

PROPOSED DETERMINATION

Rexea solandri - Gemfish as a Vulnerable Species

The Fisheries Scientific Committee, established under Part 7A of the *Fisheries Management Act 1994* (the Act), is proposing to list *Rexea solandri* – Gemfish as a VULNERABLE SPECIES in NSW in Part 1 of Schedule 5 of the Act.

The listing of Vulnerable Species is provided for by Part 7A, Division 2 of the Act.

The Fisheries Scientific Committee, with reference to the criteria relevant to this species, prescribed by Part 16, Division 1 of the *Fisheries Management (General) Regulation 2010* (the Regulation) has found that:

Background

- 1) *Rexea solandri* – Gemfish (Cuvier, 1832) is a valid, recognised taxon and is a species as defined in the Act.
- 2) Gemfish inhabit oceanic continental shelf and upper slope waters, and are distributed throughout southern Australian and New Zealand waters. The eastern Australian population (hereafter called "Eastern Gemfish" in this document) is distributed from Cape Moreton, Queensland to the east coast of Tasmania (north and east of 43° latitude), while the western stock extends from western Bass Strait to Geraldton, WA (Rowling et al. 2010, Morison et al. 2012). The Eastern Gemfish population is genetically different from both the western Australian population and the two populations of Gemfish found in New Zealand waters. However, the eastern Australian population shows more genetic similarity to the populations in New Zealand than to the population of Western Australia (Colgan and Paxton 1997). Because only the Eastern Gemfish population occurs in NSW, the following points will pertain to this population unless otherwise noted.
- 3) Gemfish is a carnivorous schooling species, feeding on fish, squid, and crustaceans (Froese and Pauly 2011). In eastern Australia, mature Eastern Gemfish undergo an annual spawning migration. The migration begins with the aggregation of fish north of Bass Strait in autumn, and concludes with fish reaching the spawning grounds off Crowdy Head, NSW in August (AFMA 2008). The eggs and pelagic larvae are then carried back down the NSW coast by the Eastern Australian Current (DSEWPC 2012b). There is very little gene flow between the eastern and western populations (Colgan and Paxton 1997).
- 4) Eastern Gemfish historically lived to a maximum age of 23 years. In recent years, females live to a maximum age of 17 years and 116 cm FL while males live to a maximum age of 12 years and 106 cm FL (Rowling et al. 2010). Currently the maximum age is thought to be about 12 years for both males and females (DSEWPC 2012b). Generation time is estimated at 9.24 years (Morison et al. 2012). Females mature at age 4-6 years and 60-75 cm FL, while males mature at 3-5 years and 50-70 cm FL (Rowling et al. 2010).

- 5) Eastern Gemfish are caught at depths from 100 to 600 metres from northern New South Wales / southern Queensland to southern Tasmania. The majority of the catch is taken north of 40° S latitude. Off New South Wales, the 100 m-depth contour generally lies between about 9 and 20 km from the coastline; however, in some areas (off Kurnell, Jervis Bay and Montague Island) the 100 m depth contour can be found 2 to 3 km from the coast.
- 6) Historically, the Commonwealth-managed South East Trawl Fishery has taken the main catches of Eastern Gemfish. This fishery targeted the winter spawning migration in depths of about 400 m (Morison et al. 2012). However, Eastern Gemfish are also taken by fisheries managed under the NSW *Fisheries Management Act 1994* (the trawl fishery north of Barrenjoey Pt, the dropline fishery that operates along the length of the NSW coast, auto-longlines and gillnets, Little and Rowling 2011). Since 1993, the commercial fishery is a by-catch fishery of juveniles and sub-adults in the trawl sector and mature fish in the dropline sector of the fishery. The dropline fishery in the Ocean Trap and Line Fishery now accounts for the majority of the commercial catch in NSW (Rowling et al. 2010), but this fishery has been restricted by a 50 kg trip limit since 2000 (Morison et al. 2012).
- 7) In the National Recreational and Indigenous Fishing Survey database there are no records of Eastern Gemfish caught in NSW. The recreational catch in NSW is estimated to be less than 10t per year, although the charter-boat fishery is thought to be 'significant' (Rowling et al. 2010). Recreational regulations are a 2 fish bag limit and a 10 fish boat trip limit. There is no minimum size limit (Rowling et al. 2010).
- 8) The eastern population of Gemfish *Rexea solandri* has the following conservation status:
 - i. IUCN - not assessed (IUCN 2012)
 - ii. Australian Commonwealth - Conservation Dependent (DSEWPC 2012a)
 - iii. NSW DPI – Recruitment Overfished (Rowling et al. 2010)
 - iv. Australian Society for Fish Biology 2010 - Vulnerable (ASFB 2010).

Criteria – reduction in abundance, geographic distribution or genetic diversity (Regulation clause 271)

- 1) Heavy commercial fishing pressure led to a large, rapid and significant decline in catch rates, estimated spawning stock biomass (SSB) and recruitment, as well as a steady decline in size at maturity of Eastern Gemfish since the 1970s: this is well documented in the listed references. The current SSB is thought to be at about 5-15% of historic SSB levels (Rowling 2012).
- 2) The trawl fishery developed in the late 1960s and early 1970s, with a peak catch of Eastern Gemfish of 5,000 tonnes (t) in 1980 (Little and Rowling 2011). Significant fisheries management intervention commenced in 1988 when regulations were changed to a 3,000t total allowable catch (TAC). This was progressively reduced to a zero TAC, which was in place from 1993 to 1996. In 1997, the commercial fishery was given a TAC of 1200t, with 1000t of this going to the trawl fishery. However, only 358t of Eastern Gemfish were caught that year. Consequently, a zero targeted TAC was set in 1998, with a 300t bycatch limit. Since 2004, there has been no target TAC, but a

bycatch TAC of 100t. The catch of Eastern Gemfish by NSW dropliners increased to around 100t in the 1990s (Little and Rowling 2011). Total commercial landings of Eastern Gemfish were 93t in 2007/08, 119t in 2008/09, 100t in 2009/10, and 109t in 2010/11, with the majority in the trawl fishery.

- 3) The proportion of the catch discarded is estimated to have increased significantly in recent years (Rowling 2012). The landed fish make up only about one-third of the actual harvest, with discards estimated to be an additional 129t in 2007, 164t in 2008, 168t in 2009, and 183t in 2010 (Morison et al. 2012).
- 4) Evidence of the depletion of the Eastern Gemfish population was shown by the low spawning stock biomass (SSB) estimated by the stock assessment models. In 2000, the SSB was estimated to be <1% to 4% of the 1979 biomass. The 2010 stock assessment estimated the SSB to be 15.6% of the 1979 biomass. However, this number may be overestimated (perhaps significantly) because of potential hyperstability in the CPUE time series, the reliance of the estimate on a strong 2002 year class that may have been overestimated (Morison et al. 2012), and the assumption of the stock assessment model that recruitment is equal to the average recruitment when recent recruitment levels are well below the historical average (Little and Rowling 2011). Hyperstability is the tendency of the CPUE indices to remain high despite declining stocks due to the targeting of spawning aggregations. The estimates of SSB are expected to decline in the near future as the strong year class of 2002 dies out without replacement by another strong year class.
- 5) The CPUE indices are also complicated by the fact that there is no longer a targeted fishery, and an index of abundance based on bycatch landings is difficult to interpret due to changes in fishermen's avoidance behaviour. Fishery independent sampling in 2007 and 2008 was designed to be as similar to the previous directed fishery and survey data as possible and these data were incorporated into the recent stock assessment (Rowling 2012). The 2008 4-boat survey caught just 45t of Eastern Gemfish for a catch rate of 0.8 t/standard day, compared to a similar survey in 1996 which caught 143t of Eastern Gemfish for a catch rate of 1.4 t/standard day (Little and Rowling 2011).
- 6) Although there are some indications that the stock status for Eastern Gemfish has improved since the low levels of the early 2000s, the fishery is still considered overfished due to historic catch levels (Morison et al. 2012), despite historically low fishing mortality levels (Little 2011). It is unclear whether the stock is rebuilding, despite 20 years of strict management (Rowling 2012). It is projected in some models that the stock could rebuild to more than 20% SSB by 2025, however these projections are based on assumptions that the stock abundance is not overestimated, the total catch including discards is no more than 100t and that recruitment rates are near the long-term average, which has not happened since the 1980s (Morison et al. 2012). In contrast, the recent high levels of discard may be an indication of some stock rebuilding (Morison et al. 2012). However Atlantis models, which take a whole ecosystem approach that includes both fishing and climate parameters, show that there is a risk of extinction by 2040 under the status quo model (Fulton 2012a). Further simulation modelling indicates that if recruitment levels remain low, the Eastern Gemfish population declines in future under all simulation scenarios, even with large fishery closures, although projecting into the future is uncertain (Fulton 2012b).

- 7) Recruitment of Eastern Gemfish has been very weak over the past 25 years (Morison et al. 2012). Recruitment was variable but high in the 1970s when female spawning biomass was above 5000t (Rowling 2012, Little and Rowling 2011). The decline in abundance of the adult stock led to a series of low recruitment years during the mid-late 1980s, which in turn produced small cohorts when these year classes became mature (Rowling 2012). There was a strong year class of 2002, however year class strength was only about 30% of the average year class strength seen in the 1970s and early 1980s (Morison et al. 2012) There has been no indication of missing cohorts (Rowling 2012), although year class strength in 2008 was the lowest on record (Morison et al. 2012).
- 8) There is some discussion of whether a 'regime shift' has occurred that is preventing the Eastern Gemfish stock from rebuilding (Morison et al. 2012), due to the reduction of recruitment that occurred even at moderate stock size (AFMA 2008). However, the stock-recruit relationship indicates that there may be a threshold level of stock necessary for 'normal' levels of recruitment, and that the stock has dropped below this threshold (Rowling 2012). If this is the case, then the fishery will not rebuild unless a series of stronger cohorts is spawned consecutively, which is unlikely to occur, given the recent history of the stock (Rowling 2012). Atlantis modelling shows that large closures would be required for the Eastern Gemfish stock to increase relative to the current level, and future declines are likely if recruitment doesn't increase (Fulton 2012b).
- 9) The length distributions of Eastern Gemfish caught in the commercial fisheries show that a large proportion of the Eastern Gemfish caught, including both landed and discarded fish, are juveniles or immature fish that have not yet spawned (Little and Rowling 2011). An increase in the survival of these fish to allow spawning at least once would facilitate stock recovery. Increased mesh size in the cod-ends of trawls would increase the survival of juvenile Eastern Gemfish, but would result in a loss of other key commercial species (AFMA 2008). Current regulations specify minimum mesh sizes or the use of bycatch reduction devices (Minimum Gear Requirements 2012) but the current minimum mesh sizes are not large enough to prevent the high catch and discards of juvenile fish (AFMA 2008).
- 10) Eastern Gemfish has not traditionally been a significant recreational species and the recreational catch primarily resulted when a small sector in the recreational fishery targeted Blue-Eye Trevella using drop-lines. Landings by the recreational fishery are unknown but thought to be below 10t (Rowling et al. 2010). However, discarding in the recreational fishery could be substantial due to the strict bag and trip limits. Landings of Eastern Gemfish by the charter boat fishery are likely to be 'significant' (Rowling et al. 2010).
- 11) The population has remained at a low level for about 20 years but has not shown additional declines under current management regulations. Current management strategies for rebuilding include the zero-targeted and low bycatch TACs and trip limits mentioned above, escape panels and increased cod-end mesh sizes, closures in the gulper shark fishery to protect Eastern Gemfish during the pre-spawning winter run, research into bycatch reduction in the Royal Red Prawn fishery, and monitoring of

discards using onboard observers. However, these measures have not been successful in rebuilding the stock.

- 12) The opinion of the Resource Assessment Group is that there is no appreciable risk of catch levels under the current management that would cause Eastern Gemfish to become extinct (Morison et al. 2012, Rowling 2012). However, as stated above, when ecosystem parameters are included in Atlantis models, there is some risk of extinction by 2040 under the status quo case (Fulton 2012a).
- 13) In light of the above, the Fisheries Scientific Committee has found that Gemfish in NSW has undergone a large reduction in abundance within a time frame appropriate to the life cycle and habitat characteristics of the taxon; this meets the criteria of Vulnerable.

The Fisheries Scientific Committee has had regard to the following in determining the extent of the reduction referred to above:

- a. Depletion from historic stock levels of 84 - 95% of the spawning stock biomass;
- b. Low potential for recruitment from the western population to replace the eastern population;
- c. Little progress in stock rebuilding despite 20 years of restrictive fisheries management;
- d. The possibility of much higher harvest levels than are currently reported due to unknown catches in the recreational fisheries and discarding in both commercial and recreational fisheries;
- e. The possibility that the current stock assessment models overestimate the stock due to hyperstability in the indices;
- f. The inability of fishermen to successfully avoid catching Gemfish as bycatch in directed fisheries;
- g. Continued poor recruitment, such that 'strong' year classes are now only a fraction of historic average recruitment levels;
- h. The stock-recruitment relationship indicating that the population will likely continue to experience low recruitment unless stock size is above a level of about 5000t SSB (4-5 times higher than current levels);
- i. High mortality of immature fish;
- j. The possibility of a 'regime shift', a change in environmental conditions that prevents the stock from rebuilding;
- k. The lack of 'buffering' in the population due to small stock sizes and poor recruitment, such that a recruitment failure of even one year could have large impacts on the population;
- l. The small but present risk of extinction shown by the Atlantis projection model over the next 30 years; and
- m. Under the above conditions, while the current management strategies may prevent further significant depletion of the stock, the stock may still decline to extinction due to low stock sizes or environmental conditions that prevent rebuilding or recovery.

Criteria – threatening processes (Regulation clause 272)

- 1) Current threatening processes affecting the species are non-targeted commercial and recreational fishing in eastern Australian waters, and predicted changes in climate.

- 2) Currently, Eastern Gemfish are captured as by-catch in a number of commercial fisheries managed by both the Commonwealth and NSW. Total catch managed by this by-catch quota is approximately 100t per year, with additional discards of 100-200t.
- 3) Eastern Gemfish are also taken in the recreational and charter-boat fisheries but the exact amount of landings and discards are not known.
- 4) The Rebuilding Strategy lists a three stage approach to Eastern Gemfish recovery, starting with voluntary and mandatory requirements in Stage 1, continuing through additional mandatory requirements such as more selective cod-end designs and lowering of TACS in Stage 2 and implementing closures in Stage 3 (AFMA 2008). The plan provides for annual review of the fishery to determine whether the rebuilding plan is working.
- 5) However, despite the fact that there were concerns expressed as early as 2009 that Stage 1 plans were not working (Rowling 2009, cited in Morison et al. 2012), the fishery is still operating under the Stage 1 strategy (Morison et al. 2012).
- 6) The Rebuilding Strategy also recommended closure of northern NSW waters during spawning times to protect spawners (AFMA 2008), rather than relying on trip limits to rebuild the stock but this closure has not been implemented.
- 7) The failure of fisheries management to move to a higher stage of mandatory rebuilding requirements or to implement closures to protect spawning fish indicates that existing management measures do not adequately protect the species.
- 8) Ecosystem modelling indicates that although fisheries and fisheries-induced ecosystem effects were likely the largest key threatening process in the past, it is possible that climate change may have an increasing impact in future.
- 9) For *Rexea solandri* in NSW, there is observed, inferred or reasonably suspected to be, historical, current and potential threatening process, or threatening processes affecting the species.
- 10) The Fisheries Scientific Committee has had regard to the following in determining the relevant extent of the effect of the threatening process or processes:
 - (a) The number and nature of the threatening processes,
 - (b) The potential for synergistic effects between threatening processes,
 - (c) The extent of the threatening processes relative to the geographic distribution of the species,
 - (d) The level of protection offered to the species by current management strategies.
- 11) In light of the above, the Fisheries Scientific Committee has found that these threatening processes continue to operate within the geographic distribution of the species and existing management measures do not protect the species. Furthermore, fisheries management intervention since 1988 has not resulted in significant recovery of the species.

Conclusion pursuant to section 220F(4) of the Act

In the opinion of the Fisheries Scientific Committee:

- (a) *Rexea solandri* - Gemfish is facing a high risk of extinction in New South Wales in the medium-term future, as determined in accordance with the criteria prescribed by the Regulation as discussed above, and
- (b) it is not eligible to be listed as an endangered or critically endangered species.

The species is eligible to be listed as a VULNERABLE SPECIES.

Sources and Links

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