

ShelfRAG has primary responsibility for monitoring the status of the blue warehou stocks to determine if rebuilding is occurring. A template outlining the minimum items for consideration by ShelfRAG each year is included at Appendix A.

SESSFRAG conducts an annual review of catches and biological information for blue warehou. Management arrangements may be changed as required in response to ongoing monitoring or stock assessment outcomes.

SEMAC reviews catches of blue warehou in the eastern and western zones against trigger limits.

Integrated Scientific Monitoring Program and monitoring

The ISMP is a data collection program which places observers on commercial fishing vessels to collect independent and verifiable information on fishing operations, the retained and discarded catch composition and protected species interactions. The program has provided information on the quantity, size and age composition of quota species, including blue warehou, caught in sectors of the SESSF since 1994.

The sampling design of the ISMP was reviewed in 2009 to ensure that data collection is representative of fishing effort and supports AFMA's ecosystem-based approach to fisheries management (Bergh *et al* 2009). The new sampling regime was implemented on 1 July 2010 and updated in 2014 with the aim of ensuring sampling remains representative of fishing effort.

Under the regime, approximately 3 per cent of trawl effort is covered by AFMA observers in the Commonwealth Trawl Sector. This level of coverage has been statistically determined to be sufficient to provide robust estimates of discard rates.

Further changes are made to annual observer targets to best capture data on blue warehou and other SESSF species.

Electronic monitoring systems (cameras and sensors) have been in use in the SESSF gillnet sector since 2010 and have proven effective at monitoring catch and detecting threatened, endangered and protected species bycatch events. The systems automatically record fishing activity as the catch is brought on board. AFMA is investigating the capability of the systems for use in the CTS for supplementing the ISMP, including whether it is possible for the systems to provide estimated size and species composition of catch.

Fishery Independent Surveys

Fishery Independent Surveys provide estimated abundance of fish stocks over time by surveys as opposed to commercial fishing data. This is important because for some species commercial catch rates are of limited use for providing an understanding of stock status. This is the case for blue warehou where commercial fishers actively avoid catching the species.

In an effort to aid assessments of stock status, a blue warehou trawl survey was conducted during 2005 (Hudson and Knuckey 2006). The data from the 2005 trawl survey were used as alternative indices of abundance in the 2006 assessment. However, due to the survey results being imprecise and to some extent contradictory (Punt 2006), they were of limited use and were not considered informative for the assessments.

A repeat of 2005 blue warehou trawl survey was run in 2011. Catch rates from 2011 were lower than those observed during the 2005 survey. While the results suggest abundance levels were lower than those during 2005, ShelfRAG considered the results very uncertain because of the unpredictability of the species and questioned the value of continuing such surveys (ShelfRAG, 2012 Species Summaries).

In addition, SESSF Fishery Independent Surveys were conducted in 2008, 2010, 2012 and 2014. To date, the surveys have not produced consistent estimates for blue warehou, however, the Fishery Independent Surveys have the potential to provide an index of abundance of blue warehou if the time series is continued. The large changes in variance and abundance of blue warehou from year to year may be a concern, but may represent the real dynamics of a spatially and temporally patchy stock distribution or availability.

Industry data collection

Industry collection of blue warehou length measurements commenced in 2011, supported by SETFIA, to supplement the ISMP observer program and will be incorporated into future length based assessments where applicable. To date over 2 000 samples have been collected.

Industry data collection continues to be encouraged by both SETFIA and AFMA, with the aim of length measurements being taken on every trip where blue warehou is incidentally caught.

EPBC Act listing and reporting to the Department of the Environment

AFMA reports annually on the stock status of blue warehou and performance against the goals of the Strategy to the Department of the Environment. AFMA also reports on the level of observer coverage and industry compliance with the Strategy.

Reviewing the Strategy

ShelfRAG will annually review the status of blue warehou stocks and performance against the objectives of the Strategy using the template at Appendix A. The Strategy itself will be reviewed by AFMA, with input from ShelfRAG and SEMAC, every five years.

Impacts of the strategy

Economic impact

Economic impacts associated with the recovery process for blue warehou include the costs of monitoring, research and the stock assessment process. Management costs are apportioned between industry and the Australian Government under AFMA's Cost Recovery Impact Statement (CRIS) which reflects the Australian Government's Cost Recovery Guidelines.

There is an additional impact on the fishing industry because no targeted fishing is permitted and only incidental catch TACs are set. However, some of these costs are expected to be offset in the longer term once blue warehou has rebuilt and commercial fishing can re-commence.

Consultation

During development of this strategy, AFMA has received comments from:

- the Department of the Environment and the Department of Agriculture
- members of SESSFRAG, ShelfRAG and SEMAC
- SETFIA and individual operators, particularly those in the Commonwealth Trawl Sector
- key stakeholders including environmental non-government organisations, recreational fishers and the public through AFMA's website.

Environmental impacts

Environmental impacts from the implementation of the Strategy are anticipated to be positive. The objective of the Strategy of returning blue warehou to ecologically sustainable levels is consistent with requirements under the EPBC Act.

References

Australian Fisheries Management Authority (AFMA) (2009). *Harvest Strategy Framework for the Southern and Eastern Scalefish and Shark Fishery 2009 (amended February 2014)*. [Online]. Canberra: AFMA. Available from: <http://www.afma.gov.au/managing-our-fisheries/harvest-strategies/southern-and-eastern-scalefish-and-shark-fishery-harvest-strategy/>.

Bergh, M. Knuckey, I. Gaylard, J. Martens, K. and Koopman, M. (2009) *A revised sampling regime for the Southern and Eastern Scalefish and Shark Fishery* AFMA Project F2008/0627. Fishwell Consulting P/L, Victoria.

Cai, W. G. Shi, T. Cowan, D. Bi and Ribbe, J. (2005). The response of the Southern Annular Mode, the East Australian Current, and the southern mid-latitude ocean circulation to global warming. *Geophysical Research Letters* 32(23), December 2005.

Department of Agriculture, Fisheries and Forestry (DAFF) (2007). *Commonwealth Fisheries Harvest Strategy Policy and Guidelines, September 2007*. [Online]. Canberra: DAFF. Available from: http://www.daff.gov.au/fisheries/domestic/harvest_strategy_policy.

Georgeson, L. Stobutzki, I. and Curtotti, R. (eds 2014), *Fishery status reports 2013–14*, Australian Bureau of Agricultural and Resource Economics and Sciences, Canberra.

Haddon, M. (2013), *Tier 4 analyses in the SESSF, including deep water species. Data from 1986 – 2012*, CSIRO Marine and Atmospheric Research, Hobart.

Henry, G.W. and Lyle, J.M. (2003). *The National Recreational and Indigenous Fishing Survey*. Final Report to the Fisheries Research & Development Corporation and the Fisheries Action Program. Project No. 1999/158. NSW Fisheries Final Report Series No. 48. ISSN 1440-3544. 188pp.

Hudson, R. and Knuckey, I. (2006). *Fishery Independent Survey for blue warehou in the South East Fishery*. Report to the Australian Fisheries Management Authority. Fishwell Consulting, 21pp.

Klaer, N.L. and Smith, D.C. (2012) *Determining primary and companion species in a multi-species fishery: Implications for TAC setting*. Report for the Australian Fisheries Management Authority, Canberra. *Marine Policy* 36 (2012) 606–612.

Klaer, N., Day, J, Fuller, M, Krusic-Golub, K., and Upston, J. (2012). *Data Summary for the Southern and Eastern Scalfish and Shark Fishery: Logbook, Landings and Observer Data to 2011*.

Knuckey, I. Koopman, M. Hudson, R. and Boag, S. (2012) *2011 Fishery Independent Survey for blue warehou in the Commonwealth Trawl Sector*. Fishwell Consulting.

Knuckey, I. and Sivakumaran, K.P. (1999). *Spawning and reproductive characteristics of blue warehou in south-east Australian waters*. FRDC Final Report, Project 96-142. 49 pp.

Lyle, J.M. and Tracey S.R. (2012) [*Recreational Gillnetting in Tasmania – an evaluation of fishing practices and catch and effort*](#). Institute for Marine and Antarctic Studies, University of Tasmania, Hobart.

Lyle, J.M., Tracey, S.R., Stark, K.E., and Wotherspoon, S. (2009) *2007/08 Survey of Recreational Fishing in Tasmania*. Institute for Marine and Antarctic Studies, University of Tasmania, Hobart.

Lyle, J.M. (2000) *Assessment of the licensed recreational fishery of Tasmania (phase 2)*. FRDC Final Report, Project 1996/161. See more at: <http://frdc.com.au/research/final-reports/Pages/1996-161-DLD.aspx#sthash.IUXHVZ7S.dpuf> Morison, A. Knuckey, I. Simpfendorfer C. and Buckworth, R. (2013) 2012 Stock assessment summaries for the southern and eastern scale fish and shark fishery. Report for the Australian Fisheries Management Authority, Canberra.

Punt A.E. (2006) Updated Stock Assessment of blue warehou (*Seriolella brama*) Based on Data up to 2006. CSIRO Marine and Atmospheric Research. SlopeRAG August 2006. 56 pp.

Robinson, N. Skinner, A. Sethuraman, L. McPartlan, H. Murray, N., Knuckey, I. Smith, D. C. Hindell, J. and Talman, S. (2008). Genetic stock structure of blue-eye trevalla (*Hyperoglyphe antarctica*) and warehou (*Seriolella brama* and *Seriolella punctata*) in south-eastern Australian waters. *Marine and Freshwater Research* 59, 502–514.

Smith, A.D.M. and Wayte S.E. (eds 2004) *The Southern and Eastern Scalefish and Shark Fishery 2003*, Fishery Assessment Report compiled by the Southern and Eastern Scalefish and Shark Fishery Assessment Group. Australian Fisheries Management Authority, Canberra.

Talman, S. Hamer, P. Robertson, S. Robinson, N. Skinner, A. and Smith, D.C. (2003). *Stock structure and spatial dynamics of the warehou: a pilot study*. Final report of FRDC Project 2001/004, Primary Industries Research Victoria, Marine and Freshwater Systems, Queenscliff.

Upston, J. and Klaer, N.L. (2013) Integrated Scientific Monitoring Program for the Southern and Eastern Scalefish and Shark Fishery – Discard estimation 2012 (DATA summary). CSIRO Marine and Atmospheric Research. Report for the Australian Fisheries Management Authority, Canberra.

Vieira, S. Perks, C. Mazur, K. Curtotti, R. and Li, M. (2010) *Impact of the structural adjustment package on the profitability of Commonwealth fisheries*, ABARE research report 10.01, Canberra.

Wilson D.T. Curtotti R. & Begg G.A. (eds (2010), *Fishery status reports 2009: status of fish stocks and fisheries managed by the Australian Government*, Australian Bureau of Agricultural and Resource Economics – Bureau of Rural Sciences, Canberra.

Woodhams, J. Vieira, S. and Stobutzki, I. (eds (2013), *Fishery status reports 2012*, Australian Bureau of Agricultural and Resource Economics and Sciences, Canberra.

Appendix A – ShelfRAG annual reporting template

Item	Actions
Indications of how stock status is tracking against the Strategy objectives using available assessments or indicators	
Analysis of management measures implemented	
Data collection <ul style="list-style-type: none"> • current data • gaps and needs 	
Recommended changes to management measures or data collection	
Any targeting analysis results and number of blue warehouse shots containing greater than 250kg of blue warehouse compared to previous years	
East and west catch trigger split percentage review and reporting regime (Appendix B) update and review	
Number of crew length samples and database status	
Catches by the top 10 boats (boat names not provided) as an indication changes to fishing operations	
Confidential catch 'heat' maps overlaid with 2008 voluntary closures: <ul style="list-style-type: none"> • trawl • gillnet 	

Appendix B – East and west catch triggers

Implementation of the following reporting regime and catch triggers:

- The catch limit in the eastern zone for the 2014–15 fishing season is 27 t.
 - All trips from which catches of 250 kg or more have been landed are to be reported to an AFMA Officer in the Demersal and Midwater Section on 02 6225 5555 or demersalreporting@afma.gov.au either individual operators or by first receivers (as agreed between individuals) on a fortnightly basis until the 16 tonne trigger (~60 per cent) is reached. The AFMA Officer will remind the operator to undertake industry length measurements if possible.
 - All operators will be notified once the 16 t has been reached, and requested to provide details of their total catches of blue warehou – the total tonnage will be reconciled against the tonnage recorded by AFMA.
 - Once 16 t is reached, all catches of blue warehou must be reported on a weekly basis until the 22 t (~80 per cent) secondary trigger is reached.
 - All operators will be notified that the 22 t trigger has been reached and that all catches must be reported on a trip basis.
 - If the 27 t catch limit of blue warehou is reached, all landings of blue warehou in the eastern zone will cease.
- The catch limit in the western zone for the 2014–15 fishing season is 91 t.
 - All trips from which catches of 250 kg or more have been landed are to be reported to an AFMA Officer in the Demersal and Midwater Section on 02 6225 5555 or demersalreporting@afma.gov.au by either individual catchers or by first receivers (as agreed between individuals) on a fortnightly basis until the 55 tonne trigger (~60 per cent) is reached. The AFMA Officer will remind the operator to undertake industry length measurements if possible.
 - All operators will be notified once 55 t has been reached, and requested to provide details of their total catches of blue warehou – the total tonnage will be reconciled against the tonnage recorded by AFMA.
 - Once 55 t trigger is reached, all catches of blue warehou must be reported on a weekly basis until the 73 tonne (~80 per cent) secondary trigger is reached.
 - All operators will be notified that the 73 t trigger has been reached and that all catches must be reported on a trip basis.
 - If the 91 t catch limit of blue warehou is reached, all landings of blue warehou in the western zone will cease.

In addition to the above, catch reports for both zones will be monitored on a quarterly basis.