



Department of  
Primary Industries

## Review of the Black Rockcod Recovery Plan

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DPI Fisheries - Threatened Species Unit

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## Introduction

The Black Rockcod is currently listed as Vulnerable in New South Wales under the threatened species schedules of the *Fisheries Management Act 1994* (FM Act). By definition, a Vulnerable species faces a high risk of extinction in the medium-term future as determined by the Fisheries Scientific Committee. A species is eligible for listing if it has undergone a large reduction in abundance, geographic distribution or genetic diversity and is affected by a threatening process.

This document reviews the NSW Black Rockcod Recovery Plan (NSW DPI 2012). The review assesses the implementation of recovery actions in NSW and details the progress made towards meeting the stated recovery objectives. The review also considers if any changes are required to actions or priorities necessary for the recovery of the species.

The Black Rockcod Recovery Plan was first released in 2011 and revised in 2012 in response to public submissions; to incorporate updated information; and to reflect the Australian Fish Names Standard AS SSA 5300 (NSW DPI 2012). The overall objective of the recovery plan is to prevent the extinction and promote the recovery and ongoing viability of Black Rockcod populations in NSW. The specific objectives of the plan are to:

- Mitigate moderate and high-risk threats to Black Rockcod;
- Initiate and support scientific research to increase knowledge of the distribution, abundance, reproductive biology, life history, ecology, migratory patterns, and genetics of Black Rockcod.
- Monitor fishery management strategies where necessary to reduce potential for interaction with Black Rockcod (either directly or indirectly).
- Establish an on-going monitoring program to document the status of Black Rockcod populations and their habitats and to evaluate the effectiveness of recovery actions.
- Provide enhanced compliance and protection for important Black Rockcod habitats.
- Educate the community about the identification of and 'best practice' catch and release methods for Black Rockcod, increase awareness of the status of and threats to Black Rockcod populations, and enhance community support for recovery actions; and
- Improve understanding of the threats to the survival of Black Rockcod and contribute to management actions to ameliorate identified threats.

Ultimately, delisting the Black Rockcod from the threatened species schedules of the FM Act is the long-term management goal. Initially, it was thought this could be achieved within 20 years, but a decade later, it is recognised that incremental and consistent positive progress coupled with significant investment over several decades will be required to achieve this. The recovery plan requires review within ten years of its publication. This document comprises the review and complies with section 220ZR (review of recovery and threat abatement plans) of the FM Act.

## Review of Recovery Actions

The statutory review of the Black Rockcod Recovery Plan has been undertaken in consultation with a range of natural resource managers and scientists and utilised multiple lines of

evidence (e.g. the Fisheries Scientific Committee’s Annual Reviews of FM Act threatened species, scientific papers, internal DPI reports and data) and personal communication with a range of professionals with involvement in Black Rockcod research and management.

The recovery plan includes three program areas:

- Research and Investigation activities
- Compliance and regulatory activities; and
- Management activities

The implementation details for each recovery action are summarised in Tables 1 – 3.

**Table 1 Review of recovery actions – Research and Investigation Activities (RIA)**

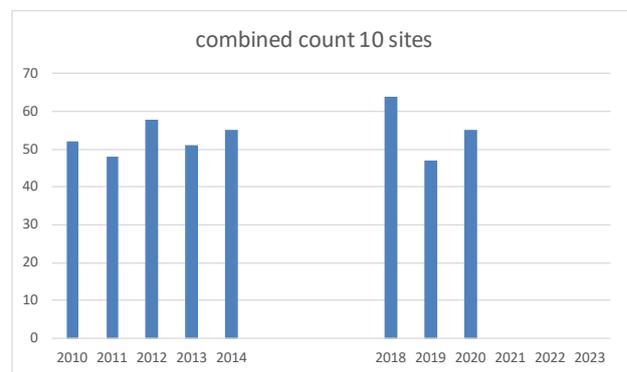
Recovery Action	Implementation Details
<p><b>RIA 1:</b> Conduct and/or facilitate targeted surveys to determine the current distribution and abundance of Black Rockcod in NSW waters.</p>	<p><b>Commenced.</b> Harasti and Malcolm (2013) undertook surveys on the distribution and relative abundance of Black Rockcod between 2009-2011. A total of 83 sites were surveyed including 34 sites in Port Stephens-Great Lakes Marine Park (PSGLMP); 31 sites between Cook Island at Tweed Heads to Fish Rock at Smoky Cape, including the Solitary Island Marine Park (SIMP); and 18 sites at Lord Howe Island Marine Park (LHIMP). The baseline survey detected 117 Black Rockcod individuals across all sites, occurring at 42% of the 83 sites surveyed. Black Rockcod were broadly distributed across several sites on shallow rocky reefs. The highest numbers recorded (14-18 individuals at a site) were at the outer Solitary Islands and Fish Rock (Smoky Cape). Fewer Black Rockcod were found further south but two sites in the PSGLMP had consistent numbers (three to six) over four annual surveys. Only 12 Black Rockcod were recorded from eight of the 18 sites at LHIMP. The numbers observed at re-surveyed sites were generally stable over years. These numbers were considered low in comparison to anecdotal reports in fishing and spear fishing magazines from the 1950-60s, and from oral accounts from fishers in these areas. A comparative survey of the 83 baseline sites is planned for 2023.</p> <p>Edgar et al. (2018) undertook Black Rockcod abundance surveys at Elizabeth and Middleton Reefs in 2013 and 2018 respectively. The biomass of Black Rockcod significantly declined between 2013 and 2018 at Elizabeth Reef, and there was an apparent increase at Middleton Reef although this</p>

Recovery Action	Implementation Details
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**RIA 2:** Continue to monitor the distribution and abundance of Black RockCod at important sites to inform population status and to assist in determining the effectiveness of recovery actions

increase was not statistically significant. Across both reefs, Black Rockcod were recorded in 35% of transects in 2013, but only 18% of transects in 2018.

**Commenced, ongoing.** A temporal trend in relative abundance of Black Rockcod has been monitored at 33 sites multiple times between 2009 and 2021 (Harasti & Malcolm, unpublished data). Of these, 10 sites have been surveyed in at least eight years (2010 to 2014; 2018 to 2020) along the east coast of NSW. The combined count at these 10 sites has shown a relatively stable trend over that 10-year period, with approximately 50 Black Rockcod recorded most years. Although numbers at these key sites do not appear to be declining, there hasn't been any noticeable increases either (Figure 1).



**Figure 1.** Combined relative abundance count at 10 key monitoring sites (Malcolm, unpublished data).

Pratchett et al. (2011) carried out a survey of Elizabeth and Middleton Reefs to assess abundance of Black Rockcod. They sampled at 16 sites across both reefs and found 2.41 Black Rockcod individuals per hectare with no significant variation between reefs or sites but did find that Black Rockcod densities had declined significantly at 4 out of 8 sites sampled in both 2006 and 2011.

Edgar et al (2018) repeated abundance surveys of Black Rockcod at Elizabeth and Middleton Reefs in 2018. As noted in RIA 1 the biomass of Black Rockcod significantly declined between 2013 and 2018 at Elizabeth Reef, an area which can be fished. An increase in abundance at Middleton Reef was not significant. Across both reefs, Black Rockcod were recorded on 35% of transects in 2013, but only

Recovery Action	Implementation Details
	<p>18% of transects in 2018 with the decline in frequency slightly more pronounced at Elizabeth Reef (Edgar et al. 2018).</p> <p>Kelaher et al. (2015) used an experimental design from 2006-2012 to test whether new enforcement initiatives enhanced abundances of target fishes and threatened species in an existing marine sanctuary relative to areas open to fishing. Black Rockcod were sighted 10 times, all sightings within the Cape Pinnacle sanctuary, with none sighted in fished areas, which is more than can be expected by chance (Binomial probability test, <math>P &lt; 0.01</math>).</p> <p>The National Environment &amp; Science Marine and Coastal Hub has solicited a proposal for continuing Black Rockcod monitoring work in 2023.</p>
<p><b>RIA 3:</b> Initiate collaborative projects to investigate the biology and ecology of Black Rockcod (e.g. life history, habitat requirements, fecundity, reproductive biology, movements, response to climate change and water pollution etc)</p>	<p><b>Commenced, ongoing.</b> From surveys undertaken in NSW over the past 11 years and opportunistic collection of otoliths for ageing (from Black Rockcod found dead), the following is known (from Francis et al. 2015):</p> <p><b>Life history</b></p> <ul style="list-style-type: none"> <li>• Age: can live &gt;65 years.</li> <li>• Size: adults can reach 170 cm.</li> <li>• Protogynous hermaphrodites. Mature as females at 12 to 20 years and about 75 cm in length. Change to males at about 25 years and 100 cm in length.</li> <li>• Largest fish recorded in NSW during surveys = 142 cm (from stereo-video measurements).</li> </ul> <p><b>Habitat</b></p> <ul style="list-style-type: none"> <li>• Predominantly a shallow-water reef (&lt;30 metres) fish.</li> <li>• Adults show a preference for habitat with structural features providing solid cover such as boulders and overhangs (Harasti &amp; Malcolm 2013).</li> <li>• Juveniles utilise rock pool and shallow reef habitats, particularly as small recruits which suggests an ontogenetic change in habitat use (Harasti et al. 2014).</li> <li>• Larger males along the mainland NSW coast predominantly found in the north, with the SIMP and Fish Rock a stronghold for larger individuals (Harasti &amp; Malcolm 2013).</li> </ul> <p><b>Ecology</b></p>

Recovery Action	Implementation Details
	<ul style="list-style-type: none"> <li>• Juveniles predominantly found further south along the PSGLMP coast. Suggests a northern and offshore migration of adults as they mature. The East Australian Current (EAC) provides a mechanism for larval transport south, with Advanced Research and Global Observation Satellite drifters deployed at North Solitary Island ending up against the coast as well as in the East Australian Current eddy field (Malcolm unpublished data).</li> <li>• Highly variable colour patterns. Can rapidly change colour from almost-black to almost-white.</li> <li>• There is no apparent difference in seasonal abundance (austral spring and autumn) of Black Rockcod at PSGLMP (Harasti &amp; Malcolm 2013).</li> <li>• The Solitary Islands is likely to be an important region for Black Rockcod reproduction in NSW given this is where large males (&gt;100 cm) were predominantly found (Harasti &amp; Malcolm 2013).</li> </ul>
<p><b>RIA 4:</b> Initiate research projects to examine the impacts of medium and high risk fishing activities on Black Rockcod. In particular, the effects of barotrauma from bottom-set baited hook and line fishing including setlining, trotlining, handlining, and droplining and the effects of hook and line fishing with soft plastic lures.</p>	<p><b>Commenced.</b> It is recognised that Black Rockcod are very susceptible to barotrauma, particularly when caught in depths of greater than ~ 30 m (Francis et al. 2015). DPI has undertaken research into fishing impacts on marine fish and barotrauma generally. Although not specific to Black Rockcod, this research is of benefit to species which are incidentally caught.</p> <p>The research led to advisory information being placed on the DPI website and the publication in 2013 of a best practice catch and release handbook. See:  <a href="http://www.dpi.nsw.gov.au/fishing/recreational/fishing-skills/catch-and-release">www.dpi.nsw.gov.au/fishing/recreational/fishing-skills/catch-and-release</a></p>
<p><b>RIA 5:</b> Undertake research into 'best practice' release methods and gear types to reduce impacts on accidentally caught Black Rockcod, particularly from Barotrauma</p>	<p><b>Commenced.</b> As noted above, DPI has undertaken research into fishing impacts on marine fish and barotrauma generally. Although not specific to Black Rockcod, this research is of benefit to species which are incidentally caught.</p> <p>The research led to advisory information being placed on the DPI website and the publication in 2013 of a best practice catch and release handbook. See:  <a href="http://www.dpi.nsw.gov.au/fishing/recreational/fishing-skills/catch-and-release">www.dpi.nsw.gov.au/fishing/recreational/fishing-skills/catch-and-release</a></p>

Recovery Action	Implementation Details
<p><b>RIA 6:</b> Undertake research into the impacts of climate change on Black Rockcod including for example rising sea levels, increasing acidity of marine waters, changing rainfall patterns and increasing global temperature.</p>	<p><b>Not commenced.</b> However, climate change is being addressed in the Marine Estate Management Strategy through Initiative 3: “Planning for climate change”.</p> <p>Impacts of water temperature and acidity changes are generally undertaken with aquaria experiments and this is not possible for Black Rockcod.</p> <p>Future work on the impacts of climate change would have to be done on other serranids or through desktop modelling to assess potential changes in their distribution, as has been undertaken in DPI on other fish species (Champion et al 2021).</p>
<p><b>RIA 7:</b> Initiate research projects to examine the precise impacts of water pollution on the biology and ecology of Black Rockcod.</p>	<p><b>Not commenced.</b> However, water quality is being addressed in the Marine Estate Management Strategy through Initiative 1: “Improving water quality and reducing litter”.</p>

**Table 2 Review of recovery actions – Compliance and Regulatory Activities (CRA)**

Recovery Action	Implementation Details
<p><b>CRA 1:</b> Incorporate Black Rockcod issues into NSW DPI Annual District Compliance Plans.</p>	<p><b>Commenced, ongoing.</b> NSW DPI Annual Zone Compliance Plans (formerly Annual District Compliance Plans) identify the key priorities for compliance service delivery within each of the four primary Compliance Zones along the NSW Coast (including the Far North Coast, North Coast, Greater Metropolitan and Far South Coast). Black Rockcod fall within the ‘Threatened Species’ sub compliance programs of each zone and proposed law enforcement and advisory services associated with Black Rockcod are identified and prioritised under these plans.</p> <p>Compliance for Black Rockcod focuses on creating a deterrence and detecting and reporting offences involving the unlawful take, possession or sale of this species or damage to their habitat. Additional compliance resources are also allocated to detect and deter all manner of unlawful fishing activities within the NSW marine park estate. This includes detecting and deterring unlawful fishing activities ranging from</p>

Recovery Action	Implementation Details
<p><b>CRA 2:</b> Maximise compliance activities at identified important sites (from RIA 1-3) and where necessary, increase protection of Black Rockcod at these sites through regulatory controls.</p>	<p>fishing within sanctuary zones where all forms of fish are prohibited, through to taking or harming threatened species including Black Rockcod.</p> <p><b>Commenced.</b> Fisheries Officers routinely patrol estuarine and marine waters where Black Rockcod are known to occur. During patrols it is routine for Fisheries Officers to directly interact with and inspect the activities of any or all vessels and fishers (including divers) that they come across. A standard component of every inspection is to inspect both fishing gear and catch, and a high priority is placed on detecting the unlawful capture and retention of threatened species such as Black Rockcod. In circumstances where threatened species or suspected threatened species are detected, compliance action ranging from formal cautions through to prosecution are implemented in line with departmental compliance policies and guidelines (J. Wright, NSW DPI Fisheries, pers Comm).</p> <p>Fisheries Officers also routinely inspect commercial and retail fish outlets to detect the illegal possession or sale of threatened species including Black Rockcod.</p> <p>Community education is key to maximising compliance with threatened species regulations. Identification signs have been installed at key sites along the NSW coastline and advisory materials including a Primefact, and a guide for protection of Black Rockcod for recreational fishers and divers, have also been prepared. Targeted advisory materials have been distributed to stakeholders when required and are also available to the public on the DPI website.</p>

**Table 3 Review of recovery actions – Management Activities (MA)**

Recovery Action	Implementation Details
<p><b>MA 1:</b> Contribute to the design of observer programs in the Ocean Trap and Line Fishery and Estuary General Fishery to quantify the extent of interactions between</p>	<p><b>Commenced, ongoing.</b> <u>Ocean Trap and Line Fishery</u></p>

Recovery Action	Implementation Details
<p>these fisheries and Black Rockcod. Compile and disseminate existing records of the interaction of bottom-set baited hook and line fishing methods with Black Rockcod.</p>	<p>Interactions between the OTL Fishery and Black Rockcod have been observed during two observer programs:</p> <ol style="list-style-type: none"> <li>1. The 'NSW Observer-based Study of Commercial Line Fishing in Waters of NSW' (Macbeth and Gray, 2015) provides information about interactions between handline, dropline and set/trotline fishing gears and Threatened, Endangered and Protected (TEPs) species based on 307 observed fisher days over a two-year period (NSW DPI 2021a). One Black Rockcod was caught and discarded during a landline fisher day.</li> <li>2. Observer-based survey of the OTL – Line Fishing West Zone (in progress). The rates of interaction between the OTL Fisher and TEP species reported by Macbeth and Gray (2015) were used to optimise a sampling design to estimate the total number of circumstances of interactions between OTL Fishery and TEP species. To date, 275 trips have been observed from the Queensland border to Newcastle (NSW DPI 2021a). Interactions with TEP species were rare with few reports overall and no reports of Black Rockcod interactions between 2019 – 2021 (NSW DPI 2021a).</li> </ol> <p><u>Estuary General Fishery</u></p> <p>An observer-based survey of the Estuary General trap fisheries targeting Blue Swimmer and Mud Crabs in six NSW estuaries has been implemented under sub-action 5.5 of the Marine Estate Management Strategy (Expanded Commercial Fishery Observer Program). To date, approximately 400 trips have been completed and &gt;8000 traps lifts monitored. The data collected from this program are currently being analysed. The estimated total number and circumstances of interactions (including the life status at the time of the interaction) between the estuary general trap fishery and Black Rockcod will be reported in the project findings. Nil mortalities of Black Rockcod were observed (D. Johnson, NSW DPI Fisheries, pers. comm).</p>
<p><b>MA 2:</b> Address identification issues by developing and distributing practical identification materials for fishers and spearfishers and by making them available on the NSW DPI website.</p>	<p><b>Ongoing.</b> Advisory materials have been prepared and distributed, including a guide for protecting Black Rockcod for fishers and divers, a Primefact, stickers and signage specifically addressing Black Rockcod identification issues. The Black Rockcod webpage on DPI Threatened Species website was also</p>

Recovery Action	Implementation Details
	<p>recently updated, and is in regular review as new information, videos and photos become available:</p> <p><a href="http://www.dpi.nsw.gov.au/fishing/threatened-species/what-current/vulnerable-species2/black-rockcod">www.dpi.nsw.gov.au/fishing/threatened-species/what-current/vulnerable-species2/black-rockcod</a></p> <p>A new webpage has been created on the DPI threatened species website about responsible fishing: <a href="http://www.dpi.nsw.gov.au/fishing/threatened-species/responsible-fishing">www.dpi.nsw.gov.au/fishing/threatened-species/responsible-fishing</a></p> <p>A video on how to identify some threatened species in NSW (including Black Rockcod) and how to minimise fishing impacts has been produced as part of Initiative 5 of the Marine Estate Management Strategy and published on the NSW DPI website and YouTube channel (<a href="https://youtu.be/w4CXPqO4tmw">youtu.be/w4CXPqO4tmw</a>). Promotion of the video occurred through social media channels such as Facebook and Instagram and has had over 2,000 views (as of July 2022).</p> <p>Advisory materials are distributed to key stakeholders when required and are also available on the NSW DPI website. Social media channels (NSW DPI Fisheries and NSW Marine Estate Instagram and Facebook) are utilised, such as for the promotion of newly produced advisory material, reporting on compliance actions or educating about the species (see Figures 1 and 2 in Appendix).</p>
<p><b>MA 3:</b> Encourage fishers/spearfishers and managers to record the capture location and approximate length and weight of incidentally caught Black Rockcod in NSW to the Threatened and Protected Species Sighting Program, and via mandatory reporting arrangements for commercial fisheries and shark meshing contractors.</p>	<p><b>Ongoing.</b> NSW DPI produces multiple Black Rockcod advisory materials for distribution at Fisheries offices, community events and at various outdoor recreational shows. These materials are also available on the DPI website and encourage community members to report any incidentally caught Black Rockcod via the NSW DPI online form: <a href="http://www.dpi.nsw.gov.au/fishing/threatened-species/report-it">www.dpi.nsw.gov.au/fishing/threatened-species/report-it</a></p> <p>NSW DPI implemented mandatory reporting of threatened and protected species interactions for all commercial fisheries in 2005 (NSW DPI 2017). If a fisher interacts with a threatened or protected species, they must record the interaction in their log sheet, then complete a 'Threatened and/or Protected Species Interaction Reporting Form' and attach it to the log sheet submitted to DPI Fisheries.</p> <p>A total of six Black Rockcod interactions were reported by endorsement holders in the OTL Fishery between 2016/17 and 2019/20. This includes two</p>

Recovery Action	Implementation Details
	<p>Black Rockcod caught by handline in 2016/17, both released healthy; one Black Rockcod caught in a demersal fish trap in 2018/19, released in a distressed state; and three Black Rockcod caught in demersal fish traps in 2019/20, one released healthy and two released distressed (NSW DPI 2021a).</p> <p>One interaction with Black Rockcod was reported in logbooks in the Estuary General Fishery between 2012 and 2016 (Commonwealth of Australia 2018). The fate of this fish was reported as unknown.</p> <p>Black Rockcod have not been recorded from the Shark Meshing Program and as such there are nil reports from the Shark Meshing contractors (M. Green, NSW DPI Fisheries, pers. Comm).</p>
<p><b>MA 4:</b> Collaborate with recreational and commercial fishing magazines to enhance publicity about Black Rockcod to improve species identification, the reporting of interactions with Black Rockcod, and to promote best practice techniques for handling and releasing incidentally caught Black Rockcod.</p>	<p><b>Ongoing.</b> A video on how to identify some threatened species in NSW (including Black Rockcod), produced under Initiative 5 of the Marine Estate Management Strategy, was voiced by Steve “Starlo” Starling - an Australian sports fishing writer and television personality. Starlo also reposted the video in his Facebook page, which has over 29,000 followers (as of July 2022).</p> <p>Fishing magazines have also previously contacted the Department for a statement, including for articles about the Black Rockcod (for example: <a href="http://www.fishingworld.com.au/news/spearo-fined-for-black-rockcod-kill">www.fishingworld.com.au/news/spearo-fined-for-black-rockcod-kill</a>)</p>
<p><b>MA 5:</b> Collate and synthesise data collected through MA 1, 3 &amp; 4 to quantify the significance of high and moderate risk threat interactions with Black Rockcod.</p>	<p><b>Commenced, ongoing.</b> The Department maintains an online threatened species reporting tool and encourages anyone who sees a threatened species to report it. Reporting threatened species sightings/catches is also a standard condition included in permits issued under the FM Act. Sightings help to inform the status and distribution of the species.</p> <p>The Department has also commenced collating sightings data from other sources, including RedMap, Reef Life Survey and iNaturalist.</p>
<p><b>MA 6:</b> Using the results from RIA 4 &amp; 5 promote the use of fishing techniques and gear that eliminate or mitigate the impact of high and moderate risk activities on Black Rockcod. Specifically promote techniques and gear that avoid the capture</p>	<p><b>Commenced.</b> As noted in RIA 4, DPI has undertaken research into fishing impacts on marine fish and barotrauma generally. Although not specific to Black Rockcod, this research is of benefit to species which are incidentally caught.</p>

Recovery Action	Implementation Details
<p>of Black Rockcod and minimise impacts on accidentally caught fish.</p>	<p>The research led to advisory information being placed on the DPI website and the publication in 2013 of a best practice catch and release handbook. See: <a href="http://www.dpi.nsw.gov.au/fishing/recreational/fishing-skills/catch-and-release">www.dpi.nsw.gov.au/fishing/recreational/fishing-skills/catch-and-release</a></p> <p>A similar page is available on the threatened species website, with a link to the threatened species video as per MA 2: <a href="http://www.dpi.nsw.gov.au/fishing/threatened-species/responsible-fishing">www.dpi.nsw.gov.au/fishing/threatened-species/responsible-fishing</a></p>
<p><b>MA 7:</b> Produce advisory material to assist in raising awareness of the identification of Black Rockcod and the protected status of the species and distribute this information to relevant stakeholders including fishing and dive clubs.</p>	<p><b>Commenced, ongoing.</b> A range of advisory materials have been prepared to assist with improving knowledge of Black Rockcod conservation and identification issues. These include a Primefact, a guide for fishers and divers, stickers and signage. Further information and videos of Black Rockcod are also available on the DPI website, YouTube account and social media pages.</p> <p>A double-sided poster on all aquatic NSW threatened species was produced in 2017, which includes information on the Black Rockcod (marine/estuarine on one side and freshwater on the other side) (see Figure 3 in Appendix).</p> <p>Advisory material is distributed to relevant district fisheries offices, marine park offices, councils, dive shops, fishing tackle stores, schools, environment centres and others as required. Anyone can request copies of threatened species advisory material by emailing the Threatened Species Unit. All advisory material is also made available in the DPI Fisheries advisory trailer "Bluey" which is taken to school and community events such as local council environment days, the Royal Easter Show, the Sydney Boat Show etc.</p> <p>The Department also releases a media statement (via the website or social media) most years for Threatened Species Day (September 7). The media release aims to raise awareness of aquatic threatened species in NSW and encourage sightings through the DPI website (See Figure 4 in Appendix for an example media statement).</p> <p>Information about Black Rockcod is included in the threatened species section of the NSW Saltwater Fishing Guide and the information is reviewed annually.</p>

Recovery Action	Implementation Details
<p><b>MA 8:</b> Work with commercial aquaria to increase public awareness of the status and threats to Black Rockcod.</p>	<p><b>Commenced.</b> DPI has begun working with SEALIFE Sydney Aquarium to raise awareness of Black Rockcod via inclusion of education materials at the Aquarium.</p>
<p><b>MA 9:</b> Where appropriate, actively encourage community involvement in aspects of Black Rockcod recovery including for example, research and monitoring programs.</p>	<p><b>Commenced, ongoing.</b> DPI encourages community involvement in various aspects of Black Rockcod research. For example, DPI scientists conducted training with volunteers from the Nature Coast Marine Group in Narooma and within Port Stephens – Great Lakes Marine Park to assist with deploying baited remote underwater video stations to locate juvenile Black Rockcod.</p> <p>DPI also encourages involvement in the Reef Life Survey program, a citizen science initiative that enhances divers’ understanding of fish assemblages and habitat while generating valuable biodiversity data and occurrence records.</p>
<p><b>MA 10:</b> Support community groups involved in the monitoring and recording of the presence of Black Rockcod.</p>	<p><b>Commenced, ongoing.</b> In addition to supporting community involvement noted in MA 9, Black Rockcod advisory materials encourage community reporting by promoting participation in the DPI Threatened Species Sighting Program.</p>
<p><b>MA 11:</b> Ensure that councils, government agencies and other relevant organisations are aware of the location of important areas for Black Rockcod, for example, by providing maps of known and potential habitat and the location of significant populations.</p>	<p><b>Commenced, ongoing.</b> Information on threatened aquatic species distribution in NSW has been distributed using Primefacts and other web based advisory materials. Black Rockcod publications are available on the NSW DPI website and are sent to coastal DPI Fisheries and Marine Parks Offices for distribution on request.</p>
<p><b>MA 12:</b> Provide other relevant information to support appropriate planning and impact assessment, e.g. Environmental Impact Assessment Guidelines.</p>	<p><b>Commenced, ongoing.</b> DPI Fisheries and Marine Parks staff assess in-water works to ensure appropriate Assessments of Significance are undertaken for Black Rockcod so that potential impacts are avoided, mitigated, and minimised.</p> <p>Environmental Impact Assessment Guidelines for threatened fish species were prepared in 2008 and made available on the NSW DPI website: <a href="http://www.dpi.nsw.gov.au/fishing/threatened-species/legislation-and-approvals/impact-assessment/info-sheet">www.dpi.nsw.gov.au/fishing/threatened-species/legislation-and-approvals/impact-assessment/info-sheet</a> The guidelines aim to help ensure that a consistent and systematic approach is taken when determining whether an action, development or activity is likely to significantly affect threatened species, populations or ecological</p>

Recovery Action	Implementation Details
	<p>communities, or their habitats either directly or indirectly.</p> <p>The DPI Policy and Guidelines for Fish Habitat and Conservation and Management were updated in 2013 and are available on the DPI website: <a href="http://www.dpi.nsw.gov.au/fishing/habitat/publications/publications/fish-habitat-conservation">www.dpi.nsw.gov.au/fishing/habitat/publications/publications/fish-habitat-conservation</a></p> <p>This document aims to maintain and enhance fish habitat and address threatening processes for the benefit of native fish species, including threatened species. It also contains legislative and policy information for planning and development assessment processes, including threatened species assessment.</p>
<p><b>MA 13:</b> Negotiate with local councils and industry groups regarding the type and scale of development near key areas known to support populations of Black Rockcod.</p>	<p><b>Ongoing.</b> Local councils and developers are required to comply with the NSW DPI Policy and Guidelines for Fish Habitat and Conservation Management as well as the Policy and Guidelines for Fish Friendly Waterway Crossings for any development that occurs in or around NSW waterways. They are also required to comply with the zoning requirements and management rules within marine parks. No licence for the harm of Black Rockcod has been required to be issued (C. Ganassin, NSW DPI Fisheries, pers. Comm).</p> <p>Opportunities to enhance Black Rockcod habitat through including specific design features incorporating habitat in seawalls, bank revetment and oyster reefs has been negotiated during the planning stage of works in aquatic habitats.</p>
<p><b>MA 14:</b> Consider information on Black Rockcod distribution, abundance and habitat preferences during development and review of Marine Park Zoning Plans.</p>	<p><b>Commenced, ongoing.</b> There are few studies that assess the role of NSW Marine Parks in management of Black Rockcod. In reviewing the literature (i.e. Francis et al 2015) the NSW Marine Estate Expert Knowledge Panel (2020) noted that the biology and behaviour of Black Rockcod make it vulnerable and concluded that further prohibitions on fishing in key locations are likely to be important for the recovery and long-term survival of this species, and that marine parks in NSW are likely to play a role in this.</p> <p>The NSW Mainland Marine Park Network Draft Management Plan 2021-2031 was released for public comment in November 2021. The plan replaces 10 separate zoning and operational plans for the five mainland marine parks (NSW DPI 2021b). New management rules (including zoning) for each marine</p>

Recovery Action	Implementation Details
	<p>park will be developed as part of stage 2 of the management planning process. Information on Black Rockcod distribution, abundance and habitat preferences will be considered as part of this process.</p>
<p><b>MA 15:</b> Implement the NSW Diffuse Source Water Pollution Strategy to coordinate efforts to reduce diffuse source water pollution impacting on Black Rockcod habitat.</p>	<p><b>Commenced, ongoing.</b> The NSW Diffuse Source Water Pollution Strategy aims to reduce diffuse source water pollution in all NSW surface and groundwaters and contribute towards NSW water quality objectives (DECC 2009). NSW DPI works with a range of government agencies, local councils, and key stakeholders to implement the key objectives of the strategy. Example actions include restoration of oyster reefs; implementation of the clean coastal catchments program focused on reducing nutrient runoff from farms; assessment of coastal floodplain systems and infrastructure to assist decision makers in enhancement of water quality; education and regulatory measures to improve sediment management during construction; and estuarine water quality monitoring.</p> <p>More recently, the Marine Estate Management Strategy introduced the key initiative of improving water quality and reducing litter. One of the projects that sits under this action is improving management of water pollution from diffuse sources in NSW. The project aims to improve how diffuse water pollution is managed by clarifying roles and responsibility across government and identify management actions. The strategy also includes a risk-based framework for urban waterway health to establish catchment specific stormwater pollution targets.</p>
<p><b>MA 16:</b> Negotiate with relevant authorities to encourage the identification, assessment and modification of natural resource management plans and policies to minimise impacts on Black Rockcod habitats and water quality.</p>	<p><b>Ongoing.</b> Dissemination of up-to-date best practice recommendations for Black Rockcod habitat management is provided by the NSW DPI Policy and Guidelines for Fish Habitat Conservation and Management. Habitat management advice is also incorporated into advisory guidelines used by DPI to inform stakeholder agencies of their responsibilities regarding Black Rockcod recovery efforts.</p> <p>New management rules (including zoning) for each marine park will be developed as part of stage 2 of the marine park management planning process. Information on Black Rockcod distribution, abundance and habitat preferences will be considered as part of this process (See MA14).</p>

## Assessment of Action Implementation

A total of twenty-three out of twenty-five Black Rockcod recovery actions have commenced or are ongoing. The incremental nature of threatened species recovery requires long term commitment and maintenance of conservation efforts. This is reflected in the large number of actions that are deemed 'ongoing' and reinforces the need for continued efforts to reach long term recovery for Black Rockcod.

**Research and Investigation Activities:** Five of the seven actions have commenced and are ongoing under this section. Knowledge of Black Rockcod ecology has progressed over the past decade and several research projects have contributed information on distribution and abundance, habitat preferences and life history. The two actions that haven't commenced (research into climate change and water pollution) are being addressed more broadly through Initiatives 1 and 3 in the Marine Estate Management Strategy.

**Compliance and Regulatory Activities:** All recovery actions have commenced and are ongoing under this section. Black Rockcod are included in relevant DPI Annual Zone Compliance plans and include specific compliance and advisory priorities for the species. Fisheries Officers routinely patrol waters where Black Rockcod occur and a high priority is placed on the protection of this threatened species.

**Management Activities:** All management actions have commenced and are ongoing. The extent of implementation varies between actions but significant progress has been made in relation to quantifying the extent of interactions between Black Rockcod and the Ocean Trap and Line and Estuary General Fisheries; development of targeted advisory materials; and ongoing assessments for proposed in-water works to ensure that impacts on Black Rockcod are avoided, mitigated and minimised. Initiatives aimed at improving water quality have also commenced including key initiatives introduced under the Marine Estate Management Strategy.

## Discussion of Recovery Plan Objectives

The overall objective of the Black Rockcod Recovery Plan is to prevent the extinction and ensure the recovery and ongoing viability of Black Rockcod populations in NSW. Research supports that while the overall abundance of Black Rockcod has not significantly declined, it has not markedly increased either and abundance appears to remain well below historical levels. This could be related to a range of factors. For example, the species' reproductive biology and life history could mean that it would take several decades for populations to show signs of recovery. Repeated long-term monitoring of key sites is instrumental to inform the effectiveness of recovery actions over time at those sites.

Delisting Black Rockcod from the schedules of the FM Act within 20 years is the long-term recovery plan measure of success. However, insights into the reproductive biology and life history of Black Rockcod now indicate that the generational increases required for recovery is likely to be slow. Therefore, the 20-year timeframe for delisting Black Rockcod may not be sufficient as the effects of implemented recovery actions may take considerable time to be reflected in population recovery. Consideration should also be given to whether eventually delisting this species from the FM Act is an appropriate objective, given the potential need

for re-listing when the impacts of threatening processes (such as increased fishing) may again result in a decline in species abundance. The life history and habits of Black Rockcod make them vulnerable to overfishing (large, long-lived, slow-moving, slow-growing, territorial, delayed maturity and generally easily approached). Their reproductive history (protogynous hermaphrodites, changing from female to male at about 25 years and 100cm in length) makes protecting smaller fish critical to ensure not only female maturity, but also to allow larger fish to change to male.

Since the adoption of the Black Rockcod Recovery Plan, legislative changes to the FM Act have required the development of a Priority Action Statement (PAS) as per Division 5A of the FM Act. The PAS sets out all the actions required to recover threatened species, populations and ecological communities and addresses key threatening processes listed in the FM Act. The actions outlined in the Black Rockcod Recovery Plan have been prioritised in the PAS. Any future actions required to recover Black Rockcod will be outlined in future reviews of the PAS (conducted every three years as per Division 5A of the FM Act). Future recovery programs or revisions to the PAS should consider alternative measures for determining recovery success. This may include for example, downgrading the status of Black Rockcod from 'threatened' to 'protected fish' under the FM Act thereby continuing to prohibit their take and possession into the future to account for their specific biology and life history, and the impacts of ongoing threatening processes.

## Recommendations

There have been many positive gains for the recovery of Black Rockcod during the life of this recovery plan, however this review has revealed several key areas where further work is required including:

- building collaborative partnerships with recreational and commercial fishers and fishing media outlets;
- further examination of the impacts of fishing activities on the species including mortality rates of caught and released fish;
- research into the impacts of climate change; and
- repeated long term monitoring at key sites to inform the effectiveness of recovery actions.

Other research gaps and opportunities include:

- genetic research on connectivity across the species' range;
- expand the surveys to include other potential key sites, including a study to look at juvenile recruitment in estuarine habitats such as breakwalls and rocky reefs;
- promoting sightings through iNaturalist and other sightings platforms; and
- investigation into biodegradable hooks to reduce the impact of ingested hooks on Black Rockcod.

Given the threatened species status of Black Rockcod, any research projects requiring experimentation should utilise findings from other more common large serranid species.

Further, it is recognised that incremental and consistent positive progress coupled with significant investment over several decades will be required to achieve recovery; therefore,

funding projects specifically targeted to Black Rockcod are essential to meet the objectives of the recovery plan. Positive outcomes for the Black Rockcod will be dependent on ongoing investment from a range of stakeholders and partners to meet the current knowledge gaps and onground interventions outlined in the Recovery Plan. Continued efforts should be pursued to resource and implement actions and initiatives specifically targeted to Black Rockcod recovery.

The NSW Fisheries Scientific Committee (FSC) is responsible for threatened species assessments and listings under the FM Act under legislated criteria. The FSC completed the national reassessment of the species in 2018 for the National threatened species list and advised that it still met the criteria for Vulnerable. The FSC will continue to monitor the status of the species at least every two years and determine whether any changes are necessary as per their requirements under s.220NA of the FM Act. The Black Rockcod can only be delisted by the FSC if it no longer meets the criteria for 'Vulnerable'.

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## Appendix 1: Communications and engagement

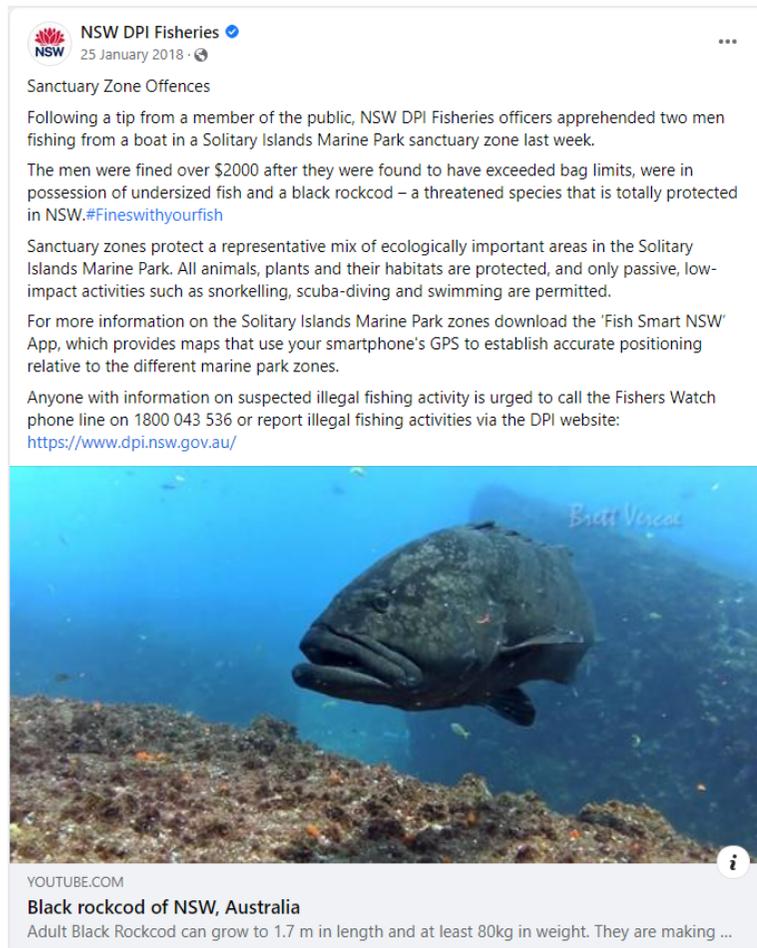


Figure 1: An example of a Black Rockcod compliance action posted on the NSW DPI Fisheries Facebook account

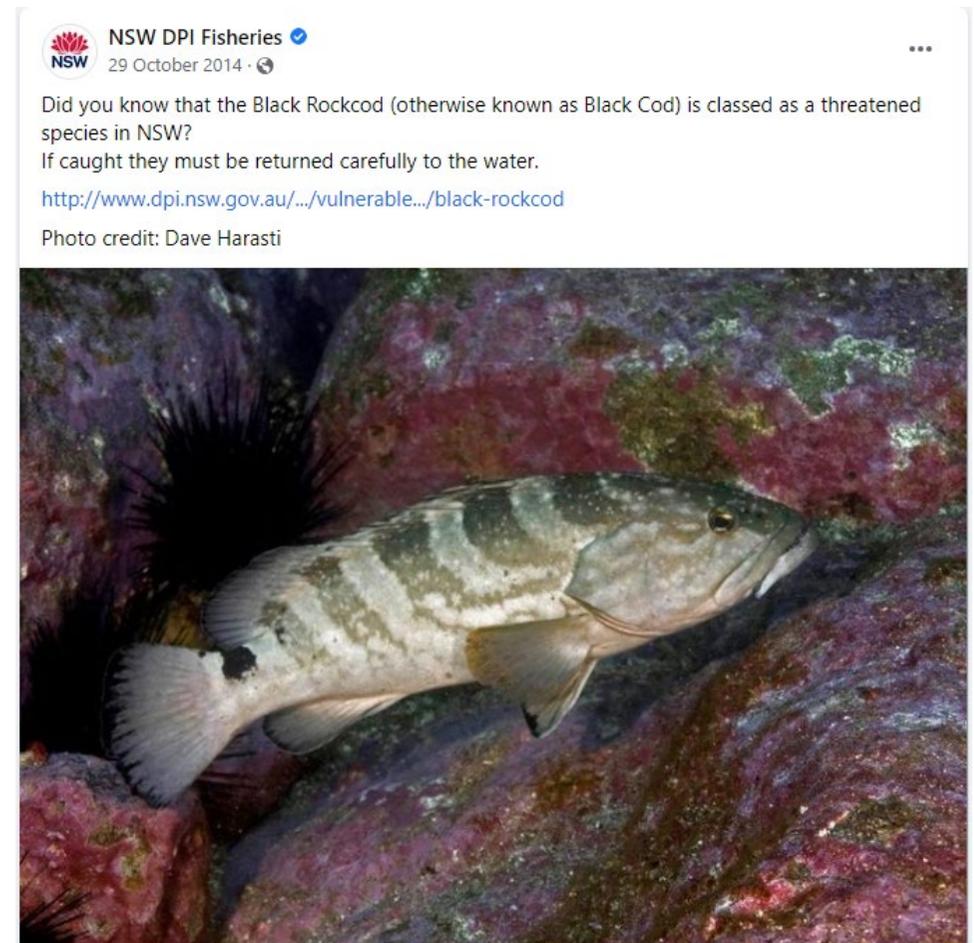


Figure 2: An example of a Black Rockcod awareness post on the NSW DPI Fisheries Facebook account

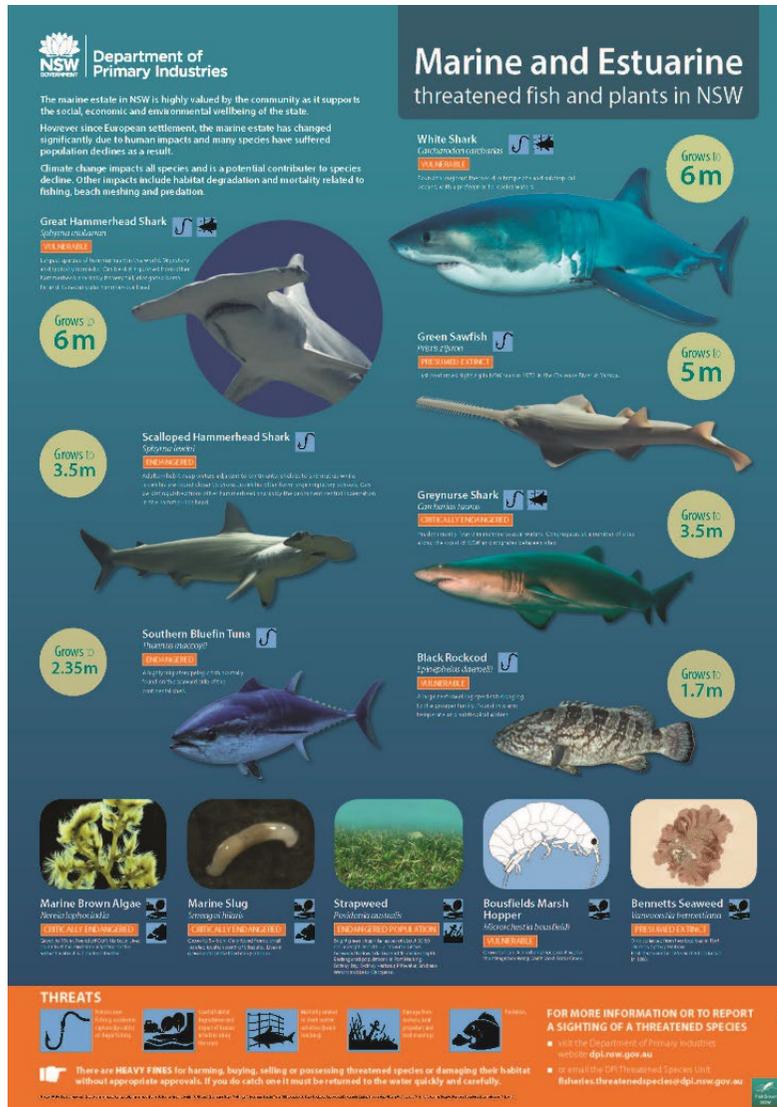


Figure 3: The marine/estuarine side of the threatened species poster produced in 2017, which includes information on the Black Rockcod.

## Be aware of what fish is rare!

7 Sep 2015

NSW Department of Primary Industries (DPI) is reminding all fishers, divers and other water users to 'Be aware of what fish is rare', as part of Threatened Species Day on September 7.

DPI Senior Conservation Manager, Dr Trevor Daly, said Threatened Species Day is a national day held each year to remember the death of the last remaining Tasmanian tiger in 1936 and promotes the importance of protecting, conserving and improving biodiversity in Australia and around the world.

"A species is listed as threatened when its numbers have declined to a point where it is at risk of becoming extinct," Dr Daly said.

"There are currently 24 aquatic species listed as threatened in NSW from both our marine and freshwater environments.

"Some of our threatened fish species look very similar to other fish which are not listed as threatened species so it's very important that all fishers know which species of fish they have caught and which they can legally keep.

"For example Banded Rockcod can be legally caught whereas both Black Rockcod and Estuary Cod are protected and must be released without harm.

"Similarly two species of hammerhead sharks, the Great Hammerhead Shark and the Scalloped Hammerhead Shark are listed as threatened species in NSW however the Smooth Hammerhead Shark is still legal to catch."

Dr Daly said it is also important to know the differences between species such as Trout Cod (threatened) and Murray Cod, and Murray Crayfish (threatened) and Yabbies, and to be aware of the local fishing rules and closed seasons when fishing in certain inland rivers.

"It is illegal to take, harm or possess threatened or protected species," Dr Daly said.

"If caught they must be returned carefully to the water."

DPI has produced a range of advisory materials to assist fishers with correctly identifying fish species, including the popular NSW Recreational Saltwater and Freshwater Fishing Guides.

Dr Daly said that as well as being aware of what a rare fish looks like, everyone can help to support recovery of our threatened aquatic species by reporting any sightings to DPI.

"This information will help us to increase our knowledge of the status and distribution of each threatened species and will add value to our fish species surveys and habitat mapping," he said.

For more information or to report a threatened species visit the DPI website or email [fisheries.threatenedspecies@dpi.nsw.gov.au](mailto:fisheries.threatenedspecies@dpi.nsw.gov.au)

Figure 4: An example of a media release for Threatened Species Day 2015