



Australian Government

Department of Agriculture, Fisheries and Forestry  
ABARES

# **North Marine Region Commonwealth Reserves Network: social and economic assessment of the impacts on commercial and charter fishing**

Report on the draft marine reserves network, with a supplementary report for the final proposed marine reserves network

Research by the Australian Bureau of Agricultural  
and Resource Economics and Sciences

June 2012



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# Executive summary

The Australian Government is undertaking marine bioregional planning in Commonwealth waters. This includes identifying areas for inclusion in the National Representative System of Marine Protected Areas. The Australian Government Department of Sustainability, Environment, Water, Population and Communities (SEWPaC; the lead government agency) commissioned the Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES) to assess the impacts of the proposed marine reserve networks on commercial and charter fishing in each marine region.

This social and economic assessment employed a range of statistical analyses, social impact assessment and economic modelling to provide a variety of perspectives on potential impacts. It drew on data from fisheries logbooks, a survey of fishing businesses, interviews and focus groups.

The scope of work does not include potential impacts on non-commercial activities, including recreational fishing, customary fishing and tourism, nor does it attempt to cost or quantify any loss of asset values (e.g. fishing access rights, boats and shore-based infrastructure). The costing and design of any Australian Government assistance (structural adjustment assistance) were also not part of the scope.

The assessment was undertaken in two stages that relate to the **draft** North Commonwealth Marine Reserves Network proposal released for public comment from August to November 2011, and the final North Commonwealth Marine Reserves Network proposal (released 14 June 2012; Map 1). This report (and this summary) are therefore structured into two sections:

- **Draft** North Commonwealth Marine Reserves Network (released August 2011). The consultative social and economic assessment was undertaken on the draft North Commonwealth Marine Reserves Network and forms the bulk of this report. It is structured to provide a variety of information and perspectives on potential impacts. In general, the assessment progresses from large-scale aggregate impacts across the entire marine reserves network in the early chapters, through to a finer scale covering the potential impacts on towns, businesses and people. Different data were used to estimate or infer potential impacts at each scale. In developing this assessment, ABARES has consulted and been guided by a working group comprising representatives from the Northern Territory, Queensland and Australian governments, and fishing industry representative bodies.
- **Final** North Commonwealth Marine Reserves Network proposal (released 14 June 2012). An abridged assessment was undertaken on the final North Commonwealth Marine Reserves Network proposal, and is contained within the supplementary section of this report. The revisions to the network were informed by the submissions received through the public consultation process and by ABARES initial analysis on the draft network released for public consultation. This abridged assessment provides (where possible) a comparative analysis of the changes to potential impacts between the draft and final proposed marine reserve networks. ABARES was not in a position to undertake additional consultation (surveys or interviews) with commercial and charter fishing businesses for this abridged assessment.

## Main findings for the draft network (released August 2011)

The potential impact of the draft North Commonwealth Marine Reserves Network (Map 1) is small relative to the gross value of production (GVP) from the fisheries in the region. The draft reserves network is expected to have a significant and concentrated impact on one entitlement holder in the N9 Fishery within of the Queensland Gulf of Carpentaria Inshore Fin Fish Fishery, one operator in the Northern Territory Offshore Net and Line Fishery, and a significant but diffuse impact on operators in the Commonwealth Northern Prawn Fishery. Karumba is expected to experience a significant impact from the draft marine reserves network, as the fisheries sector accounts for a relatively large share of the local economy.

There is potential for some Northern Territory and Queensland fisheries to grow based on the potential to increase catch and remain within biologically sustainable limits. However, some of this capacity for growth is likely to be moderated by the draft marine reserves network. In addition, some fisheries are undergoing management changes (e.g. the management of the Northern Prawn Fishery is currently under review), which is an additional stress for some operators.

**Potential displacement of fishing:** The draft North Commonwealth Marine Reserves Network (Map 1) would displace an estimated annual GVP of \$2.8–4.2 million (Table 1), representing 2.4–3.7 per cent of the collective GVP of potentially impacted fisheries. This comprises \$1.65–3.06 million (159–209 tonnes) from Commonwealth fisheries, \$0.39 million (117 tonnes) from Northern Territory fisheries and \$0.77 million (102 tonnes) from Queensland fisheries. This represents a small proportion of the combined fisheries production from potentially impacted fisheries (around \$114 million). These values are the totals for the potentially impacted fisheries in each jurisdiction and are not adjusted to account only for fishing in the North Marine Region.

Summary of impacts of the draft North Commonwealth Marine Reserves Network (Table 1):

- Eleven fisheries would potentially be impacted by the draft marine reserves network, with the degree of impact ranging from close to zero through to 17 per cent of the total GVP for each fishery.
- In percentage terms the greatest impact would be to the Northern Territory Offshore Net and Line Fishery (longline method; displacement estimates are confidential) where, it is understood, a single operator would be affected.
- In absolute terms, the greatest potential displacement of GVP would be from the Commonwealth Northern Prawn Fishery (\$1.65–3.06 million; 1.9–3.5 per cent of fishery) and the N9 Fishery of the Queensland Gulf of Carpentaria Inshore Fin Fish Fishery (estimates confidential). The impact on the N9 Fishery of the Queensland Gulf of Carpentaria Inshore Fin Fish Fishery would be borne by a single company that is also potentially impacted by displacement from other fisheries.
- Of the eight draft reserves, the Gulf of Carpentaria marine reserve would have the largest potential impact (\$1.48–2.90 million annual average GVP; primarily on the Commonwealth Northern Prawn Fishery), followed by the draft West Cape York marine reserve (\$0.64 million; primarily on the N9 Fishery of the Queensland Gulf of Carpentaria Inshore Fin Fish Fishery) (Table 1).
- The draft marine reserves network is expected to have a relatively small impact on charter fisheries, potentially displacing 0.2 per cent of clients in the Northern Territory and around 0.1 per cent of clients in Queensland.

There may be minor cumulative impacts to the Commonwealth Northern Prawn Fishery by the draft North-west Commonwealth Marine Reserves Network (ABARES 2012c; however, these impacts are relatively small compared with those from the draft North Marine Reserves Network.

The impact on prospective fishing (future potential fishing not accounted for in the estimates of displacement) was identified as a significant issue in the North Marine Region. The catch and GVP from several fisheries in the North Marine Region have generally trended upward over the 10-year reference period. Short-term prospective fishing may be impacted in several fisheries—fisheries where there was evidence that businesses have made specific plans or investments, or where development prospects were clearly identified by fisheries management agencies. Impacts to the value of fishing entitlements were also identified as a potential issue in some fisheries. However, this impact is difficult to quantify, and is beyond the scope of this report.

**Flow of impacts:** Potential impacts on commercial fishers were traced back to ports and coastal communities using information on landings and the supply chains of potentially impacted businesses:

- Towns with the highest potential GVP displacement were Cairns, (\$1.8 million GVP potentially displaced; \$14.81 GVP displaced per capita), Karumba (\$1.6 million; \$3173.41 per capita) and Darwin (\$0.672 million; \$10.41 per capita). These were also the main centres identified as providing goods and services to potentially impacted businesses.
- Karumba is thought to be particularly vulnerable to change due to its low adaptive capacity.
- Cairns and Darwin are thought to be more resilient to the impact due to their large population base, diverse economies and lower dependence on the consolidated fishing industry.
- Cumulative impacts may occur to towns identified in the North Marine Region from GVP displaced from other draft marine reserves networks. Darwin is also potentially impacted by the draft marine reserves network in the North-west Marine Region (ABARES 2012c), and Cairns is also potentially impacted by the draft Coral Sea marine reserve (ABARES 2012b).

**Potential impacts on the economy:** The ABARES AusRegion model was used to estimate the economic impact on subregional, state and national economies, and the corresponding impact on jobs in the short term (2012–13) and in the longer term (2019–20).

The economic modelling did not find impacts at the state (Queensland) or national levels and impacts to these economies are assessed as negligible (in the context of the state and national economies).

The modelled estimates of total potential regional impacts to the economy and jobs are reported as the sum of impacts to regions and the Northern Territory, scaled linearly to account for the proportion of potential GVP displacement that was not modelled.

- Total potential economic impact (gross regional product; GRP) was estimated at \$4.6–6.9 million in the short term, the vast majority of which is expected to occur in directly impacted regions.
- The total potential regional job loss in directly impacted regions was estimated at 13–20 full-time jobs lost in the short term and 1–2 jobs lost in the long term.

- The potential net economic impact (gross regional product; GRP) on the Carpentaria subregion (including Karumba) was estimated to be a loss of \$1.6–2.4 million in the short term, corresponding with a reduction in employment of 4–6 full-time equivalent jobs.
- The potential net economic impact on the Northern Territory as a result of displacement in Darwin was estimated to be \$1.3 million in the short term. Short-term job losses in the Northern Territory were projected to be 4 jobs.
- There are likely to be flow-on effects in other regions; however, changes in economic activity and employment at the state (Queensland) and national level are negligible in terms of the size of those economies and job markets.

Independent of the AusRegion modelling, potential job losses from the catching and processing sectors was estimated at 30 full-time jobs in the short term, based on survey responses from fishing businesses.

**Potential impacts on fishing businesses:** A survey was sent to 227 fishing businesses in the catching sector identified in consultation with fisheries agencies and industry associations as being potentially impacted by the draft marine reserves network. The survey was completed by most, but not all, impacted fishing businesses operating in North Marine Region.

Of the 53 responses received, 39 respondents indicated they were potentially impacted. Of these, 18 indicated they would stay in the fishing industry and make up the shortfall, 11 indicated they would reduce catches or downsize their fishing operation and five reported that they would leave the fishing industry (three were unsure how they would respond). Most fishing businesses indicated the impact would be up to 30 per cent of their catch, while some indicated larger impacts.

Fishing businesses reported the main impacts as being a loss of access to fishing grounds, loss of income and devaluing of licences and capital.

Respondents indicated there had been an erosion of confidence in the industry that would have flow-on implications to securing finance and future investments. The potential impacts of the draft reserves need to be considered in context with other changes and pressures occurring in the fishing industry, such as high fuel costs, unfavourable exchange rates and other market drivers, as well as fisheries management changes.

**Personal and community impacts:** Personal impacts of the draft marine reserves for those displaced and having to change their fishing activities were increased stress, having to work longer hours and the flow-on impacts to their families. Generally, the respondents felt that they would be able to cope at a personal level and that there was some confidence in the social relations of the community to provide some degree of support (social capital). However, lack of financial resources and alternative employment options were identified as limitations to adaptation.

Community impacts would be most acute in small communities like Karumba that have a strong reliance on the fishing industry, lower levels of economic diversity, greater socioeconomic disadvantage and are remotely located. Larger communities such as Darwin and Cairns, while impacted, have a greater capacity to adapt.

**Case studies:** Six case studies were undertaken to provide a broader understanding of how potential impacts of the draft marine reserves network would emerge at different scales. Case

study themes and topics were chosen through consultation with industry, state and territory governments and SEWPaC. The case studies are:

- Vertically integrated fishing business

The Karumba-based fishing business Wren Fishing Pty Ltd faces significant displacement from the West Cape York marine reserve, which will potentially have secondary impacts on their processing and cold store facility in Karumba, and other supply chain businesses in Karumba and Cairns. Wren Fishing is a significant employer in the Gulf–Karumba region (11 full-time and 52 casual staff).

- Impact on a community/town

Karumba is a remote community in the Gulf of Carpentaria, Queensland. Commercial fishing is a key economic driver in the town. Potential impacts will flow from the displacement of the Commonwealth Northern Prawn Fishery and the N9 Fishery of the Queensland Gulf of Carpentaria Inshore Fin Fish Fishery. The estimated potentially displaced GVP flowing through Karumba is \$1.1–\$1.6 million per year.

- Impact on a large fishery

The Northern Prawn Fishery, located primarily in the Gulf of Carpentaria, is one of the most valuable fisheries in Australia. The draft North Marine Reserves Network is estimated to displace \$1.6–3.1 million annual average GVP, which is up to 3.5 per cent of the total annual average GVP of the fishery.

- Developmental and prospective fisheries

Examples are given from a large-scale fishery in the North Marine Region that is still developing, and also examples from several small-scale fisheries.

- Supply chain impacts

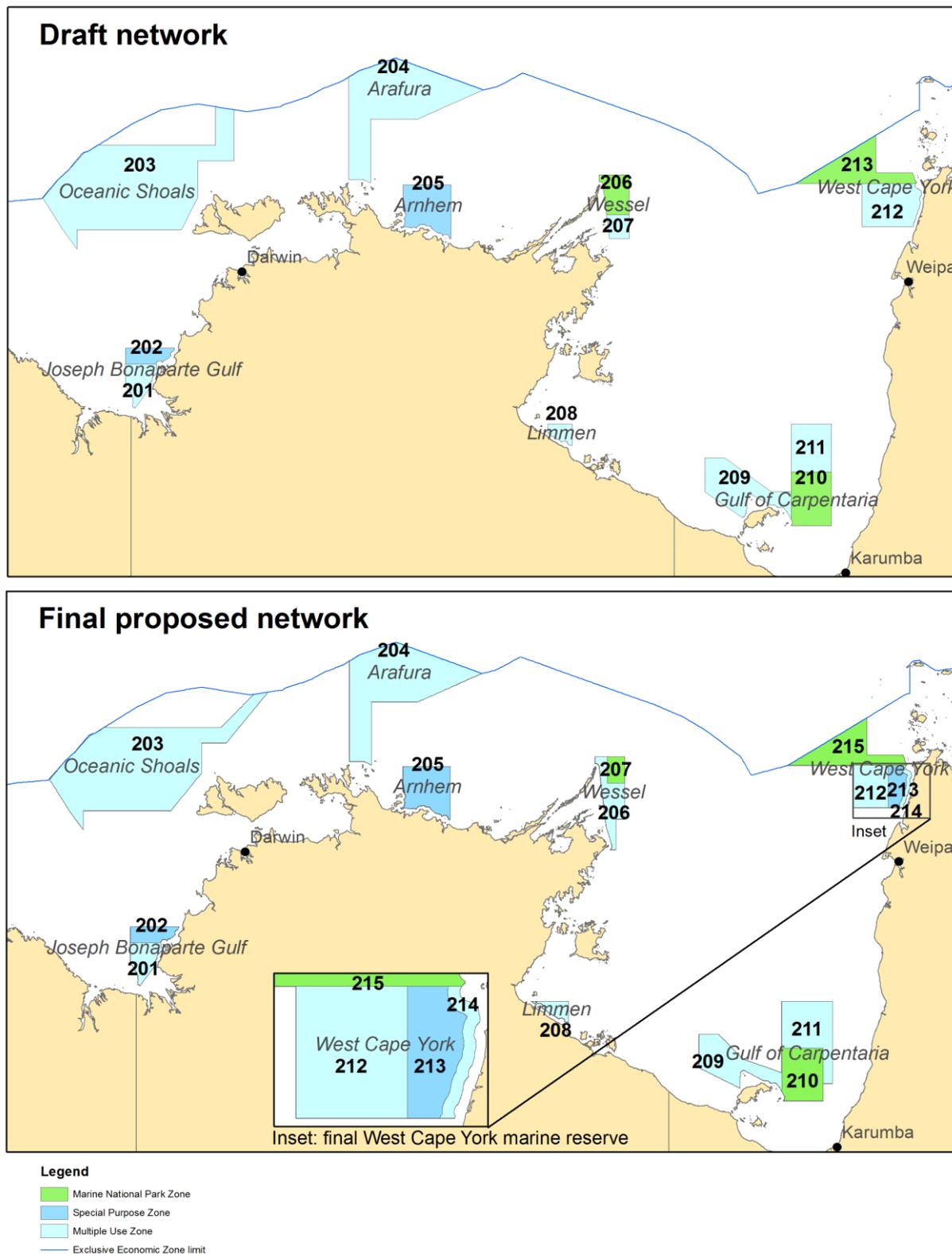
A total of 146 input businesses and 29 output businesses across Darwin, Cairns and Karumba were identified as servicing potentially impacted fishing businesses in the North Marine Region.

- Economic modelling of Darwin and Karumba

The ABARES AusRegion model was used to estimate the economic effects of establishing the draft North Commonwealth Marine Reserves Network on two subregions (the Carpentaria subregion and the Darwin subregion).

The total short term regional economic impact from the North Marine Region Commonwealth Marine Reserves Network is estimated to be \$4.6–6.9 million. In the short term, the effect on regional employment is estimated to be the loss of 13–20 full time equivalent positions. There are likely to be flow-on impacts in other regions; however, changes in economic activity at the state and national level are negligible in terms of the size of those economies.

Map 1 North Marine Region draft (released August 2011) and final proposed (released 14 June 2012) marine reserves networks with zones and area numbering



Data sources: marine reserve boundaries from the Australian Government Department of Sustainability, Environment, Water, Population and Communities; coastline from Geoscience Australia, Zoning is described in Appendix A: Fisheries data processing methods

**Table 1 Comparison of estimates of catch and gross value of production (GVP) potentially displaced by the draft (August 2011) and final proposed (14 June 2012) marine reserves networks in the North Marine Region**

<i>Fishery</i>	<b>Total catch displaced (tonnes)</b>		<b>Total GVP displaced (\$'000)</b>			
	<i>Draft</i>	<i>Final proposed</i>	<i>Draft</i>	<i>Final proposed</i>	<i>Absolute change</i>	<i>Percentage change</i>
<b>Commonwealth</b>						
Northern Prawn Fishery	159.3 to 208.7	119.9 to 144.7	1645.4 to 3061.5	1176.6 to 2081.4	-468.8 to -980.1	-28.5 to -32.0
<i>Commonwealth total</i>	<i>159.3 to 208.7</i>	<i>119.9 to 144.7</i>	<i>1645.4 to 3061.5</i>	<i>1176.6 to 2081.4</i>	<i>-468.8 to -980.1</i>	<i>-28.5 to -32.0</i>
<b>Northern Territory</b>						
A16 Finfish Trawl	*	*	*	*	*	0.2
A4 Spanish Mackerel Fishery	*	*	*	*	*	-73.0
A5 Offshore Net and Line Fishery (drifting gillnet)	*	*	*	*	*	-26.7
A5 Offshore Net and Line Fishery (longline)	*	*	*	*	*	-1.0
<i>Northern Territory total</i>	<i>116.7</i>	<i>112.0</i>	<i>385.2</i>	<i>370.25</i>	<i>-14.9</i>	<i>-3.9</i>
<b>Queensland</b>						
GoC Developmental Finfish Trawl	12.2	12.4	72.1	73.5	1.3	1.8
Line (QFJA)	17.8	20.9	59.8	70.5	10.7	17.9
Line (L4)	4.9*	5.4*	37.9*	42.4*	4.5*	11.9*
Net (N3)	2.8*	2.6*	13.9*	12.7*	-1.2*	-8.6*
Net (N9 and QFJA)	*	*	*	*	*	-53.4
<i>Queensland total</i>	<i>102.4</i>	<i>73.0</i>	<i>768.3</i>	<i>486.6</i>	<i>-281.7</i>	<i>-36.7</i>
<b>Grand total</b>	<b>378 to 428</b>	<b>305 to 330</b>	<b>2799 to 4215</b>	<b>2033 to 2938</b>	<b>-765.4 to -1276.7</b>	<b>-27.3 to -30.3</b>

GoC = Gulf of Carpentaria; QFJA = Queensland Fisheries Joint Authority;

Note: Queensland N9 and QFJA net sectors were not separated in these analyses; however, the displacement is thought to be almost entirely from the N9 Fishery. Estimates are mean annual for the reference period. Confidential data are marked with an asterisk (\*). In some fisheries, only one area is confidential. In these cases, the total does not include the confidential value as it would be possible to back-calculate the displacement from that area. These are denoted by showing the sum of the non-confidential areas followed by an asterisk (e.g. 2.8\*).

## Main findings for the final proposed network (14 June 2012)

SEWPaC provided a final North Commonwealth Marine Reserves Network proposal on 14 June 2012 (Map 1) following consideration of submissions received during the public consultation period, as well as the ABARES's assessment of potential social and economic impacts associated with the draft North Commonwealth Marine Reserves Network.

In general, the potential impact of the final North Commonwealth Marine Reserves Network proposal is reduced when compared with the draft marine reserves network.

**Potential displacement of fishing:** The final North Commonwealth Marine Reserves Network proposal would displace an estimated annual GVP of \$2.03–2.94 million (Table 1), representing 1.8–2.6 per cent of the collective GVP of potentially impacted fisheries. This comprises \$1.18–2.08 million (120–145 tonnes) from Commonwealth fisheries, \$0.37 million (112 tonnes) from Northern Territory fisheries, and \$0.49 million (73 tonnes) from Queensland fisheries. This represents a small proportion of the combined fisheries production from potentially impacted fisheries (around \$114 million). These values are the totals for the potentially impacted fisheries in each jurisdiction and are not adjusted to account only for fishing in the North Marine Region.

Summary of impacts of the final North Commonwealth Marine Reserves Network proposal:

- Eleven fisheries would potentially be impacted by the final proposed marine reserves network. The degree of impact would range from close to zero to 17 per cent of the total GVP for individual fisheries.
- In percentage terms, the greatest impact remains to the Northern Territory Offshore Net and Line Fishery (longline method; displacement estimates are confidential). This is understood to be on a single operator.
- The largest potential impact of the final proposed network in absolute terms would be to the Commonwealth Northern Prawn Fishery (120–145 tonnes; \$1.18–2.08 million), which was also the largest displacement under the draft marine reserves network. Other significant potential impacts are on the N9 Fishery of the Queensland Gulf of Carpentaria Inshore Fin Fish Fishery, the Northern Territory Offshore Net and Line Fishery (longline method), Northern Territory Finfish Trawl Fishery, Queensland Fisheries Joint Authority Line Fishery and the Queensland Gulf of Carpentaria Developmental Fin Fish Fishery.
- Overall, the potential displacement from the final proposed network was 19–23 per cent less catch and 27–30 per cent less GVP than the draft network. This reduction in impact is largely due to a reduced impact on the N9 Fishery of the Queensland Gulf of Carpentaria Inshore Fin Fish Fishery (53 per cent reduction in impact in GVP) and the Commonwealth Northern Prawn Fishery (28–32 per cent reduction in impact). This reduction was partially offset by small increases in the impact on four fisheries: the Northern Territory Finfish Trawl Fishery, the Queensland Gulf of Carpentaria Developmental Fin Fish Trawl Fishery, the Queensland Fisheries Joint Authority (QFJA) Line Fishery and the Queensland Gulf of Carpentaria Line Fishery.
- The final proposed marine reserves network is expected to have a relatively small impact on charter fisheries, potentially displacing less than 0.1 per cent of clients in the Northern Territory, and approximately 0.1 per cent of clients in Queensland.

- There are cumulative impacts to the Northern Prawn Fishery from the draft North-west Marine Reserves Network (ABARES 2012c), but these are small in comparison with the impact from the final North Commonwealth Marine Reserves Network proposal.

**Flow of impacts:** Potential impacts on commercial fishers were traced back to ports and coastal communities using information on landings under the final proposed network:

- Although overall potentially displaced GVP is reduced by up to 30 per cent, the same five towns identified as having catch displaced by the draft marine reserves network are thought to receive catch displaced by the final proposed network. These towns are Darwin, Gove, Karumba, Weipa and Cairns.
- The impact has remained relatively low on Gove and has reduced for the other towns, particularly on Karumba (reduced by 36–39 per cent to \$0.65–1.05 million potentially displaced GVP landed in Karumba) and Cairns (reduced by 22–31 per cent to \$0.76–1.25 million).
- Cairns and Darwin are thought to be more resilient to the impact due to their large population base, diverse economies and lower dependence on the consolidated fishing industry.
- Cumulative impacts may occur to towns identified in the North Marine Region from GVP displaced from other marine reserve networks. Darwin is also potentially impacted by the draft marine reserves network in the North-west Marine Region (ABARES 2012c), and Cairns is also potentially impacted by the draft Coral Sea marine reserve (ABARES 2012b).

**Potential impacts on the economy:** The impact of the final proposed marine reserves network was assumed to scale linearly with the change in GVP impact. Under this assumption, the estimated effect is a reduction in regional economic activity of \$3.3–4.8 million in the short term compared with the reference case and displacement of 9–14 jobs in directly affected regions. There are likely to be flow-on effects in other regions; however, changes in economic activity at the state (Queensland) and national level are negligible in terms of the size of those economies.

**Potential fishing business and personal impacts:** ABARES has not undertaken consultations (surveys or interviews) with potentially displaced or impacted commercial fishing, charter or supply chain businesses, or individuals based on the final North Commonwealth Marine Reserves Network proposal. Although the potential business and personal impacts arising from the final proposed network cannot be assessed using data collected through the survey on the draft network, they are likely to be similar to those identified for the draft network.

**Case studies:** The case studies for the draft North Commonwealth Marine Reserves Network were re-examined under the final North Commonwealth Marine Reserves Network proposal. No further consultation with potentially impacted fishers or interviewees was possible for this purpose. However, the case studies include discussion of likely changes in displacement estimates, flow to ports and likely changes in impacts from the final proposed network.

- Impact on a vertically integrated fishing business—Wren Fishing:

The reduced impact on the Queensland N9 Fishery is expected to reduce the impacts to Wren Fishing. However, an area in which the operator has recently increased activity is still largely excluded under the final proposed network. Based on recent fishing trends, it is expected that the impact is being somewhat masked by the long reference period used in the analysis.

- Impact on a community/town—Karumba:

The potential impact on Karumba is expected to have moderated through the reduced impact on the Commonwealth Northern Prawn Fishery and the Queensland N9 Fishery. However, it is anticipated that Karumba will remain one of the most impacted towns under the final proposed marine reserves network, due to the large amount of catch flowing to it and its low adaptive capacity.

- Impact on a large fishery—Northern Prawn Fishery:

The potential impact to the Commonwealth Northern Prawn Fishery has been reduced by the final proposed marine reserves network. However, the potential GVP displacement is still the highest of any single fishery in the region, representing 1.4–2.4 per cent of total GVP for the fishery. Monitoring sites used for annual recruitment, spawning trawl surveys and trawl gear trials remain within the final proposed network.

- Fishery development/prospectivity:

The potential impact of the final proposed network on the current development of many fisheries in the North Marine Region may be reduced, but cannot be accurately determined without consultation with fishers. The impact on potential future licence value in the Timor Reef Fishery is unlikely to change because both the final proposed and draft networks cover a similar area around the Timor Reef Fishery.

- North Marine Region supply chain impacts:

In general terms, the final proposed marine reserves network would be expected to have less impact on supply chain businesses—notably for some supply chain businesses in Karumba because of the reduced impact to the Queensland N9 Fishery. It is difficult to provide further meaningful commentary without consulting the fishing industry.

- Economic modelling of Darwin and Karumba:

Assuming the modelled impact on the economy and that employment scales linearly with the magnitude of the impact, the net regional economic impact of the final proposed network was estimated at \$3.3–4.8 million, and 9–14 jobs in directly impacted regions in the short term. This is a 27–30 per cent reduction in estimated economic impact and job loss compared with the draft network, in line with the change in magnitude of the GVP impact. There are likely to be flow-on impacts on other regions; however, changes in economic activity at a state (Queensland) and national level are negligible in terms of the size of those economies and job markets.

# Draft North Commonwealth Marine Reserves Network proposal

This section of the report provides the social and economic assessment of the draft North Commonwealth Marine Reserves Network proposal that was released in August 2011 (SEWPaC 2011a) and open for public consultation for 90 days until 28 November 2011.

# 1 Background and introduction

The Australian Government is undertaking a marine bioregional planning program in Commonwealth waters. The program includes identifying areas for inclusion in the National Representative System of Marine Protected Areas.

For background to marine bioregional planning in the North Marine Region and the establishment of Commonwealth marine reserves, see:

- *Marine bioregional plan for the North Marine Region: draft for consultation* (SEWPaC 2011a)—describes the marine environment and conservation values (protected species, protected places and key ecological features) of the North Marine Region, sets out broad objectives for its biodiversity, identifies regional priorities, and outlines strategies and actions to achieve these.
- *Proposal for the North Commonwealth Marine Reserves Network: consultation paper* (SEWPaC 2011b)—presents a proposal for the North marine reserves network, as well as rationale and design principles.

## The North Marine Region

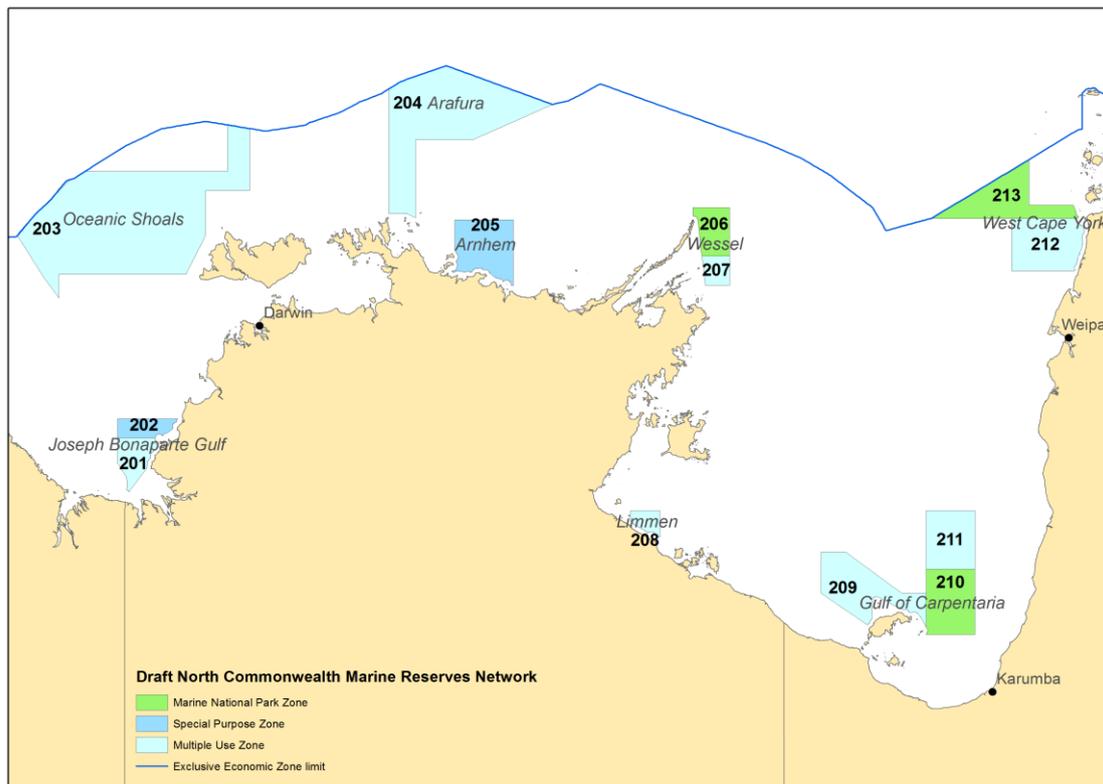
The North Marine Region covers an area of more than 625 691 km<sup>2</sup>, from Joseph Bonaparte Gulf in the west to Cape York in the east (Map 2). The region encompasses Commonwealth waters, which generally extend from three nautical miles offshore from the territorial sea baseline out to the 200 nautical mile limit of Australia's exclusive economic zone. The North Marine Region is adjacent to the waters of the Northern Territory and Queensland. Some territory, and state-managed fisheries overlap with the North Marine Region (i.e. extend into Commonwealth waters) and are managed by territory and state fisheries agencies under Offshore Constitutional Settlement arrangements with the Australian Government. A detailed description of the North Marine Region can be found in the North Marine bioregional profile (DEWHA 2008).

The Australian Government has proposed a draft marine reserves network across the North Marine Region (SEWPaC 2011b; Map 2). This draft North Commonwealth Marine Reserves Network has three levels of zoning, which affect whether fishing activities may or may not occur within an area:

- Marine National Park Zone (green)—all commercial, charter and recreational fishing excluded
- Multiple Use Zone (light blue)—demersal (and semi-demersal) trawl, set-mesh net, pelagic gillnet and demersal longline excluded
- Special Purpose Zone (dark blue)—demersal (and semi-demersal) trawl and demersal longline excluded.

There are eight marine reserves in the draft North Commonwealth Marine Reserves Network. The Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES) has allocated area numbers to these to help identify individual areas within a marine reserve. The reserves and internal numbering are: Joseph Bonaparte Gulf (areas 201 and 202), Oceanic Shoals (area 203), Arafura (area 204), Arnhem (area 205), Wessel (areas 206 and 207), Limmen (area 208), Gulf of Carpentaria (areas 209–211) and West Cape York (areas 212 and 213) (Map 2).

**Map 2 Draft North Commonwealth Marine Reserves Network proposal zones with area numbering**



Data sources: marine reserve boundaries from the Australian Government Department of Sustainability, Environment, Water, Population and Communities; coastline from Geoscience Australia, Zoning is described in Appendix A: Fisheries data processing methods

## Fisheries in the North Marine Region

Commercial fishing is generally defined as the take of fish and other marine life for commercial purposes. In this report, commercial fishing refers to the wild-catch sector (as opposed to aquaculture). A range of commercial fisheries operate within the North Marine Region, and some of these are potentially impacted by the draft marine reserves network. Table 2 provides reference information on potentially impacted fisheries that are managed by the Commonwealth, Northern Territory or Queensland. The state and territory fisheries in the North Marine Region are characterised by having a small number of operators, many of which are still developing and growing.

Map 3 shows the total fisheries gross value of production (GVP) for all jurisdictions in the North Marine Region (note that these data are for 2000–02). Generally, the most valuable fishing grounds in the North Marine Region are close to shore, with relatively little activity in the centre of the Gulf of Carpentaria or far offshore; fishing grounds around Timor Reef are the notable exception.

Charter fishing in Commonwealth waters off the Northern Territory and Queensland is managed by the relevant territory and state governments. Charter fishing is generally defined as a commercial fee-for-service operation that provides services relating to the taking, capture or catching of fish as part of recreational fishing activities.

Table 2 Reference information of potentially impacted fisheries in the North Marine Region

Fishery	Management arrangements	Target species	Number of licences	Number of vessels	Fishing effort	Catch	Sources
<b>Commonwealth</b>							
Northern Prawn Fishery	Limited entry, gear restrictions include ITE) spatial and temporal closures	Banana, tiger, endeavour prawns	48 gear SFR owners 24 boat SFR owners	52	Banana fishing days 3146 (2010) Tiger fishing days 4898 (2010)	Banana: 5642 t Tiger: 1628 t Endeavour: 429 t	AFMA 2011a, Woodhams et al. 2011
<b>Northern Territory</b>							
Finfish Trawl Fishery	Limited entry, catch, gear and area restrictions, prohibited species, trigger points for target species	Red snappers	1	n.a.	323 vessel days	1114 t	NT DoR 2010
Offshore Net and Line Fishery	Limited entry, gear restrictions, spatial restrictions on gear, ITE	Blacktip sharks, grey mackerel	17	n.a.	941 days	1287 t	NT DoR 2010
Spanish Mackerel Fishery	Trigger points, performance indicators, limited entry, gear restrictions, catch sharing with recreational, Indigenous and charter operators	Spanish mackerel	16	n.a.	662 vessel days	233 t	NT DoR 2010
<b>Queensland</b>							
Gulf of Carpentaria Developmental Fin Fish Trawl Fishery	Limited entry, TAC, prohibited species, gear restrictions, size limits	Red snappers	2	2	n.a.	744 t	DEEDI 2010a
Gulf of Carpentaria Inshore Fin Fish Fishery	Limited entry, vessel and gear restrictions, spatial and temporal closures, possession limits, fish size limits	Various, includes barramundi, threadfins, shark, grey mackerel	91	82	20 907 days	1867 t	DEEDI 2010b
Gulf of Carpentaria Line Fishery	Limited entry, spatial closures, gear restrictions, species-specific size and number regulations, prohibited species	Spanish mackerel	47	27	803 days	185 t	DEEDI 2010c

ITE = individual transferable effort; ITQ = individual transferable quota; n.a. = not available; SFR = statutory fishing right; TAC = total allowable catch

## Demographics of the North Marine Region

The coastal areas of the North Marine Region incorporate a diverse range of individuals and communities that are linked to the fishing industry. A small number of communities are linked to the fishing industry in the North Marine Region: Darwin, Nhulunbuy, Karumba, Weipa and Cairns. As would be expected from such a large area—much of which is very remote—there is diversity in the range of inhabitants, industries and economies, and in the standard of living.

These differences play an important role in how the potential impacts of the draft North Commonwealth Marine Reserves Network will be felt by individuals, businesses and communities, and how they will respond to these changes.

Some key indicators of social and economic characteristics of these communities have been listed in Appendix C: Estimating job reduction using the survey.

### Employment in the fishing industry

The Australian Bureau of Statistics collects data on direct employment within the commercial fishing sector through the census. Data from the 2006 census provides an indication of employment in the consolidated fishing industry by statistical local area (SLA). These data include direct commercial fishing and aquaculture employment, as well as wholesaling and seafood processing. It should be noted that census employment data are not collected at a level that can distinguish between Commonwealth and state/territory fisheries. In addition, it is believed that these data tend to under-report the number of employees by allocating them to other industries (FRDC 2004).

The 2006 census showed that approximately 2.3 per cent of the national consolidated fishing industry employment occurs in the Northern Territory and 21.3 per cent in Queensland (Table 3).

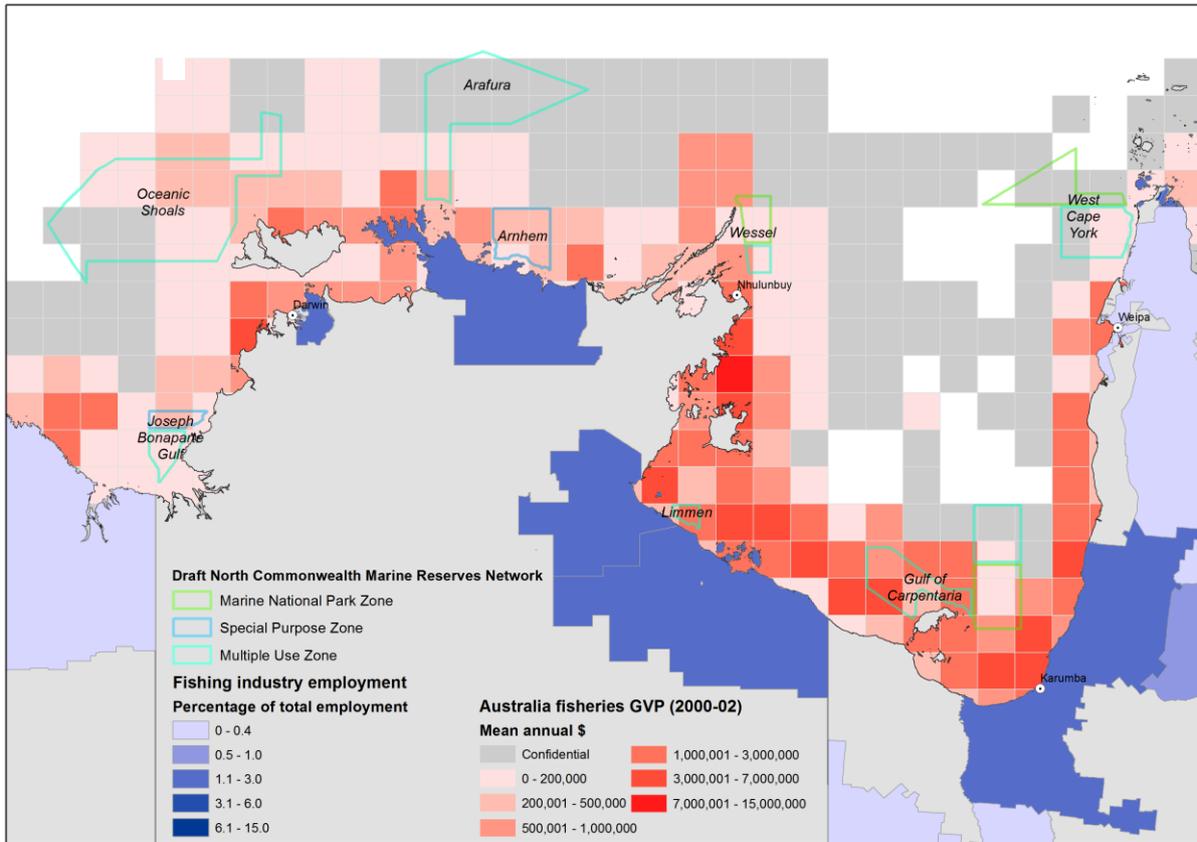
**Table 3 Estimated direct employment in the fishing industry by sector in the Northern Territory, Queensland and Australia (full-time equivalent positions)**

<b>Jurisdiction</b>	<b>Wild-catch fishing*</b>	<b>Processing</b>	<b>Wholesaling</b>	<b>Total</b>
Northern Territory	208	17	43	268
Queensland	964	275	1035	2274
Australia	6217	2002	4202	12 421

Note: \* Includes offshore aquaculture. Source: Australian Bureau of Statistics census data, August 2006.

Map 3 shows the proportion of individuals employed in the consolidated fishing industry (commercial fishing including aquaculture, fish wholesaling and seafood processing) based on 2006 census data. The SLAs with the highest dependency ratio for consolidated fishing industry employment adjacent to the North Marine Region include Darwin, West and East Arnhem, Carpentaria, Cook and Weipa.

**Map 3 All commercial fishing gross value of production (GVP) in the North Marine Region, employment in the consolidated fishing industry and draft North Commonwealth Marine Reserves Network**



Data sources: commercial fishing GVP from Larcombe et al. 2006; marine reserve boundaries from the Australian Government Department of Sustainability, Environment, Water, Population and Communities; coastline and bathymetry from Geoscience Australia; fishing industry employment from ABS 2006, Zoning is described in Appendix A: Fisheries data processing methods

## Scope of work

ABARES was commissioned by the Australian Government Department of Sustainability, Environment, Water, Population and Communities (SEWPaC) to assess the social and economic implications of the draft North Commonwealth Marine Reserves Network. The assessment focuses on impacts to commercial and charter fisheries, and the implications for associated local communities and regional economies.

## Goals

- To develop and refine estimates of the potential displacement of commercial fishing activity (including charter fishing) from the draft marine reserves network.
- To provide quantitative and qualitative information about the way commercial fisheries inputs and outputs interact with regional economies and associated local communities. This includes potential short-term and longer term responses of those economies and communities to the levels and types of displacement estimated for the draft marine reserves network. This information is required to assess potential short-term and longer term impacts on employment and economic flows at local (e.g. key ports) and regional levels.
- To provide quantitative and qualitative information about the degree of economic dependence of individual fishers and local communities on fisheries that will potentially be displaced by the draft marine reserves network.
- To provide sufficient data and information about the methods, structure and patterns of potentially affected fisheries to ensure that changes in the design of draft marine reserves can be evaluated for their relative social and economic impacts.
- To provide suitable information to be incorporated in the regulatory impact statement for the draft marine reserves network to ensure that the economic and social costs and benefits of the proposal are transparent to government.

## The social and economic assessment

This assessment relates to the impacts on commercial and charter fishing of the draft North Commonwealth Marine Reserves Network that was released August 2011. The Australian Government produced the final North Commonwealth Marine Reserves Network proposal (Map 3) following consideration of public submissions. ABARES completed an abridged assessment on the final North Marine Reserves Network proposal, which is contained in the supplementary section at the end of this report.

The assessment has three main components:

### **1) Estimates of direct displacement of commercial and charter fishing by draft marine reserves**

This analysis aimed to provide an indication of the potential fishery catch that would be displaced by the draft marine reserves network and place a value on those displaced catches. This was undertaken using the best available fisheries logbook data from each jurisdiction in the period 2000 to 2010.

### **2) Social impact assessment**

The social impact assessment included an extensive survey of commercial and charter fishers and fishing businesses that may be affected by the draft marine reserves network.

This survey allowed ABARES to better understand the impacts on individuals and businesses, as well as indirect impacts on the supply chain. The assessment also included in-depth interviews with some industry and community stakeholders, as well as workshops and focus groups in some regions. Secondary data from the Australian Bureau of Statistics were used to understand the socioeconomic characteristics of the fishing sector and communities.

### 3) **Subregional economic modelling**

Economic modelling was undertaken for two towns (Darwin and Karumba) adjacent to the North Marine Region to determine the short-term and long-term impacts of the draft marine reserves on employment and regional production.

The assessment provides a variety of information and perspectives on potential impacts. In general, the report progresses from large-scale aggregate impacts across the entire marine reserves network in the early chapters, through to a finer scale where the potential impacts to towns, businesses and people are covered. Different data were used to estimate or infer potential impacts at each scale; for example, the chapter 'Potential displacement of fishing' relied on fisheries logbook data collected by fisheries management agencies, while the chapter 'Flow of impacts to ports and supply chains' relied on logbook data and a survey of impacted businesses. The chapters 'Impacts on fishing businesses' and 'Community and personal impacts' are drawn predominantly from the survey of impacted businesses, but also from focus groups and interviews. Finally, the set of case studies use a range of data and approaches. Some of the case studies use a narrative approach specifically intended to 'tell the fishers' story' about potential impacts. For the most part, we have simply reflected the individuals' perceptions of impact in these case studies. There is also a case study that used economic modelling to understand impacts on two subregions (Darwin and Carpentaria, encompassing Karumba).

It was not always possible to cross-check information across chapters or scales—for example, cross-checking stated business impacts with estimates of potential GVP displacement was not possible on a case-by-case basis because individual logbook data were not available. However, where possible, information from other parts of the report is given to provide context. The assessment necessarily relies on responses from individuals through the survey, focus groups or interview data collection. The survey, focus groups and interviews were specifically directed at potentially impacted parties, so results from these data represent this potentially impacted group and not the wider commercial fisher population in the North Marine Region.

In developing this assessment, ABARES consulted and was guided by a working group of representatives from the Northern Territory Department of Resources – Fisheries (NT DoR), the Queensland Department of Agriculture, Fisheries and Forestry (DAFF Qld), the Commonwealth Fisheries Association (CFA), the Northern Prawn Fishery Industry (NPF Industry), the Northern Territory Seafood Council (NTSC), the Queensland Seafood Industry Association (QSIA) and SEWPaC. The working group met via teleconference every 1–2 weeks from September 2011 to March 2012. An industry liaison officer also helped to coordinate activities, such as the survey and focus groups, as well as relaying industry concerns about the scope of impacts and providing commentary on the assessment approach.

## 2 Potential displacement of fishing

This chapter provides estimates of the quantities of catch for commercial fisheries that would potentially be displaced by the draft North Commonwealth Marine Reserves Network. These estimates are derived from historical catches during the period 2000–10, although reference periods for individual fisheries varied depending on data availability. The gross value of production (GVP) of the potentially displaced catch has also been estimated. This value is intended to reflect recent (2008–10) landed prices or beach prices for product. All values and prices have been adjusted to account for inflation and are expressed in 2011 dollars. A full, technical explanation of methodology is in Appendix B: Fisheries data processing methods.

ABARES used logbook data as collected by the Northern Territory Department of Resources (NT DoR), the Queensland Department of Agriculture, Fisheries and Forestry (DAFF Qld) and the Australian Fisheries Management Authority (AFMA), together with price data from NT DoR, DAFF Qld and ABARES to estimate the potential catch and GVP displaced by the marine reserves network. Marine reserve boundaries and zoning were provided by SEWPaC. Fisheries logbook data combined with market data were used to calculate the annual average displaced GVP. Fishing methods were included or excluded from the different zones based on the zoning framework provided by SEWPaC. The following caveats apply:

- GVP is a relatively simple aggregate measure of the level of commercial fishing activity. See Box 1 for a discussion of more complete measures of the impact of area closures.
- The use of historical GVP information to estimate the impact on future fishing activities (i.e. the opportunity cost) should be interpreted with caution. This is because GVP will vary with market prices, inflation, exchange rates and the reference period of analysis. Potential displacement estimates may not incorporate the impact of any historical or long-term cyclical fluctuations in fish stocks, and do not account for potential future harvests.
- GVP is the assessed value of commercial fishery products at the point of landing for the quantity produced and excludes the cost of transporting, processing and marketing of fish products for wholesale and retail markets (Box 1). It does not take into account flow-on effects, such as value-adding and other potential benefits to individuals and communities.
- Potential displacement estimates are given as annual means spanning up to 11 years. Catches in the most recent years may have been higher or lower than the mean. For example, the Queensland Gulf of Carpentaria Developmental Fin Fish Trawl fishery has grown over the 11-year reference period, so potential displacement of GVP in the past three years would be almost twice as large as the full 11-year mean.
- Potential displacement calculations are based on different reference periods depending on the jurisdiction. Catch data for Commonwealth fisheries are over a 10-year reference period (2001–10), up to 10 years for Northern Territory fisheries and 11 years for Queensland fisheries.
- The estimates use data at different spatial reporting scales, depending on the jurisdiction, and have correspondingly different accuracy when assessing the displacement of fishing.
- The reduction in total GVP following closure of a particular fishing ground is likely to be less than the historical GVP associated with catches in those grounds. Fishers may be able to move to alternative fishing grounds and maintain a similar level of activity, catch and viability of their operations. This may not be the case in some fisheries, and will depend on a

number of (potentially interrelated) factors, such as economics, distance to port facilities, management arrangements, availability of target species and the suitability of fishing grounds in adjacent areas.

- For the Northern Prawn Fishery, range estimates are provided for the draft Gulf of Carpentaria marine reserve. The upper estimate accounts for a fisheries management closure that applied to part of the draft Gulf of Carpentaria marine reserve during the 2001–10 reference period. Fishing activity from an earlier reference period (1990–2000) was used to estimate potential displacement for the areas and times when the closure applied (see Appendix A: Fisheries data processing methods).

### Box 1 Assessing the economic impact of marine reserves

There are a variety of different approaches that could be used to assess the economic impact of marine reserves. The use of historical commercial fishery GVP together with a range of qualitative information constitutes a first step in assessing these impacts.

A full economic assessment would account for all use and non-use values associated with the relevant marine resources and estimate the difference between the flows of goods and services over a defined time horizon; both with and without the draft reserve arrangements.

Focussing on commercial fishing, a standard approach would be to estimate the change in the net present value (NPV) of future net revenues from the affected fisheries under the draft area closures. Varying levels of sophistication can be brought to this calculation. Ideally the effects of the closures on recruitment and catchability, changes in fishery management related to the area closures, the costs of accessing alternate fishing grounds and the behavioural response of fishers to the area closures would be taken into account. These are discussed qualitatively in this chapter.

Estimating historical fishery revenue is relatively straightforward while cost information is less readily available. For Commonwealth fisheries regular surveys are available (see ABARES 2011a).

Using a gross revenue measure such as GVP does not account for the costs involved in generating that revenue and the spatial variation of these costs affect the value of different fishing grounds. Additionally, GVP does not account for net revenues generated by downstream industries.

Temporal factors are an important consideration under different valuation approaches. In response to area closures, fishers may shift their effort to other areas and possibly other fisheries within fishery management and profitability constraints. Historical measures give some indication of how much of a shock is applied to different fisheries but while some fisheries may be able to adjust to a large shock with relatively little reduction in net revenues others may be forced to contract - if, for example, no other fishing grounds are available. In addition, some increase in stocks and resilience of stocks to environmental shocks may result from area closures. However, predicting the magnitude of these effects is difficult.

GVP is a relatively simple aggregate measure of the level of commercial fishing activity and the use of historical GVP information to estimate the impact of marine reserves on future fishing activities should be treated with caution. The reduction in total GVP following closure of particular fishing grounds is likely to be less than the historical GVP associated with catches in those grounds.

### **Impacts on the wider economy**

This assessment uses a model to examine the impact of a contraction in the fisheries sector on the wider economy. The AusRegion dynamic computable general equilibrium (CGE) model of the Australian economy is used to examine the net economic impact of a marine reserves network to part, or all, of the Australian economy. The economic effects of the changes are reported as changes in gross product at the regional, state and national level. As noted above, the historical GVP measures are likely to over-estimate the impact of the marine reserves and thus the broader estimates of economic impact should also be interpreted as upper bound estimates.

## **Area closures and entitlement values**

Fishing entitlements derive their value from the profits that fishers expect to earn from the fishing access rights entitlements provide. Restricting access to a fishery through area closures, such as marine reserves, may directly affect the future commercial returns that can be generated and as such would be expected to affect the value of fishing entitlements.

Area closures can potentially affect the value of a fishery and its entitlements in a number of ways. Most obviously, exclusion from historical fishing grounds will reduce access to known productive areas and can be expected to reduce fishery profits in the immediate and longer term. Exclusion from fishing grounds that are currently not profitable may also affect the value of a fishing entitlement. For example, changes in fish prices or fishing costs may improve the attractiveness of currently unused areas significantly. The option to develop new areas of a fishery has some value and may be affected by changes in fishing access arrangements.

Secondary effects of area closures may also affect the value of fishing entitlements. For example, an area closure may affect stock availability in adjacent areas, changing the productivity of areas which remain open. The net effect of all of these factors will be reflected in the change in value of fishery entitlements.

## **Commercial fishing potential displacement**

The draft North Commonwealth Marine Reserves Network would potentially displace \$2.8–4.2 million annual average GVP (378–428 tonnes of catch) (Table 4), comprising \$1.6–3.1 million (159–209 tonnes of catch) from Commonwealth fisheries (the Northern Prawn Fishery), \$0.8 million (102 tonnes of catch) from Queensland fisheries and \$0.4 million (117 tonnes of catch) from Northern Territory fisheries.

For comparison, the total value of those fisheries that are potentially impacted across the three jurisdictions was \$114 million, comprising \$11 million for Northern Territory fisheries (mean annual within the period 2001–10), \$17 million for Queensland fisheries (mean annual 2000–10) and \$86 million for Commonwealth fisheries (mean annual 2001–10). These values are the totals for the impacted fisheries in each jurisdiction and are not adjusted to account only for fishing in the North Marine Region.

The most impacted fisheries in terms of catch would be the Commonwealth Northern Prawn Fishery and the longline method in the Northern Territory Offshore Net and Line Fishery. The most impacted fisheries in terms of GVP would be the Commonwealth Northern Prawn Fishery and the N9 Fishery of the Queensland Gulf of Carpentaria Inshore Fin Fish Fishery. The most impacted fisheries in terms of the percentage of the fishery catch and GVP potentially impacted would be to the longline method in the Northern Territory Offshore Net and Line Fishery and the Queensland N9 Fishery (Table 4). The impact on the longline method in the Northern Territory

Offshore Net and Line Fishery is understood to be on a single operator who leases all the boat days from licence holders. The impact on the N9 Fishery is to a single company that owns all five licences in the fishery.

The size of potential displacements for individual Northern Territory fisheries cannot be reported due to confidentiality constraints (less than five vessels in each case). Table 4 contains a ranking relative to all other potentially impacted fisheries across the three jurisdictions. It is apparent that the potential impacts on Northern Territory fisheries would be borne by a small number of operators.

**Table 4 Estimated potential displacement of catch and gross value of production (GVP) by fishery for the entire draft North Commonwealth Marine Reserves Network**

<i>Fishery</i>	<b>Total catch displaced (tonnes)</b>	<b>Total GVP displaced (\$'000)</b>	<b>Percentage GVP of total fishery</b>	<b>Ranked order of GVP displacement</b>
<b>Commonwealth</b>				
Northern Prawn Fishery	159–209	1645–3061	1.9–3.5*	1
<i>Commonwealth total</i>	<i>159–209</i>	<i>1645–3061</i>	<i>1.9–3.5*</i>	
<b>Northern Territory</b>				
A16 Finfish Trawl Fishery	*	*	*	4
A4 Spanish Mackerel Fishery	*	*	*	10
A5 Offshore Net and Line Fishery (drifting gillnet)	*	*	*	8
A5 Offshore Net and Line Fishery (longline)	*	*	*	3
<i>Northern Territory total</i>	<i>116.7</i>	<i>385.2</i>	<i>–</i>	<i>–</i>
<b>Queensland</b>				
Gulf of Carpentaria Developmental Fin Fish Trawl Fishery	12.2	72.1	2.2	5
Gulf of Carpentaria Line Fishery (QFJA)	17.8	59.8	10.8	7
Gulf of Carpentaria Line Fishery (L4)	4.9*	37.9*	4.4*	6
Gulf of Carpentaria Inshore Fin Fish Fishery (N3)	2.8*	13.9*	0.2*	9
Gulf of Carpentaria Inshore Fin Fish Fishery(N9 and QFJA)	*	*	*	2
<i>Queensland total</i>	<i>102.4</i>	<i>768.3</i>	<i>–</i>	<i>–</i>
<b>Total</b>	<b>378–428</b>	<b>2799–4215</b>	<b>–</b>	

– = not applicable; QFJA = Queensland Fisheries Joint Authority

Note: Estimates are mean annual for the reference period. Confidential data are marked with an asterisk (\*). In some fisheries, only one area is confidential. In these cases, the total does not include the confidential value as it would be possible to back-calculate the displacement from that area. These are denoted by showing the sum of the non-confidential areas followed by an asterisk (e.g. 2.8\*).

Potential catch and GVP displacements for each reserve and area within the reserve are given in Table 5 for Commonwealth fisheries, in Table 6 for Northern Territory fisheries and in Table 7 for Queensland fisheries.

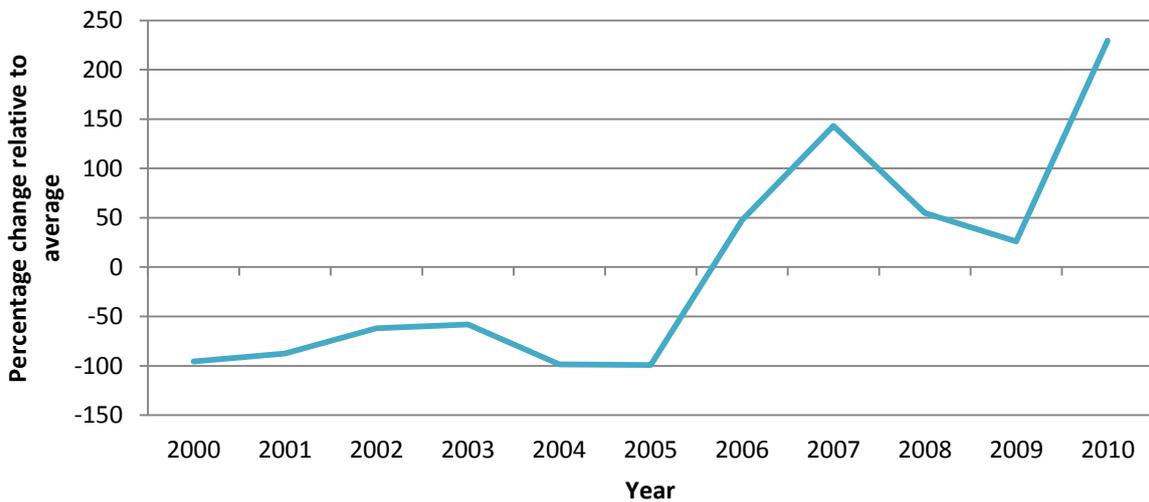
The reserves facing the greatest potential impact were the draft Gulf of Carpentaria and West Cape York marine reserves. The impact on the draft Gulf of Carpentaria marine reserve is primarily on the Northern Prawn Fishery, while the impact on the draft West Cape York marine reserve is primarily on the N9 Fishery of the Queensland Gulf of Carpentaria Inshore Fin Fish Fishery.

In addition to the draft Gulf of Carpentaria marine reserve potentially displacing the largest amount of catch and GVP, parts of area 209 and 210 are also used for Northern Prawn Fishery annual recruitment and spawning surveys.

Although the draft Oceanic Shoals marine reserve has the second largest impact on the Northern Prawn Fishery, the impact is largely from the south-east part of the draft marine reserve (the area west of Bathurst Island).

The estimate of potential displacement for the N9 Fishery of the Queensland Gulf of Carpentaria Inshore Fin Fish Fishery cannot be reported due to confidentiality constraints. The draft West Cape York marine reserve and, to a lesser extent, the Gulf of Carpentaria marine reserve have a large potential impact on the Queensland N9 Fishery of the Gulf of Carpentaria Inshore Fin Fish Fishery. The potential displacement of the N9 Fishery increased throughout the 11-year reference period (Figure 1), and was well in excess of \$1.5 million in 2010 (for more information see Case study: Vertically integrated fishing business in the Gulf of Carpentaria—Wren Fishing). Additionally, this impact would be borne by one company as it owns all five licences in the N9 Fishery.

**Figure 1 Time series of potential gross value of production displacement from the Queensland N9 Fishery of the Gulf of Carpentaria Inshore Fin Fish Fishery, per cent relative to the average displacement, 2000–10**



Note: Includes displacement from both the draft Gulf of Carpentaria and West Cape York marine reserves.

### Commonwealth fisheries—catch and gross value of production

Table 5 Estimates of mean annual potential catch and gross value of production (GVP) displaced in the Northern Prawn Fishery by the draft North Commonwealth Marine Reserves Network

Catch (t)	Joseph Bonaparte Gulf		Oceanic Shoals	Arafura	Arnhem	Wessel		Limmen	Gulf of Carpentaria			West Cape York		Total	Percentage of total fishery GVP
Fishery	201	202	203	204	205	206	207	208	209	210	211	212	213		
NPF - Demersal trawl	*	*	14.8	4.3	2.0	0.6	0.3	1.5	89–131	40–47	3–4	2.2	*	159–209	2.4–3.1

GVP (\$'000)	Joseph Bonaparte Gulf		Oceanic Shoals	Arafura	Arnhem	Wessel		Limmen	Gulf of Carpentaria			West Cape York		Total	Percentage of total fishery GVP
Fishery	201	202	203	204	205	206	207	208	209	210	211	212	213		
NPF - Demersal trawl	*	*	166.7	66.9	20.8	6.0	4.7	23.3	848–2125	428–567	35–37	33.9	*	1645–3061	1.9–3.5
	Marine National Park Zone			Special Purpose Zone			Multiple Use Zone								

Note: Catch and GVP estimates are mean annual for the reference period. Confidential data are marked with an asterisk (\*). For an explanation of the methodology used for the range of potential displacement, caveats and limitations of the data, refer to Appendix B: Fisheries data processing methods.

## Northern Territory fisheries—catch and GVP

Table 6 Estimates of mean annual potential catch and gross value of production (GVP) displaced from Northern Territory fisheries by the draft North Commonwealth Marine Reserves Network

Catch (t)		Joseph Bonaparte Gulf		Oceanic Shoals	Arafura	Arnhem	Wessel		Limmen	Total	Percentage of total fishery catch	Rank
Fishery	Method	201	202	203	204	205	206	207	208			
A16 Finfish Trawl	Trawling				*	*	*	*		*	*	2
A4 Spanish Mackerel Fishery	Trolling						*			*	*	4
A5 Offshore Net and Line Fishery	Drifting gillnet	*		*	*		*	*	*	*	*	3
A5 Offshore Net and Line Fishery	Longline	*	*	*	*	*	*	*	*	*	*	1
Total		*	*	*	*	*	*	*	*	116.7		
Rank		7	8	1	4	3	2	6	5			

GVP (\$'000)		Joseph Bonaparte Gulf		Oceanic Shoals	Arafura	Arnhem	Wessel		Limmen	Total	Percentage of total fishery GVP	Rank
Fishery	Method	201	202	203	204	205	206	207	208			
A16 Finfish Trawl	Trawling				*	*	*	*		*	*	2
A4 Spanish Mackerel Fishery	Trolling						*			*	*	4
A5 Offshore Net and Line Fishery	Drifting gillnet	*		*	*		*	*	*	*	*	3
A5 Offshore Net and Line Fishery	Longline	*	*	*	*	*	*	*	*	*	*	1
Total		*	*	*	*	*	*	*	*	385.2		
Rank		7	8	1	4	3	2	6				

Marine National Park Zone
Special Purpose Zone
Multiple Use Zone

Note: Catch and GVP estimates are mean annual for the reference period. Confidential data are marked with an asterisk (\*). For an explanation of the methodology used to estimate potential displacement, reference period used for individual fisheries, caveats and limitations of the data, refer to Appendix B: Fisheries data processing methods.

## Queensland fisheries—catch and gross value of production

Table 7 Estimates of potential catch and gross value of production (GVP) displaced from Queensland fisheries by the draft North Commonwealth Marine Reserves Network

Catch (t)		Gulf of Carpentaria			West Cape York		Total	Percentage of total sector
Fishery	Method	209	210	211	212	213		
Gulf of Carpentaria Developmental Finfish Trawl	Fish trawling	*		*	7.4	4.2	12.2	2.4
Gulf of Carpentaria Line (QFJA)	Longline/trotline/dropline	5.4	*	*	*	*	17.8	10.0
Gulf of Carpentaria Line (L4)	Line fishing		4.9			*	4.9*	2.3*
Gulf of Carpentaria Inshore Fin Fish (N3)	Set mesh net (gillnet)	0.4	<0.1		2.4	*	2.8*	0.2*
Gulf of Carpentaria Inshore Fin Fish (N9 and QFJA net)	Set mesh net (gillnet)	*	*	*	*	*	*	*
Total		7.0	11.2	11.7	60.1	12.4	102.4	

GVP (\$'000)		Gulf of Carpentaria			West Cape York		Total	Percentage of total sector
Fishery	Method	209	210	211	212	213		
Gulf of Carpentaria Developmental Finfish Trawl	Fish trawling	*		*	43.9	25.0	72.1	2.2
Gulf of Carpentaria Line (QFJA)	Longline/trotline/dropline	16.2	*	*	*	*	59.8	10.8
Gulf of Carpentaria Line (L4)	Line fishing		37.9			*	37.9*	2.5*
Gulf of Carpentaria Inshore Fin Fish (N3)	Set mesh net (gillnet)	1.9	<0.1		12.0	*	13.9*	0.2*
Gulf of Carpentaria Inshore Fin Fish (N9 and QFJA net)	Set mesh net (gillnet)	*	*	*	*	*	*	*
Total		28.2	71.9	67.5	503.3	97.4	768.3	

Marine National Park Zone	Special Purpose Zone	Multiple Use Zone
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GoC = Gulf of Carpentaria; QFJA = Queensland Fisheries Joint Authority

Note: Catch and GVP estimates are mean annual for the reference period. Confidential data are marked with an asterisk (\*). In some fisheries, only one area is confidential. In these cases, the total does not include the confidential value because it would be possible to back-calculate the displacement from that area. These are denoted by showing the sum of the non-confidential areas followed by an asterisk (e.g. 2.8\*). For an explanation of the methodology used to estimate potential displacement, caveats and limitations of the data, refer to Appendix B: Fisheries data processing methods.

## **Links to other marine regions–fisheries**

There may be minor cumulative impacts to the Commonwealth Northern Prawn Fishery (1.7 t; \$16 600 GVP) by the draft North-west Commonwealth Marine Reserves Network (ABARES 2012c), although this is relatively small compared with estimated displacement from the draft North Commonwealth Marine Reserves Network (ABARES 2012b).

## **Reliability and trends over time**

Some key issues for interpreting the estimates of potential displacement are noted in this section. The full methodology and caveats are contained in Appendix B: Fisheries data processing methods.

Displaced catch and GVP were estimated using logbook data supplied by the relevant jurisdictions. Shot-by-shot data were supplied for Commonwealth and Northern Territory fisheries; consequently, estimates for these fisheries have high accuracy. Queensland data were supplied at 6-minute 'site' and 30-minute 'grid' scales; estimates for these fisheries have medium accuracy. Estimates of displacement for individual Northern Territory fisheries cannot be reported here as they all came from less than five vessels.

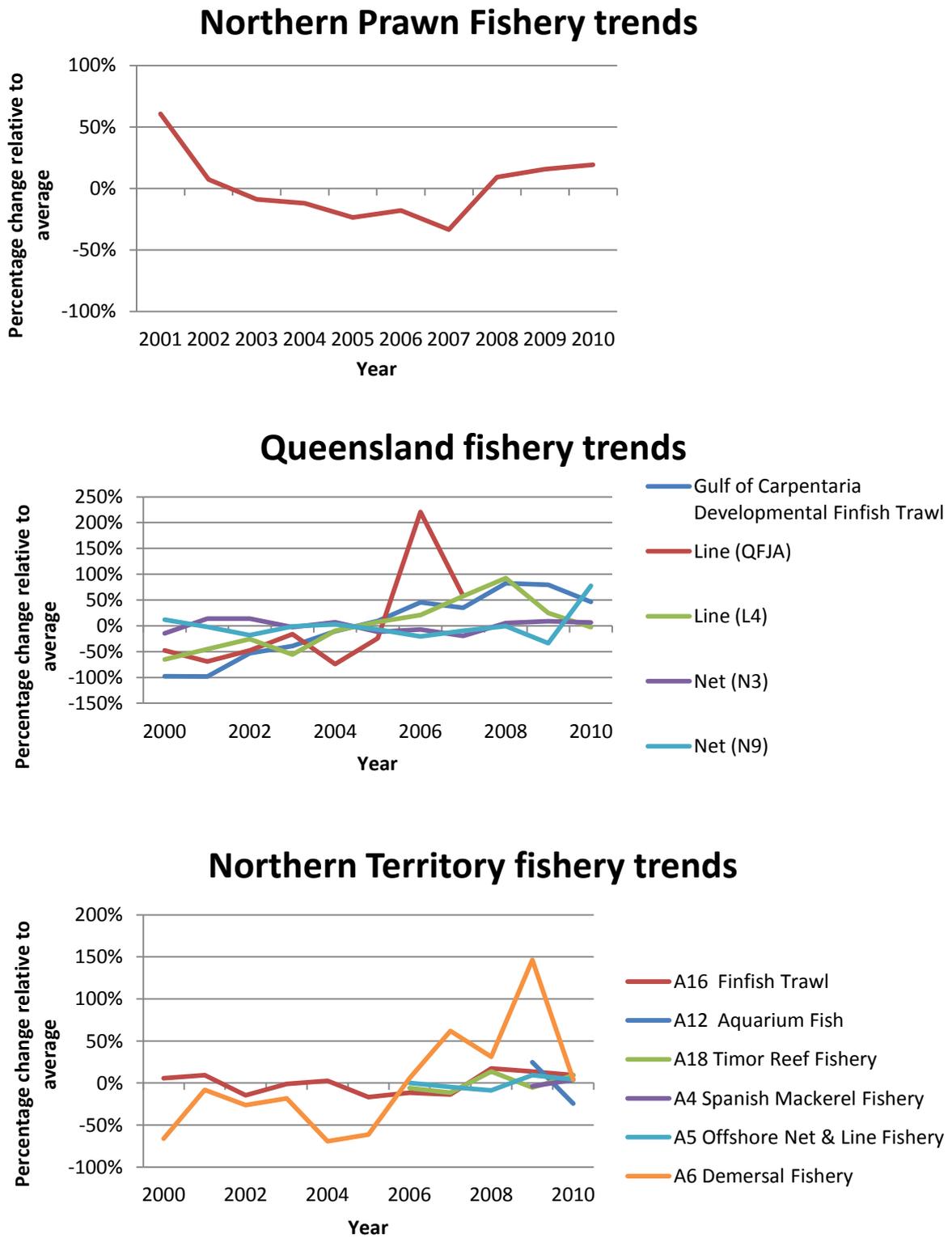
Time trends in total annual catch for each potentially impacted fishery are shown in Figure 2. These illustrate trends in each fishery and are expressed in relative terms (percentage change relative to the mean).

The Northern Prawn Fishery contracted through the early 2000s while the fishery was subject to increasing effort restrictions and a restructure. Some of these restrictions eased around 2009 and, together with several good fishing seasons, have resulted in an increase in catches in recent years.

Queensland and Northern Territory fisheries were either stable (e.g. the N3 sector) or grew (e.g. the Gulf of Carpentaria Developmental Fin Fish Trawl Fishery) over the reference period. The total N9 Fishery doubled its size in 2010 (Figure 2).

In general, fisheries in the North Marine Region have seen stable or increased production over the reference period (Figure 2). There is also significant capacity for expansion of some fisheries, based on the capacity to increase production and remain within biologically sustainable catch limits. This applies to fisheries currently operating under developmental permits, should operating circumstances permit.

Figure 2 Trends in fishery gross value of production (change relative to average)



Data source: Commonwealth, state and territory fisheries logbook data

## Charter fishing potential displacement

Analysis of charter fisher logbook data indicates the draft marine reserves network would have a small impact on the charter fishing sector (Table 8 and Table 9). This is consistent with discussions with charter vessel industry representatives who suggested the draft marine reserves network would have a small impact on them.

Charter activity was reported in all three draft Marine National Park zones (the only zone in the North Marine Region from which charter fishing is excluded) in the North Marine Region; however, the majority of activity was from the Northern Territory charter sector operating in the draft Wessel marine reserve. The most activity in any one year in this draft marine reserve occurred in 2004 when 10 licensees reported activity in the area. This declined to three licensees reporting activity in the draft marine reserve in 2010. Northern Territory licensee activity was also reported in the area of the draft West Cape York marine reserve. This is likely to be from an operator with licences to operate in both the Northern Territory and Queensland charter fisheries reporting valid fishing activity in the wrong logbook. Queensland charter licensees reported activity in the draft Gulf of Carpentaria and West Cape York marine reserves.

**Table 8 Potential annual average displacement of Northern Territory charter fishing activity**

	<b>Total displaced</b>	<b>Percentage displaced</b>
Number of fish caught	235.7	0.1
Number of clients	179.1	0.2

Note: Percentage displaced is relative to the total number of fish caught and the total number of clients in the North Marine Region, and excludes Northern Territory waters.

**Table 9 Potential annual average displacement of Queensland charter fishing activity**

	<b>Total displaced</b>	<b>Percentage displaced</b>
Days fished	1.7	0.1
Catch	41.4	0.1
Number of fishers	5.1	0.1

Note: Percentage displaced is relative to all Queensland charter operations in the Gulf of Carpentaria and does not include charter operations on the east coast of Queensland.

## Prospective fishing

In this report, prospective fishing is treated as potential fishing that has not been accounted for in the estimates of potential direct displacement of catch and GVP. Prospective fisheries range from short-term prospects that have been clearly identified, through to long-term, speculative prospects. Establishing the full long-term set of fisheries development possibilities (i.e. the present value of all future fisheries opportunities) for the oceans within the draft North Commonwealth Marine Reserves Network is outside the scope of this report. Instead, we focus on the short term, where there is evidence that companies or individuals have made specific plans or investments to develop prospects, where potential for expansion has been clearly identified by fisheries management, and where there are strong, well-defined rights of access. This section provides a brief overview of the concepts of prospective fishing, and highlights several fisheries where evidence is available and where these prospects were raised during the ABARES consultation process.

Prospective fishing includes:

- developing completely new fisheries (e.g. for new species and using new fishing methods, targeting practices or new fishing areas)
- fisheries where there is capacity for expansion within long-term sustainable limits based on the size or productivity of the fish stock, or recovery of depleted stocks
- current fisheries expanding into new fishing areas or intermittently productive fishing areas, or movement back into historically productive areas, or by using new methods or targeting practices
- redeveloping fisheries that have ceased operating or are operating at a reduced level (e.g. catches that are well below defined long-term sustainable management levels).

In addition, some developed fisheries such as prawns, scallops and squid are highly variable through time and space. Areas may not be fished for years but are still part of the mosaic of potentially productive grounds that make up the fishery. If historical reference periods are too short then periods of activity within a given area may not be captured. In an attempt to account for temporal variability in fisheries, where suitable, a relatively long reference period was applied when generating the estimates of potential displacement—however, in some cases the availability of finer scale data necessitated a shorter reference period.

Prospective fishing is fundamentally about the future and cannot always be predicted from past activity. It is therefore difficult to quantitatively assess and assign a value to the prospectivity of any given fishery or area of ocean.

There are several factors to consider when assessing the value a fisher places on a prospective fishery. Any value that the fisher determines would need to take account of the perceived value if the fishery is developed to its potential, the likelihood of an individual accessing the fishery, the likelihood of the fishery reaching its expected potential and the fisher's time-value of money.

In light of this, factors that may influence the value of a prospective fishery include:

- the expected abundance and quality of stocks
- the expected costs of accessing, harvesting and transporting the stocks
- the expected market price at the time at which the stocks will be sold
- the confidence in the assessment of the fishery
- the likelihood that the area will be used preferentially over other prospective areas
- the expected time of accessing the prospective fishery.

Given that the value of fisheries endorsements is closely related to the value of a fishery, these factors also have the potential to affect the value of endorsements. In addition, because of the need to adjust for the risk and time involved with prospective fisheries, their value is often significantly less than the value of their expected potential.

The following examples of prospective fishing were found in the draft North Commonwealth Marine Reserves Network:

- Many fisheries in the North Marine Region are actively under development and have an increasing trend in catch and GVP, in contrast to the national trend (Figure 2). Under current trends, this expansion might continue; however, it is not always clear how much developmental potential exists. For these fisheries, the historical GVP displacement is probably not a good indicator of future prospects.
- Management changes are being introduced to Northern Territory fisheries to manage red snapper catches (the Demersal, Fin Fish Trawl and Timor Reef fisheries) because the current catch of red snapper stocks is well below the estimated sustainable harvest levels (NT DoR 2010). These changes include relaxing restrictions on effort and are designed to increase the catch of red snappers.
- The Northern Territory Timor Reef Fishery is a good example of an evolving fishery. The fishery has changed methods several times (switching between line and trap fishing), which in part reflects the expanding nature of the fishery as operators explore new grounds. Additionally, as markets emerge, there is growing interest in retaining different species that have traditionally been discarded (e.g. trevally). Although the Timor Reef Fishery is not displaced by the draft marine reserves network, it is one example of the way in which fisheries may evolve over time.
- There are two developmental fisheries in the Northern Territory; one trialling a lift net, and one trialling a small purse-seine net. These fisheries have been operating for a number of years and the operator is continuing to develop markets for the products. Due to a potential loss in flexibility of his operation, the operator was not confident he would be able to continue fishing the two developmental permits if he is displaced by the draft marine reserves.

Placing a value on prospective fisheries is a difficult task and was outside the scope of this assessment. In the case of licences, it appears likely that part of the value of fishing rights is associated with the full scope of prospective fisheries that could be developed under that right. This is particularly the case for tradeable statutory fishing rights in fisheries with management measures that actively limit fishing. If the prospective values of a licence are diminished then the value of the licence may also be diminished (see Box 1). For businesses that have made investments specifically to develop prospective fisheries, it should be possible (case by case) to provide clear evidence of this investment and to estimate potential loss associated with the draft marine reserves.

## Fisheries management

Changes to the current management of a fishery may be necessary after the announcement of the final proposed marine reserve boundaries. Where a significant amount of fishing effort is displaced by a marine reserve, management may need to consider how this effort will be redistributed or removed. Any changes will need to be assessed in the context of the size of the impact, and managers will need to determine if the remaining effort within the fishery triggers a reassessment of the current management arrangements. Management arrangements also need to consider any increased pressure as a result of displaced operators moving within or between fisheries. Any management changes will be fishery specific and depend on the nature of the fishery, but management agencies may need to consider changes to the input (e.g. limited entry, area or spatial closures) or output controls (e.g. total allowable catch, individual transferable quotas). This assessment does not attempt to assess the cost of fisheries management changes that are directly attributable to the marine reserves network.

### 3 Flow of potential impacts to ports and supply chains

This chapter examines the ‘flow’ of impacts, from exclusion of fishing and associated catches within the draft marine reserves, through to towns and communities and their resident businesses. The chapter is partly informed by results from the ABARES survey *Your marine areas matter: a survey of commercial fishers’ values and preferences for Commonwealth marine reserves in the North and North-west Marine Regions of Australia* (‘the survey’), conducted as part of this assessment. The survey contained specific questions about where respondents sourced inputs from, and where they sent their outputs to. For an explanation of the social assessment methodology, refer to Appendix B: Social impact assessment methods.

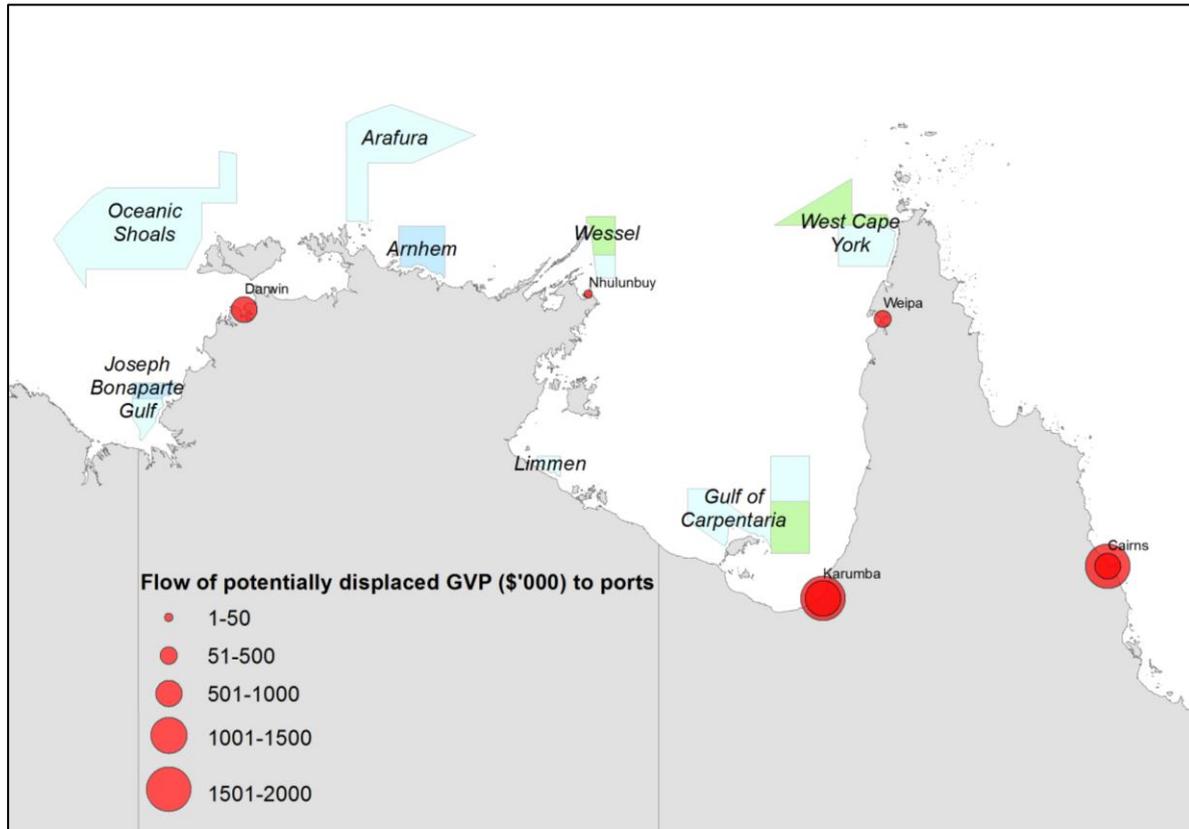
Flow of potential impact was examined using three approaches:

- 1) *Fishing vessel home port or landing port of the displaced catch*. This approach relies on logbook and ancillary data supplied by each jurisdiction and makes a direct link between the estimates of potential displacement (Table 4) and where that catch is landed or the home port of the fishing vessel.
- 2) *The location of inputs to fishing business (upstream impacts)*. This approach relies on supply chain data from the survey, where respondents were asked where they source inputs to their fishing business (e.g. fuel, bait, ice, fishing gear and maintenance). Reductions in catch volumes or changes to fishing behaviour would be expected to flow ‘upstream’ to those businesses and towns that supply inputs to affected fishers.
- 3) *The location of outputs from fishing businesses (downstream impacts)*. This approach relies on supply chain data from the survey, where respondents were asked where their catch is landed (or distributed directly to). Reductions in catch volumes would be expected to flow ‘downstream’ to those businesses and towns that receive outputs from affected fishers.

#### Flow of gross value of production to ports

The flow of potentially displaced catch and GVP to towns and coastal communities was estimated using fisheries logbook data, survey results, and discussions with fishing industry peak bodies and individual fishers. Total potential GVP impact would primarily be on Cairns, Karumba, Darwin, Weipa and Nhulunbuy (Map 4).

Map 4 Flow of potentially displaced gross value of production (GVP) to ports



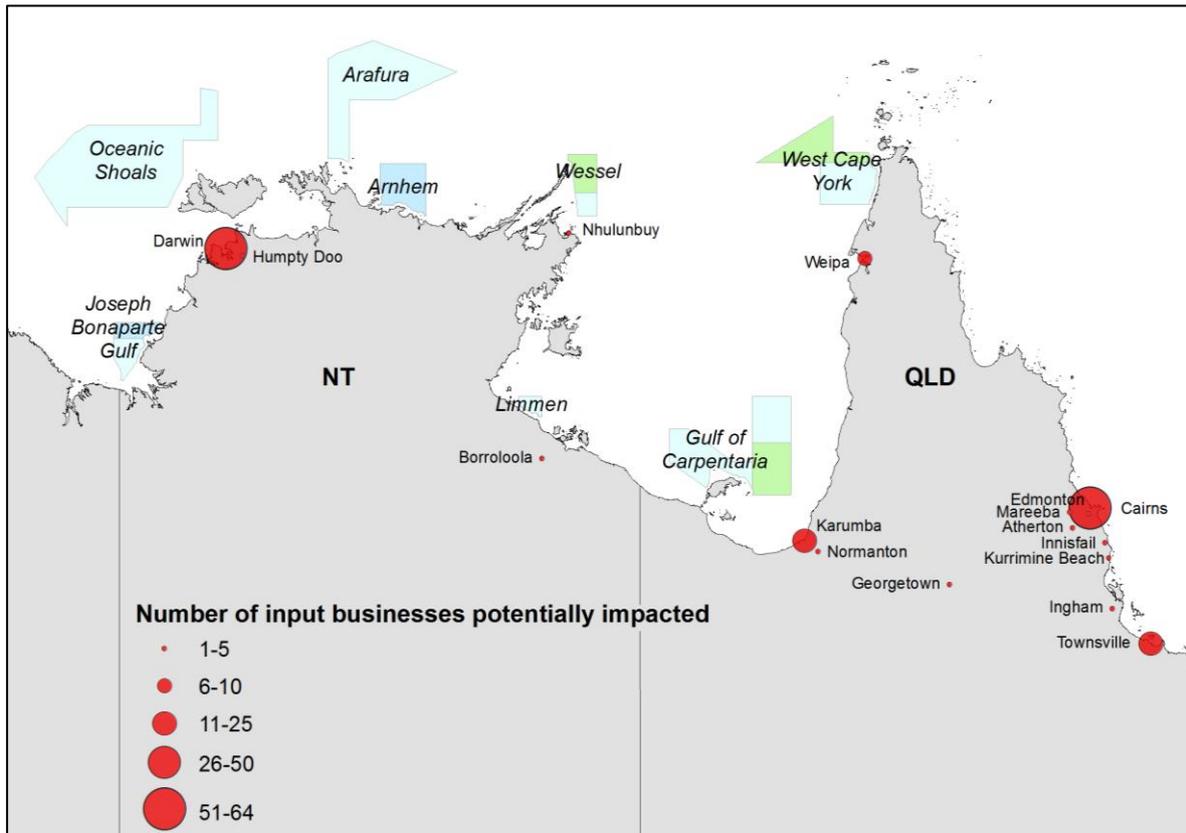
Note: GVP flow estimates are based on discussions with fishing industry peak bodies and individual fishers, survey responses and logbook data. Where a point and an upper estimate exist for one port, the point appears as a clear circle within the larger upper estimate. Zoning is described in Appendix A: Fisheries data processing methods.

Data source: ABARES, *Your marine areas matter: a survey of commercial fishers' values and preferences for Commonwealth marine reserves in the North and North-west Marine Regions of Australia*; marine reserve boundaries from the Australian Government Department of Sustainability, Environment, Water, Population and Communities

## Inputs to fishing businesses (upstream impacts)

The flow of impacts to upstream businesses (i.e. those that supply products to fishing businesses) was determined through the survey. The survey was filtered to exclude responses from operators where no displacement could occur. These were scenarios where either fishing methods were compatible with the zoning of a particular reserve, or where logbook analysis indicated no displaced fishing effort. Respondents reported the largest number of upstream businesses that would potentially be impacted by the draft marine reserves network were in Cairns (64 businesses), Darwin (63 businesses) and Karumba (19 businesses) (Map 5). Other upstream businesses identified as potentially impacted included those located in Nhulunbuy and Weipa. As not all potentially impacted fishers returned a survey there are likely to be other potentially impacted businesses that have not been identified here.

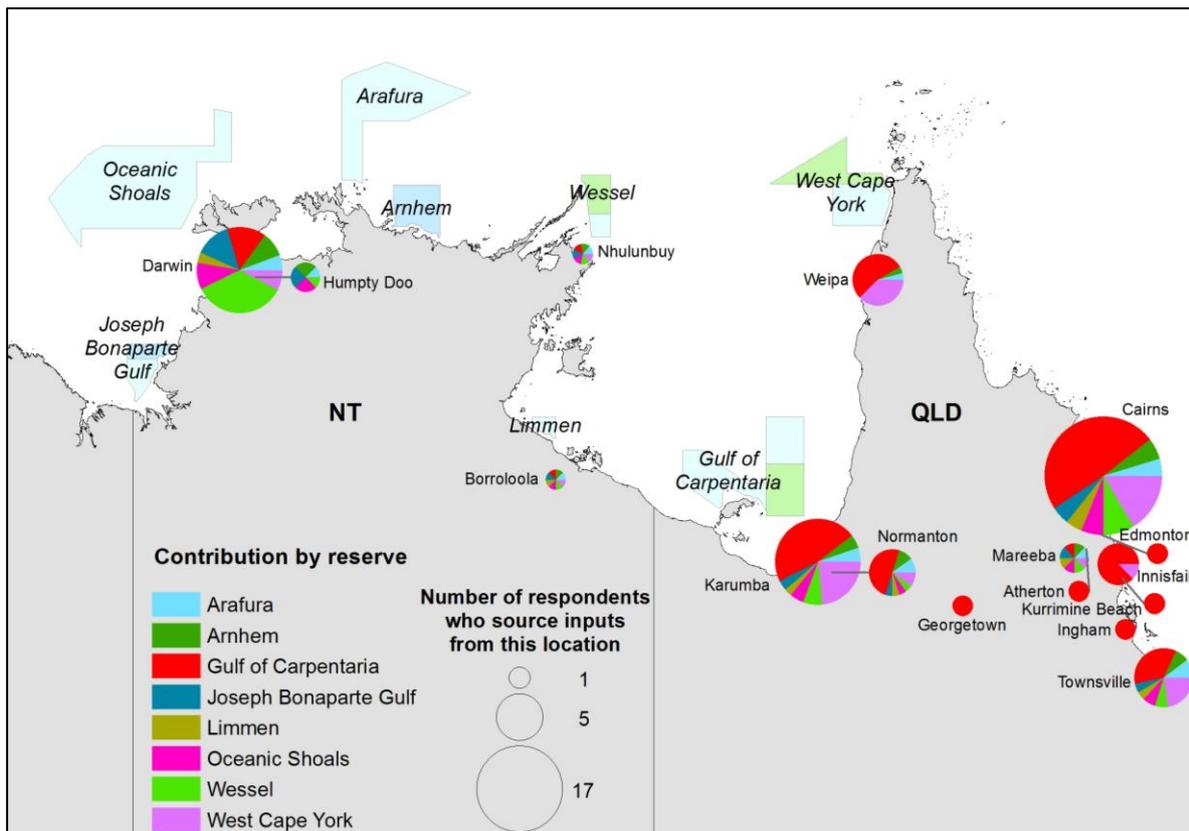
**Map 5 Number of input businesses identified as potentially impacted by the draft Commonwealth Marine Reserves Network**



Note: Input businesses provide goods and services such as fuel and lubricants, bait, ice, fishing gear, repairs/maintenance, boat slipping and accessories/chandlery. , Zoning is described in Appendix A: Fisheries data processing methods  
 Data source: ABARES, *Your marine areas matter: a survey of commercial fishers' values and preferences for Commonwealth marine reserves in the North and North-west Marine Regions of Australia*, marine reserve boundaries from the Australian Government Department of Sustainability, Environment, Water, Population and Communities

Map 6 shows the number of survey respondents who source inputs from each location, as well as the marine reserves that potentially impacted those respondents. The most frequently identified towns for supplying inputs were Cairns (32 respondents), Darwin (17 respondents) and Karumba (17 respondents). A number of other towns were also identified, including towns adjacent to the North Marine Region, such as Nhulunbuy, Borroloola, Normanton and Weipa, and others further inland or on the east coast, such as Georgetown, Innisfail and Townsville. The draft marine reserves that impacted the largest number of respondents were the Gulf of Carpentaria, Wessel and West Cape York marine reserves.

**Map 6 Number of respondents who source inputs from this location for their fishing business (size of the circle), with proportional allocation to each draft marine reserve (pie chart)**



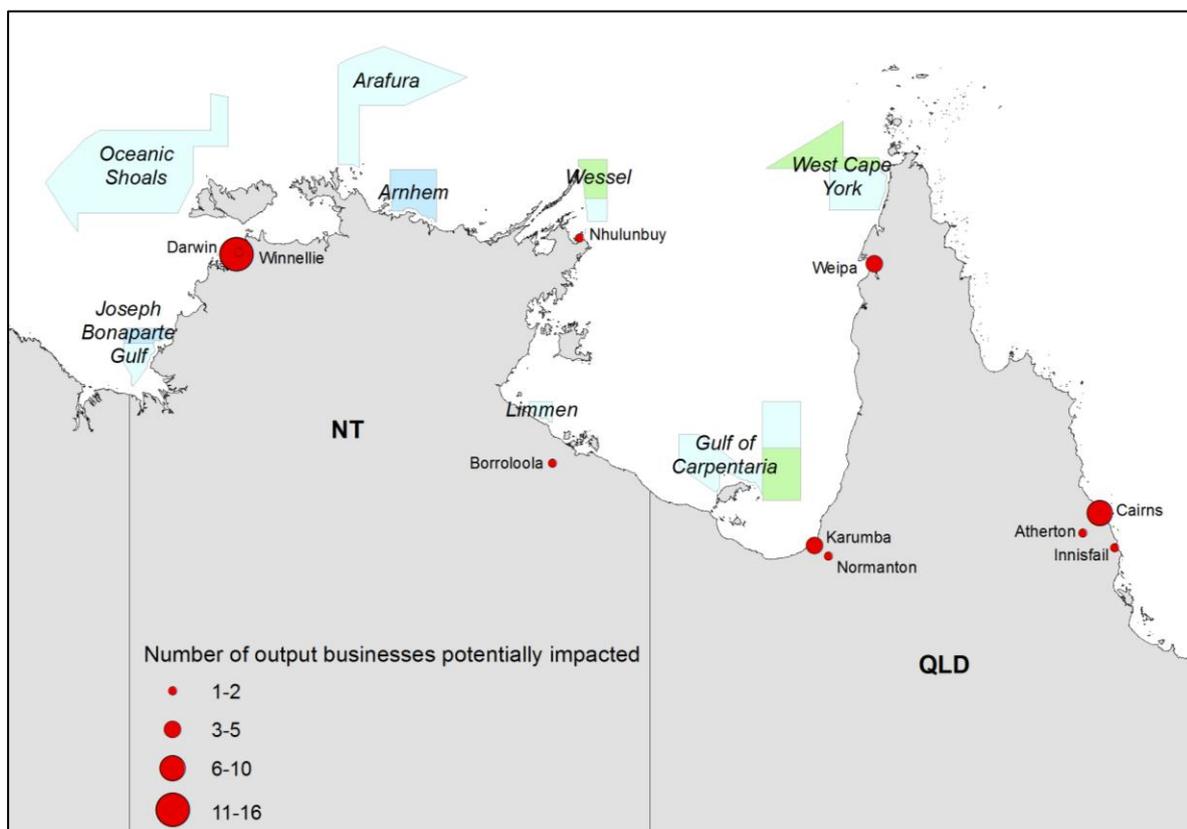
Data source: ABARES, *Your marine areas matter: a survey of commercial fishers' values and preferences for Commonwealth marine reserves in the North and North-west Marine Regions of Australia*, marine reserve boundaries from the Australian Government Department of Sustainability, Environment, Water, Population and Communities. Zoning is described in Appendix A: Fisheries data processing methods

## Outputs from fishing businesses (downstream impacts)

The flow of impacts to downstream businesses (i.e. those that receive products from fishing businesses) was determined through the survey. The survey was filtered to exclude responses from operators where no displacement could occur. These were scenarios where either fishing methods were compatible with the zoning of a particular reserve, or where logbook analysis indicated no displaced fishing effort. There were a small number of towns with a large number of businesses receiving outputs (catch)—Darwin (15 businesses) and Cairns (10 businesses)—with the remaining towns each having less than five output businesses identified by respondents (Map 7).

Although only four output businesses were identified in Karumba, a large amount of potentially displaced catch (\$1.1–1.6 million) was landed here (see Map 4). The impact of the draft marine reserves network on these businesses is likely to be large.

**Map 7 Number of output businesses identified as potentially impacted by the draft North Commonwealth Marine Reserves Network**

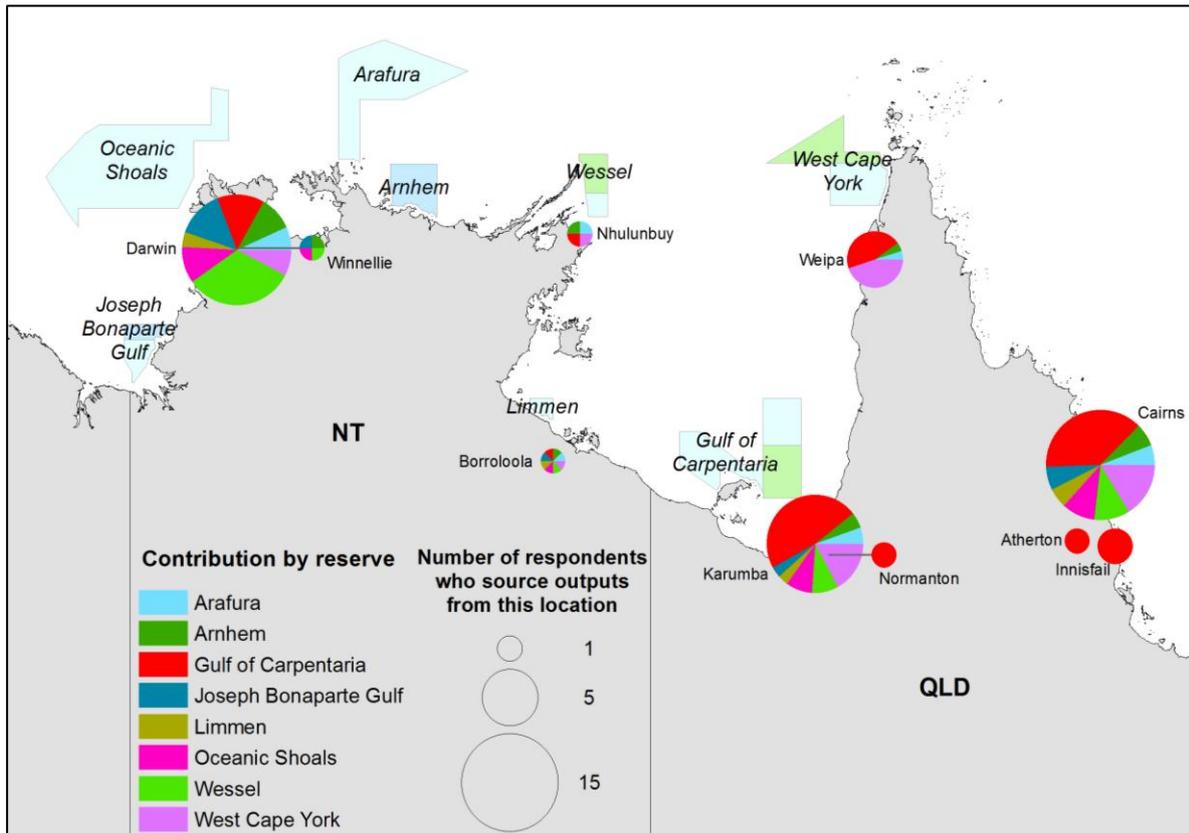


Note: Output businesses provide goods and services related to receiving, transport and processing of catch.

Data source: ABARES, *Your marine areas matter: a survey of commercial fishers' values and preferences for Commonwealth marine reserves in the North and North-west Marine Regions of Australia*, marine reserve boundaries from the Australian Government Department of Sustainability, Environment, Water, Population and Communities. Zoning is described in Appendix A: Fisheries data processing methods

Map 8 shows the number of survey respondents who send outputs to each location, as well as the marine reserves that potentially impacted those respondents. The most frequently identified towns for output impacts were Cairns (41 respondents), Darwin (40 respondents) and Karumba (35 respondents). The draft marine reserves in the North Marine Region that impacted the largest number of respondents were the Gulf of Carpentaria, West Cape York and Wessel marine reserves.

**Map 8 Number of respondents who send outputs from their fishing business to this location (size of the circle), with proportional allocation to each draft marine reserve (pie chart)**

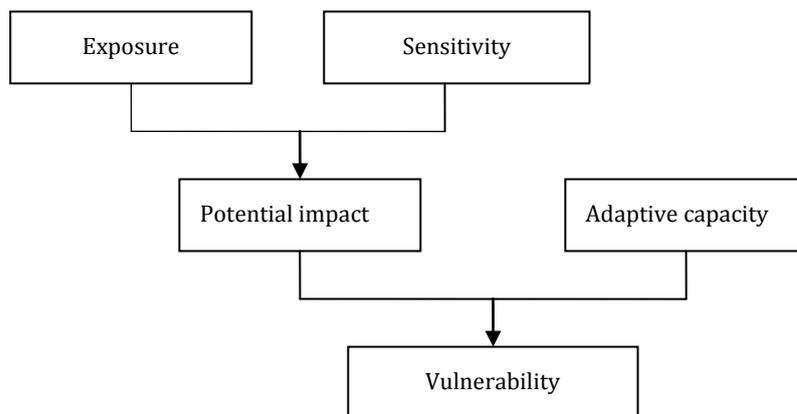


Data source: ABARES, *Your marine areas matter: a survey of commercial fishers' values and preferences for Commonwealth marine reserves in the North and North-west Marine Regions of Australia*, marine reserve boundaries from the Australian Government Department of Sustainability, Environment, Water, Population and Communities. Zoning is described in Appendix A: Fisheries data processing methods

## Town and local area summary

To identify which communities would be impacted most by the displacement of GVP from the draft North Commonwealth Marine Reserves Network, data on flow of impacts to towns was combined with demographic and socioeconomic data. Figure 3 summarises the elements that make up community vulnerability. Community vulnerability is a function of a community's exposure (GVP displaced per capita), sensitivity (percentage employment in commercial wild-catch fishing) and adaptive capacity (community socioeconomic characteristics). It provides a broad view of which communities will potentially face the biggest impacts, and which might be least able to adapt to these changes. It is important to read the methods in Appendix D regarding construction, caveats and limitations before interpreting the vulnerability index.

**Figure 3 Conceptual model of community vulnerability**



Source: Allen Consulting Group 2005, based on Schröter and the ATEAM Consortium 2004

To identify which communities would be impacted most by the displacement of GVP resulting from the declaration of the draft North Commonwealth Marine Reserves Network, the following approach was used:

- A composite index of community vulnerability was constructed and analysed to provide an initial understanding of which communities may be most impacted and least adaptable. A complete set of impact flow and supply chain results, together with a community vulnerability index ranking and demographic data are presented in Appendix E: Summary information on flow of impacts, supply chains and demographics of communities. Methods, caveats and limitations on the index are provided in Appendix D: Developing an index of community vulnerability.
- Communities were identified where total flow of potentially displaced GVP is greater than or equal to \$50 000 or where GVP displaced per capita is greater than or equal to \$20 per person.
- Communities that meet either of the criteria above are reported on with the addition of data on supply chain businesses, employment in the commercial fishing industry (sensitivity) and community characteristics influencing adaptive capacity.

## Community exposure, sensitivity and adaptive capacity

Table 10 presents community exposure, sensitivity and adaptive capacity measures. Four communities had a potential flow of GVP impact greater than \$50 000 per year. In descending order of impact, these were Cairns, Karumba, Darwin and Weipa.

**Table 10 Community exposure, sensitivity and adaptive capacity–draft Commonwealth North Marine Reserves Network**

Town	Population geography	EXPOSURE			SENSITIVITY	ADAPTIVE CAPACITY			
		GVP displaced (\$'000 max)	Population (2006)	GVP displaced per capita (\$)	Fishing industry employment (% of total employ)	Economic diversity index	ARIA remoteness index	Median household income (\$ weekly)	SEIFA Index of relative disadvantage
Cairns	Cairns City Part A (Statistical subdivision)	1818.0	122 732	14.81	0.39	0.88	2	1284	6
Karumba	Karumba (UC/L)	1647.0	519	3173.41	1.33	0.30	4	949	1
Darwin	Darwin City (Statistical subdivision)	672.0	66 289	10.14	0.47	0.72	2	1277	6
Weipa	Weipa (T)	51.2	2 833	18.08	0.00	0.45	4	1857	8

ARIA = Accessibility/Remoteness Index of Australia; GVP = gross value of production; SEIFA =Socio-Economic Indexes For Areas; T = town; UC/L = Urban Centre/Locality

Note: The 'traffic light' indicators for each measure follow the logic of green being a positive measure through to red being a negative measure. Indicators are based on a measures distribution within the group of localities. Australian Bureau of Statistics population statistics are available for a variety of geographies within the Australian Standard Geographical Classification (ASGC). To reflect the most appropriate representation of a community's population, different geographies were used to calculate the GVP displaced per capita.

These four communities are further analysed by adding data on supply chain businesses, employment in the commercial fishing industry (sensitivity) and community characteristics influencing adaptive capacity. These additional data are reported at the statistical local area (SLA) level because this better represents the regional social and economic catchments that the communities sit within, are influenced by and are accessible to community members.

### Karumba

Potential displaced GVP linked to Karumba was estimated at between \$1.08 and \$1.65 million. Survey results identified 19 upstream or input businesses and 4 downstream businesses that could potentially be impacted and flow through to the community via the supply chain. Focus group participants identified two cold store/wholesale/seafood processing facilities in Karumba. The exposure indicator of potential GVP displacement per capita for Karumba urban centre/locality (UC/L) was \$3173 (based on the upper range of GVP). Community sensitivity and adaptive capacity measures show that the SLA of Carpentaria, in which Karumba is located, has relatively high levels of employment in the consolidated fishing industry compared with other SLAs in the North Marine Region (1.3 per cent). It also has a relatively high level of socioeconomic disadvantage (Socio-Economic Indexes For Areas decile ranking of 1), a low level of economic diversity (0.30) and a lower median household income (\$949.30 per week, compared with the Australian median household income of \$1026.80/week). The SLA of Carpentaria is located in a very remote area (Accessibility/Remoteness Index of Australia score of 4) and is relatively sparsely populated (population for the SLA in 2006 was 1939 usual residents). This assessment indicates that Karumba is likely to experience a high impact due to displaced GVP from the declaration of the draft North Commonwealth Marine Reserves Network and has a relatively low capacity to adapt.

## **Cairns and Darwin**

Cairns and Darwin have large absolute GVP displacements. However, they will most likely be able to mitigate the impact due to their larger size, diversity of economy and small proportion of people employed in the commercial fishing industry. Cairns and Darwin are home to a substantial number of fishing industry supply chain businesses.

Cairns and Darwin are potentially subject to cumulative impacts from draft Commonwealth reserves in neighbouring marine regions. Darwin is potentially impacted by the draft North-west Commonwealth Marine Reserves Network (\$187 200 potentially displaced GVP [ABARES 2012c]). Cairns is potentially impacted by the draft Coral Sea Commonwealth Marine Reserves Network (\$2.35 million potentially displaced GVP [ABARES 2012b]).

## **Weipa**

The potential impacts to Weipa are expected to be lower due to lower levels of exposure to the draft marine reserves network (lower GVP displacement per capita), a low level of sensitivity (employment in the consolidated fishing industry), low levels of socioeconomic disadvantage, fewer input supply and output businesses that would potentially be impacted and higher median household income levels (above the Australian median of \$1026.80 per week).

## **Links to other marine regions–towns and local areas**

Cumulative impacts may occur to towns in the North Marine Region that receive catch that would be displaced by the draft North Commonwealth Marine Reserves Network from displaced GVP from other draft marine reserve networks. The most substantial include cumulative impacts to Darwin (\$187 200 annual average GVP from the draft North-west Commonwealth Marine Reserves Network [ABARES 2012c]) and Cairns (\$2 350 110 from the draft Coral Sea Commonwealth marine reserve [ABARES 2012b]).

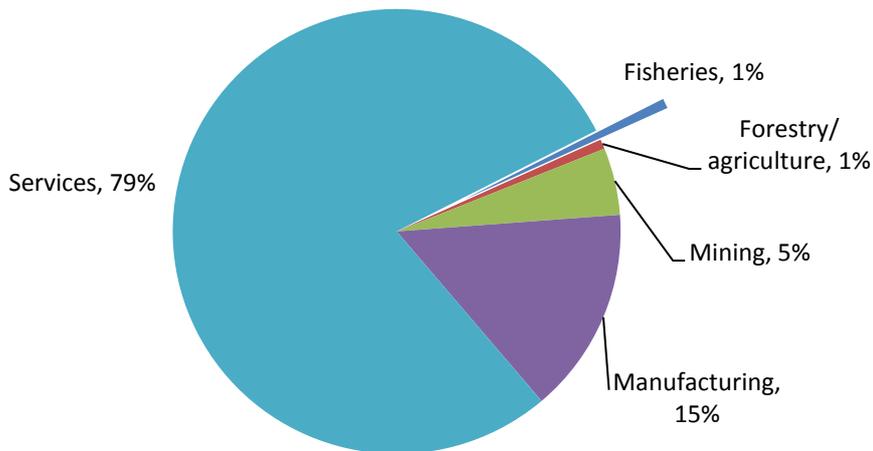
## **Potential impacts on the economy**

Two coastal subregions (Darwin and Carpentaria) that would potentially experience higher impacts from the draft marine reserves network were modelled to estimate the economic effects of the displacement of GVP (for a full description refer to Case study: Economic modelling of Darwin and Karumba).

## **Darwin**

The Darwin economy accounted for over 50 per cent of the Northern Territory's economy in 2010–11. The fishing sector (including catching and processing, but excluding retail) accounted for approximately 1 per cent of the local economy (Figure 4). Services sectors (including construction, retail and wholesale trade, restaurants and hotels, transport, public services and other services) accounted for 79 per cent of the local economy, with the manufacturing sector accounting for approximately 15 per cent.

Figure 4 Structure of the Darwin economy



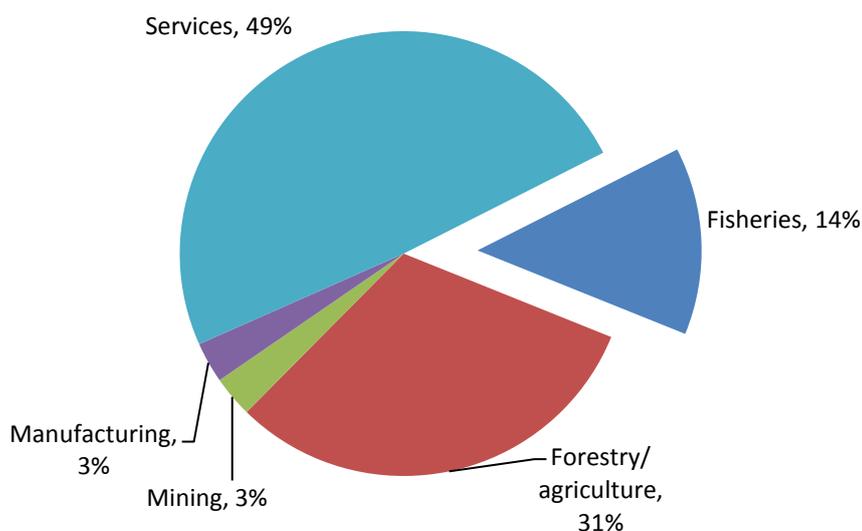
Source: ABARES AusRegion

According to the 2006 census, Darwin had a population of around 86 000. The unemployment rate was 3.7 per cent, compared with the national unemployment rate at the time of 5.2 per cent.

### Carpentaria

The Carpentaria economy accounted for less than 1 per cent of Queensland’s economy in 2010–11. The fishing sector (including catching and processing, but excluding retail) accounted for approximately 14 per cent of the local economy (Figure 5). Services sectors (including construction, retail and wholesale trade, restaurants and hotels, transport, public services and other services) accounted for 49 per cent of the local economy, with forestry and agriculture accounting for the majority of the remainder (31 per cent).

Figure 5 Structure of the Carpentaria economy



Source: ABARES AusRegion

According to the 2006 census, Carpentaria had a population of around 2000. The unemployment rate was 4.9 per cent, compared with the national unemployment rate at the time of 5.2 per cent.

Modelling used AusRegion, which is a dynamic computable general equilibrium (CGE) model of the Australian economy specified at the national level, the level of the eight states and territories, and selected subregional levels. It was used to examine the *net economic impact* to the economy and to employment in both the short term (2012–13) and long term (2019–20).

The modelling demonstrates how the draft North Commonwealth Marine Reserves Network is likely to affect gross regional product (GRP) and employment.

Economic impacts are expected to be felt directly through reduced fisheries production and indirectly through decreased activity for those businesses that supply inputs to, and process outputs from, the fishing industry. These impacts are expected to occur in towns within, and to some extent adjacent to, the North Marine Region. The combined effects of the direct and indirect impacts are captured in changes to economic activity and employment in the subregions and, where applicable, across the Northern Territory. The results indicated a small percentage decline in gross regional product, relative to the reference case, in the Darwin and Carpentaria subregions in the short and long term.

Applying the modelled percentage impacts as a result of the decline in GVP, the projected decline in GRP from the draft North Commonwealth Marine Reserves Network in the two subregions modelled was estimated to be \$2.8–3.7 million in the short term and \$3.7–4.9 million in the long term each year. As the two subregions accounted for around 55–63 per cent of total estimated GVP displacement, linear scaling of the effects suggest a total projected decline in GRP of \$4.6–6.9 million in real terms each year in the short term, compared with the baseline. All of the economic impacts would occur in regions directly affected by displacement. There are likely to be flow-on effects in other regions; however, changes in economic activity at the state and national level are negligible in terms of the size of those economies.

## Potential impacts on employment

The potential impact of the draft North Commonwealth Marine Reserves Network on jobs was estimated using two methodologies; *economic modelling* (for a full description refer to Case study: Economic effects for two key subregions) and from the *survey* of fishing businesses. The two approaches provide different measures of potential impacts. The economic modelling estimated job loss from the economy as a whole, including the supply chain (businesses that supply inputs to, and process outputs from, the fishing industry). The survey provided an estimate of job loss from impacted fishing businesses in the catching sector, and to some extent in the processing sector, for respondents that completed the survey.

### Economic modelling (method 1)

Two coastal subregions that would potentially experience higher impacts were the subject of modelling to estimate the economic and employment effects of the displacement of GVP. Employment impacts were forecast for the short term, where adaptation (labour and capital mobility) in the economy was limited, and in the longer term where adaptation was free to occur.

Using the modelling of the potential impact in the short term (\$1.75–2.32 million annual average potential GVP displacement) on the two subregions, ABARES estimated job loss in the two subregions at 4 full-time jobs from the Darwin subregion and 4–6 full-time jobs from the

Carpentaria subregion, which represents a small proportion of total employment in the Darwin (0.01 per cent) and Carpentaria (0.2–0.3 per cent) subregions.

If these results are extended linearly to account for the entire potential GVP impact of the draft North Commonwealth Marine Reserves Network (\$2.80–4.21 million annual average potential displacement), 13–20 full-time jobs in directly affected regions would be lost in the short term and 1–2 jobs in the long term.

## Survey results (method 2)

Survey and consultation with industry stakeholders suggests that over both the short and long term, the reduction in total positions in the fishing sector may be greater than indicated by the models because of the high proportion of part-time and seasonal positions in the industry (see Appendix C: Estimating job reduction using the survey).

Job losses are likely to occur in the most affected fisheries (Table 4) and in the towns where potentially impacted catch is landed (Map 4), as well as to towns and subregions involved in the supply chain (Map 5 and 7).

Estimates of job loss derived from the survey apply only to businesses in the catching and processing sectors that completed the survey. They do not include fishing businesses that did not complete the survey, or supply chain businesses. The estimate was also based on each surveyed business' prediction about how they would respond to the draft North Commonwealth Marine Reserves Network, how many staff they employed and whether they would need to reduce employees.

From the survey responses, it was estimated there would be a reduction of 54 individual positions, comprising mostly seasonal jobs (Table 11). This represented 30 positions expressed in terms of full-time equivalents. The majority of fishing businesses that are potentially impacted by the draft marine reserves network were believed to be surveyed; however, there are some that are not accounted for in this estimate.

The issue of 'tipping points' was raised by a number of business operators, whereby as the level of impact increases, staff numbers are cut at certain critical points. Similarly, for a business as a whole, there may come a point where it is not viable and all paid positions in the business are lost. This issue can present difficulties for businesses when predicting potential job loss from the draft marine reserves in isolation from other factors affecting the business (see Chapter 4: Impacts on fishing businesses).

**Table 11 Estimated paid job reduction anticipated by survey respondents due to the draft North Commonwealth Marine Reserves Network**

Employment type	Positions	Full-time equivalent
Casual (year round)	12.5	3.8
Full-time (year round)	17.1	17.1
Part-time (year round)	2.7	1.3
Seasonal	21.4	7.6
<b>Total</b>	<b>53.7</b>	<b>29.8</b>

Note: Conversion to full-time equivalent used the following conversion multipliers: casual 0.3, full-time 1, part-time 0.5 and seasonal 0.35. For methods, see Appendix A: Estimating job reduction using the survey.

Source: ABARES, *Your marine areas matter: a survey of commercial fishers' values and preferences for Commonwealth marine reserves in the North and North-west Marine Regions of Australia*

## Summary of flow of impacts

The towns potentially most impacted by the draft marine reserves network would be Karumba, Cairns and Darwin. These towns have the largest amount of potentially displaced GVP flowing to them and have the largest number of upstream and downstream businesses. Additionally, Karumba is thought to be particularly vulnerable to changes due to its low adaptive capacity. Cairns and Darwin are thought to be more resilient to the impact due to their large population base, diverse economies and lower dependence on the consolidated fishing industry. A number of other towns not immediately adjacent to the North Marine Region, such as Georgetown and Townsville, were also identified as having input and output businesses that would be potentially impacted by the draft marine reserves network.

The main reserves that contribute to the potential impact on businesses were the draft Gulf of Carpentaria, Wessel and West Cape York marine reserves.

Using economic modelling, the regional net economic impact arising from the potentially displaced GVP was an annual estimated loss of \$4.5–6.8 million in real terms in the short term. There are likely to be flow-on effects on other regions; however, changes in economic activity at the state and national level are negligible in terms of the size of those economies. Potential job reduction was estimated at 13–20 full-time jobs lost in the short term and 1–2 jobs in the long term using the economic modelling, and 54 individual positions or 30 full-time equivalent positions using survey data.

## 4 Impacts on fishing businesses

This chapter presents a synthesis of results from the survey, *Your marine areas matter: a survey of commercial fishers' values and preferences for Commonwealth marine reserves in the North and North-west Marine Regions of Australia*, and qualitative data from focus groups and interviews with potentially impacted fishers, supply chain businesses and community representatives. The synthesis explores the potential impacts of the draft marine reserves on fishing businesses and investigates:

- values held by fishers in the North Marine Region
- potential displacement of current fishing activities
- response to displacement and indirect impacts
- business plans and investment based on current entitlements to fish
- other factors currently impacting the fishing industry
- ability to adapt.

### Survey data caveats and notes

The survey instrument and survey frame were developed in consultation with industry and governments. The target group for the survey was state/territory and Commonwealth commercial fishers with a likelihood of being displaced and impacted by the draft North Commonwealth Marine Reserves Network. The following notes and caveats apply to the survey:

- The target population is a subset of all fishers in the North Marine Region. The goal was to ensure the highest number of potentially displaced and impacted licence holders would be identified for the survey. The survey results are intended to be representative of the potentially impacted businesses and not all fishing businesses operating in the North Marine Region.
- The final survey frame consisted of 227 businesses, and the consultative process used to develop the frame gave a high degree of confidence that the vast majority of potentially impacted fishing businesses were given an opportunity to participate.
- Measurement error may result from inaccurate responses to questions, an inability of the respondent to recall information, differences in how respondents interpreted a question or socially desirable responding.
- Cognitive biases can affect survey responses and lead to response error. These are difficult to address because the respondent may unintentionally or deliberately provide inaccurate information due to a perceptual distortion, inaccurate judgment or illogical interpretation of reality. Cognitive biases of this type may be an issue in this study due to the sensitive nature of the study topic and general objections within the fishing industry to the draft Commonwealth marine reserves.

Throughout the following sections, people who participated in the survey are referred to as respondents. For further detail on the survey process see Appendix B: Social impact assessment methods.

## Commercial fishery qualitative value mapping

To understand how and to what degree commercial fishers value specific areas within the draft North Commonwealth Marine Reserves Network survey participants were asked to undertake a value mapping exercise as a part of the survey. Respondents were given a map of the region (which included a graticule, the draft marine reserve boundaries and significant regional ports) and asked to identify valued areas within the region by placing up to three marks for each of six different fishing-related values: 'catch reliability'; 'catch diversity'; 'easy to access'; 'a safe area'; 'less competition'; and 'future use value' (for a maximum of 18 marks per respondent). These qualitative data allow a better understanding of which areas within the draft marine reserves network have higher values according to the survey respondents. A profile of survey respondents is contained in Appendix E: Profile of survey respondents.

Map 9 provides a summary of all the value points provided in the survey, across all six value classes. Data were summarised at both fine and coarse scales to protect confidentiality and to allow all data to be displayed.

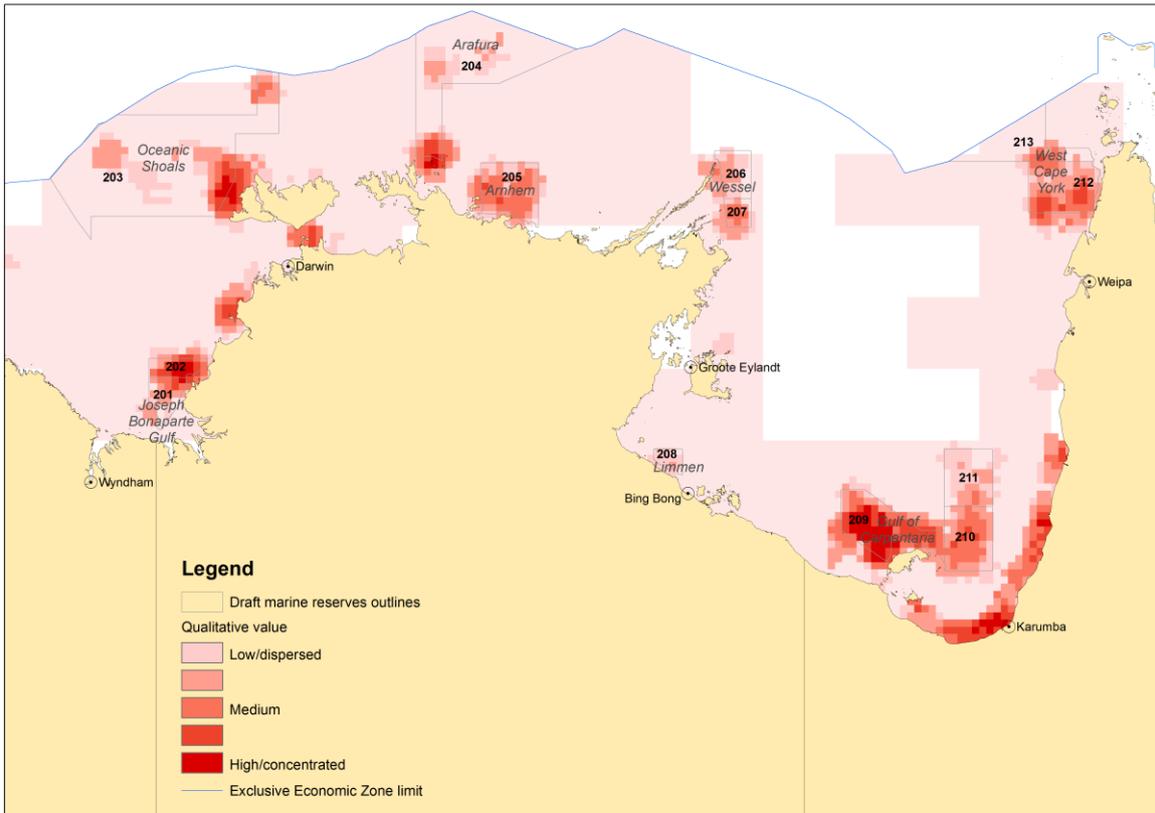
High fishing values were concentrated near to the coastline, notably within the draft Joseph Bonaparte Gulf marine reserve, the south-east corner of the draft Oceanic Shoals marine reserve, the southern end of the draft Arafura marine reserve, the western and southern end of the draft Gulf of Carpentaria marine reserve, and the southern end of the draft West Cape York marine reserve. Additionally, the south-east coastal margin of the Gulf of Carpentaria was consistently highly valued (Map 9). One survey respondent highlighted that the entire area was important for future use, which is not reflected in the value mapping.

Table 12 provides counts of the number of value markers placed in each reserve zone and for each of the value categories. The most commonly marked values were for future use (prospective fishing; 25 per cent of responses) and catch reliability (19 per cent of responses).

It is important to note that this qualitative value mapping is not the same as impact mapping. Some areas of high value to fishers do not have high impact because zoning will allow continued use for some fishing methods (most notably the Timor Reef Fishery in the draft Ocean Shoals marine reserve; Map 9).

This process does not fully explore why fishers value the areas they marked. It may be best to interpret the qualitative value mapping as largely reflecting areas valued by impacted fishers; however, there may be some bias towards areas of high impact (e.g. no-take areas).

**Map 9 Commercial fishery qualitative value mapping for all value classes ('catch reliability', 'catch diversity', 'easy to access', 'a safe area', 'less competition', 'future use value')**



Note: mapping is at fine scale in areas with a high density of value points and at coarse scale where value points are less dense. Zoning is described in Appendix A: Fisheries data processing methods

Data source: ABARES, *Your marine areas matter: a survey of commercial fishers' values and preferences for Commonwealth marine reserves in the North and North-west Marine Regions of Australia*, marine reserve boundaries from the Australian Government Department of Sustainability, Environment, Water, Population and Communities

**Table 12 Number of value markers placed in draft marine reserve areas for each of the value categories**

Draft marine reserve	Area	Catch diversity	Catch reliability	Ease of access	Future use	Less competition	Safe area	Total
Joseph Bonaparte Gulf	201			3	3		1	7
	202	2	3	2	2	4	2	15
Oceanic Shoals	203	6	5	7	14	6	4	42
Arafura	204	3	4	3	11	7	1	29
Arnhem	205	4	7	2	7	5	5	30
	206	1	1	1	3			6
Wessel	207	2	1		2	4	1	10
	208				1	1	1	3
Gulf of Carpentaria	209	8	13	13	7	4	7	52
	210	5	9	5	5			24
	211	3	4	2	4	1		14
West Cape York	212	5	3	4	7	6	5	30
	213	2	2	1	1	1		7
		<b>41</b>	<b>52</b>	<b>43</b>	<b>67</b>	<b>39</b>	<b>27</b>	<b>269</b>
Marine National Park Zone		Special Purpose Zone		Multiple Use Zone				

Data source: ABARES, *Your marine areas matter: a survey of commercial fishers' values and preferences for Commonwealth marine reserves in the North and North-west Marine Regions of Australia*

## Direct displacement impacts on fishing businesses

This section presents results from the survey, where respondents were asked about direct displacement of fishing from the draft marine reserves. For this analysis of direct impacts, the survey was filtered to exclude responses from operators where no displacement could occur. These were scenarios where either fishing methods were compatible with the zoning of a particular reserve (i.e. fishing could continue), or where logbook analysis indicated no displaced fishing effort.

Table 13 indicates the marine reserves that respondents identified they would be excluded from. The draft Gulf of Carpentaria marine reserve is expected to displace the largest number of fishers and was also the reserve that the most fishers indicated they were unsure if they would be excluded.

**Table 13 Number of survey respondents who indicated they would be excluded or displaced to some degree by the draft marine reserves**

Draft marine reserve	Excluded	Unsure
Arafura	15	4
Arnhem	19	5
Gulf of Carpentaria	29	7
Joseph Bonaparte Gulf	18	4
Limmen	9	4
Oceanic Shoals	18	4
Wessel	20	3
West Cape York	16	5

Note: Respondents could choose more than one reserve.

Data source: ABARES, *Your marine areas matter: a survey of commercial fishers' values and preferences for Commonwealth marine reserves in the North and North-west Marine Regions of Australia*

Fishers that identified themselves as being displaced by the draft marine reserves, provided estimates for the proportion of their total catch in 2010–11 that was taken from within the draft marine reserves (Table 14). Not all respondents completed this question, so counts in Table 13 and Table 14 are not equal. Most respondents indicate a level of displacement between 0 and 30 per cent; however, there were several respondents who indicated potential impacts of over 50 per cent in the draft Gulf of Carpentaria and Oceanic Shoals reserves.

**Table 14 Number of survey responses that indicated a defined proportion of their total catch during 2010–11 was taken from within draft marine reserves**

Draft marine reserve	Percentage of catch from within draft marine reserves									
	0–10	11–20	21–30	31–40	41–50	51–60	61–70	71–80	81–90	91–100
Arafura	14	1	4							
Arnhem	9	8								
Gulf of Carpentaria	12	5	10	4	4	1		4		2
Joseph Bonaparte Gulf	8	1	4							
Limmen	14									
Oceanic Shoals	5	4				3	1			
Wessel	6	9	3							
West Cape York	11	6		7						

Note: Respondents could choose more than one reserve.

Data source: ABARES, *Your marine areas matter: a survey of commercial fishers' values and preferences for Commonwealth marine reserves in the North and North-west Marine Regions of Australia*

## Fishing business impacts

This section reports fishers' responses to their perceived displacement and how this response will impact their fishing business, themselves, their families and their employees.

Survey respondents were asked if they believed they would have to change their current fishing activities if the draft marine reserves were declared. Respondents who indicated that their current fishing activities would have to change were asked what their most likely response would be:

- 1) stay in the same fishery and make up the shortfall from other fishing areas
- 2) move into an alternative fishery
- 3) continue operating with reduced catch in the same fishery(s) or downsize the operation
- 4) leave the fishing industry
- 5) unsure

Based on the likely response to displacement, each respondent then indicated how strongly they agreed or disagreed with a series of statements about potential impacts.

The potential impacts on the fishing businesses have been collated into three groups based on the above responses options—Group 1 (responses 1 and 2), Group 2 (response 3) and Group 3 (response 4). Where applicable, potential impacts are further supported by qualitative data collected through interviews and focus groups with potentially impacted fishers.

### Fishing business response to displacement

Thirty-nine respondents indicated that they would have to change their current fishing activities if the draft marine reserves were declared (Table 15).

**Table 15 Responses to the question, ‘If the draft reserves are declared I would have to change my current fishing activities’**

Respondents	
Yes	39
No	14

Data source: ABARES, *Your marine areas matter: a survey of commercial fishers' values and preferences for Commonwealth marine reserves in the North and North-west Marine Regions of Australia*

Of the 39 respondents that indicated they would have to change their fishing activities, most said that they would stay in the fishery and make up the shortfall in other fishing areas. No respondents indicated that they would move into an alternative fishery (Table 16). Two respondents did not indicate what their response would be.

**Table 16 Responses from those who declared their fishing activity would have to change**

Response	Count
Stay in the same fishery and make up the shortfall from other fishing areas	18
Move into an alternative fishery(s)	0
Continue operating with reduced catch in the same fishery(s) or downsize the operation	11
Leave the fishing industry	5
Unsure	3

Data source: ABARES, *Your marine areas matter: a survey of commercial fishers' values and preferences for Commonwealth marine reserves in the North and North-west Marine Regions of Australia*

Qualitative findings across the North Marine Region revealed that fishers in general will continue operating in the region. However, five respondents indicated that they would leave the industry due to:

- the mounting cumulative impacts on the fishing industry that the draft North Commonwealth Marine Reserves Network further exacerbates

- the devaluing of licences and quota due to the high level of risk (increased uncertainty) in operating in this marine region
- the inability or reduced ability to further develop fisheries in this marine region
- the belief that access to the resource will be further restricted in the future
- the potential offer of structural adjustment assistance.

### **Fishing business impacts—Group 1**

Group1 (respondents who would stay in the same fishery and make up the shortfall from other fishing areas, or move into an alternative fishery) had 18 respondents. The majority of these either agreed or strongly agreed that their business would be impacted by (Figure 6):

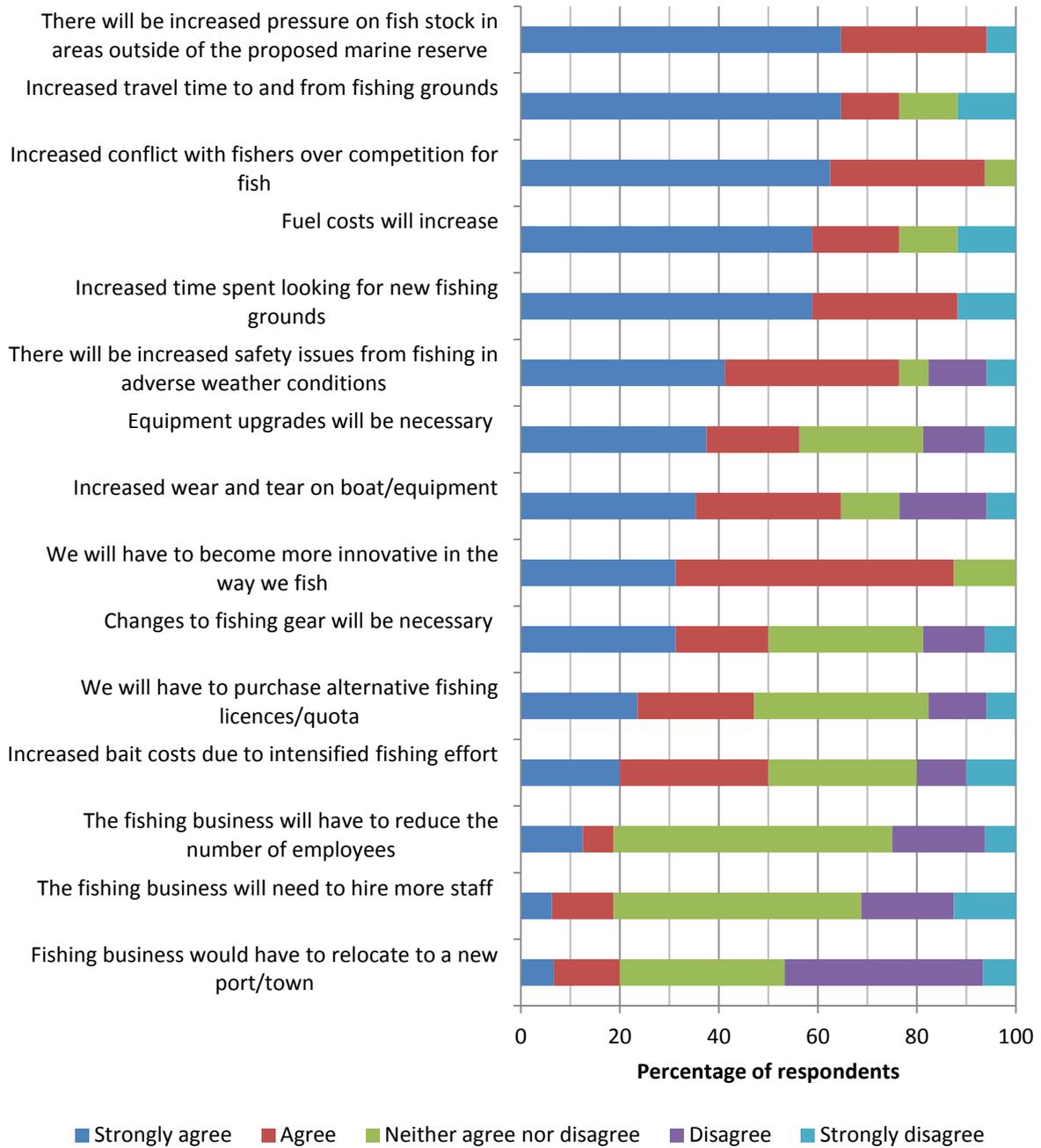
- increased pressure on fish stocks outside the draft marine reserves
- increased travel time to and from fishing grounds
- increased fuel costs
- increased conflict with other fishers over competition for fish
- increased time spent looking for new fishing grounds
- increased safety issues from fishing in adverse weather conditions.

In addition the majority of survey respondents indicated they would have to become more innovative in the way they fish, this may include changing gear types and purchasing/leasing quota in alternative fisheries.

Qualitative findings revealed flow-on impacts—consistent with the survey results—that fishers believed would result from the displacement of fishing in the North Marine Region. These impacts were not seen as isolated to their businesses, but would extend to other fishing businesses, fisheries and the marine environment in the region.

Fishers in the North Marine Region were highly concerned about transfer of effort to other areas and other fisheries, and the causal sequence of impacts this would produce. They believed that if displaced fishers remained in the industry and the same level of fishing effort was maintained it would lead to a concentration of effort outside of the reserves. Fishers from the Queensland N3 sector in the Gulf of Carpentaria cited this as a major issue. These fishers believed that the concentration of effort would in itself produce biological, environmental and economic impacts, such as the transfer of offshore effort to inshore species such as barramundi and mud crab (all N3 licence holders have the right to fish barramundi and many also hold Mud Crab Fishery licences), and increased bycatch of protected species, such as dugong and sawfish, through concentration of effort into inshore areas. There were also economic concerns around transfer of effort, notably increased competition and devaluing of licences. Fishers believed that the level of effort should be reduced proportionally to the level of displacement—for example, if 5 per cent of the catch is displaced then this should equate to the removal of 5 per cent of licences in a fishery that the effort could be transferred into.

**Figure 6 Fishing business impacts for respondents who indicated they would continue operating by making up shortfall or moving into an alternative fishery**



Data source: ABARES, *Your marine areas matter: a survey of commercial fishers' values and preferences for Commonwealth marine reserves in the North and North-west Marine Regions of Australia*

## Fishing business impacts—Group 2

Group 2 (respondents who would either continue operating with reduced catch or downsize their operation) had 11 respondents. The majority of these either agreed or strongly agreed that their business would be impacted in the following ways (Figure 7):

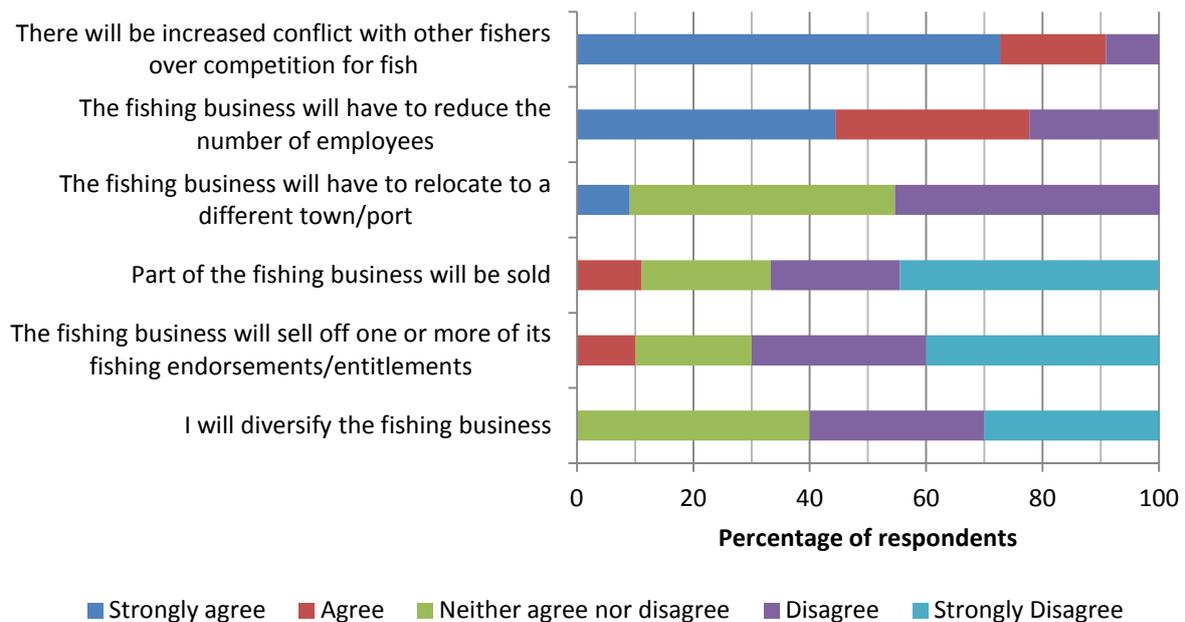
- There will be increased conflict with other fishers over competition for fish.
- The fishing business would have to reduce the number of employees.

Conversely the majority of these businesses did not believe that they would:

- diversify their business
- sell part of their business
- sell off their fishing endorsements or entitlements.

Nearly half of these respondents were not sure if they would relocate the fishing business to a different town or port.

**Figure 7 Fishing business impacts for respondents who indicated they would continue operating with a reduced catch**



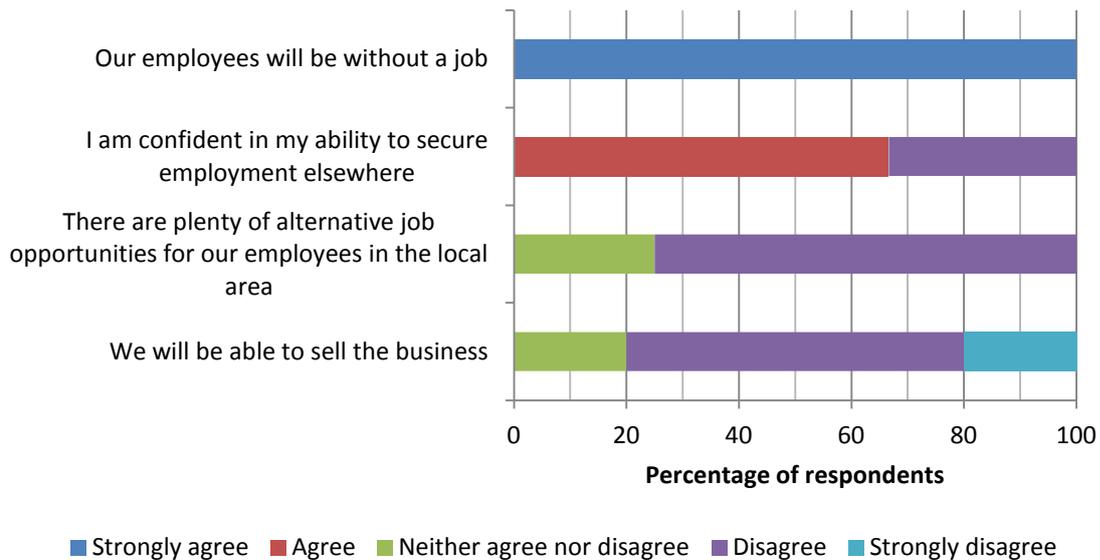
Data source: ABARES, *Your marine areas matter: a survey of commercial fishers' values and preferences for Commonwealth marine reserves in the North and North-west Marine Regions of Australia*

### Fishing business impacts—Group 3

Of the five respondents in Group 3 (respondents who would leave the fishing industry), the majority indicated that the flow-on impacts of leaving the industry would be (Figure 8):

- their employees would be without a job
- their employees have limited employment opportunities in the local area
- they would have difficulty selling the business.

Figure 8 Business impacts for respondents indicating they would leave the fishing industry



Data source: ABARES, *Your marine areas matter: a survey of commercial fishers' values and preferences for Commonwealth marine reserves in the North and North-west Marine Regions of Australia*

## Fishing business plans and future investments

The potential impact of the draft North Commonwealth Marine Reserves Network on future plans and investments was raised as a major concern by the fishing industry and individual fishers.

A total of 53 survey respondents reported that they had made business plans and financial investments, collectively encompassing all the draft marine reserves (Table 17). The draft Gulf of Carpentaria, Oceanic Shoals, Arafura and Arnhem marine reserves had the highest number of survey responses.

**Table 17 Number of respondents with business and investment plans in place**

<b>Draft marine reserve</b>	<b>Business plans made</b>	<b>Investments made</b>
Joseph Bonaparte Gulf	9	9
Oceanic Shoals	12	11
Arafura	12	11
Arnhem	12	11
Wessel	11	10
Limmen	3	4
Gulf of Carpentaria	17	14
West Cape York	11	8

Note: Respondents could nominate more than one reserve.

Data source: ABARES, *Your marine areas matter: a survey of commercial fishers' values and preferences for Commonwealth marine reserves in the North and North-west Marine Regions of Australia*

The potential impact on business plans and financial investments was raised by interviewees and focus group participants. Potentially impacted fishers raised the following issues:

- Fishers and industry in the Northern Territory were concerned about the impact the draft reserves on the future development of fisheries.
- It was considered that some fisheries are underdeveloped in northern Australia and licences have been bought with the expectation that there is capacity for expansion, including into the areas overlapping with the marine reserves network. These expectations are now less certain. An example is a developmental licensed trevally fishery in the draft Oceanic Shoals marine reserve, where a fisher indicated he has made plans and invested substantial time and effort into assessing the viability and environmental impacts (e.g. carrying government observers, undertaking gear trials and developing markets). The fisher indicated that the status of his developmental permit is now unclear.
- Fishers in the Northern Territory Timor Reef Fishery operating in the draft Oceanic Shoals marine reserve were concerned that future investment in the fishery would be jeopardised. Although the zoning of the reserve currently permits the gear types used in this fishery (line and trap), fishers are concerned that once declared the zoning could be changed. Fishers indicated that this uncertainty could make investment in the future development of this fishery too risky.
- Some fishers indicated that investment decisions were being delayed; especially decisions to upgrade or purchase new vessels that would be used with developmental permits or for entering new fisheries.
- Fishers were concerned about the value of licences, vessels and associated capital falling as a result of the draft reserves. One fisher took 3–4 years to sell a prawn trawler after the most recent Northern Prawn Fishery structural adjustment assistance, when 20–30 boats were

put on the market at the same time. While waiting to sell, the boats still need to be maintained and serviced.

## Other issues and cumulative factors impacting fishing businesses

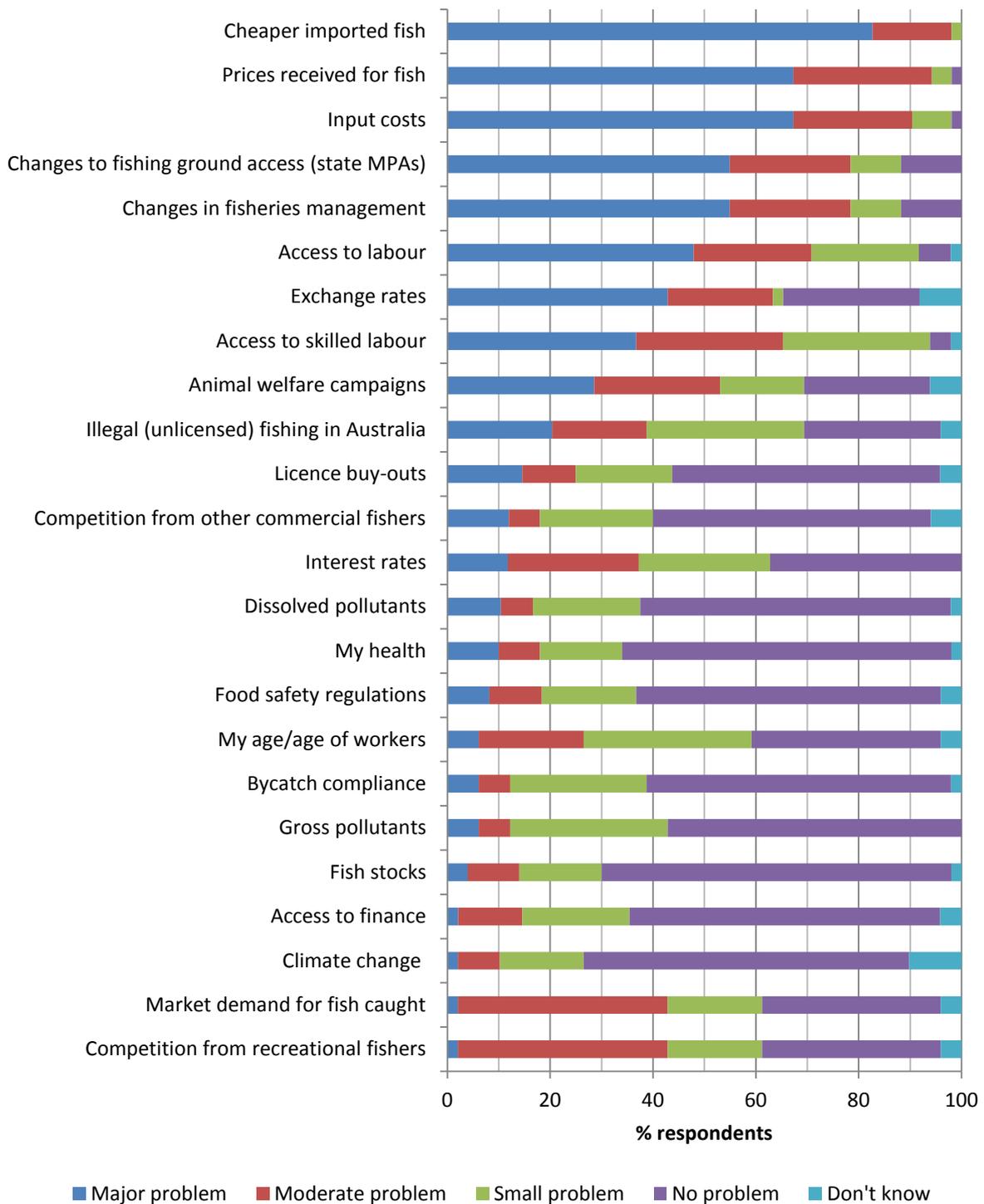
The potential impacts of the draft marine reserves network on fishing businesses should not be viewed in isolation. However, full accounting for these factors is not within the scope of this assessment. A strong and consistent theme raised by survey respondents, interviewees and focus group participants in the North Marine Region was that many factors impact their businesses, and they were concerned that these factors would compound with the draft Commonwealth marine reserves.

Most respondents indicated that other issues affecting their business included (Figure 9):

- competition from imported fish
- prices received for product
- input costs
- access to fishing grounds
- changes in fisheries management
- access to labour
- exchange rates
- access to skilled labour
- animal welfare campaigns.

The potential for state and territory governments to introduce marine reserves was a major concern raised by interviewees and in focus groups. The potential introduction of Commonwealth marine reserves was regarded as a potential catalyst, for the introduction of state or territory marine reserves, especially in the Northern Territory.

Figure 9 Other issues impacting fishing businesses in the North Marine Region



MPAs = marine protected areas.

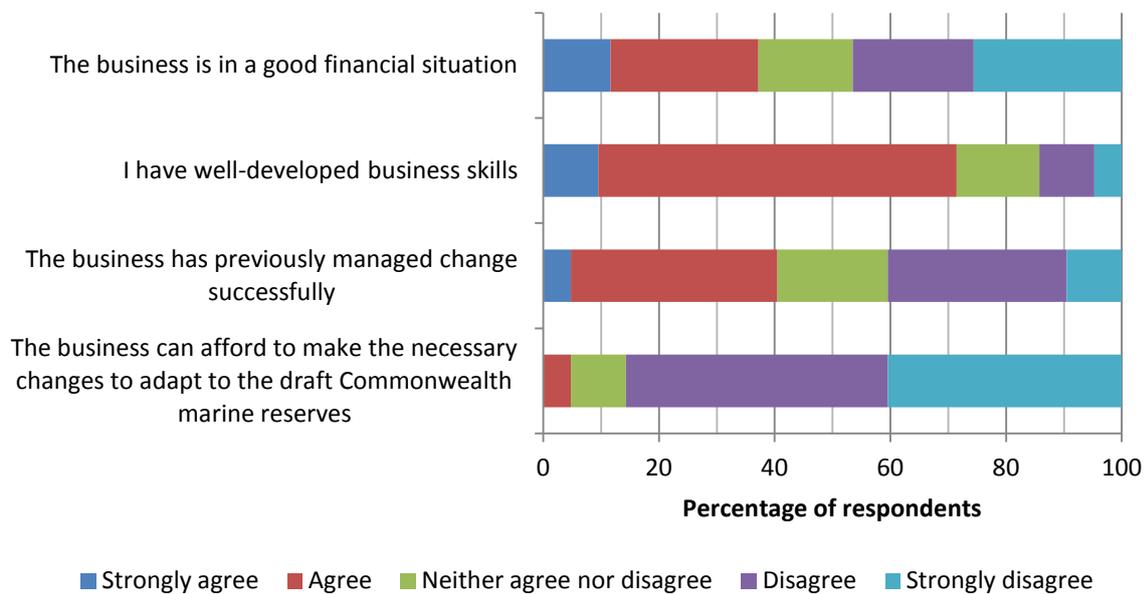
Data source: ABARES, *Your marine areas matter: a survey of commercial fishers' values and preferences for Commonwealth marine reserves in the North and North-west Marine Regions of Australia*

## Ability to adapt–fishing businesses

Survey respondents were asked a series of questions about the ability of their fishing business to adapt to changes (Figure 10). In summary:

- respondents were evenly split between agreeing and disagreeing whether their business had previously managed change successfully
- the majority of respondents believed they had well-developed business skills
- 16 respondents agreed that their business was in a good financial situation, while 18 indicated that their business was not in a good financial situation
- the majority of respondents disagreed or strongly disagreed that their business was able to afford to make the necessary changes to adapt to the draft North Commonwealth Marine Reserves Network.

**Figure 10 Ability to adapt—fishing businesses**



Data source: ABARES, *Your marine areas matter: a survey of commercial fishers' values and preferences for Commonwealth marine reserves in the North and North-west Marine Regions of Australia*

## Fishing business impacts summary

Based on the GVP displacement estimates (see Chapter 2: Potential displacement of fishing), the impacts of the draft North Commonwealth Marine Reserves Network will be felt most by a relatively small number of operators in the N9 Fishery of the Queensland Gulf of Carpentaria Inshore Finfish Fishery, and by longline operators in the Northern Territory Offshore Net and Line Fishery. The impact on the Northern Prawn Fishery is expected to be large, but diffuse. The size of the impact may be quite acute for some operators in potentially impacted fisheries, and each individual business will experience the impact in a way unique to their circumstance.

The survey was completed by 53 fishers or fishing businesses. Survey findings showed that if the draft marine reserves were declared:

- the majority of respondents anticipated less than 30 per cent of their catch would be displaced
- 39 respondents indicated that they will have to change their current fishing activities. Of this group, the majority (29) indicated that they would remain in the same fisheries and continue to operate and attempt to make up the shortfall (18), or operate with a reduced catch or downsize their operation (11). The majority of these indicated they would have to become more innovative in the way they fish.
- a small number of respondents (5) indicated that they would leave the fishing industry.

Survey and qualitative findings found secondary impacts on businesses continuing to operate would include potential increased pressure on fish stocks and bycatch outside of the draft marine reserve; increased travel time to fishing grounds; increased fuel costs; increased conflict with other fishers; increased time spent looking for new fishing grounds; increased safety issues from fishing in adverse weather conditions; and devaluing of licences, quota and capital.

Respondents also thought that the draft marine reserves would impact on the future development of fishing in the North Marine Region, noting that some fisheries are perceived as underdeveloped.

For those downsizing their operations or leaving the industry, the potential secondary impacts included increased conflict with other fishers, reducing the number of employees, difficulty in selling the fishing business, and devaluing of licences, quota and capital. These respondents were also concerned that their employees may find it difficult to secure alternative employment.

A major concern was the cumulative impacts that result from other factors that exacerbate the potential impact of the draft marine reserves network. These other factors included competition from imported fish, prices received for product, exchange rates, input costs, difficulty in accessing labour, fisheries management objectives, and potential creation of state and territory marine parks.

Most respondents believed that they could not afford to make the changes necessary to adapt to the draft marine reserves.

## 5 Personal and community impacts

Participants in the survey, focus groups and interviews expected a number of community and personal impacts to occur if the draft marine reserves were declared. Many of the comments about impacts reflect people’s attempts to understand what the changes would mean for themselves, their families and their communities. Note that there is inherent uncertainty when predicting or speculating about the future based on what respondents know of the draft marine reserves, their current personal circumstances and that of their communities.

### Personal impacts

Personal impacts are discussed in terms of three groups based on responses to the survey:

- Group 1: Stay in the same fishery and make up the shortfall in other fishing areas, or move into an alternative fishery
- Group 2: Continue operating with reduced catch or downsize operation
- Group 3: Leave the fishing industry.

The caveats regarding the survey frame discussed at the start of Chapter 4: Impacts on fishing businesses also apply to this chapter. References are made to case studies where relevant.

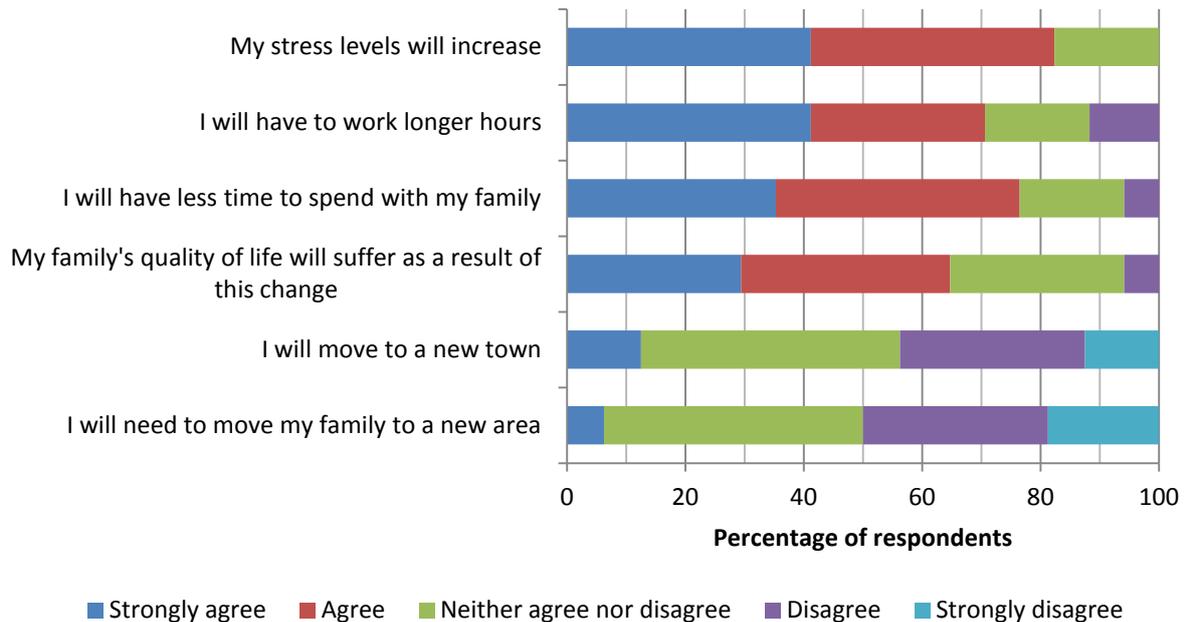
### Personal impacts—Group 1

Eighteen respondents indicated that they would stay in the same fishery and make up the shortfall fishing in other fishing areas, or move into an alternative fishery, in response to the draft North Commonwealth Marine Reserves Network. Most of these respondents indicated personal impacts of (Figure 11):

- increased stress levels
- working longer hours
- less time to spend with family
- less quality family time.

Most respondents in this group did not indicate an intention to relocate to a new town if the draft marine reserves were declared.

**Figure 11 Indirect personal impacts for respondents who indicated they would continue operating by making up the shortfall or moving into an alternative fishery**



Data source: ABARES, *Your marine areas matter: a survey of commercial fishers' values and preferences for Commonwealth marine reserves in the North and North-west Marine Regions of Australia*

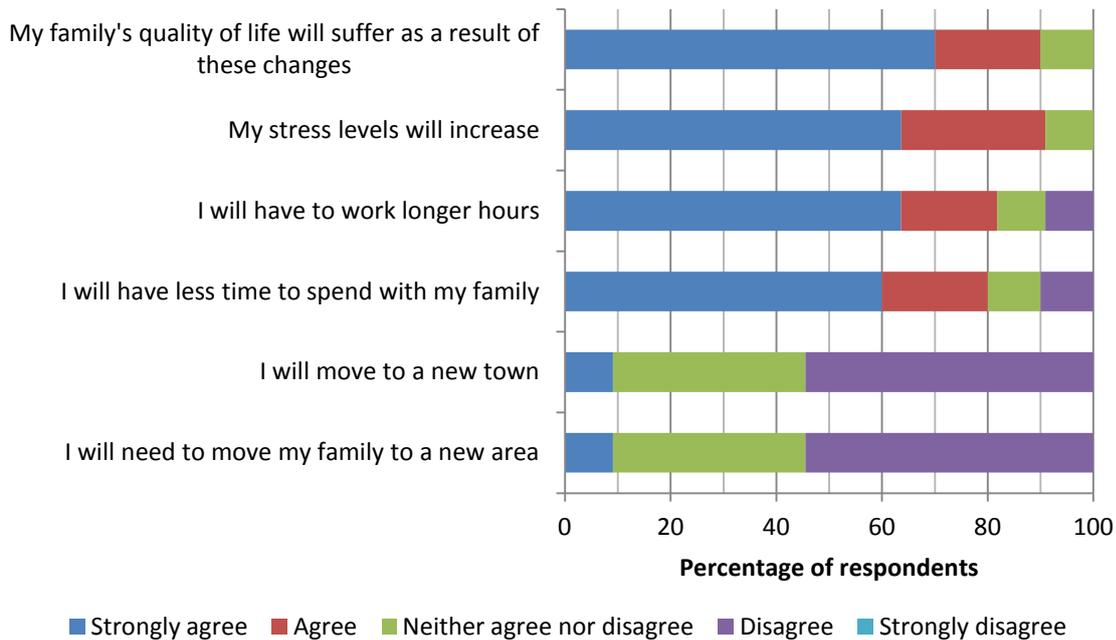
## Personal impacts—Group 2

Eleven respondents indicated they would continue operating with reduced catch or downsize their operation in response to the draft North Commonwealth Marine Reserves Network. Most of these respondents indicated personal impacts of (Figure 12):

- increased stress levels
- working longer hours
- less time to spend with family
- family quality of life will suffer.

Most respondents in this group did not indicate an intention to relocate to a new town if the draft marine reserves were declared.

**Figure 12 Indirect personal impacts for respondents who indicated they would continue operating with a reduced catch**



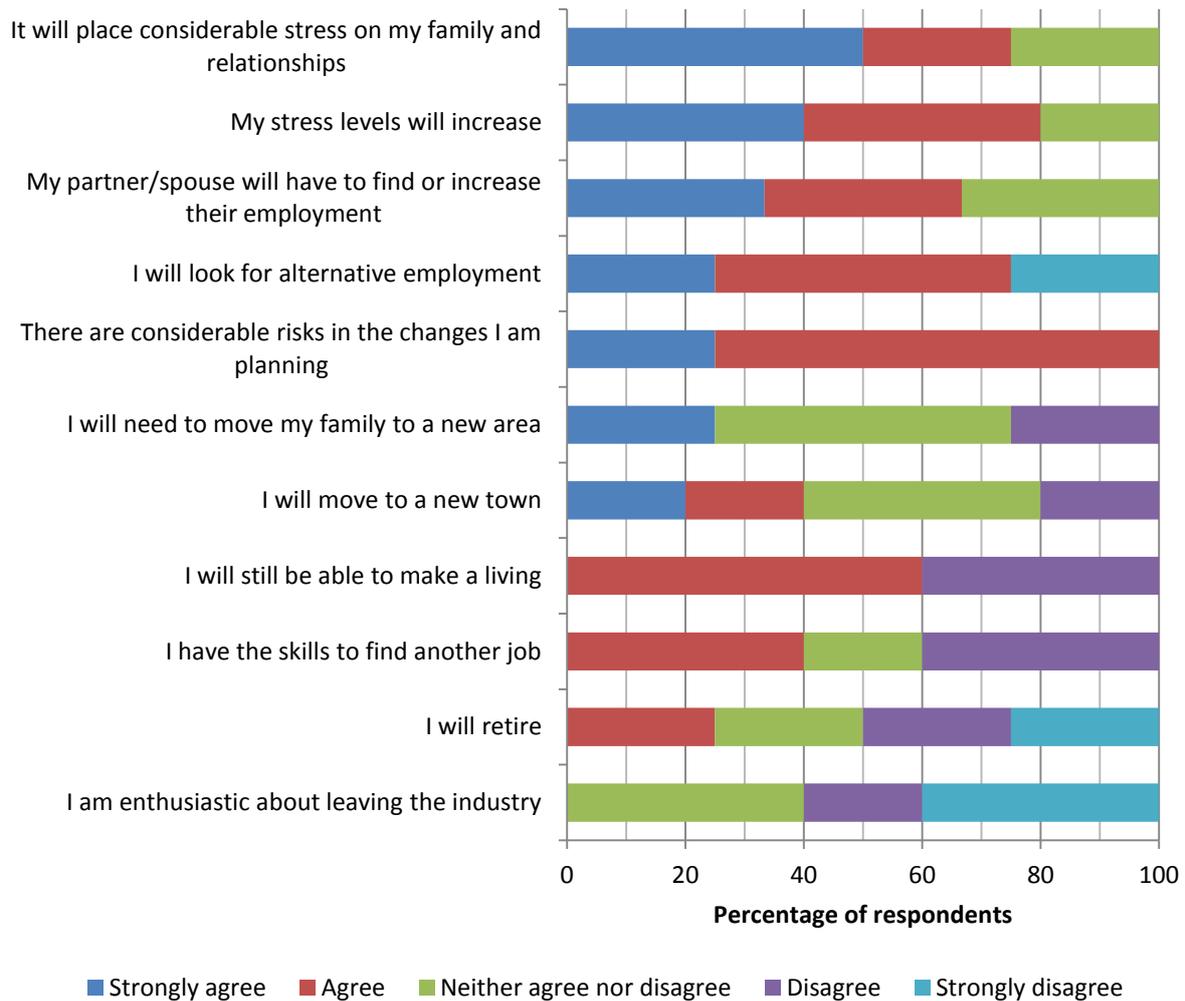
Data source: ABARES, *Your marine areas matter: a survey of commercial fishers' values and preferences for Commonwealth marine reserves in the North and North-west Marine Regions of Australia*

### Personal impacts—Group 3

Five respondents who indicated that they would leave the industry if the draft marine reserves were declared felt that (Figure 13):

- there would be considerable stress placed on their families
- their own stress levels would increase
- their partner or spouse would have to find or increase their employment
- they would look for alternative employment
- there was considerable risks in the changes they were planning
- they were not enthusiastic about leaving the industry.

**Figure 13 Indirect personal impacts for respondents who indicated they would leave the fishing industry**



Data source: ABARES, *Your marine areas matter: a survey of commercial fishers' values and preferences for Commonwealth marine reserves in the North and North-west Marine Regions of Australia*

Overall, reporting on personal impacts during the interviews and focus groups in the North Marine Region was limited, with respondents focusing more on business and supply chain impacts. However, a licence holder in the N9 Fishery of the Queensland Gulf of Carpentaria Inshore Fin Fish Fishery did reveal some clear personal impacts (see Case study: Vertically integrated fishing business in the Gulf of Carpentaria—Wren Fishing), including that the draft marine reserves network was having a negative impact on the aspirations of the next generation to continue in the fishing industry. In Darwin, one fisher also reported on personal impacts, which concurred with the survey results. He expected he would make less income and would therefore have to spend more time on the boat, and do more of the boat maintenance himself, this would mean more time spent away from his family.

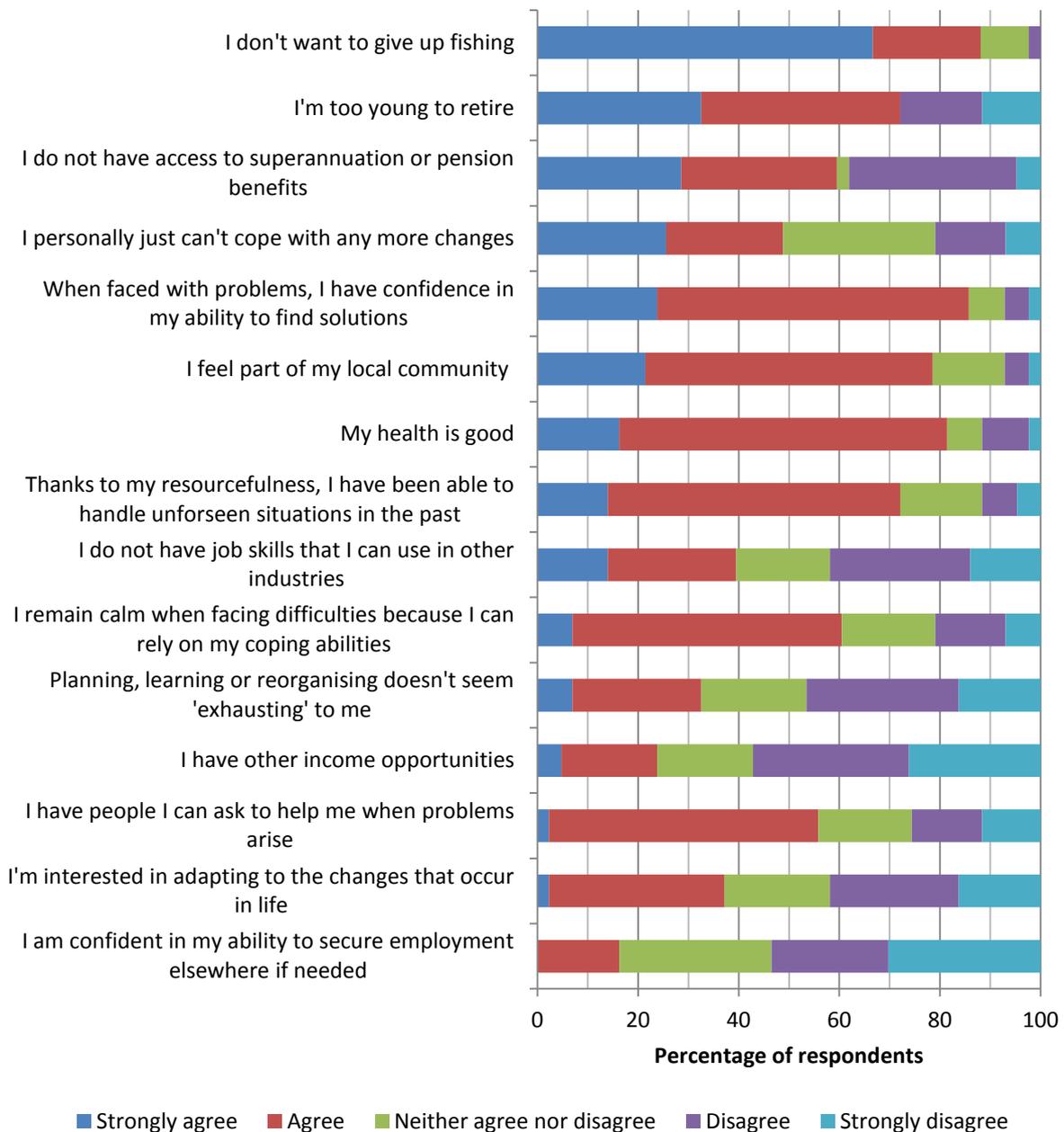
## Ability to adapt—personal

The ability to adapt includes the inherent capacities and resources that enable people to adapt to change and manage and cope with stresses. Questions in the survey were specifically aimed at understanding the extent to which respondents felt connected to their communities, how they respond to challenges, their confidence in their skill levels and their ability to assess their own health (Figure 14). These factors and attributes can provide insight into the personal ability of respondents to adapt.

Results suggest that survey respondents are generally confident in their ability to manage and cope with change (Figure 14). Furthermore, there was a strong indication that respondents perceive they have some degree of social capital—the social ties and reciprocal bonds that bind a community together—to draw on that may assist them respond and adapt to change. However, the majority of respondents also indicated that they lack financial resources (particularly superannuation) and alternative income sources, and are not confident in being able to secure alternative employment.

The case study on the Wren Fishing business reflects many of these aspects of resilience and social capital that characterise the impacted fishers of this region. Although they noted that they would most likely change their fishing activities and make up their shortfall from other areas, they are currently experiencing significant stress and worry from the proposed changes. Additionally, their capacity to adapt will flow directly through to their family, their employees and to the broader community.

Figure 14 Ability to adapt—personal



Data source: ABARES, *Your marine areas matter: a survey of commercial fishers' values and preferences for Commonwealth marine reserves in the North and North-west Marine Regions of Australia*

## Community impacts

Information about community impacts was largely derived from the focus groups, and interviews with fishers and community members.

Reported information on community impacts largely focused on the impacts to the supply chain. For example, in Cairns, it was reported that community impacts would mainly be felt through supply-chain effects; that is, the loss of day-to-day expenditure of waged and salaried staff linked directly to fishing and to the fishing sector.

Other community impacts covered a wide range of issues and included:

- the mentoring role of fishers for young people (in Darwin)
- the potentially greater impact on a small regional community (i.e. Karumba)
- impacts to the Gulf of Carpentaria community via the Sea Swift mothership operation, which provides transport and freight services to remote communities and mothership services to the fishing industry, impacts on the broader Australian community in terms of loss of marine surveillance in the North Marine Region.

In the Darwin region, focus group participants spoke of the important role that fishers play in mentoring young people in the community. Young people, including those at risk of adolescent delinquency, are trained and develop skills working on the fishing boats, which can give them a sense of ‘family’. They gain maturity during this time, and many have gone on to have stable jobs and make positive contributions to the community.

Although a large regional city like Darwin will most likely be able to absorb many of the community impacts, it is the small regional centre of Karumba that is likely to be most heavily impacted because of the proportion of townspeople who are either employed in the fishing sector or rely on expenditure from the fishing sector for their livelihoods (e.g. cafes, restaurants, education, accommodation). A large proportion of catch from the two main impacted fisheries—the Northern Prawn Fishery and the N9 Fishery of the Queensland Gulf of Carpentaria Inshore Fin Fish Fishery—is landed in Karumba, and the town has significant fish processing facilities that provide employment for local residents and transient people, and business for local transport, fuel supply, engineering and electrical businesses. The fishing industry in Karumba supports community groups and is a key part of the town’s identity. The fishing industry is identified as a tourist attraction and has helped attract investment in key infrastructure, such as roads (see the Karumba, Wren Fishing and Northern Prawn Fishery case studies).

Linked to the fishing industry, Sea Swift’s mothership operation in the Gulf of Carpentaria services fishing vessels operating in the Gulf, as well as some remote communities in the Gulf region (e.g. Mornington Island, Weipa, and Aurukun). Any impact on the fishing industry in the Gulf would have a direct impact on Sea Swift and that in turn would compromise its ability to transport equipment, goods and people to communities in the region.

In terms of fisher contributions to the broader Australian community, any loss of active fishing vessels is expected to reduce surveillance capacity to detect foreign vessels, including illegal fishers and asylum seekers. Fishing vessels also help detect biosecurity threats associated with foreign vessels. These surveillance roles are particularly relevant to the areas of the draft Oceanic Shoals (area 203) and Arafura (area 204) marine reserves. The fishers also have a surveillance role in collecting drift nets and undertaking boat rescues. The Northern Prawn Fishery businesses cover a large area and also spot prawn shoals by plane.

## Ability to adapt–community

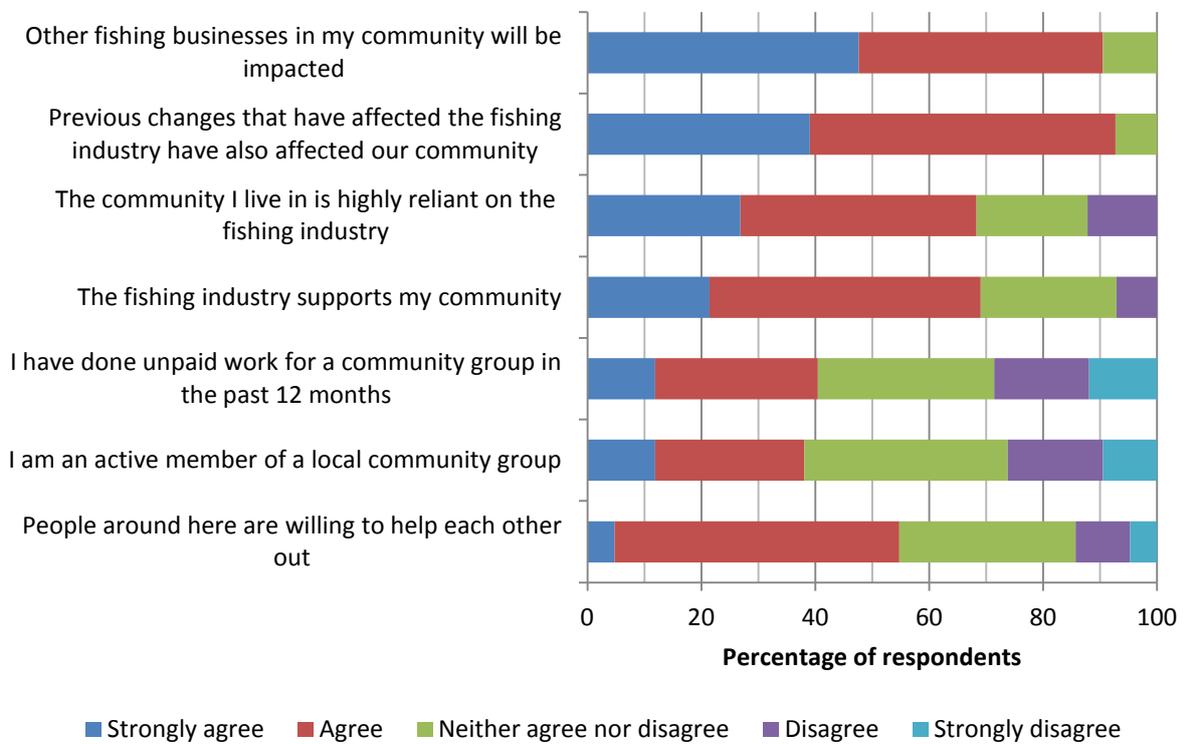
The ability for communities to adapt includes the degree to which they rely or depend on the fishing industry, as well as potential inherent capacities and resources that enable them to adapt to changes and manage stresses. Questions in the survey were specifically aimed at understanding a community’s dependence on the fishing industry, whether previous changes in the fishing industry had also impacted the community and the degree of social capital within the community (Figure 15). These indicators and attributes can provide insight into a community's ability to adapt.

Most of the 41 respondents agreed or strongly agreed that:

- the fishing industry supports their community
- the community they live in is highly reliant on the fishing industry
- other fishing businesses in their community will be impacted
- previous changes that have affected the fishing industry have also affected their community.

These results suggest there are communities that are potentially highly dependent on the fishing industry, that other businesses are also reliant on the fishing industry, and that there are potential secondary flow-on impacts to the broader community. However, individual respondents’ perception of their home ports dependence on the fishing industry varies because the concept of dependence is construed in different ways by different people. Therefore, the fishers’ perception may not be consistent with other measures of dependency, such as statistics on employment or economic diversity measures from the Australian Bureau of Statistics.

**Figure 15 Ability to adapt—community**



Data source: ABARES, *Your marine areas matter: a survey of commercial fishers' values and preferences for Commonwealth marine reserves in the North and North-west Marine Regions of Australia*

## Community and personal impacts summary

Several key messages emerge about the personal and community impacts and their ability to adapt.

Survey results indicated that the majority of respondents would be likely to stay in the industry if the draft marine reserves were declared. At a personal level, for many of them, this would result in increased stress, a need to work longer hours, less time with their family, and the possibility that their family's quality of life would suffer. Most of these fishers indicated they would not relocate to a new town if the draft marine reserves were declared.

A smaller number of respondents indicated they would leave the industry if the draft North Commonwealth Marine Reserves Network was declared. They envisaged that they and their families would experience increased stress, that they would have to look for alternative employment, and that there are considerable risks involved in their plans.

Generally, the respondents were confident in their ability to manage and cope with change, and there was a strong indication that they have some degree of social capital—the social ties and reciprocal bonds that bind a community together—that may assist them in responding and adapting to change. The Wren Fishing business reflects these characteristics (see Case study: Vertically integrated fishing business in the Gulf of Carpentaria—Wren Fishing).

The main limitation to adaptation is a lack of financial resources and confidence in being able to secure alternative employment.

Reports of community impacts largely focused on the impacts to the supply chain. Other community impacts that were highlighted covered a wide range of issues, including the mentoring role of fishers for young people (in Darwin), the potentially greater impact on a small regional community (see Case study: Impact on a community/town—Karumba), the impacts to the Gulf of Carpentaria community via the Sea Swift mothership operation and the impacts on the broader Australian community in terms of loss of marine surveillance.

At a community level, the economic diversity of the larger centres of Darwin and Cairns means they are likely to have a strong capacity to adapt. The small regional town of Karumba strongly depends on the local fishing industry and is likely to be less resilient to changes if the draft marine reserves are declared (see Case study: Impact on a community/town—Karumba).

## 6 Case studies

The purpose of the case studies was to provide a broader understanding of how the impacts of the draft North Commonwealth Marine Reserves Network would emerge at different levels. This provided a means of exploring the impact through different perspectives, including from an individual business's perspective through to that of a community. Case study themes and topics were chosen through consultation with industry, state and territory governments, and the Australian Government Department of Sustainability, Environment, Water, Population and Communities (SEWPaC). Working group members agreed on six case studies, presented in this chapter across a range of key themes:

- Impact on a vertically integrated fishing business—Wren Fishing.
- Impact on a community/town—Karumba.
- Impact on a large fishery—Northern Prawn Fishery.
- Fishery development/prospectivity.
- North Marine Region supply chain impacts.
- Economic modelling of Darwin and Karumba.

### Telling the fisher's story: a narrative approach

A case study narrative approach was adopted for case studies 1, 2, 4 and 5. The narrative case studies are specifically intended to 'tell the fisher's story' about potential impacts. For the most part, perceptions of impact have simply been reflected in the report. This approach provides a broader contextual understanding of the impacts that representatives of fishing communities think they will experience as a result of the draft North Commonwealth Marine Reserves Network. A mixed-methods social science research methodology was used to develop these narratives, with material sourced from qualitative data from interviews and focus groups, with additional quantitative and qualitative data provided by the survey, literature and secondary data sources.

### Macroeconomic context

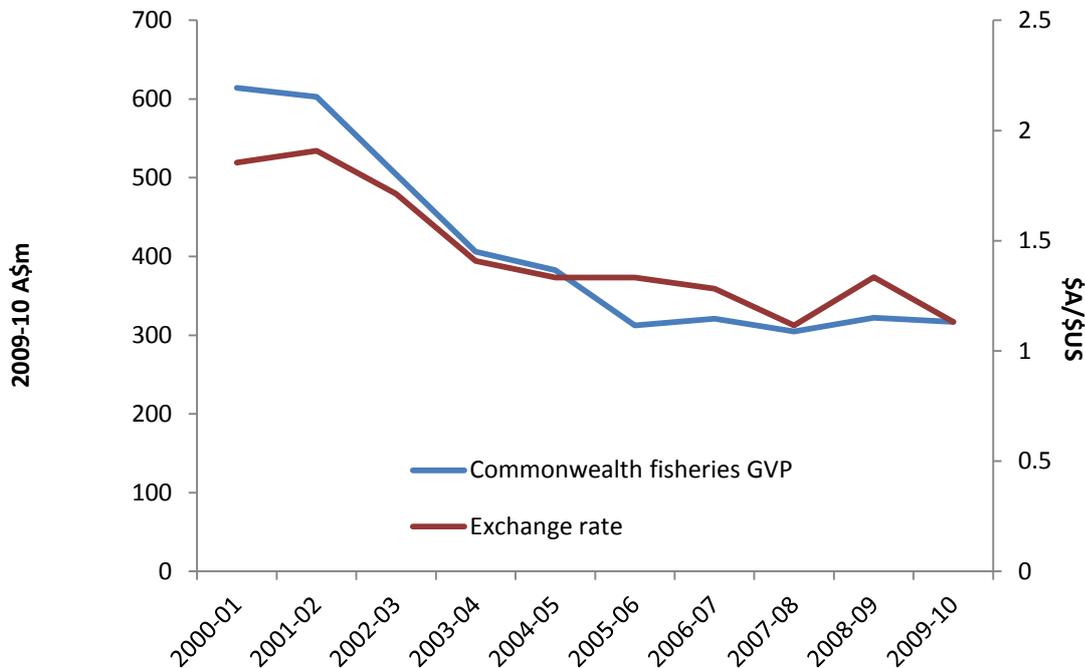
The success of a fisheries operation depends on a wide range of factors, some of which are within the control of the operator, and many of which are outside their control. These include broader economic trends such as the exchange rate, the fuel price, competition for labour and international market effects. The following case studies should be read in this context.

#### Exchange rate

The value of the Australian dollar is outside the control of fisheries operators, but has been a significant factor in determining profitability, particularly in highly export dependent fisheries. The value of the Australian dollar relative to the value of the currencies of major trading partners can have a significant impact on the value of exported fisheries products. An appreciation of the Australian dollar (i.e. an increase in the value of the Australian dollar relative to the currency of a trading partner) will make the price received by Australian producers decrease and make imports more competitive. A depreciation of the Australian dollar will result in an increase in the price received by Australian producers and make imports less competitive.

Producers who supply domestic markets may also be affected if they compete with imported products. Since 2000, the Australian dollar has appreciated significantly, which has placed downward pressure on the price of Australian fisheries product exports (Figure 16) and made imports cheaper relative to domestically produced seafood.

**Figure 16 Commonwealth fisheries gross value of production (GVP) and Australian dollar exchange rate, 2000–01 to 2009–10**



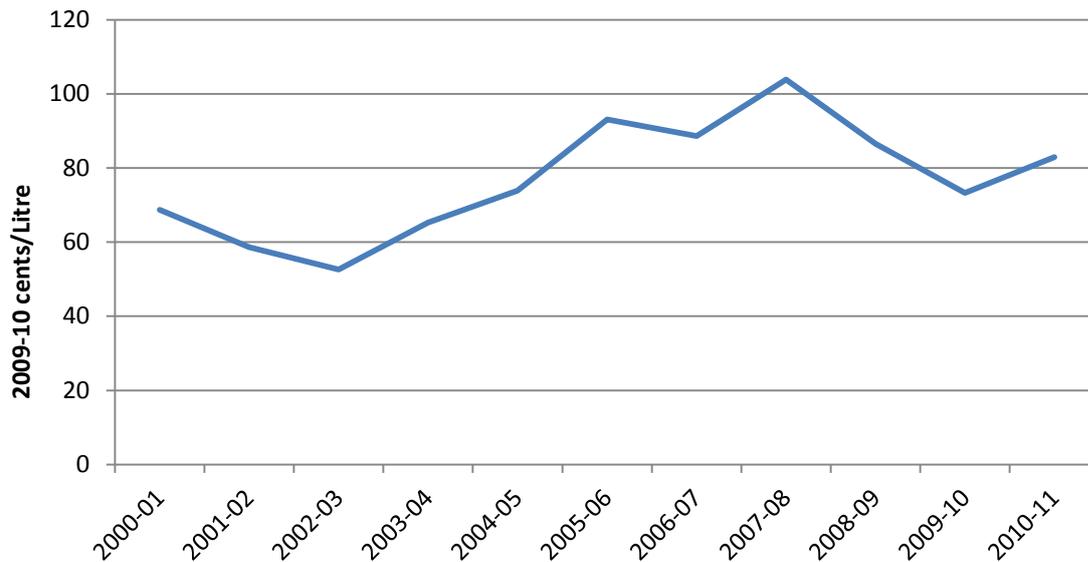
Data source: ABARES 2011b

### Fuel price

Fuel is a major input to most fisheries businesses. For example, fuel accounted for around 26 per cent (in 2009–10) of average total cash costs in the Northern Prawn Fishery, and around 14 per cent (in 2008–09) in the Eastern Tuna and Billfish Fishery (ABARES 2010, 2012a).

The price paid for fuel by fishers has been volatile in recent years (Figure 17). This has caused substantial uncertainty about costs for many fishers, placing additional pressure on the profitability of many fisheries operators.

**Figure 17 Real average off-road diesel price, inclusive of farm rebates and subsidies, but excluding GST, 2000–01 to 2009–10**



Data source: ABARES 2011a

## Competition for labour

The competitive nature of the labour market and the need to compete with other industries has presented some issues for the fishing sector in attracting employees with desired skill sets. The Australian mining industry has grown strongly over the past decade, with the value of resources and energy exports increasing at an average annual rate of around 12 per cent from 2000–01 to 2010–11 (BREE 2011). This has increased labour demand from the industry, resulting in increased competition for labour economy-wide. This includes unskilled workers (who could be employed as fishing crew) and people with transferrable skills, such as skippers and engineers, resulting in some people leaving the fishing industry to work in the mining industry for higher and more secure income. Competition for labour from the mining industry is particularly relevant in Western Australia and Queensland, given the substantial iron ore and coal mining industries in these states. This has placed additional pressure on some fishing operations where labour is a significant input to the production process.

## International market effects

Exporters of Australian seafood compete with other international seafood suppliers and, for many species, Australian producers are unable to influence the world price. Therefore, changes in supply in other countries can have a significant impact on the price that Australian producers receive for their product. For example, the increased supply of aquaculture prawn from the developing world, particularly China, has resulted in downward pressure on prawn prices.

## Case study: Vertically integrated fishing business in the Gulf of Carpentaria—Wren Fishing

This case study explores the potential impacts of the draft North Commonwealth Marine Reserves Network on a vertically integrated Karumba based fishing business—Wren Fishing Pty Ltd. Wren Fishing operates in the Gulf of Carpentaria and off the Northern Territory coast, depending on the season. The business also has a processing and cold storage facility in Karumba.

Information used in this case study was collected from a survey the business filled in and a qualitative interview with people linked to Wren Fishing during November 2011 as part of ABARES' social impact assessment process. The owner–operators and administrator of the business provided insights about the likely effects of the draft marine reserves on the integrated business.

### Background to Wren Fishing

Wren Fishing owns all five licences in the Queensland N9 Fishery (although only three are fished at any one time) and leases three Queensland Fisheries Joint Authority (QFJA) licences. They own one N3 licence that they lease to a third party.<sup>8</sup> The N3 and N9 Fisheries are part of the Queensland Gulf of Carpentaria Inshore Fin Fish Fishery, and the licences are used from February to September. Wren Fishing also lease three licences for Northern Territory fisheries that they fish during the second half of the year to ensure continuity of supply of their product to the market.

The business has three vessels, all of which use gillnets (called set mesh nets in the N3 and N9 fisheries). The decision to purchase all licences in the N9 Fishery despite not fishing them at the same time was to have greater control of the way the fishery is fished. Each N9 licence cost approximately \$400 000.

Potential displacement of the N3 sector was estimated at \$13 900 annual average GVP (2.8 tonnes). As displacement for the N9 Fishery came from less than five vessels, the amount cannot be reported here; however, it was the second largest displacement (the largest being the Commonwealth Northern Prawn Fishery at \$1.65-3.06 million annual average GVP). Eighty per cent of the displacement from the N9 Fishery was from area 212 of the draft West Cape York marine reserve, the remainder being split mainly between area 211 of the draft Gulf of Carpentaria marine reserve and area 213 of the draft West Cape York marine reserve. The time series of annual potential displacement of the N9 Fishery during the period 2000–10 (Figure 1) was quite low in the first half of the reference period, but increased substantially in the second half because of a decision to target mackerel instead of shark, which changed the area being fished. The estimated displacement using only data from 2010 was over \$1.5 million and was second only to the upper estimate of the Northern Prawn Fishery displacement.

The history of the development of Wren Fishing is complex and parallels the history of development of Queensland's fishery management in the Gulf of Carpentaria. In 1999, following the implementation of the Fisheries (Gulf of Carpentaria Inshore Fin Fish) Management Plan, the original N3 sector was separated into N3 (permitted to operate within 7 nm of the coastline) and N9 (permitted to operate between 7 to 25 nm from the coastline) sectors, and five N9 licences were made available. The fishery is now reviewed every 10 years. Potential changes to management stemming from this review may incur considerable cost to the company. This is an additional stress on top of the uncertainty from the draft marine reserves network.

Wren Fishing has leased a Northern Territory Offshore Net and Line Fishery licence from one of Wren's staff members since 1999. There were substantial reductions in net and line days in 2005.

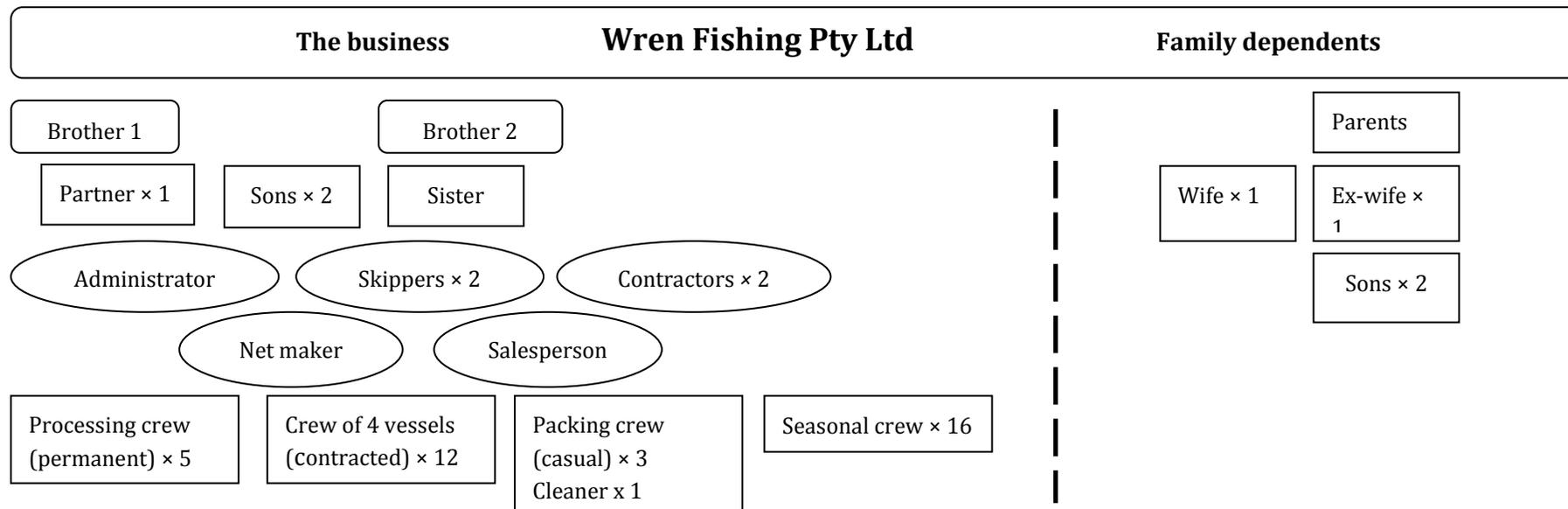
### **Structure of the vertically integrated business**

The Wren family have fished commercially for five generations. The business has grown from a small family business to an incorporated company with a multi-million dollar turnover. In the 2010–11 financial year, Wren Fishing employed 11 full-time and 52 casual staff and was a significant employer in the Gulf–Karumba region. The entire business has assets valued at approximately \$6 million.

The integrated business has two main components, both of which sit within Wren Fishing: a fishing business and a cold store–processing business, both based in Karumba. The company also operates out of Cairns and Darwin. Inputs to the fishing business are sourced primarily from businesses in Karumba, Normanton, Cairns and Townsville. It also intermittently uses mothership services provided by the Cairns-based company Sea Swift. All of the catch from the fishing business supplies the Queensland fish and chip market—mostly to areas north of Rockhampton—except for shark fin, which is exported. Figure 18 details the fish wholesalers, local Karumba businesses, Cairns businesses and other businesses that supply Wren's and that Wren's supply. The cost of freighting the product is approximately \$1 million per year.

Wren Fishing also owns the Wren Cold Store (previously called the Karumba Cold Store) for processing fish and holding additional stock. Currently, the processing business relies on the fishing business for a significant proportion of its stock. Processing involves filleting and portioning to produce approximately 1000 kg of value-added product per week. The processing business provides work for 5 permanent and 15-plus seasonal or casual employees.

Figure 18 Business dependency structure of Wren Fishing Pty Ltd



**Wren Fishing Pty Ltd—other dependent supply chain businesses**

- Buyers**
- Fish wholesalers:
  - Allwild
  - Austral
  - Australian Dried Seafood
  - Doblos
  - Glenn Murray
  - Harbourside
  - Lentex
  - Mackerel Man
  - Mackay Reef
  - NQ Trawler Supplies
  - Roslyn Bay
  - Seafresh
  - TH Seafood
  - Western Australian Seafood
  - Other smaller buyers

- Suppliers/inputs**
- Local businesses:
- Ausnorth Electricians
  - Carpentaria Fuel
  - Gallaghers Butchery
  - Hawkins Transport
  - Karumba Hot Bread
  - Karumba Marine Services
  - Karumba Supermarket
  - Wells Plant Hire

- Cairns businesses**
- Access Coldstore
  - Cairns Food Processing
  - Cummins
  - Deckstore
  - Global Welding
  - Island and Cape
  - Masons Electrical
  - Noltmasters
  - Sea Swift
  - Sharplift
  - Trinity Fire Services
  - Trinity Petroleum
  - Troncs Transport
  - Tropical Engineering
  - Other businesses

- Out-of-town businesses**
- Ancor Fibre Packing
  - ATS Nets
  - Australian Film Manufactures
  - Net Supply
  - Signet
  - Other businesses

- Other fishing vessels**
- Prawns during banana season
  - Unloading facility

## Business impacts

The integrated business may be impacted in multiple ways if the draft marine reserves network is declared. Some are direct impacts on the individual components of the business, while other impacts will result from the links between the components.

### Impact on fishing business

The owner–operators and administrator of Wren Fishing identified the following potential impacts on the fishing business:

- The greatest impact is expected to be from the draft West Cape York marine reserve. In 2010–11, up to 40 per cent of their total landed catch was taken from within the draft West Cape York marine reserve.
- Fishing area is estimated to reduce by 50 per cent; they would need to change their fishing activity and most likely make up the shortfall from other areas.
- More time would be needed to look for new fishing grounds, with associated increases in fuel costs. Alternative licences would need to be purchased, the value of existing licences would decrease, there would be increased pressure on fish stocks outside the marine reserves and more innovative ways to fish would need to be developed to maintain catches.
- The number of employees would have to be reduced, leading to a loss of highly skilled workers, where opportunities for employment in the fishing industry are already limited. The business currently spends approximately \$1 million on employees and contractors per year.

### Impact on cold store–processing business

The cold store houses Wren’s processing business and provides storage for some NPF prawn catch during the banana season, as well as for catch from Wren Fishing vessels.

As a result of flow-on impacts, the processing business might struggle to be viable in the short term if other sources of product from the fishing business could not be found quickly. The cold store is one of the few land-based places in the area where catch can be landed and stored before processing or transportation to markets. This part of the business provides land-based employment in an area where there are limited employment opportunities.

## Ability to adapt

The owner–operator and administrator noted that the draft marine reserves network would have a compounding impact on the business that is already dealing with pressures through:

- rising input costs
- uncertain financial markets
- cheap imported fish
- ongoing changes in fisheries management and access to other fishing grounds
- animal welfare campaigns.

The owner–operators clearly demonstrate a high level of personal resilience while at the same time facing potentially significant stress from the proposed changes.

If the draft marine reserves network was declared, the owner–operators would be likely to change their fishing activity and most likely make up the shortfall in catch from other areas. However, Wren Fishing is a significant employer in the area, both in direct employment and in the number of upstream and downstream businesses that are linked to their business.

### **Flow-on impact on a downstream business**

Wren Fishing is heavily integrated with The Mackerel Man, a fish distributor based in Cairns. This family-run business works closely with Wren Fishing and is the sole distributor of the grey mackerel portions Wren Fishing produces at their facility in Karumba. The Mackerel Man receives 1–2 tonnes a week from Wren Fishing, which is approximately 50 per cent of The Mackerel Man's its throughput. The Mackerel Man also sources barramundi and Spanish mackerel from operators in the Gulf of Carpentaria. This product is sent to restaurants, fish and chip shops and large food-supply businesses such as Bidvest and PFD Foods. The owner of The Mackerel Man highlighted that while the companies that are actually fishing will be impacted first, the impact will flow directly through to his company, because he is entirely reliant on their product. There is a cultural factor associated with the impact as mackerel is a highly sought after species because it is the standard fish sold at fish and chip shops in northern Australia (analogous to flake in southern Australia). Consequently, the owner does not believe he can replace mackerel with a different species. He also indicated that he cannot easily source product elsewhere, so his throughput will reduce in line with any reductions in catch that the fishing fleet experience.

### **Personal impacts**

The owner–operators of Wren Fishing are part of a family with many generations experience of fishing. They are very successful with their business, do not want to leave the fishing industry and are not ready to retire. Their vision has always been to pass on a sustainable fishery and fishing business to their children.

In addition to potential business impacts on Wren Fishing, there were some particular personal impacts that emerged.

The administrator of Wren Fishing is also the owner of one of the Northern Territory licences Wren Fishing leases. Wren Fishing has leased this licence since she first acquired it. The ongoing lease income and total value of the licence is being used as backup for her house mortgage. The administrator now expects to see this source of income and the final sale value of the licence decrease as a result of the draft marine reserves. This is having a stressful impact on her personal plans for the future and putting her livelihood at risk.

Although Wren Fishing is an incorporated company, it is very much a family business and they hold strong family values within their business ethic. The Wrens use business income to pay a family member to care for their ageing mother and to pay other family members to work in the business. If the business is impacted, then it is likely that the family support structures could be impacted as well.

The owner anticipates that even a 10 per cent reduction in throughput will have severe impacts on his business, and is unsure whether he will be able to find work elsewhere. In addition, his wife, who also works full-time in the business, and their son, who works part-time in the business, would have to look elsewhere for work. This is complicated by the fact that his wife works in their business from home to be the primary caregiver for their severely disabled son. As such, the owner considers them to be particularly vulnerable.

Finally, the perception that there will be reduced fishing opportunities as a result of the draft marine reserves is having a negative impact on the aspirations of the next generation and their hopes to continue in the fishing industry. Along with this impact would be the associated loss of specialist skills over time if they are not used.

### **Wren Fishing's suggestions for government assistance**

To assist businesses impacted by the draft North Commonwealth Marine Reserves Network proposal, Wren Fishing suggests that government:

- recategorise one of the zones in the North Marine Region to allow set mesh net—with area 212 being the highest priority
- provide compensation for the loss in the value of licences.

## Case study: Impact on a community/town—Karumba

This case study explores the potential impacts of the draft North Commonwealth Marine Reserves Network on Karumba, a remote community in the Gulf of Carpentaria, Queensland. Information used in the case study is based on surveys and interviews with commercial fishers, processors and community representatives from Karumba.

### General background to Karumba

Karumba is a small, remote community at the mouth of the Norman River in the south-east of the Gulf of Carpentaria. It relies on the nearby town of Normanton for higher level services such as education and medical support. In 2006, the town had an estimated permanent population of 518 people, but anecdotal reports suggest that this has declined to 350–400 people in 2011 (Y Tunney, pers. comm., 2012). Historically, the population has fluctuated in the past 15–20 years. Community representatives believe that contributing factors to this decline might include a change from locally based mining employees to fly-in fly-out workers, and changes to education services that has seen families with children of secondary school age moving to larger urban centres.

There are seasonal fluctuations in population in Karumba. During the banana prawn season (April to June) and with tourists throughout the dry season, the population can increase by up to 5000 people. The town attracts many tourists and ‘grey nomads’ during March–April to December if the roads stay open. The shoulder periods of the tourist season have consistently grown stronger over the past 5–8 years (Y Tunney, pers. comm., 2012).

### Economic drivers

Karumba has four key economic drivers: tourism, commercial fishing, mining and pastoralism. The Karumba port plays a critical role for these industries and for the broader distribution of goods and services to communities in the Gulf region.

According to the Australian Bureau of Statistics (ABS), the consolidated fishing industry, which includes the fishing, hunting and trapping; seafood processing; and fish and seafood wholesaling (ABS industry of employment categories) sectors employs 14 people in the Karumba urban centre / locality [UC/L] (ABS 2006). Although ABS census data indicate that only 14 people were employed in the fishing industry in Karumba in 2006, the employment data from survey respondents suggest that employment levels in fishing businesses are higher, particularly the seasonal workforce (see Background to fishing businesses). This underestimate may arise from the ABS data allocating some employees in the fishing industry to other industries, such as transport and generalised food processing (FRDC 2004).

Other important industries in the town include accommodation (19 people employed), mining (15 people employed), cafes and restaurants (11 people employed) and primary education (9 people employed) (ABS 2006).

Key informants from Karumba reported that tourism and commercial fishing are the most significant industries for Karumba. The limited available data and anecdotal evidence suggest that between 80 000 and 100 000 tourists visit the Gulf region each year (Gulf Regional Planning Advisory Committee 2000), many of whom would pass through Karumba.

The majority of tourists come to Karumba for recreational fishing and to experience the ‘frontier’ lifestyle and associated natural environment offered by the area. Tourism is also driven

by the commercial fishing activities that enable tourists to experience the ‘workings’ of the industry first hand.

The fishing industry is a significant contributor to economic activity in the community. Fishing is also important to the culture of the community and forms an important part of the town’s identity and tourist attractions.

### **Background to fishing businesses**

Karumba is an important port for many fishers operating in the North Marine Region. Thirteen survey respondents nominated Karumba as their homeport (‘Karumba fishers’). All 13 Karumba fishers sourced fish from within the draft marine reserves in 2010–11, and all indicated being potentially impacted.

Karumba fishers own or lease licences in a range of fisheries, notably the Queensland Gulf of Carpentaria Inshore Fin Fish Fishery (comprising the N9 and N3 sectors), Queensland Mud Crab Fishery, Queensland Blue Swimmer Crab Fishery, Queensland Gulf of Carpentaria Developmental Fin Fish Trawl Fishery, Queensland Gulf of Carpentaria Line Fishery, Northern Territory Offshore Net Fishery, Northern Territory Demersal Fishery and Commonwealth Northern Prawn Fishery.

Product landed in Karumba included prawns, barramundi, king salmon, blue salmon, crabs, shark, mackerel, grunter, mud crabs and tropical snapper. Of the survey respondents who landed their catch in Karumba, the combined number of landings was approximately 200 per year, and most of this catch went to two cold storage/wholesaler/processor businesses situated in Karumba (refer to Case study: Supply chain). These facilities in Karumba primarily supply the domestic market.

Karumba fishers said that they used 20 different supply chain businesses in Karumba to repair, maintain or source supplies for their fishing operation. Karumba fishers reported a combined value of vessels and gear of over \$6 million and an annual value of catch for 2010–11 ranging from less than \$50 000 to more than \$15 million.

The majority of Karumba fishers identified themselves as second (or more) generation fishers who, on average, had worked in commercial fishing for 24 years. Between them, the Karumba fishing businesses employed 96 full-time, 12 part-time and 92 casual employees all year round, and a further 271 seasonal workers. Note that although the businesses are based in Karumba, not all employees live in Karumba.

## **Impacts**

### **Reserve impacts**

The draft Gulf of Carpentaria marine reserve (particularly areas 209 and 210) and the draft West Cape York marine reserve (areas 212 and 213) potentially have the greatest impact on the Karumba community through impacts on the Northern Prawn Fishery and the Queensland N9 Fishery, which land substantial quantities of product in the town. There are also substantial processing facilities in Karumba that are used by these fisheries and that provide work for transport businesses through the distribution of product to markets on the east coast. The estimated potentially displaced GVP from fishing product going through Karumba is between \$1.08 million and \$1.65 million per year. This comprised primarily catches from the N9 Fishery and the Northern Prawn Fishery.

Further potential indirect impacts highlighted by interviewees and survey respondents included a potential increase in effort in areas outside the draft marine reserves as fishers seek to make

up their catch elsewhere. Note that these responses are based on an assumption that there is no intervention by government to prevent movement or to remove the incentive to move into other areas or fisheries.

In the survey, the Karumba fishers indicated the areas they relied on within the draft marine reserves. Fishers identified multiple reserves from which they had taken their total landed catch in 2010–11; therefore, there are more than 13 responses recorded here:

- Gulf of Carpentaria marine reserve: seven respondents reported catch in the reserve, with two reporting 41–100 per cent of their total catch coming from within the draft marine reserve in 2010–11.
- West Cape York marine reserve: four respondents reported catch in the reserve, with one respondent reporting 31–40 per cent of their total landed catch coming from within the draft marine reserve in 2010–11.
- Wessel reserve: two respondents reported catch in the reserve, with one respondent reporting 11–20 per cent of their total landed catch coming from within the draft marine reserve in 2010–11.
- Areas where five Karumba fishers caught up to 10 per cent of their total landed catch in 2010–11 are the draft Oceanic Shoals, Arafura, Limmen and Arnhem marine reserves. No Karumba fishers reported catch from within the draft Joseph Bonaparte Gulf area in 2010–11.

### **Fishing and supply chain business impacts**

For more information on fishing business and supply chain impacts in Karumba refer to the Northern Prawn Fishery, Wren Fishing and Supply chain case studies.

### **Community impacts**

The key community impacts from the draft marine reserves in the North Marine Region were summarised as:

- perceived loss of fishing and transportation industry from the town
- loss of skilled employees and secure employment
- loss of seasonal employment opportunities for the transient population
- possible loss of mothership service providing social benefits to small coastal towns along the Gulf of Carpentaria
- loss of a general surveillance function (e.g. less ability to detect illegal fishing vessels)
- potential loss of future investment in the town (e.g. reduced investment from private bank/lending institutions; reduced infrastructure investments being funded by government)
- reduced financial support from the fishing industry to the primary school, childcare centre and local recreation club, which provides sporting and community activities (Y Tunney, pers. comm., 2012).
- potential loss of value of businesses and residential properties should the commercial fishing industry decline (Y Tunney, pers. comm., 2012).

## **Compounding factors**

Interviews with Carpentaria Mayor Fred Pascoe and Yvonne Tunney of the Karumba Progress Association highlighted that commercial fishing is very important to the Karumba economy, along with mining and tourism. They indicated that small towns like Karumba need all the diversity they can get in their economy. They reported that people in Karumba are currently feeling a high level of uncertainty due to:

- uncertain operating future of the Zinifex Century mine beyond 2015
- emigration of families due to Queensland government education policies
- recent ban on live cattle exports
- the belief that the Queensland Government will introduce marine reserves in state waters to mirror those proposed through the marine bioregional planning process, which will impact the inshore commercial fisheries and recreational fishing.

## Case study: Impact on a large fishery—Northern Prawn Fishery

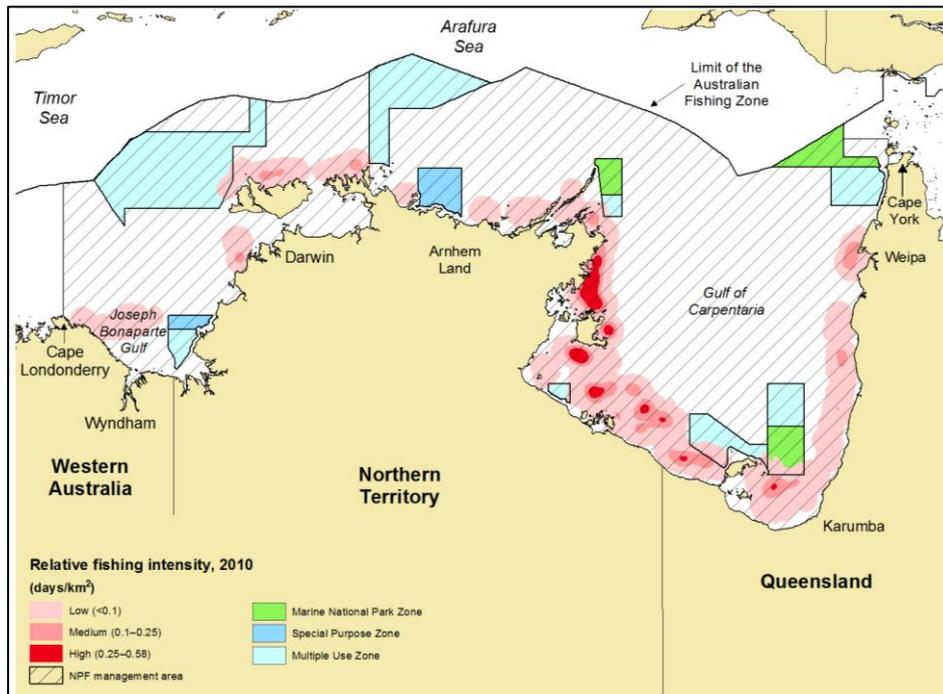
This case study explores the potential impacts of the draft North Commonwealth Marine Reserves Network on the Northern Prawn Fishery, which mainly operates in the Gulf of Carpentaria (Map 10). The information in the case study is based on focus groups; surveys and interviews with operators in the Northern Prawn Fishery; processors; supply chain business owners; and community representatives.

### General background to the Northern Prawn Fishery

The Northern Prawn Fishery extends across northern Australia, from the low water mark to the outer edge of the Australian Fishing Zone (AFZ), between Cape York in Queensland and Cape Londonderry in Western Australia. The gross value of production (GVP) of the Northern Prawn Fishery was estimated at \$89 million in 2009–10, making it the most valuable Commonwealth-managed fishery in Australia (Woodhams et al. 2011). The draft marine reserves network is estimated to displace \$1.6–.1 million annual average GVP (1.9–3.5 per cent of the total fishery annual average GVP) and 159–209 tonnes of catch (2.4–3.1 per cent of the total fishery annual average catch). The fishery targets nine species of prawn—particularly banana, tiger and endeavour prawns. Other commercial species taken include scampi, scallops, bugs and squid. The relative intensity of fishing in 2010 in the Northern Prawn Fishery is shown in Map 10.

There are two main seasons in the fishery: a banana prawn season lasting 6–10 weeks starting from April and a tiger prawn season from August to November inclusive (Woodhams et al. 2011). The fishery is managed using a range of input controls, including limited entry, seasonal closures, permanent area closures, gear restrictions and operational controls under the Northern Prawn Fishery Management Plan. The management of the fishery is currently under review. Many fishers commented that vessel numbers had been substantially reduced over the past three decades, from 286 boats in 1981 to 52 boats in 2007 through a series of restructures and restrictions on the fishery (AFMA 2011b).

Map 10 Intensity of fishing in the Northern Prawn Fishery, 2010



Data sources: Marine reserve boundaries from the Australian Government Department of Sustainability, Environment, Water, Population and Communities; coastline and bathymetry from Geoscience Australia; fishing intensity from logbook data. Zoning is described in Appendix A: Fisheries data processing methods

## Background to fishing businesses

In June 2010, 52 vessels operated in the Northern Prawn Fishery. The fishery uses demersal trawl, which is excluded from all zones in the draft marine reserve network.

Fourteen survey respondents said they held licences in the Commonwealth Northern Prawn Fishery (some respondents hold multiple-vessel entitlements). These fishing businesses reported a combined value of vessels and gear of \$33.7 million, and an annual value of catch ranging from \$50 000 to \$100 000, to more than \$15 million. They collectively employed 124 full-time, 38 part-time and 64 casual employees all year round, and a further 606 workers during the seasons. This indicates that the majority of the workforce in the fishery is seasonal.

## Impacts

### Reserve impacts

The draft Gulf of Carpentaria marine reserve (particularly areas 209 and 210) will potentially have the greatest impact on Northern Prawn Fishery. Surveyed operators in the fishery reported that a considerable percentage of their total landed catch was taken from the area of the draft marine reserve in 2010–11 (up to 80 per cent of landed catch).

Operators in the Northern Prawn Fishery at focus groups in Darwin and Cairns reported that area 209 in the draft Gulf of Carpentaria marine reserve is an important area from April to June for banana prawns. The south-east of area 210 is also important for banana prawns, while banana and tiger prawns are caught in the south-west of the draft Gulf of Carpentaria marine reserve.

The middle of area 210 of the draft Gulf of Carpentaria marine reserve contains monitoring sites that are used for annual recruitment and spawning surveys for stock assessments of the Northern Prawn Fishery. It is also used for gear trials, and has previously been used to assess the effects of demersal trawl on benthic habitats (Kenyon et al. 2010).

Area 211 of the draft Gulf of Carpentaria marine reserve is less important to the Northern Prawn Fishery and has not been fished extensively recently (logbook analysis indicated an annual average of 3–4 tonnes of catch were taken from the area). However, fishers indicated that the area could become important in the future due to variability in the distribution of prawns.

Other potential impacts described by operators in the Northern Prawn Fishery at the focus groups in Darwin and Cairns were:

- the draft West Cape York marine reserve would impact on some operators in the Northern Prawn Fishery, but to a lesser extent
- the draft Limmen marine reserve is between two different grounds and is not expected to have a large impact on Northern Prawn Fishery fishers. Four survey respondents indicated that they would be impacted by the draft Limmen marine reserve, with all four suggesting 1–10 per cent of their total catch came from the area of the draft marine reserve
- the draft Joseph Bonaparte Gulf marine reserve does not have a large impact on the Northern Prawn Fishery. This is consistent with survey results (two Northern Prawn Fishery respondents reported taking catch in the area), and logbook analysis (less than five vessels reported catch in the area).

In addition, there may be minor cumulative impacts to the Commonwealth Northern Prawn Fishery (1.7 t; \$16 600 GVP) by the draft North-west Commonwealth Marine Reserves Network (ABARES 2012c), although this is relatively small compared with the estimated displacement from the draft North Commonwealth Marine Reserves Network.

### **Fishing business impacts**

Of the 14 businesses in the Northern Prawn Fishery that responded to the survey, 13 outlined their most likely course of action if the draft marine reserves network was declared. Of these, five said they would 'stay in the same fishery and make up the shortfall from other areas', six said they would 'continue to operate with a reduced catch' if the marine reserves were declared. One respondent indicated that they would leave the fishing industry if the reserves were declared and another was unsure how they would respond.

Overall, the anticipated impacts of the draft marine reserves on fishing businesses were:

- increased conflict with other fishers over competition for fish (six survey respondents)
- need to reduce the number of employees (five survey respondents)
- fall in value of assets
- inability to borrow against the value of licences (i.e. bank managers already rejecting proposals for investment)
- sell one or more endorsements (one survey respondent)
- sell part of fishing business (one survey respondent)

- reduced ability to be innovative
- health and safety issues involved in stowing fishing gear to transit reserves in bad weather, especially around the draft Wessel marine reserve (areas 206 and 207) where weather conditions make boom operation risky
- reduced capacity for reporting illegal fishing in the North Marine Region through reduced commercial activity (e.g. via plane spotting)
- reduced capacity to assist government authorities by early detection of foreign fishing vessels and biosecurity threats if fewer fishing vessels were operating in the North Marine Region
- reduced capacity for retrieving abandoned or lost nets ('ghost nets').

### **Supply chain business impacts**

Key ports used by the Northern Prawn Fishery in the North Marine Region are Cairns, Darwin and Karumba. These ports are used to unload product, resupply product and refit vessels, and are used by freight services to move product to markets in the south, including Brisbane, Sydney, Perth and Melbourne.

Northern Prawn Fishery survey respondents used Cairns as their main input supplier port, and identified 36 businesses from which services and supplies are purchased, including boat repairs, boat slippage, motor repairs, fuel, and lube and fishing gear. Darwin was identified as the second most important port for input services or supplies, with 24 input businesses used there; followed by Brisbane (6 input businesses); Perth (4 input businesses); and Fremantle, Hervey Bay and Karumba (each with 3 input businesses identified by Northern Prawn Fishery respondents).

The main ports where Northern Prawn Fishery survey respondents currently land their catch were Cairns (14 respondents), Darwin (10 respondents) and Karumba (5 respondents). Of those who identified Cairns as a landing port, 6 respondents landed their catch at sea to the Sea Swift mothership between 5 and 14 times during the year. Focus group participants reported that approximately 80 per cent of the landed catch of the Northern Prawn Fishery goes to Cairns or Brisbane.

Karumba is an important port for trans-shipping of landed catch, and for services and supplies to the Northern Prawn Fishery fleet. Two cold store businesses operating in Karumba provide important refrigeration/storage facilities for Northern Prawn Fishery operators. These businesses are likely to be impacted if fewer prawn trawlers were using Karumba for repairs, services and supplies (see Case study: Impact on a community/town—Karumba). These impacts would occur through potential loss of employment and income into the town from these supply chain businesses.

Few ports in the Gulf of Carpentaria have the infrastructure necessary to load and unload prawn trawlers, so the fishing vessels are highly reliant on mothership operations, such as the Cairns-based Sea Swift, to remain at sea. Two of Sea Swift's motherships are dedicated to the fishing industry, both in the Gulf and also on the Queensland east coast. The motherships provide food, fuel, staff transport, repairs and spare parts so that fishing vessels can continue to operate without returning to port. In addition, the Sea Swift mothership operation provides critical transport and freight links between communities in the Gulf of Carpentaria, including Weipa and

Aurukun, particularly in the wet season when roads may be cut by flood waters and to island communities, such as Mornington Island.

Sea Swift reported that they would be directly affected if the fishing industry in the Gulf of Carpentaria—particularly boats in the Northern Prawn Fishery—were impacted by the draft marine reserves, particularly the draft Gulf of Carpentaria marine reserve.

### **Individual (personal) impacts**

The impacts on individual operators in the Northern Prawn Fishery are summarised as:

- projected loss of income and asset value
- stresses created in personal relationships and family (general)
- increased stress levels (seven survey respondents)
- less time to spend with family (five survey respondents)
- family's quality of life will suffer (five survey respondents)
- increased travel times and longer working hours (four survey respondents).

### **Community impacts**

The impacts on communities that depend on fishing operations in the Northern Prawn Fishery are summarised as:

- perceived loss of fishing and transportation industry from the Gulf of Carpentaria through reduced economic activity
- loss of skilled employees and secure employment
- reduced expenditure of employees and crew in coastal communities
- possible reduced mothership services that currently provide economic and social benefits (e.g. services, transport, provisions) to isolated towns along the Gulf of Carpentaria coast.

### **Ability to adapt**

Generally, survey responses indicated a reasonably good ability to adapt. Most survey respondents in the Northern Prawn Fishery agreed or strongly agreed that:

- previous changes that have affected the fishing industry also impacted on the community (12 of 13 respondents)
- other fishing businesses in the community will be impacted (12 of 14 respondents)
- they have well-developed business skills (11 of 14 respondents)
- they have confidence in their ability to find solutions to problems (11 of 14 respondents)
- they have good health (10 of 14 respondents)
- they do not want to leave the fishing industry (10 of 13 respondents)

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- they have been able to handle unforeseen situations in the past because of their resourcefulness (9 of 14 respondents)
- they feel part of their local community (9 of 14 respondents).

## Case study: Fishery development/prospectivity

The potential impact of the draft marine reserves network on existing, well-established fisheries can be assessed through a combination of catch and GVP displacement analyses, social surveys and economic modelling. However, the impact on ‘prospective fisheries’ (i.e. new fisheries or current fisheries with the capacity for expansion or redevelopment) cannot be so readily quantified (also see Links to other marine regions: Prospective fishing).

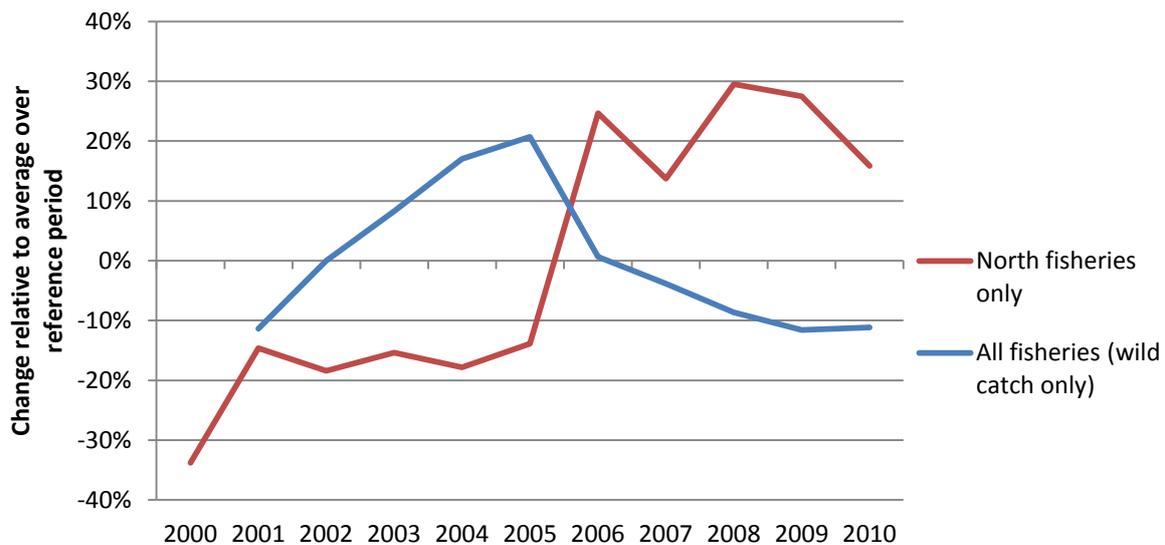
This case study explores the potential impact of the draft marine reserves network on prospective fisheries in the North Marine Region. Examples are given of a large-scale fishery that is broadly still developing, and also examples of several small-scale fisheries.

Fishers have stated that when trading licences, they are valued not only on what catches have previously been achieved, but also on potential catches that could be taken in the future. This prospective value is more evident in fisheries where there are management arrangements that actively limit capacity (such as limited entry or quotas), have low levels of latent (unused) capacity, and large geographical areas available for exploration and development.

### **Fishery trends in the North Marine Region relative to national trends**

Nationally, the volume of wild-catch fish production in Australia increased until 2005, then decreased sharply (Figure 19), while the total GVP for wild-catch fisheries has generally declined (ABARES 2011a). In contrast, a number of fisheries across northern Australia that are in a developmental or growth phase have generally increased production over the past decade (Figure 19). As defined for the context of this study (see Links to other marine regions—prospective fishing), prospective fishing in northern Australia follows the theme of fisheries where capacity for expansion within long-term sustainable limits exists and expansion of current fisheries into new fishing areas or by using new methods or target practises is possible. This is largely due to the smaller population around northern Australia, and the intrinsic logistical challenges associated with a small and dispersed population. These challenges include finding and retaining good crew, lack of infrastructure, and transporting product and equipment over long distances in a hot climate. Examples of fisheries that have had substantial growth in recent years include the Queensland Gulf of Carpentaria Line Fishery and the Queensland Gulf of Carpentaria Developmental Fin Fish Trawl Fishery. The Queensland Gulf of Carpentaria Developmental Fin Fish Trawl Fishery is also an example of a ‘developmental’ fishery. These fisheries may develop from the discovery of a previously unknown resource, growth of markets making a previously unviable species attractive (e.g. sardines in the Northern Territory Developmental Lift Net Fishery) or shift to a different gear (e.g. movement between traps and line in the Northern Territory Timor Reef Fishery).

**Figure 19** Change in catch for all Australian wild fisheries and fisheries in the North Marine Region relative to the average over the same period, 2000–10



## Red snappers

Crimson (*Lutjanus erythropterus*) and saddletail (*Lutjanus malabaricus*) snappers (collectively 'red snappers') are one of the key species targeted in the North Marine Region. Northern Territory fisheries that target red snappers are the Finfish Trawl Fishery (72 per cent of catch in 2009 was red snappers), the Demersal Fishery (36 per cent of catch in 2009 was red snappers) and the Timor Reef Fishery (36 per cent of catch in 2009) (NT DoR 2010). In addition, the Queensland Gulf of Carpentaria Developmental Fin Fish Trawl Fishery targets red snappers (77 per cent of catch in 2009 was red snappers). These fisheries collectively had a GVP in 2009 of \$13.4 million in the Northern Territory and \$4.9 million in Queensland (DEEDI 2010a). Note that this includes the value of all species caught, including red snappers.

Total catch of red snappers in Northern Territory fisheries was approximately 1250 t in 2009, well below the estimated annual sustainable harvest level (estimated at 3800 t) for the red snapper fisheries (NT DoR 2010). Most of the red snapper catch is taken by the Northern Territory Finfish Trawl Fishery; however, activity in this fishery is limited to a single vessel. To increase catches to better reflect the annual sustainable harvest estimate, a range of management changes are due to take effect in early 2012. These include abolishing the Northern Territory Finfish Trawl Fishery and moving that operator to the Northern Territory Demersal Fishery, zoning the fishery into trawl and non-trawl grounds, introducing vessel monitoring systems to boats operating in the Demersal and Timor Reef fisheries, and allowing for additional effort to enter the fishery. These changes were driven largely by industry and it is therefore expected that the additional available effort will be taken up and that catch will increase. As these changes have not taken place yet, they are not reflected in the historical analysis for displaced catch and GVP; however, if catch expands to the estimated annual sustainable harvest, the red snapper catch will double. Therefore, displacement estimates in the current assessment do not accurately reflect the prospective value of this stock or the Northern Territory Demersal Fishery.

## **Growing fisheries**

Other fisheries expanding in the near future include the Northern Territory Timor Reef Fishery, and developmental fisheries in the Northern Territory. The Timor Reef Fishery has changed from using predominantly line methods, to a trap fishery in 2002, back to a line fishery in 2004 and then reversed again to a trap fishery in recent years. These changes reflect the developing nature of the wider fishery grounds and the concept of a prospective fishery through the expansion of current fisheries into new fishing areas, intermittently productive fishing areas, movement back into historically productive areas, or by using new methods or target practice. Additionally, industry expect markets to continue to develop for species not currently targeted (e.g. trevally), which will lead to further expansion of the fishery. Although the Northern Territory Timor Reef Fishery is not displaced by the draft marine reserves network, operators were concerned they could be displaced if the marine reserve zoning scheme changed in the future. Consequently, they suggested their licence value would decrease as a result of the draft marine reserves network because potential buyers would be reluctant to enter a fishery that operates almost entirely within a marine reserve.

The Northern Territory Department of Resources can grant developmental permits to allow fishers ‘To conduct trials of new fishing gear, or to encourage the sustainable harvest of aquatic resources not utilised by existing fisheries ...’ (NT DoR 2010). In 2009, two developmental permits were issued (both to the one operator): one permit using a lift net to target squid and one using a small purse-seine net to target baitfish. The operator has reported good emerging markets for his product. It appears likely that this fishery will continue to operate and potentially expand; however, potential expansion may be inhibited by the draft marine reserves network, particularly in the draft Arnhem, Wessel and Arafura (southern part) marine reserves. This potential impact depends on whether the methods used are excluded from the zones, an issue discussed below.

## **Developmental fisheries—fishing gear risk assessment**

Although the majority of methods have been assessed in the North Marine Region fishing gear risk assessment (Lack 2010), a number of developmental fisheries use novel gear types that were not included in this assessment. These include lift nets and purse seines that are used in the two Northern Territory developmental fisheries. Both these methods are used by one operator, who also operates in the Offshore Net and Line Fishery. This operator knows the extent of potential impact on his operations in the Offshore Net and Line Fishery, and can therefore plan his responses to the draft reserves. However, the operator has no definitive statement on whether his lift net and purse-seine permits will also be impacted, and is therefore trying to make decisions when there is considerable uncertainty as to what the total impact to him will be.

## Case study: Supply chain impacts

This case study explores the potential impacts of the draft marine reserves network on supply chain businesses servicing fisheries in the North Marine Region. The information in the case study is based on focus groups, surveys and interviews with commercial fishers, supply chain business managers or owners, and community representatives in Darwin, Cairns and Karumba. It should be noted that until reserves are declared and fishing businesses operate under new conditions, it is difficult to determine the degree of impact on the upstream and downstream businesses in these communities. This case study attempts to highlight the potential impacts from the business operator's perspective.

### Darwin

Darwin derives income and employment from fishing operators who will be displaced by the draft marine reserves network. Survey respondents identified 63 upstream and 15 downstream supply businesses that are based in Darwin are rely on the fishing industry in the North Marine Region. Some Darwin-based businesses also rely on fishers in the North-west Marine Region who may be affected by draft marine reserves.

#### Upstream suppliers and servicing

Upstream suppliers and service businesses that depend on the fishing industry in Darwin include refrigeration, marine electronics, refitting and boat-slipping companies. Boats serviced by these companies mainly include prawn trawlers, and shark and mackerel boats.

Potential impacts identified by suppliers that were interviewed were:

- loss of income and customers due to fewer fishing boats
- financial stress and therefore increased family stress
- more effort needed to diversify the business's customer base to make up business in other industries (e.g. offshore oil)
- competing against other companies for the reduced level of fishing business.

One business owner supplying marine electronics systems estimated about 30 per cent of his customers were in the fishing industry, mainly the Northern Prawn Fishery, representing about 30 per cent of the business's turnover. It was not clear whether the business's customers were likely to be affected by the draft marine reserves network. This business owner indicated that if the draft marine reserves were declared, additional effort would be required to diversify his customer base into servicing cruise boats, cargo boats, and offshore oil and gas rigs to make up the loss.

Another business owner, who supplied refrigeration services and repairs, estimated that 40 per cent of his business was derived from fishing vessels, including prawn trawlers, mackerel boats, finfish trawlers, barramundi, salmon and trepang (sea cucumber) boats. This business owner said that if the draft marine reserves were declared, it would not have a substantial impact on the business because it is somewhat insulated from the changes. However, more effort would be required to diversify their customer base to non-fishing industries (i.e. defence and oil and gas vessels, to make up for potential lost income).

### **Downstream—processor, wholesale and retail**

Darwin has well-developed infrastructure to support fishing, including cold storage, processing, wholesaling and product distribution. The main potential impacts identified by downstream businesses were:

- reduced fish supply for wholesale businesses
- increased fish prices
- reduced number of employees
- closure of some supply chain businesses
- reduced quantity of high-quality fish available for the domestic market.

A wholesale seafood business in Darwin that processes about 14 tonnes of seafood each month commented that 90 per cent of their product is distributed interstate, with a small amount distributed locally. The interviewee said that if the draft marine reserves are declared it will affect the business, but that it was difficult to define the impacts or severity.

### **Cairns**

Cairns derives income and employment from fishing operators who will be displaced by the draft marine reserves network. Survey respondents identified 64 upstream and 10 downstream supply businesses in the North Marine Region that are based in Cairns and rely on the fishing industry. Cairns-based businesses also rely on operators in the Coral Sea.

### **Upstream suppliers and servicing**

Upstream suppliers of fishing equipment, supplies and servicing in Cairns expect to be impacted by the draft marine reserves network. One boat-slipping company suggested that up to 30 per cent of its business may be fishers who operate in the North Marine Region. Specific potential impacts reported were:

- difficulty in meeting financial investments / loans due to shrinking fishing business income
- increased effort to diversify customer base to include non-fishing vessels (e.g. customs, defence vessels, transport barges).

Several business owners that were interviewed reported they had already adapted to a reduced fishing effort in the Northern Prawn Fishery due to the reduction in the fleet; from 286 boats in 1981 to 52 in 2007. They highlighted that the effects of the draft marine reserves network need to be seen as a continuation of the impact of reductions in the fleet size.

Fishing vessels that operate in the North Marine Region contribute a substantial amount of economic value to Cairns. For example, one of the large fishing businesses operating in the North Marine Region spends \$1 million on repairs and maintenance of its boats in Cairns, including food provisioning, pumps, chandlery, engineering, welding, fire and freight services. The interviewee said this expenditure to suppliers in Cairns would reduce if there were reductions in the fishing fleet in the North Marine Region and there was less need for equipment, repairs and servicing.

### **Downstream—processor, wholesale and retail**

Downstream business owners and managers indicated that they faced potential impacts of:

- fewer fishing vessels resulting in a reduced number of customers
- increased fish prices
- reductions in staff
- closure of some supply chain businesses
- entry of cheaper imported fish into the domestic market.

It was also highlighted that the draft marine reserves network will impact over and above the previous closures from the Great Barrier Reef Representative Areas Program, which have already reduced fishing business.

### **Karumba**

Karumba depends socially and economically on fishing-based income and employment. Survey respondents identified 19 upstream and 4 downstream supply businesses that are based in Karumba and rely on the fishing industry.

#### **Upstream suppliers and servicing**

Upstream suppliers of fishing equipment, resources and servicing stated that they expect to be impacted by the draft marine reserves network. Specific potential impacts were:

- reduction in demand for equipment, repairs and servicing
- potential loss of mothership services to Karumba
- reductions in staff numbers in onshore supply businesses
- need to diversify customer base to non-fishing-related industries.

Potentially impacted fishers who returned surveys in the North Marine Region identified a wide range of business categories in Karumba that they use regularly to source supplies and services. Twenty-seven businesses were identified as likely to be affected by a reduced demand for services if there were fewer vessels using the port of Karumba for repairs, services and supplies. These included boat repairs (10 respondents), motor repairs (6 respondents), fuel and lube (5 respondents), fishing gear (3 respondents), boat slippage (1 respondent), ice (1 respondent), bait (1 respondent) and accessory suppliers (1 respondent).

#### **Downstream—cold storage, processor, wholesale, refrigerated transport and retail**

Suppliers commented that fewer active vessels in the North Marine Region would have a substantial impact on Karumba.

Several supply chain business interviewees said they would lose business if the draft marine reserves network was declared. Some of the specific concerns that downstream businesses raised were:

- reduction in active vessels
- less product going through Karumba
- higher prices for fish (and competition from cheaper, imported seafood)
- reduction in staff numbers
- reduced freight through the port
- less expenditure on accommodation, food and goods by fishing industry employees.

Karumba is an important receiving port for landed catch. Two cold store businesses in Karumba receive a large proportion of the prawns that are fished in the east of the Gulf of Carpentaria. Raptis Cold Store receives 40–50 per cent of prawns from vessels fishing in the Gulf of Carpentaria. In addition, Wren Fishing provides cold storage for operators in the Northern Prawn Fishery during the banana season. These businesses expect to be impacted if the draft marine reserves network in the North Marine Region is declared.

During the fishing season, Raptis and Wren Cold Store employ up to 76 people (full-time, part-time and casual) in Karumba. These companies have a Karumba-based workforce as follows:

- Raptis' onshore business in Karumba employs up to 42 staff, including 2 full-time staff, 4 semi-permanent casuals in the factory, and up to 36 staff from the local community in the prawn season
- Wren Fishing's onshore business in Karumba employs up to 34 staff, including permanent and seasonal crew. They also employ up to 14 crew and skippers on their vessels.

These employment figures may not be represented in the ABS employment figures (noted in the Karumba case study) because the workforce is highly seasonal and the 2006 Census (8 August) occurred outside the Northern Prawn Fishery banana prawn season (April–June).

Raptis supplies fresh barramundi, mackerel, shark and prawns via Karumba to the east coast. Wren Fishing send some landed catch direct to wholesalers, but process about 1000 kg of fish portions each week at the cold store processing room in Karumba. Fish portions are packed and sent to fish and chip shops across Queensland.

Hawkins Freight Transport is based in Normanton (70 km south-east of Karumba) and provides important land freight services for dry goods, live cattle and seafood. In the last few years this has been a critical service for transporting product when the roads were cut off by flood waters. The company operates in the wet season via Weipa, and works closely with Sea Swift to transport freight to and from the region via the Sea Swift barge. If the demand for these services is constrained due to reduced seafood freight, businesses that provide essential services to seasonally isolated communities could be impacted.

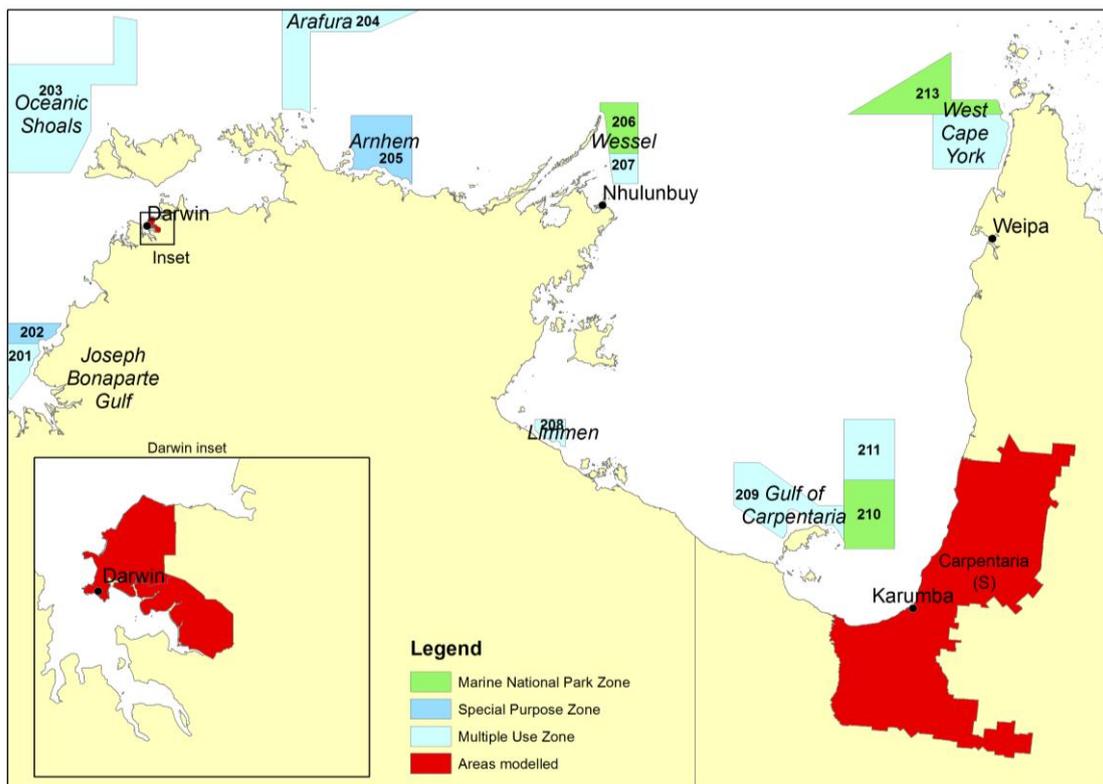
## Case study: Economic modelling of Darwin and Karumba

### The subregions assessed using AusRegion

AusRegion is a dynamic computable general equilibrium (CGE) model of the Australian economy that depicts the Australian economy at the national level, the level of the eight states and territories and the subregional level. It can be used to examine the *net economic impact* of a policy change to part of the economy.

The ABARES AusRegion model has been used to estimate the economic effects of establishing the draft North Commonwealth Marine Reserves Network on two subregions (Map 11). In Queensland, Carpentaria (encompassing Karumba) is modelled. In the Northern Territory, Darwin (the Darwin and Palmerston statistical subdivisions) is modelled. These two subregions together account for \$1.75–2.32 million (or 55–63 per cent) of the \$2.8–4.2 million total GVP that would potentially be displaced by the draft marine reserves network. The relatively higher potential displacement of GVP from these subregions would be expected to have relatively stronger economic impacts than for other subregions adjacent to the North Marine Region or further afield.

**Map 11 Areas modelled by AusRegion: Darwin and Palmerston statistical subdivisions and Carpentaria statistical local area**

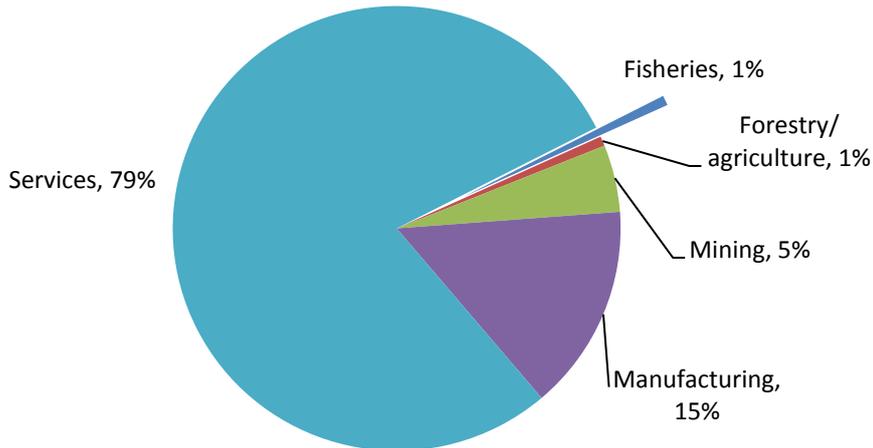


Data sources: Draft marine reserve boundaries from the Australian Government Department of Sustainability, Environment, Water, Population and Communities; coastline and bathymetry from Geoscience Australia. Zoning is described in Appendix A: Fisheries data processing methods

## Darwin

The Darwin economy accounted for more than 50 per cent of the Northern Territory's economy in 2010–11. The fishing sector (including catching and processing, but excluding retail) accounted for approximately 1 per cent of the local economy (Figure 20). Services sectors (including construction, retail and wholesale trade, restaurants and hotels, transport, public services and other services) accounted for 79 per cent of the local economy, with the manufacturing sector accounting for approximately 15 per cent.

Figure 20 Structure of the Darwin economy



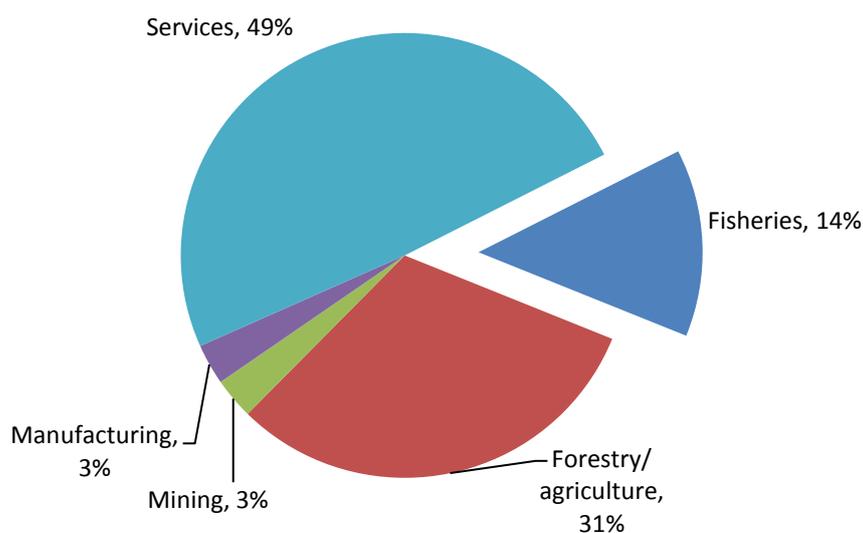
Source: ABARES AusRegion

According to the 2006 census, Darwin had a population of around 86 000 people. The unemployment rate was 3.7 per cent, compared with the national unemployment rate at the time of 5.2 per cent.

## Carpentaria

The Carpentaria economy accounted for less than 1 per cent of Queensland's economy in 2010–11. The fishing sector (including catching and processing, but excluding retail) accounted for approximately 14 per cent of the local economy (Figure 21). Services sectors (including construction, retail and wholesale trade, restaurants and hotels, transport, public services and other services) accounted for 49 per cent of the local economy, with forestry and agriculture accounting for the majority of the remainder (31 per cent).

Figure 21 Structure of the Carpentaria economy



Source: ABARES AusRegion

According to the 2006 census, Carpentaria had a population of around 2000 people. The unemployment rate was 4.9 per cent, compared with the national unemployment rate at the time of 5.2 per cent.

### The AusRegion framework of analysis

AusRegion allows the impact of changes in economic variables on different sectors and subregions to be analysed. This makes AusRegion highly suited for the analysis of economic effects on regional fishing communities from the creation of Commonwealth marine reserves. The CGE framework for analysing these effects allows impacts on key economic variables to be reported at the subregional, state and national levels. For example, the economic effects from these changes can be reported in terms of changes in gross domestic product (GDP), employment and industry activity levels at the national, state and subregional level. A detailed description of the AusRegion modelling framework is provided in ABARE (2010).

A key strength of CGE analysis is being able to identify how effects arising from changes in the economic environment affect different sectors of the economy. This is possible because the underlying strong trade links between sectors and subregions, and the mobility of factors of production, such as labour, are built into CGE models.

AusRegion has four factors of production: land, labour, capital and natural resources that combine with other business inputs to reflect the productive capacity of national, state and subregional economies. AusRegion is flexible, and allows the user to select the subregions to be modelled and the sectors that are analysed.

In practical terms, changes to any given sector (or sectors) in a regional economy are applied as an externally imposed shock to the equilibrium (or economic status quo) operating in that subregion. The results from the change are compared with the reference case that shows how the economy evolves over time without any externally imposed changes. This allows the net economic impact of the policy change to be determined. Changes from the reference case arising from any change in government policy, or economic shock, are typically reported as a per cent deviation in key economic variables—for example, regional income levels or employment—from

the reference case at particular points in time. Absolute level changes, for example number of jobs lost or the dollar amount of reduction in regional income, can then be inferred outside the modelling process from the percentage changes.

The AusRegion model typically estimates the long-term effects of a given policy change. For the analysis in this report, the temporary effects of the policy change have also been examined. The main difference between the short-term and longer term effects is the assumed flexibility in resource mobility. In the short term, it is assumed that resources are restricted in their ability to move between sectors and subregions of the economy. As a result, a policy change results in some productive resources being not fully used in the short term. For example, unemployment rates can rise as workers from affected industries are temporarily displaced before being absorbed in other industries or subregions over time. Over the longer term, however, it is assumed that both capital and labour resources move to sectors and subregions where their productive value is highest. When this occurs, the sector or subregion has fully adjusted in response to the changed economic environment.

### **Modelling limitations**

Economic modelling allows complex policy changes to be analysed within a disciplined analytical framework. Economic modelling of the impacts of the draft marine reserves aims to estimate the potential economic effect of a given scenario relative to a defined reference case scenario, holding other variables constant. As such, modelling estimates presented here should not be interpreted as forecasts of future fisheries production or economic activity, which will depend on a wide range of external uncertain variables not incorporated into modelling frameworks. General uncertainties include future changes in the price of fisheries products, future changes in fisheries productivity, changes to fisheries management and future climatic conditions.

Modelling necessarily requires some degree of simplification. An understanding of the limitations of modelling is necessary to correctly interpret estimates. As such, some of the study's key model and data limitations are provided below. The modelling:

- does not account for interannual variability and uncertainty in the economic shock
  - The economic shock calculated for the AusRegion model was based on the estimates of GVP displacement. Therefore, the caveats and limitations of the methodology to reach this estimate also apply to the economic modelling.
- provides estimates only for large aggregated regions
  - The economic modelling presents estimates of changes in the subregion, state and national economies. In practice, economic effects are likely to be highly variable within these large regions and concentrated in small fisheries-dependent communities.
- does not include transition costs
  - AusRegion presents estimates of changes in employment, assuming that labour is able to move between regions and industries in the long run, without cost. The AusRegion model does not take into account the costs of transition that individuals may be required to undertake to find new employment in alternative industries or regions.

- does not include threshold effects
  - The nature of the AusRegion CGE modelling framework is that it cannot predict ‘tipping point’ effects such as the closure of particular processing facilities.
- does not include feedback effects
  - The two-stage approach involves separately estimating GVP displacement through the logbook analyses and using these results as a basis for input into AusRegion. This approach does not allow for any feedback effects between the logbook analyses and the AusRegion model.

## Model reference case

ABARES was asked to model the potential economic impact of the reduction in commercial fishing activity associated with establishing marine reserves. The model operates under the assumption that the local fishing fleet is predominantly only capable of short-range fishing activities and/or fishing boats are geared to fish for particular species, but not others (i.e. the fleet would have limited capacity to fish further afield or target different species if key fishing grounds were made inaccessible). The closure of some areas to commercial fishing would therefore lead to a reduction in fisheries GVP at ports of landing. Parts of the fishing industry and associated factors of production (capital and labour) would be free to move to other areas that are not affected by the establishment of marine reserves, in search of higher returns.

### Reference case assumption regarding fishery sector growth

ABARES used available data to construct a reference case dataset to represent the long-term average catch and fisheries GVP in each of the modelled subregions over the period to 2019–20. The fisheries data used in the AusRegion model for establishing the reference case level of fisheries production in the modelled subregions were sourced from Queensland and Northern Territory fisheries departments and from ABARES own fisheries databases. Table 18 indicates that GVP is forecast to remain constant or grow in all states between 2009–10 and 2019–20, reaching a national total of \$2.8 billion in 2019–20.

**Table 18 Reference case gross value of production (GVP) projections by jurisdiction (\$billion)**

	2009–10	2010–11	2015–16	2019–20
NSW	0.2	0.2	0.2	0.2
Vic	0.1	0.1	0.1	0.1
Qld	0.4	0.4	0.4	0.5
SA	0.4	0.4	0.5	0.5
WA	0.5	0.5	0.6	0.6
Tas	0.6	0.6	0.7	0.7
NT	0.1	0.1	0.1	0.1
Total	2.2	2.1	2.5	2.8

Source: ABARES estimates and projections

## Scenarios

Scenarios were defined for each subregion being analysed, reflecting the level of GVP potentially displaced from the draft North Commonwealth Marine Reserves Network (see Potential displacement of fishing). Note that two scenarios were examined for the Carpentaria subregion, representing the point and upper bound estimates of potential displacement for that subregion. The value of fisheries production presented represents a higher proportion of the total fisheries sector in the Carpentaria subregion due to its smaller size compared with the Darwin subregion fishing sector. The potential displacement of fisheries output represents a 0.9 per cent reduction in the fisheries output of the Darwin subregion, and a 2.7 per cent reduction in the fisheries output of the Carpentaria subregion.

This analysis uses a period of one year (2012–13) to represent short-term economic impacts and eight years (2019–20) to represent longer term impacts. The mobility of resources between different sectors of the economy is assumed to be restricted in the short term, while resources are assumed to be fully mobile when assessing longer term impacts.

## Results

### Short-term effects (2012–13)

The potential employment impacts of the draft North Commonwealth Marine Reserves Network is greater in the short term than over the longer term. This is because labour and capital that are displaced from the fisheries sector take time to be redeployed to other sectors and areas.

The economic modelling did not find impacts at the state (Queensland) or national levels and impacts to these economies are assessed as negligible (in the context of the state and national economies). The modelled estimates of total potential impacts to the economy and jobs are reported as the sum of impacts to regions and the Northern Territory, scaled linearly to account for the proportion of potential GVP displacement that was not modelled.

The model results are expressed in percentage terms (Table 19). These results demonstrate that the effect on the local economy and local employment is small, with the largest impact expected in Carpentaria with a 0.53 per cent decline in GRP and a 0.21 per cent decline in employment. These results are consistent with the relatively small size of the fishing industries in the regional economies and the relatively small size of the economic shock in the context of the regional economy. Modelled impacts at the state and national level are negligible in the context of the state and national economies and job markets. Given the computational limits of the model, the smaller the percentage impact on a region (subregion, state or nation), the greater the uncertainty around the results. As a result, percentage change results of less than 0.005 were considered to be negligible and actual values derived from them are not reported.

**Table 19 Short-term (2012–13) model results of the potential impact of the draft North Commonwealth Marine Reserves Network on the economy and employment (percentages)**

Economic impact	Darwin	Carpentaria (point)	Carpentaria (upper estimate)
Gross regional product	-0.01	-0.53	-0.81
Gross state product	-0.01	-	-
Gross domestic product	-	-	-
<b>Employment</b>			
Subregional	-0.01	-0.21	-0.32
State/territory	-	-	-
National	-	-	-

Note: dash (“-”) represents negligible modelled impact (less than 0.005 per cent).

Absolute results for economic and employment effects are calculated externally to the AusRegion model. AusRegion results for regional employment impacts (in percentage terms) can be applied to Australian Bureau of Statistics data to calculate estimates of impacts in absolute terms. Reference case model estimates can be applied to the impacts in percentage terms to provide an indication of impacts in absolute dollar and employment values (Table 20).

The total short term regional economic impact from the North Marine Region Commonwealth Marine Reserves Network is estimated to be \$4.6–6.9 million. In the short term, the effect on regional employment is estimated to be the loss of 13–20 full time equivalent positions. There are likely to be flow-on impacts in other regions; however, changes in economic activity at the state and national level are negligible in terms of the size of those economies.

Gross regional product (GRP) in the Darwin subregion is estimated to fall by 0.01 per cent (\$1.2 million) relative to the reference case in 2012–13. The effect on Northern Territory gross state product (GSP) changed only very slightly with the larger spatial scale (0.01 per cent, \$1.3 million) because the economy of the Darwin subregion encapsulates the majority of the Northern Territory economy.

A larger percentage effect on GRP is estimated for the Carpentaria subregion at 0.53–0.81 per cent; \$1.6–2.4 million in absolute terms. The larger percentage effect on the subregion reflects a smaller subregional economy.

In the short term, employment is projected to be slightly lower as a result of the establishment of the draft North Commonwealth Marine Reserves Network. Modelling estimates a loss of 3 full-time equivalent positions in the Darwin subregion, and about 4 positions across the Northern Territory. In the Carpentaria subregion, 4–6 full-time positions are estimated to be lost in the short term, with a small to negligible impact at the state and national levels in the context of those labour markets.

For the fisheries sector, these job losses are projected to result in 0.01 per cent less full-time positions in the Darwin subregion and 0.2–0.3 per cent less full-time positions in the Carpentaria subregion. The larger impact on Carpentaria reflects the small size of the fishing sector relative to the estimated loss in GVP.

**Table 20 Summary of estimated short-term impacts in 2012–13 (absolute terms)**

Economic impact (2010–11 A\$ million)	Darwin	Carpentaria (point)	Carpentaria (upper estimate)
Economic shock (displacement)	-0.67	-1.08	-1.65
Gross regional product	-1.23	-1.60	-2.44
Gross state product	-1.26	-	-
Gross domestic product	-	-	-
<b>Employment (full-time equivalent)</b>			
Subregional	-3	-4	-6
State/territory	-	-	-
National	-	-	-

Notes: Gross regional product refers to the subregion modelled (i.e. the Darwin or Carpentaria subregion). Economic and employment impacts at subregional and state levels are cumulative and should not be added. Dash (“-”) represent negligible modelled impact.

### Longer term effects (2019–20)

Long term effects reflect the impact of the reduction in commercial fishing activity on overall economic activity and employment compared with the reference case, where the national, state/territory and regional economies are projected to grow over the period to 2019–20. In the long term, the economy would have adjusted to the reduced fishing activity, with factors of production such as labour and capital being redeployed to where they are used most productively.

In the longer term, it is projected that GRP will remain lower in both subregions relative to the reference case (Table 22). Long-term changes in the value of production reflect both continued growth assumed to occur in the subregional, state and national economies, and the ability of resources and capital to be redeployed in the economy to its next most productive use.

The long-run model results indicate that the economic and employment impacts on the subregions are greater than 0.01 per cent; however, most results for impacts on the state and national economies and employment are less than 0.01 per cent. Absolute values for economic and employment impacts have been estimated externally to the model (Table 22).

**Table 21 Longer term (2019–20) model results of the potential impact of the draft North Commonwealth Marine Reserves Network on the economy and employment (percentages)**

Economic impact	Darwin	Carpentaria (point)	Carpentaria (upper estimate)
Gross regional product	-0.01	-0.60	-0.91
Gross state product	-0.01	-	-
Gross domestic product	-	-	-
<b>Employment</b>			
Subregional	-	-0.04	-0.06
State/territory	-	-	-
National	-	-	-

Note: dash (“-”) represents negligible modelled impact (less than 0.005 per cent).

In the long term, the total regional economic impact is estimated to be \$6.3–9.1 million, reflecting the sum of estimated impact in Carpentaria and the impact on the Northern Territory, scaled linearly to account for the proportion of potential GVP displacement not modelled. In 2019–20, estimated total job loss from the draft marine reserves network was 1–2 full time equivalent jobs. There are likely to be flow-on impacts to regions outside of Karumba and the

Northern Territory; however changes in economic activity and employment were negligible in terms of the size of those economies and job markets.

In 2019–20, under the assumption of full capital and labour mobility, GRP is projected to be 0.01 per cent lower in the Darwin subregion (\$1.55 million lower in absolute terms) than in the reference case. In the Northern Territory, GSP is projected to be \$1.59 million lower than in the reference case in absolute terms.

In the Carpentaria subregion, GRP is projected to be 0.60-0.91 per cent lower than in the reference case, (\$2.20–3.35 million lower in absolute terms). Modelled impacts at the state and national level are negligible in the context of those economies.

In the longer term, the impact on employment is projected to moderate compared with the short term as the labour market adjusts and workers move to other industries and areas.

**Table 22 Summary of long-term economic impacts in 2019–20 (absolute terms)**

<b>Economic impact (2010–11 A\$ million)</b>	<b>Darwin</b>	<b>Carpentaria (point)</b>	<b>Carpentaria (upper estimate)</b>
Economic shock (displacement)	-0.67	-1.08	-1.65
Gross regional product	-1.55	-2.20	-3.35
Gross state product	-1.59	-	-
Gross domestic product	-	-	-
<b>Employment (full-time equivalent)</b>			
Subregional	-	-0.85	-1.31
State/territory	-	-	-
National	-	-	-

Notes: Gross regional product refers to the subregion modelled (i.e. the Darwin or Carpentaria subregion). Economic and employment impacts at subregional, state and national levels are cumulative and should not be added. Dash (“-”) represents negligible modelled impact.

AusRegion modelling indicated a small benefit to other sectors in both the Darwin and the Carpentaria subregions as a result of capital and labour redeploying to these sectors, but these effects are relatively small.

## **Concluding comments**

The models demonstrate how the draft North Marine Region Commonwealth Reserves Network is likely to affect economic activity and employment across the selected subregions. Economic impacts are expected to be felt directly through reduced fisheries production, and indirectly through decreased activity for those businesses that supply inputs to, and process outputs from, the fishing industry in affected subregions and the broader economy. The combined effects of the direct and indirect impacts are captured in changes to economic activity and employment at the subregional level and in the Northern Territory. The modelled impacts at the Queensland and national levels were negligible in the context of those economies.

The results indicated small percentage decline in GRP in the Darwin subregion and a slightly larger percentage decline in the Carpentaria subregion in both the short and long term.

These economic impacts will generally be felt more acutely in affected areas, but have little effect on the state and national economies.

The effect of the loss of GVP on employment levels in the subregions was larger in the short term and declined over the longer term, which is consistent with increasing labour and capital mobility over time.

Survey and consultation with industry stakeholders suggests that over both the long term and the short term, the reduction in total positions in the fishing sector may be greater than modelled because of the high proportion of part-time positions in the industry (see Table 34).

# 7 Appendixes

## A: Fisheries data processing methods

The analysis of commercial fishing gross value of production (GVP) within the draft marine reserves network in the North Marine Region was based on Commonwealth, Northern Territory and Queensland fishers operating in Commonwealth waters. Commonwealth waters extend 3 nautical miles offshore from the territorial sea baseline out to the 200 nautical mile limit of Australia’s exclusive economic zone. Under Offshore Constitutional Settlement arrangements, state and territory fisheries may operate in Commonwealth waters to target agreed species, under the management jurisdiction of state and territory fisheries agencies.

Draft marine reserve boundaries and zoning provided by the Australian Government Department of Sustainability, Environment, Water, Population and Communities (SEWPaC) form the basis of these analyses. Fisheries logbook data and market data were used to calculate the annual average GVP that may be displaced by the draft North Commonwealth Marine Reserves Network.

### Notes and caveats

The estimates of catch and GVP in this report are derived from logbook and market data supplied by the Australian Fisheries Management Authority (AFMA); the Northern Territory Department of Resources – Fisheries; the Queensland Department of Agriculture, Fisheries and Forestry; and the Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES).

Fishing methods were included or excluded from the different zones based on the zoning framework provided by SEWPaC (Table 23 and Table 24):

- The estimates use data at different spatial reporting scales and have correspondingly different accuracy when assessing the displacement of fishing. These are identified in the displacement tables (Table 5–7).
- Queensland fisheries report catch aggregated by cells (6-minute or 30-minute grids). These reporting cells often occupy only a portion of a draft marine reserve. In such cases, the catch and GVP are apportioned based on the percentage of overlap with the reporting cell. It is assumed that catch is taken uniformly across the area of the reporting cell; however, this may not be the case.
- Input from fishing industry representatives and Northern Territory and Queensland fisheries agencies was used to refine the analyses where possible.
- GVP is not equivalent to the likely cost of structural adjustment assistance that may occur.
- All prices used for GVP calculations are average beach prices that have been adjusted to 2010–11 dollars to account for consumer price index (i.e. inflation). Individual operators may obtain higher or lower prices over the course of a year.
- GVP is the assessed value of commercial fishery products at the point of landing for the quantity produced, and excludes the cost of transporting, processing and marketing of fish products for wholesale and retail markets. It does not take into account flow-on effects, such as value-adding and other potential benefits to individuals and communities.

- A number of assumptions are made with respect to calculating GVP and the reference period used. These are discussed in the section ‘Rationale for gross value of production calculations’. Potential displacement estimates are given as annual means spanning up to 11 years. Catches in the most recent years may have been higher or lower than the mean. For example, the Queensland Gulf of Carpentaria Developmental Fin Fish Trawl fishery has consistently grown over the 11-year reference period, so potential displacement of catches in the past three years would be almost twice as large as the full 11-year mean.
- This report uses commercial fishery logbook data. These are generally a good reflection of actual catches but are largely unverified. As commercial fisheries logbook data are provided by fishers and then processed and stored by fisheries agencies, misreporting and data entry errors may arise. In addition, reporting of an operation’s spatial coordinates is not necessarily a completely accurate representation of where fishing occurred.
- Estimates of potential displacement may be affected by data confidentiality constraints such that no estimate can be reported for some fisheries. This is particularly the case for Northern Territory fisheries where no individual results could be reported. A ranking has been provided instead to give some indication of where the major potential impacts exist. As ABARES received confidential data for all jurisdictions, the estimates of overall displacement across all fisheries and reserves is not affected by confidentiality constraints.
- This analysis assumes that fishing is at optimum levels and there is no scope for further expansion of catch in the future. However, it is possible that where a fishery is displaced by a marine reserve that fishers may be able to move to alternative fishing grounds and maintain the same level of activity, catch and viability of their operation. This may not be the case in other fisheries, but either way will depend on a number of (potentially interrelated) factors such as economics, distance to port facilities, management arrangements, availability of target species or even the suitability of fishing grounds in adjacent areas.

## Consultation

ABARES consulted with industry and Northern Territory and Queensland fisheries representatives on management boundaries and unit prices for GVP calculations. A number of refinements were made to the analyses as a result of this consultation.

## Rationale for gross value of production calculations

The objective of this analysis is to provide an indication of the potential fishery catch that would be displaced by the draft North Commonwealth Marine Reserves Network and to place a value on the displaced catch. As such, the analysis uses a historical reference period to provide an indication of the size of past catches from the areas where fishing would be excluded.

Fishery yields may fluctuate over time and a longer reference period allows for a better understanding of what catches have been achieved in an area, and is not limited to current activity. However, a long reference period cannot fully account for a number of factors, such as maximum sustainable resource limits; whether the fishery is in development, fully fished at long-term sustainable levels or recovering from depletion; or large changes in catch over time due to external drivers.

A 10-year reference period (2001–10) has generally been used for the Commonwealth Northern Prawn Fishery to determine annual average catches in the areas of the draft marine reserves. To account for a fisheries closure that was in force during most of the 2001–10 reference period, estimates for the draft Gulf of Carpentaria marine reserve also used data from 1990–2000.

A reference period of 2000–10 was used for Queensland fisheries. A variable reference period was used for Northern Territory fisheries: 2001–10 for the Finfish Trawl Fishery, 2009–10 for the Spanish Mackerel Fishery, and 2006–2010 for the Offshore Net and Line Fishery. A shorter reference period was used where high spatial resolution data have recently become available. In these fisheries, the increase in spatial resolution (from 60-minute grids to shot-by-shot data) was considered most important to resolve catches inside or outside the draft marine reserves.

To place a value on the displaced catch, the preferred approach was to use recent prices instead of prices obtained in the year of capture. This is because contemporary prices are thought to better reflect likely near-term future prices when effects would be experienced. In all analyses, prices and GVP were adjusted to 2010–11 dollars using the consumer price index. Under this preferred approach, prices were taken from a three-year reference period (2007–08 to 2009–10). GVP was calculated by multiplying the volume of catch recorded in logbooks by the average 'beach price'. Beach prices exclude the cost of transporting, processing, value-adding and marketing of fish products for wholesale and retail markets. Where there were no records in the price reference period, the most recent year of data was used.

### **Commonwealth fisheries**

The only Commonwealth fishery to be affected by the draft North Commonwealth Marine Reserves Network is the Northern Prawn Fishery. An area within the draft Gulf of Carpentaria marine reserve (areas 209–211) was subject to a seasonal closure (banana prawn season) during most of the standard reference period of 2001–10. This area, which had previously seen active fishing, was reopened in 2010. To account for this, estimates of potential displacement are provided through both the standard approach, using only catches from 2001–10, and a second approach that seeks to account for the potential future impact if fishing catch patterns return to those seen in the pre-closure period of 1990–2000. This estimate makes a clear assumption that fishing patterns will return to those of the past, but this may not occur because of significant structural changes in the fishery in recent times. The location of catches, particularly during the banana prawn season, is subject to some variability from year to year.

#### **Standard methodology (point estimate)**

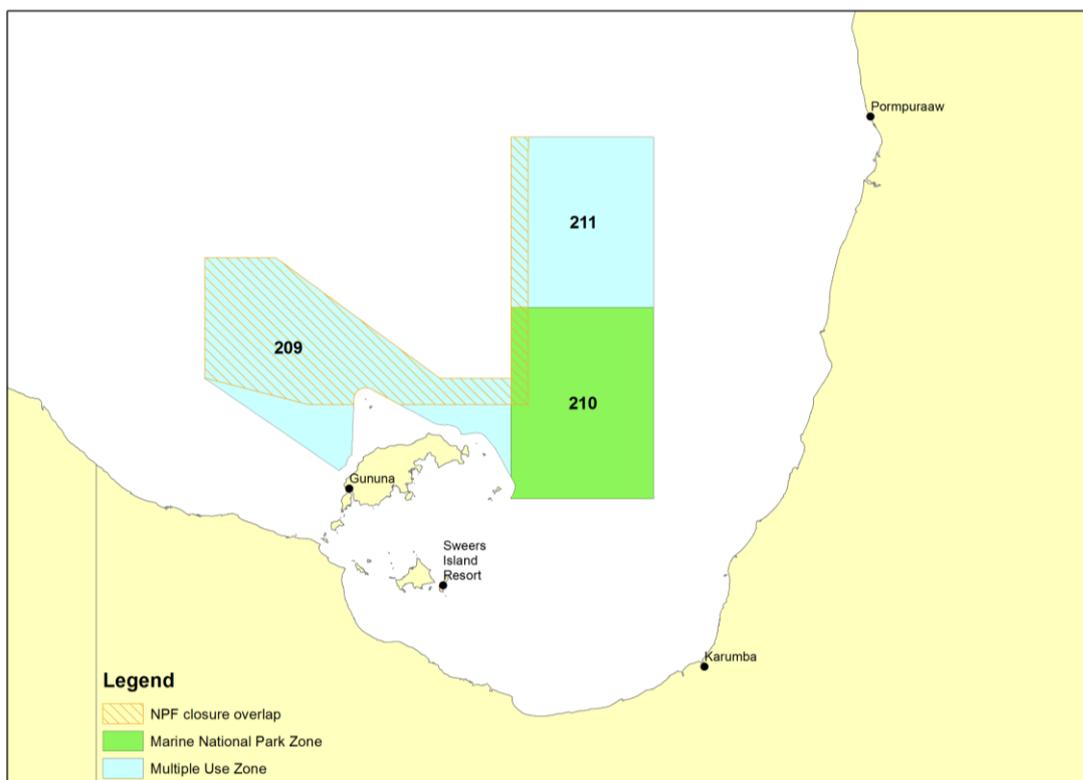
- 1) Operators in the Northern Prawn Fishery record data in their mandatory AFMA logbooks, which can be used to determine location of operations and volumes of species caught. GVP calculations were derived using market data collected by ABARES.
- 2) Estimates of potential displacement from the Northern Prawn Fishery were derived from operations that occurred within the marine reserve over the reference period 2001–10. Demersal prawn trawling was excluded from all zones based on the zoning framework provided by SEWPaC.
- 3) GVP was calculated using an average of the most recent three years of price data for each species caught, as supplied by ABARES.
- 4) This report was filtered so that confidential data (representing fewer than five vessels) are not shown.

#### **Accounting for the Gulf of Carpentaria seasonal closure (upper estimate)**

- 1) For the parts of the draft Gulf of Carpentaria marine reserve (parts of areas 209, 210 and 211) that were partially affected by a fisheries management closure (Map 12), a second, upper estimate was made. This estimate used different reference periods for different areas and seasons of the fishing year.

- 2) The standard method (reference period 2001–10) was used for:
  - areas not affected by the fisheries management closure (unshaded in Map 12),
  - areas affected by the fisheries management closure (shaded in Map 12) during the months August–December (the second season) when the closure has never applied
  - areas affected by the fisheries management closure (shaded in Map 12) during the months January–April when the closure continues to apply.
- 3) An alternative method was used in areas affected by the fisheries management closure (shaded in Map 12) during the months May–July when the closure no longer applies. For this area and time of year, an earlier reference period of 1990–2000 was used, and potentially displaced catch and GVP were rescaled to represent the same percentage of the fishery (in terms of tonnage) during 2001–10.
- 4) The upper estimate was the sum of the catch and GVP described in stages 2 and 3.

**Map 12 Northern Prawn Fishery management area closure where it intersects with the draft Gulf of Carpentaria marine reserve (hatched area)**



Data sources: Marine reserve boundaries from the Australian Government Department of Sustainability, Environment, Water, Population and Communities; coastline and bathymetry from Geoscience Australia. Zoning is described in Appendix A: Fisheries data processing methods

## Northern Territory fisheries

Complete Northern Territory commercial fisheries data for each fishing operation were provided to ABARES by the Northern Territory Department of Resources. These data contained a licence identifier that was used to identify data when summaries were confidential (less than five vessels) and could not be revealed. Analysis was undertaken in consultation with the Northern Territory Department of Resources.

Northern Territory fishers record data in their mandatory logbooks, which can be used to determine where, when and by which method each species is caught. GVP was calculated using an average of the most recent three years of price data for the main species caught in each fishery. Annual, aggregate price data for each sector were supplied by the Northern Territory Department of Resources. Northern Territory pricing data are determined annually in consultation with the Northern Territory Seafood Council.

Charter fishing data was provided at 60 minute grid resolution. These grids were intersected with the draft Commonwealth marine reserves and displacement was estimated according to the proportion of the reporting block that intersected the reserve. This approach assumed fishing was distributed uniformly within the reporting block.

Estimates of potential displacement for Northern Territory commercial and charter fisheries were derived from operations using excluded methods (Table 23) that occurred within draft marine reserves.

This report has been filtered so that confidential data (representing fewer than five vessels) are not shown.

**Table 23 Excluded fishing methods in the Northern Territory, and zoning implications**

Fishery	Method	Marine National Park Zone	Multiple Use Zone	Special Purpose Zone
A16 Finfish Trawl	Trawling	x	x	x
A4 Spanish Mackerel	Trolling	x		
A5 Offshore Net and Line	Pelagic (drifting) gillnet	x	x	
A5 Offshore Net and Line	Longline	x	x	x
Charter fishing		x		

x = method would be excluded

## Queensland fisheries

Complete Queensland commercial fisheries data, not filtered for confidentiality, were provided to ABARES by the Queensland Department of Agriculture, Fisheries and Forestry. These data contained a vessel count flag that was used to identify which data were confidential (fewer than five vessels) and could not be revealed. Analysis was undertaken in consultation with the Queensland Department of Agriculture, Fisheries and Forestry, and the Queensland Seafood Industry Association. This included exclusion of some fisheries because they occurred only in Queensland state waters.

- 1) Queensland commercial fishers record data in their mandatory logbooks, which can be used to determine where, when and by which method each species is caught. Queensland charter fishers record data in mandatory logbooks which provides information on number of clients, number of fishers and number fish caught. Fishing positions for commercial and charter fishers are recorded at the scale of sites (6-minute reporting blocks) or grids (30-minute reporting blocks) (Map 13).
- 2) The 6-minute and 30-minute reporting blocks were intersected with the draft marine reserves and displacement was estimated according to the proportion of the reporting block that intersected the reserve. This approach assumed fishing was distributed uniformly within the reporting block. Six-minute data were used wherever available; otherwise, 30-minute data were used.

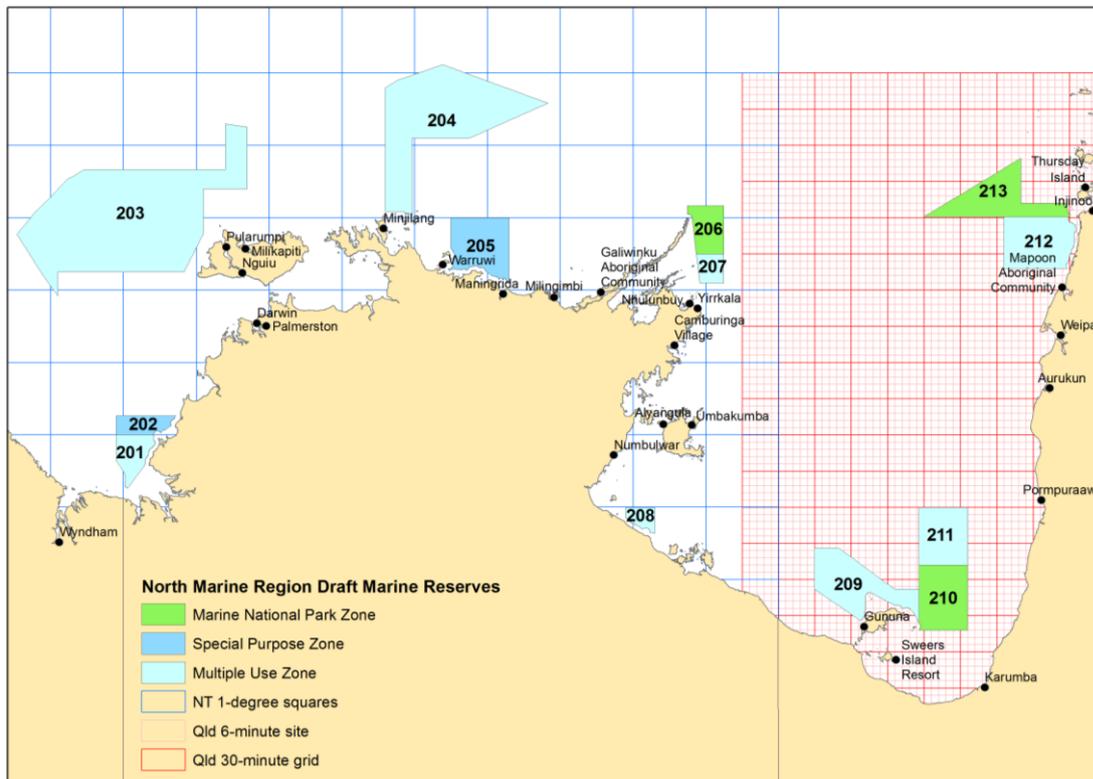
- 3) Estimates of potential displacement for Queensland fisheries were derived from operations using excluded methods (Table 24) that intersected with, or were wholly within, a draft marine reserve. GVP was calculated using 2009–10 price data for the main species caught in each fishery, as supplied by the Queensland Department of Agriculture, Fisheries and Forestry.
- 4) This report has been filtered so that confidential data (representing fewer than five vessels) are not shown.

**Table 24 Excluded fishing methods in Queensland, and zoning implications**

Fishery (symbol)	Method	Marine National Park Zone	Multiple Use Zone	Special Purpose Zone
Gulf of Carpentaria	Fish trawling		x	x
Developmental Fin Fish Trawl			x	x
Gulf of Carpentaria Line (QFJA)	Longline	x		x
Gulf of Carpentaria Line (QFJA)	Trotline	x		
Gulf of Carpentaria Line (QFJA)	Dropline	x		
Gulf of Carpentaria Line (L4)	Line fishing	x		
Gulf of Carpentaria Inshore Fin Fish (N3, N9, QFJA)	Set mesh net (demersal gillnet)	x	x	x
Charter fishing		x		

x = method would be excluded; QFJA = Queensland Fisheries Joint Authority

**Map 13 Queensland fisheries and Northern Territory charter fishery reporting grid systems overlaid on the outline of the draft North Commonwealth Marine Reserves Network**



Note: Commonwealth and Northern Territory commercial fisheries report latitude–longitude data for each operation. Data sources: Marine reserve boundaries from the Australian Government Department of Sustainability, Environment, Water, Population and Communities; coastline and bathymetry from Geoscience Australia. Zoning is described in Appendix A: Fisheries data processing methods

## B: Social impact assessment methods

Social impact assessment (SIA) is a process to assess or estimate the social consequences that are likely to follow from specific policy actions, including programs, or the adoption of new policies.

### Scope of the social impact assessment

The scope of the SIA is outlined in the Record of Understanding (ROU) provided to ABARES by the Australian Government Department of Sustainability, Environment, Water, Population and Communities (SEWPaC), as well as in the objectives and scope of work activities (see Scope of work). The type of assessment undertaken and the methods applied therefore reflect the requirements of the ROU, within the constraints of time and resources available.

The SIA covers the South-west, North, North-west and East marine regions. This document reports on the North Marine Region SIA. It includes all commercial fisheries occurring within each region. The SIA focuses on the commercial and charter boat operators that will be potentially displaced by the draft North Commonwealth Marine Reserves Network and other stakeholders (i.e. operators that fish outside the draft marine reserves, supply chain and communities) who will be impacted by displaced fishing activity. Recreational and Indigenous fishers, and any other resource users, are out of scope of the assessment. An attempt will be made to provide an opportunity for all in-scope persons to provide input to the assessment; however, participation of all relevant people cannot be guaranteed. This may affect the ability to disaggregate the assessment results to an individual impact level; therefore, impacts will be assessed at the fishery, regional and community scales.

### Social impact assessment approach

SIA has been increasingly used by decision makers, including both government and private sector organisations, to predict potential consequences of proposed changes in access to natural resources. SIA is a useful tool to help understand the potential range of impacts of a proposed change, and the likely responses of those impacted if the change occurs. This understanding can be used to help design impact mitigation strategies that can minimise negative, and maximise positive, impacts of any change.

The following steps are considered as core components of SIA:

- scoping an impact assessment
- profiling the current context and identifying who is likely to be impacted
- assessing direct social impacts
- assessing indirect social impacts.

The process used in this SIA broadly followed these steps. Efforts were made to incorporate cumulative impacts into the assessment.

To assess the potential impacts of the draft North Commonwealth Marine Reserves Network, three primary data collection methods were used.

## **Method 1: Survey of commercial fishers**

A mail-based survey of potentially displaced and impacted commercial fishers in the North Marine Region was undertaken in December 2011.

### **Survey scope and sampling frame**

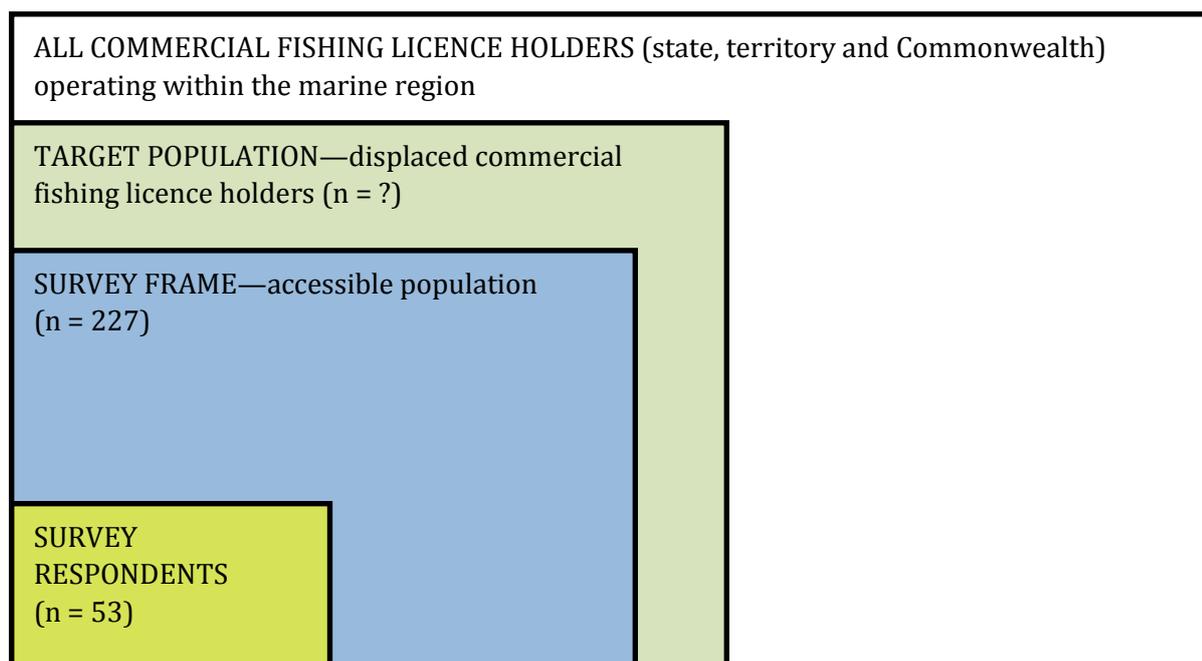
The scope of the survey was developed in consultation with industry, state and Commonwealth fisheries institutions, and SEWPaC. It was agreed that the study target population would be individual fishers and fishing businesses currently holding licences in state and Commonwealth fisheries with the highest likelihood of being displaced and impacted by the draft North Commonwealth Marine Reserves Network. The intent was not to survey all fishery licence holders in the region, but to create a target population and provide all accessible people and businesses with a survey. Although the target population was identified in theory, it is difficult to identify all individuals and businesses that would fall within this target population, largely because this population does not yet exist. Therefore, an accessible population was identified from which a survey frame was developed (see survey frame development below).

Figure 22 illustrates the different population groups referred to when developing the survey scope and sampling frame. Impacted fishing licence holders are a subset of fishers that are potentially impacted by the draft North Commonwealth Marine Reserves Network. Impacts could be via:

- reduced access to resource due to displacement
- loss of income
- increased competition with displaced fishers
- changes to fisheries management
- decreased value of licences and capital
- loss of essential infrastructure (e.g. supply chain businesses and facilities).

The target population includes fishery licence holders operating within the North Marine Region who will be displaced by the draft North Commonwealth Marine Reserves Network. The total number of fishery licence holders in this target population was unknown. However, this target population (i.e. displaced fishers) was derived using the approach described below. For the purposes of constructing the survey frame, displaced fishers were any licence holders who fished within the draft marine reserves during the period 2000-10 (Refer to Chapter 2: Potential displacement of fishing).

**Figure 22 The relationship among all fishers, impacted fishers, target population, survey frame and survey respondents**



### **Survey frame design and development**

The primary goal in designing and developing the survey frame was to ensure that the highest number of displaced licence holders (i.e. the target population) would be identified for the survey. A secondary goal was to minimise potential cognitive biases, such as impact bias and bandwagon bias. This was seen as essential due to the sensitive nature of the study topic and general remonstrations within the fishing industry to the draft Commonwealth marine reserves.

The sample frame was developed through the following processes:

- ABARES obtained fishery logbook data from state, territory and Commonwealth agency data holders. Logbook data contains information on the spatial position and times of fishing operations and is compulsorily acquired from all licensed fishing businesses.
- ABARES analysed fishers' logbook data from state, territory and Commonwealth fishery agencies to determine which fisheries would be displaced by the draft North Commonwealth Marine Reserves Network, that is, fisheries with operators who had recently fished within the draft marine reserve boundaries
- Commonwealth, state and territory fishery agencies were informed of the potential displaced fisheries and provided a preliminary list of displaced licence holders from the identified fisheries.
- AFMA provided a preliminary list of displaced licence holders operating in Commonwealth fisheries. The Commonwealth Fisheries Association (CFA) and a Northern Prawn Fishery representative reviewed the list and added additional licence holders they believed would be displaced based on recent fishing activity.
- Northern Territory fisheries agencies provided a preliminary list of displaced licence holders to the Northern Territory Seafood Council who reviewed the list and added additional licence holders they believed would be displaced.

- Queensland state fisheries agencies provided a preliminary list of displaced licence holders to the Queensland Seafood Industry Association who reviewed the list and added additional licence holders they believed would be displaced.

The final lists of displaced licence holders were analysed and duplicates were removed.

The resulting survey frame consisted of 227 licence holders across Commonwealth (27 licence holders), Queensland state fisheries (114 licence holders) and Northern Territory fisheries (86 licence holders). The use of Commonwealth and state log data and the expert knowledge of industry in constructing the survey frame provide a high level of confidence that the 227 licence holders in the survey frame would cover more than 90 per cent of licence holders in the target population.

### **Survey error**

It is important to understand the types of survey error that are most likely to occur. Most surveys report the sampling error. However, in many instances this is quite small relative to other sources of error. This section discusses the errors that should be considered when reading the survey findings in this impact assessment.

The main sources of survey error could include (de Leeuw et al. 2008):

- coverage error
- sampling error
- non-response error
- measurement error.

### **Coverage error**

Coverage error is the difference between the survey frame and the target population. Because we did not know the size of the target population, and constructed the target population based on state and Commonwealth agency logbook data analysis, we most likely had both undercoverage and overcoverage error. We were unable to address undercoverage error as we were not sure that all displaced licence holders were in the survey frame, and were unable to contact non-respondents. Overcoverage is possible due to the over sampling of some fisheries, for example, the Queensland N3 sector. This was evident in survey responses where individuals believed they were displaced, but in fact were not based on the fishery they operate in, gear type and reserve zonings. We used a post-survey filtering process to ensure these out-of-scope respondents were not included in the displacement analysis.

Usually, the target population would be identified through a filtering process such as a mail-out card to all fishers in the region with a question (e.g. 'Are you likely to be displaced by the North Commonwealth Marine Reserves Network?' (Yes/No)), then administering the full survey to the group that answered 'Yes'. This would establish the target population. However, the difficulty with this filtering approach is that it would have required the respondent to have a complete knowledge of the marine reserve system zoning, and their spatial use pattern of the resource. It would have been impractical to include this information in a simple card.

### **Sampling error**

Sampling error can occur if a sample is taken instead of measuring the entire population. It is usually not feasible to send a survey to every individual in the target population, and a random or purposive sample is selected from which inferences can be made about the target population. However, we believe that the sampling error is less relevant in this study because a survey was sent to all licence holders in the survey frame (i.e. we did not take a sample from our survey frame). Therefore, we are confident we covered a high proportion of the accessible population.

### **Non-response error**

Non-response error can occur if particular groups of people do not complete and return survey forms, thus under-representing those groups and skewing the survey results. For example ‘impact bias’ could arise if people who think they may be impacted by the draft marine reserves are more motivated to respond to the survey than those who do not; or if larger fishing operations that are well connected to industry groups or have attended industry briefing sessions are more likely to respond than smaller operators who may be less well informed. In general, the reasons for non-response could include:

- failure of the data collector to identify the individual (e.g. we had the incorrect address, we could not find the respondents’ location)
- refusal to participate (e.g. deciding not to answer, or forgetting to answer the survey)
- inability to participate due to health, absence, etc.
- inability to communicate (e.g. requiring an interpreter)
- accidental loss of the data or questionnaire.

The response rate was 53 out of 227 (i.e. 23 per cent). We did not follow up with any of the non-respondents so we cannot determine the non-response error or the characteristics of the non-respondents.

### **Measurement error**

Measurement error can include inaccurate responses to questions, an inability of the respondent to recall information or differences in how respondents interpreted a question.

Measurement error arose in our survey through:

- misinterpretation of zoning of marine reserve areas (although we used filters to help screen for actually displaced fishers)
- methods of fishing that related to the zones (limitations of the gear risk assessment process)
- difficulty for people to determine future events and how they would respond to the changes
- respondents having difficulty in interpreting the questions (e.g. ‘safe area’ question in the value mapping section of the survey could be interpreted as a safe area to fish or a safe area to go in bad weather, or the ‘fully’ and ‘partially’ excluded question).

To reduce these errors, the survey was tested before administering it. We also modified wording and questions from region to region to improve the measurement as the project progressed.

## Method 2: Focus groups

Focus groups were held with fishing industry and community representatives to gain an understanding of the relationships between the fisheries and communities. The key questions were:

- Which fisheries, related fishing businesses, supply chain businesses and communities will potentially be impacted?
- What are the direct, indirect and cumulative impacts on individuals, businesses and communities?
- How will impacted people manage the change?

Focus groups were held in Darwin and Cairns with participant numbers shown in Table 25.

The location of the focus groups was determined through consultation with the North Marine Region working group (Commonwealth, state and territory fishing industry representatives, SEWPaC and the Industry Liaison Officer) and reflected where impacts were likely to be greatest.

**Table 25 Focus group participants**

Focus group location	Fishing industry representatives	Community representatives
Darwin	4	1
Cairns	6	3

Note: A number of other fishing industry and community representatives were also invited to the focus groups but did not attend.

## Method 3: Interviews

Twenty-five in-depth interviews (11 face to face and 14 by telephone) were held with commercial fishers, supply chain businesses and community representatives. Many of the interviewees were also involved in the focus groups. We took the opportunity after the focus groups to interview individual fishers to gain a deeper perspective of how the change would impact on their business, personal life and community.

## Data management and analysis

Survey data were entered into the computer program — Statistical Package for the Social Sciences (SPSS). Routine data checking and cleaning processes were applied to produce a final data set. Focus groups and interviews were recorded either by hand notes or digital audio recordings. These recordings were transcribed and used as a basis for analysis. A qualitative analysis package, NVivo8, was used to help summarise, sort and thematically interpret the information provided by the fishers and community representatives. Note that all survey results are reported as valid percents in this report (valid percentages will change depending on the question because not all respondents answered all questions).

## Ethical process

Several processes were undertaken to maintain ethical standards in this SIA.

- Survey participants were provided with an introductory letter outlining the purpose of the SIA, who should fill out the survey and details on confidentiality. It was emphasised that

their name will never be placed on the survey and only aggregate data will be used in reports. Similar information about how confidentiality was provided inside the front cover of the survey.

- Focus group invitees were sent a fact sheet outlining the purpose and approach of the SIA. Verbal approval for audio recording of the focus group discussion was obtained at the start of the focus group meeting.
- Interviewees received information about the SIA via the survey process or the focus group process, and were asked for verbal approval to record at the start of the interview.
- Care was taken to remove any personal information from case study reports that would allow individuals to be identified (unless the participants explicitly indicated to ABARES that this information could be included).
- Participants were informed that all information would be stored in a secured system and no individual identified except where permission was granted.

## C: Estimating job reduction using the survey

The survey was used to estimate the potential jobs lost from the surveyed businesses as a result of the draft North Commonwealth Marine Reserves Network. The comments at the beginning of Chapter 4: Impacts on fishing businesses about interpreting the survey data are very relevant here. The survey specifically targeted impacted businesses and is not representative of the wider commercial fisher population in the North Marine Region (see also Appendix B. Social impact assessment methods). The estimates are also based on each surveyed business's prediction about how they would respond to the draft North Commonwealth Marine Reserves Network.

The survey was filtered to exclude responses from operators where no displacement could occur. These were scenarios where either fishing methods were compatible with the zoning of a particular reserve, or where logbook analysis indicated no displaced fishing effort.

For each respondent, potential job loss was calculated as a percentage reduction in their reported numbers of employees. The percentage reduction was dependent on their overall response to the draft marine reserves (i.e. stay and make up shortfall, stay with reduced catch or leave the fishing industry) and their subsequent response to a question about reducing employees (Table 11). For example, if a respondent stated that they had 10 full-time employees, would continue operating with reduced catch or downsize their operation, and strongly agrees that they would reduce employees, following Table 26, there would be a 30 per cent reduction in employees for that business resulting in three job losses.

The percentage reductions in Table 26 were partly based on counts of survey responses indicating what proportion of their total catch during 2010–11 they estimate would be displaced by the draft marine reserves (Table 14).

**Table 26 Percentages used to calculate reduction in employees based on (a) the overall response to the draft marine reserves and (b) response to a question of whether the business will reduce employees**

(a) If the draft marine reserves were declared, would the fishing business need to change its fishing activities? [yes]	(b) The fishing business will have to reduce employees	
	Agree (%)	Strongly agree (%)
Stay in the same fishery and make up the shortfall fishing in other areas or move into an alternative fishery	10	20
Continue operating with reduced catch or downsize operation	15	30
Leave the fishing industry	50	100

Data source: ABARES, *Your marine areas matter: a survey of commercial fishers' values and preferences for Commonwealth marine reserves in the North and North-west Marine Regions of Australia*

## D: Developing an index of community vulnerability

In this study, the concept of community vulnerability to the impacts of the draft Commonwealth marine reserves in the North Marine Region is explored to provide an indication of which communities are vulnerable to the impacts of the draft marine reserves. This appendix outlines the approach taken to measure community vulnerability.

### Communities of place and interest

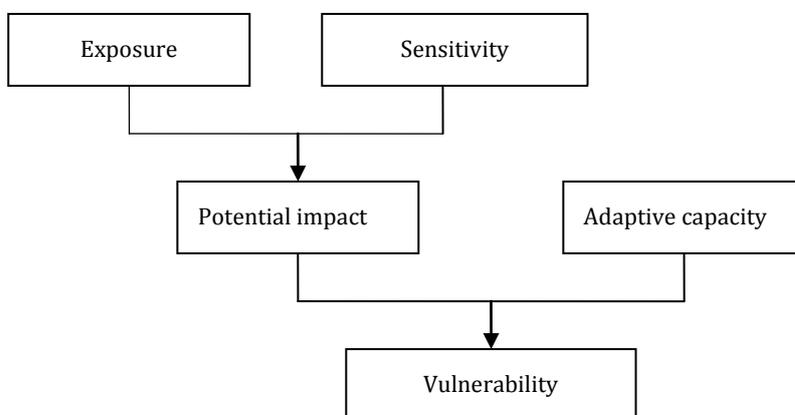
In this study, the emphasis is on communities of place and interest. Communities of place refer to people living within a defined geographical boundary, which in this study is the Australian Standard Geographical Classification (ASGC) spatial unit, statistical local area (SLA). Communities of interest refer to people who share a common interest, which in this case is those employed in the consolidated commercial fishing industry.

### Community vulnerability

The concept of vulnerability has gained increasing popularity in understanding the socioeconomic dimensions of change within communities (Steneke et al. 2010). The following vulnerability assessment is based on a conceptual model used by the Allen Consulting Group (2005), which was based on Schröter and The ATEAM Consortium (2004). This model has been widely adopted and is generally accepted by researchers (Johnston & Williamson 2007; Parkins & MacKendrick 2007). In the model, vulnerability (V) is a function of a system's exposure (E), sensitivity (S) and adaptive capacity (A) (see Figure 23).

To operationalise the conceptual model, an indicator approach was applied. Indicators of social change are widely accepted as reliable and practical tools to summarise complex socioeconomic phenomena (Herrera et al. 2008). The authors acknowledge that vulnerability is a dynamic construct that changes over space and time. However, in this assessment, vulnerability is measured as a static phenomenon using indicators selected a priori. In reducing complex phenomena to a single metric, local contextual differences are masked. However, the approach does allow for a consistent assessment over large spatial units (Steneke et al. 2010). The resulting summary metric of vulnerability indicates that adaptation efforts should be directed at those communities with the greatest sensitivity and least adaptive capacity to changes in access to marine resources (Smit & Wandel 2006).

Figure 23 Conceptual model of community vulnerability



Source: Allen Consulting Group 2005, based on Schröter and the ATEAM Consortium 2004

## Developing the community vulnerability index

The approach applied to develop the index of vulnerability in this study synthesises previous applied research on indicators used to understand the relationship between community resource dependence and the concepts of resilience, adaptive capacity, wellbeing and disadvantage (Machlis et al. 1990; Beckley 1998; Turton 1999; Ellis 2000; Yohe & Tol 2002; Brooks & Adger 2004; Adger & Vincent 2005; Armitage 2005; Fenton 2005; Nelson et al. 2005; Smit & Wandel 2006; Burnside 2007; Marshall et al. 2007; Patriquin et al. 2007; Herreria et al. 2008; Stenekes et al. 2010). The approach is therefore theoretical and does not differentiate variables that maybe more relevant at a local level in identifying factors that influence vulnerability. Table 24 provides the indicators used in this assessment to measure the component concepts of the vulnerability model.

## Measures of community vulnerability

The conceptual framework (Figure 23) and previously mentioned literature were used as a guide to the selection of indicators to measure the vulnerability of communities that depend on fishery resources. Table 27 presents the indicators, data items and the geographical scale used to measure the sub-index of sensitivity and the sub-index of adaptive capacity. All data used in this study are derived from the Australian Bureau of Statistics (ABS)—namely, the Census of Population and Housing 2006; Socio-Economic Indexes For Areas (SEIFA) and Accessibility/Remoteness Index of Australia (ARIA) 2001.

**Table 27 Indicators and data**

Concept sub-index	Indicator and ABS data used	Scale
Exposure	Potential displaced GVP flow to town per person within a nominated geography	Town and SLA
Sensitivity	Proportion of total labour force employed in the consolidated commercial fishing industry (excluding onshore aquaculture), based on ABS data from the 2006 Census of Population and Housing	SLA
Adaptive capacity	ABS Socio-economic Indexes For Areas. Index of Relative Socio-economic Disadvantage – Australia decile ranking, ABS 2006	SLA
	Economic Diversity Index. Diversity of local economy relative to the Australian economy, calculated using employment by sector data from the ABS 2006 Census of Population and Housing	SLA
	ABS Accessibility/Remoteness Index for Area, ABS 2001	n.a.
	Median household income, ABS 2006	SLA

ABS = Australian Bureau of Statistics; GVP = gross value of production; n.a. = not available; SLA = statistical local area

## Calculation of community vulnerability index

A key consideration in developing a composite index is the relative weight of each component or indicator that contributes to the index (Herreria et al. 2008). For this study, neutral weightings of 1.0 were used and each of the indicator values were standardised to a value between 0 and 1 based on the distribution of scores for all SLAs of interest in the marine bioregion.

- The exposure sub-index is a calculated score based on the GVP displacement divided by the number of persons residing within the nominated geography, which was then standardised.
- The sensitivity sub-index has only one indicator (see Table 27), which was standardised based on the distribution of values for the SLAs of interest in the North Marine Region.

- The potential impact ( $PI = E \times S$ ) is a sub-index made up of standardised exposure multiplied by standardised sensitivity scores for each SLA of interest in the North Marine Region. This sub-index score was then standardised.
- The adaptive capacity sub-index was calculated as the sum of the standardised values for the indicators listed in Table 27.
- The vulnerability index ( $V = PI - A$ ) was calculated by subtracting the standardised value of the adaptive capacity sub-index from the standardised potential impact sub-index.
- The resulting index of community vulnerability provides a distribution of ranked scores between 0 and 1, where an index score of 1 indicates the highest rank of vulnerability and an index score of 0 indicates the lowest rank of vulnerability.
- Data used in this study is derived from the Australian Bureau of Statistics (ABS) namely, the Census of Population and Housing 1996 and 2006; SEIFA and ARIA 2001. In addition to these datasets, an index of economic diversity was constructed from ABS data.

## Caveats and limitations

A number of general caveats and limitations are relevant to the interpretation of the town vulnerability assessment. These are summarised below:

- The vulnerability index is a relative unweighted ranked order measure. It indicates a community's ranked position within the set of communities examined in the given marine region. The indices generated should not be interpreted as absolute values. Hence, a score of 1.0 in the community vulnerability index does not mean that area is twice as vulnerable as an area with a score of 0.5, only that it is relatively more vulnerable.
- Relative community vulnerability is a summary indicator and, to understand the factors contributing to the composite index, it is necessary to look at the potential impact and adaptive capacity sub-indices and their contributing indicators.
- A community's degree of vulnerability and adaptive capacity has many dimensions; this complexity makes it difficult to reduce these concepts to a single numeric value that covers all factors influencing the concept. Inclusion of other indicators, such as the mobility of people between regions, can significantly change these relative rankings. Therefore, this type of assessment should include supplementary quantitative and qualitative data and research (such as the case studies in this report).
- The index is constructed using data from a range of sources at different units of measurement and scales, including GVP displacement estimates, employment data, SEIFA relative disadvantage, remoteness at a regional level, and census housing and population data at SLA level. Therefore, there are smoothing effects that will affect the rankings.
- Consideration must be given to how accurately a sub-index measures the concept. For example, the sensitivity measure is based on the proportion of people employed in the commercial fishing industry in a given community. This measure includes all people in the fishing industry and does not differentiate between those in fisheries that are impacted and those that are not. Therefore, it may result in an overestimation of the sensitivity of a community to the impact.
- Aggregated data at the SLA unit of geography is applied across all towns in that SLA. This will influence some dimensions of the index and in some cases decrease the overall index

ranking. Therefore, the impact on small towns that sit within SLAs needs to be considered within this context.

Data used in this study is derived from the ABS, namely, the Census of Population and Housing 1996 and 2006; SEIFA and ARIA 2001. In addition to these datasets, an index of economic diversity was constructed from ABS data.

## Other index definitions

### SEIFA: relative disadvantage

The study applies the ABS SEIFA Index of Relative Socio-economic Disadvantage—Australia decile rank. The SEIFA index of relative disadvantage is considered useful in profiling communities and can be applied to indicate a community's lack of resilience and ability to adapt to change. The SEIFA Index of Relative Disadvantage score used in the analysis is a comparative decile ranking that indicates an SLA's rank in comparison with all other SLAs within Australia. High scores on the index indicate a *lack of disadvantage* while low scores indicate higher *levels of disadvantage*. Scores that occur at either end of the distribution are of most interest because those around the middle (i.e. around 5) are neither particularly disadvantaged nor lacking disadvantage relative to other areas.

### ARIA: Accessibility/Remoteness Index of Australia

The ABS defines the underlying concept of remoteness in the ARIA as 'the measure of the physical road distance between where people reside and where those people travel to in order to obtain goods and services, and to enjoy opportunities for social interaction'. The ABS Remoteness Structure defines the level of remoteness, with values ranging from 0 to 5:

- 0—Major cities of Australia
- 1—Inner regional Australia
- 2—Outer regional Australia
- 3—Remote Australia
- 4—Very remote Australia
- 5—Migratory.

### EDI: Economic Diversity Index

The Economic Diversity Index (EDI) compares the proportion of the workforce employed at the SLA geography in the 19 industry sectors identified by the ABS Australian and New Zealand Standard Industrial Classification (ANZSIC) (2006) with those in the entire Australian workforce. The closer an EDI score for a SLA is to 1.0, the more it represents the distribution of employment across industries for Australia, and thus its economy is considered to be more diverse. Conversely, an EDI closer to zero suggests less diversity compared with that of Australia.

## E: Profile of survey respondents

This appendix provides background and profile information on the survey respondents.

### Fisheries

Table 28 lists the licences held by survey respondents. Note that respondents may hold licences in multiple fisheries.

**Table 28 Licences held by survey respondents in 2010–11**

<b>Fishery</b>	<b>Percentage of respondents with a licence</b>
<b>Commonwealth</b>	
Northern Prawn	73.5
Western Tuna and Billfish	3.8
<b>Northern Territory</b>	
Aquarium	1.9
Coastal Line	15.1
Demersal	5.7
Finfish Trawl	1.9
Mud Crab	1.9
Offshore Net	5.7
Offshore line	5.7
Spanish Mackerel	11.3
Timor Reef	1.9
Developmental fishery permit	3.8
<b>Queensland</b>	
Blue Swimmer Crab	1.9
Gulf of Carpentaria Developmental Fin Fish Trawl	3.8
Gulf of Carpentaria Inshore Fin Fish (N3)	32.1
Gulf of Carpentaria Inshore Finfish (N9)	3.8
Gulf of Carpentaria Line	17.0
Mud Crab	17.0
Spanner Crab	0.0
Tropical Rock Lobster	1.9
QFJA Developmental Net Fisheries	0.0

QFJA = Queensland Fisheries Joint Authority

Data source: ABARES, *Your marine areas matter: a survey of commercial fishers' values and preferences for Commonwealth marine reserves in the North and North-west Marine Regions of Australia*

## Fishing methods

The most common methods of fishing used by survey respondents were trolling, gillnet (pelagic and bottom set) and handlining (see Table 29 Fishing methods, 2010–11).

**Table 29 Fishing methods, 2010–11**

<b>Method</b>	<b>Percentage of respondents</b>
Bottom trawl	17.0
Trawl (other)	13.2
Finfish trawl	1.9
Gillnet (bottom set)	22.6
Pelagic gillnet	22.6
Longline (bottom set)	5.7
Finfish longline	3.8
Pelagic longline	5.7
Troll	28.3
Handline	22.6
Squid jig	3.8
Purse seine	1.9
Fish trap	9.4
Lobster pot	0.0
Crab traps	18.9
Hand collection	3.8
Drop line	9.4

Data source: ABARES, *Your marine areas matter: a survey of commercial fishers' values and preferences for Commonwealth marine reserves in the North and North-west Marine Regions of Australia*

## Fishing history

- Just over 60 per cent of survey respondents have been working in the fishing industry for more than 30 years.
- Nearly 60 per cent of fishing businesses have been operating for more than 25 years.
- The majority of survey respondents are first or second generation fishers.

**Table 30 Fishing history**

	<b>Years worked in commercial fishing</b>	<b>Years fishing business has been operating</b>	<b>Generations having worked in commercial fishing</b>
Mean	31.2	26.4	2.0
Median	34.0	29.0	2.0
Minimum	1.0	1.0	1.0
Maximum	50	50.0	5.0

Data source: ABARES, *Your marine areas matter: a survey of commercial fishers' values and preferences for Commonwealth marine reserves in the North and North-west Marine Regions of Australia*

## Respondents role in business

The majority of survey respondents were owner–operators.

**Table 31 Respondents role in fishing business**

	<b>Percentage of respondents</b>
Owner–operator	84.9
Non-fishing owner	11.3
Employee skipper	1.9
Nominated fisher	1.9
Business manager	26.4

Data source: ABARES, *Your marine areas matter: a survey of commercial fishers' values and preferences for Commonwealth marine reserves in the North and North-west Marine Regions of Australia*

## Fishing business structure

**Table 32 Fishing business structure**

<b>Structure</b>	<b>Percentage of respondents</b>
Sole trader	23.1
Family partnership	34.6
Incorporated company	42.3

Data source: ABARES, *Your marine areas matter: a survey of commercial fishers' values and preferences for Commonwealth marine reserves in the North and North-west Marine Regions of Australia*

## Business activities

All respondents undertook fishing activities at the time of the survey. Half (56.6 per cent) of the survey respondents were integrated businesses undertaking processing activities, while 45.3 per cent were undertaking wholesaling activities. An important finding is that 24.5 per cent of respondents lease licences to other fishers. As noted in the methods section, these fishers are difficult to access and have not participated in this assessment process. This could lead to an underestimation of the number of fishers impacted.

**Table 33 Fishing business activities**

<b>Activity</b>	<b>Percentage of respondents</b>
Fishing	100.0
Processing	56.6
Wholesale/distribution	45.3
Retail	17.0
Export	24.5
Input supply	5.7
Leasing licences	24.5

Data source: ABARES, *Your marine areas matter: a survey of commercial fishers' values and preferences for Commonwealth marine reserves in the North and North-west Marine Regions of Australia*

## Fishing business employees

The majority of survey respondents employed people on a full-time paid, casual paid, full-time seasonal paid and seasonal casual paid basis.

**Table 34 Fishing business employees**

<b>Employment type</b>	<b>Mean</b>	<b>Minimum</b>	<b>Maximum</b>
Full-time paid	6.28	0	73
Full-time unpaid	0.32	0	4
Part-time paid	1.55	0	14
Part-time unpaid	0.11	0	2
Casual paid	9.38	0	230
Casual unpaid	0.02	0	1
Seasonal full-time paid	6.26	0	90
Seasonal full-time unpaid	0.08	0	3
Seasonal part-time paid	0.45	0	16
Seasonal part-time unpaid	0.09	0	5
Seasonal casual paid	5.70	0	150
Seasonal casual unpaid	0.28	0	10

Data source: ABARES, *Your marine areas matter: a survey of commercial fishers' values and preferences for Commonwealth marine reserves in the North and North-west Marine Regions of Australia*

## Value of total landed catch

Half (51.1 per cent) of the survey respondents landed catch for 2010–11 was valued at or below \$400 000

**Table 35 Value of total landed catch, 2010–11**

	<b>Percentage of respondents</b>
Less than \$50 000	14.9
\$50 001–100 000	10.6
\$100 001–250 000	21.3
\$250 001–400 000	4.3
\$500 001–1 million	8.5
\$1–2.5 million	19.1
\$2.5 million–5 million	6.4
\$5–10 million	8.5
\$10–15 million	2.1
greater than \$15 million	4.3

Data source: ABARES, *Your marine areas matter: a survey of commercial fishers' values and preferences for Commonwealth marine reserves in the North and North-west Marine Regions of Australia*

## Fishing income dependency

- 74 per cent of survey respondents indicated that 100 per cent of their personal income comes from fishing-related employment.
- 64.0 per cent of survey respondents indicated that 100 per cent of their household income came from fishing-related employment.
- The majority (66.7 per cent) of survey respondents did not receive income from any other source apart from the fishing business.
- The majority (75 per cent) of respondents have less than 4 dependents that they are financially responsible for.
- The majority (69.8 per cent) of survey respondents planned to hand their fishing business on to their children.

## Age

- The median age of survey respondents was 45 years.

**Table 36 Age of respondents**

	<b>Years</b>
Mean	53
Median	54
Minimum	26
Maximum	76

Data source: ABARES, *Your marine areas matter: a survey of commercial fishers' values and preferences for Commonwealth marine reserves in the North and North-west Marine Regions of Australia*

## F: Summary information on flow of impacts, supply chains and demographics of communities.

Table 37 summarises a range of information useful in assessing potential impacts of the draft North Commonwealth Marine Reserves Network to towns and areas. The following information is provided:

<i>Accessibility/Remoteness Index of Australia</i>	An index that measures the physical road distance between where people reside and where those people travel to in order to obtain goods and services, and to enjoy opportunities for social interaction. Values range from 0 to 5, high scores indicate more remote. Source: ABS census 2006.
<i>Community vulnerability index</i>	An index that combines potential impact and social data to provide a guide to compare community vulnerability. Scores range between 0 and 1, where a score of 1 indicates the highest level of vulnerability. Community vulnerability was analysed only for towns with GVP displacement. Source: This study.
<i>Economic diversity index</i>	An index that compares the proportion of the workforce employed in 19 industry sectors with those in the entire Australian workforce. The closer a score is to 1.0, the more it represents the distribution of employment across industries for Australia (more diverse). Source: ABS census 2006.
<i>Fishing industry employment (percentage of total employment)</i>	Employment in the consolidated fishing industry (catching, processing and wholesale) as a percentage of total employment for the statistical local area. Employment in onshore aquaculture activities was excluded. Source: ABS census 2006.
<i>GVP displaced (\$'000 max)</i>	Estimate of the potentially displaced catch that flows to this location (if this was a range then the upper bound is reported here). Source: logbook data.
<i>Home port</i>	Number of survey respondents that identified this location as home port. Source: survey
<i>Median household income (\$ per week)</i>	Source: ABS census 2006
<i>Number of potentially impacted input businesses</i>	Number of potentially impacted input businesses at this location. Source: survey.
<i>Number of potentially impacted output businesses</i>	Number of potentially impacted output businesses at this location. Source: survey
<i>Population</i>	Number of persons. Source: ABS census 2006.

North Marine Region social and economic assessment–ABARES

*Seafood processors*

Number of registered seafood processors at this location.  
Source: State government registers.

*SEIFA index of relative disadvantage*

An index that is useful in profiling a community's resilience and ability to adapt to change. High scores indicate a lack of disadvantage. Source: ABS census 2006

North Marine Region social and economic assessment–ABARES

Table 37 Summary of flow of impacts, supply chain, demographics and vulnerability–draft North Commonwealth Marine Reserves Network

Data source		Logbook	Survey			State	ABARES	Census					
Town	Population geography	GVP displaced (\$'000 max)	Home port	Number of potentially impacted input businesses	Number of potentially impacted output businesses	Seafood processors*	Vulnerability index	Fishing industry employment (% of total employment)	SEIFA index of relative disadvantage	Economic diversity index	ARIA remoteness index	Median household income (\$/week)	Population
Albany	Albany (C) - Central					9		0.26	3	0.97	2	728	15 977
Atherton	Atherton (S)			1	1			0.09	4	0.79	2	762	10 912
Augusta	Augusta-Margaret River (S)			2		1		0.33	7	0.73	2	922	1 072
Borroloola	Borroloola (CGC)			2	1			1.42	1	0.24	4	1012	775
Bowen	Bowen (S)			2				0.76	2	0.40	2	826	12 381
Bundaberg	Bundaberg (C)							0.29	2	0.96	1	676	45 806
Carnarvon	Carnarvon (S)					6		4.23	2	0.53	3	858	5 284
Dampier	Roebourne (S)			1	1	3		0.11	7	0.19	3	2010	16 421
Edmonton	Cairns (C) - Trinity			1				0.36	5	0.95	2	1074	33 847
Exmouth	Exmouth (S)					1		6.24	6	0.82	4	1059	2 064
Geraldton	Geraldton (C)			3		10		2.17	2	0.91	2	783	18 915
Georgetown	Etheridge (S)			1				0.00	5	0.13	4	642	850
Gove Harbour/ Nhulunbuy	East Arnhem - Bal	27.3	2	1			0.50	0.00	1	0.22	4	1070	6 523
Hervey Bay	Hervey Bay (C) - Pt A		2	3	2			0.60	3	0.89	1	655	48 155
Humpty Doo	Litchfield (S) - Pt B			2				0.68	7	0.84	2	1313	14 321
Innisfail	Johnstone (S)							0.45	3	0.72	2	817	18 251
Ingham	Hinchinbrook (S)			1				0.24	3	0.51	2	750	11 559
Inverleigh	Golden Plains (S) - South-East							0.16	8	0.78	1	1083	9 014
Karumba	Karumba (UC/L)	1647.0	28	19	4		1.00	1.33	1	0.30	4	949	519
Normanton	Carpentaria (S)			3	1			1.33	1	0.30	4	949	1 939
Kunda Park	Maroochy (S) - Buderim			1				0.28	9	0.94	0	1039	39 910
Kurrimine Beach	Johnstone (S)		1	1				0.45	3	0.72	2	817	18 251
Mackay	Mackay (C) - Pt A			1				0.10	6	0.71	1	1144	72 847
Mareeba	Mareeba (S)			2				0.32	2	0.63	2	743	18 209
Mooloolaba	Maroochy (S) - Mooloolabah							0.43	6	0.85	0	941	10 243
Rockhampton	Rockhampton (C)			1				0.03	3	0.93	1	914	58 749
Weipa	Weipa (T)	51.2	2	7	3		0.50	0.00	8	0.45	4	1857	2 833
Winnellie	Winnellie				1			1.68	3	0.79	2	878	304
Yeppoon	Livingstone (S) - Pt B				1			0.00	9	0.81	1	1452	3 905

North Marine Region social and economic assessment–ABARES

Data source	Logbook	Survey			State	ABARES	Census							
		GVP displaced (\$'000 max)	Home port	Number of potentially impacted input businesses			Number of potentially impacted output businesses	Seafood processors*	Vulnerability index	Fishing industry employment (% of total employment)	SEIFA index of relative disadvantage	Economic diversity index	ARIA remoteness index	Median household income (\$/week)
Town	Population geography													
Gold Coast	Gold Coast (statistical division)			1			0.11	7	0.87	0	1267	482 326		
Brisbane	Brisbane (statistical division)			10	1		0.13	7	0.91	0	1256	1 763 124		
Townsville	Northern Bal (statistical division)		1	13			0.08	4	0.53	2	1289	53 344		
Cairns	Cairns City Part A (statistical subdivision)	1818.0	18	64	10	0.50	0.39	6	0.88	2	1284	122 732		
Darwin	Darwin City (statistical subdivision)	672.0	38	63	15	0.50	0.47	6	0.72	2	1277	66 289		
Hobart	Greater Hobart (statistical subdivision)			1			0.59	5	0.88	1	1266	200 516		
Perth	Central Metropolitan (statistical subdivision)		1	12			0.11	9	0.75	0	1259	124 949		
Adelaide	Adelaide (statistical division)			1		6	0.08	6	0.93	0	1272	1 105 846		
Sydney	Sydney (statistical division)			1			0.04	7	0.88	0	1279	4 119 169		

\* = only available for SA and WA; ARIA = Accessibility/Remoteness Index of Australia; C = city; CGC = Community Government Council; GVP = gross value of production; SEIFA =Socio-Economic Indexes For Area; S = shire; T = towns; UC/L = Urban Centre/Locality

Note: The 'traffic light' indicators for each measure follow the logic of green being a positive measure through to red being a negative measure. Indicators are based on a measures distribution within the group of localities. Australian Bureau of Statistics population statistics are available for a variety of geographies within the Australian Standard Geographical Classification (ASGC). To reflect the most appropriate representation of a community’s population, different geographies have been used to calculate the GVP displaced per capita. This assessment includes towns that do not have a GVP displacement and therefore do not have a vulnerability ranking; however, these towns were identified as locations of input and output business through the survey and therefore may potentially be impacted. The vulnerability index is calculated on the draft and final GVP scenarios for all impacted towns in the region. The global scaling approach enables comparison of ranked scores across the two GVP scenarios.

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# Supplementary report: final North Commonwealth Marine Reserves Network proposal

As part of the Marine Bioregional Planning process, the Australian Government, through the Australian Government Department of Sustainability, Environment, Water, Population and Communities (SEWPaC; the lead government agency) revised the proposal for the North Commonwealth Marine Reserves Network. These revisions arose from consideration of submissions received during the public consultation period and the Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES) social and economic assessment of the draft marine reserves.

This supplementary report provides, where possible, a comparative analysis of the changes to the potential social and economic impacts between the draft North Commonwealth Marine Reserves Network proposal released for public comment in August 2011 (SEWPaC 2011b) and the final North Commonwealth Marine Reserves Network proposal released 14 June 2012. ABARES was not able to undertake additional consultation (surveys or interviews) with commercial and charter fishing businesses for the supplementary assessment due to timing constraints.

## Overview

The final North Commonwealth Marine Reserves Network proposal (Map S1) would displace an estimated annual GVP of \$2.03–2.94 million (Table 1), representing 1.8–2.6 per cent of the collective GVP of potentially impacted fisheries. This comprises \$1.18–2.08 million (120–145 tonnes) from Commonwealth fisheries, \$0.37 million (112 tonnes) from Northern Territory fisheries, and \$0.49 million (73 tonnes) from Queensland fisheries.

The final proposed network represents a reduction from \$2.8–4.2 million (annual average GVP) under the draft network, to \$2.03–2.94 million under the final proposed network. Overall, the potential displacement from the final proposed network was 19–23 per cent less in terms of catch and 27–30 per cent less in terms of GVP than the draft network. This reduction in impact is largely due to a reduced impact on the N9 Fishery of the Queensland Gulf of Carpentaria Inshore Fin Fish Fishery (53 per cent reduction in impact) and on the Commonwealth Northern Prawn Fishery (28–32 per cent reduction in impact on GVP). These reductions were partially offset by small increases in the impact on four fisheries: the Northern Territory Finfish Trawl Fishery, the Queensland Gulf of Carpentaria Developmental Fin Fish Trawl Fishery, the Queensland Fisheries Joint Authority (QFJA) Line Fishery and the Queensland Gulf of Carpentaria Line Fishery (Table s1)

The potential impact on charter fishing would be less than 0.1 per cent (in client numbers) in the Northern Territory, and approximately 0.1 per cent (in client numbers) in Queensland. The potential impact of the final proposed network is smaller than the draft network for Northern Territory charter fishing, largely because of the change to the Marine National Park Zone in the Wessel marine reserve (Table S2 and Table S3). The impact on Queensland charter fishing is slightly greater because of the increased size of area 210 in the revised Gulf of Carpentaria marine reserve.

There are also cumulative impacts to the Northern Prawn Fishery from the draft North-west Marine Reserves Network (ABARES 2012c).

The same five towns identified as having catch displaced by the draft marine reserves network would also have catch displaced by the final proposed network. These towns are Cairns, Karumba, Darwin, Weipa and Gove. The impact has remained relatively small on Gove and has reduced for the other towns, particularly on Karumba (reduced by 36–39 per cent to \$0.65–1.05 million landed catch), Cairns (reduced by 22–31 per cent to \$0.76–1.25 million) and Darwin (reduced by 16–18 per cent to \$0.55–0.57 million) (Table S11).

Cumulative impacts may occur to towns identified in the North Marine Region from GVP displaced from other final proposed marine reserves networks. Darwin is also potentially impacted by the final proposed marine reserves network in the North-west Marine Region (ABARES 2012c), and Cairns is also potentially impacted by the final proposed Coral Sea marine reserve (ABARES 2012b).

Assuming the results of the economic modelling scale linearly with the magnitude of the impact, the final proposed marine reserves network is expected to result in a decline in regional economic activity of \$3.3–4.8 million in the short term and displace 9–14 jobs in directly affected regions. There are likely to be flow-on impacts on other regions; however, changes in economic activity and employment at the state (Queensland) and national levels are negligible in terms of those economies and job markets.

ABARES has not undertaken consultations (survey or interviews) with potentially displaced or impacted commercial fishing, charter or supply chain businesses, or individuals based on the final North Commonwealth Marine Reserves Network proposal. Although the potential business and personal impacts arising from the final proposed network cannot be assessed using data collected through the survey on the draft network, they are likely to be similar to those identified for the final proposed network.

The case studies for the draft North Commonwealth Marine Reserves Network have been re-examined under the final North Commonwealth Marine Reserves Network proposal. No further consultation with impacted fishers or interviewees was possible for this purpose. However, from the changes in displacement estimates, flow to ports and examination of the final proposed network, a discussion of likely changes in impacts is provided.

## Changes to the North Commonwealth Marine Reserves Network

The changes to the draft reserve network are summarised in Table S1 and mapped in Map S1. A key change to the zoning scheme between the draft and final proposed network was to allow set mesh net into Special Purpose Zones.

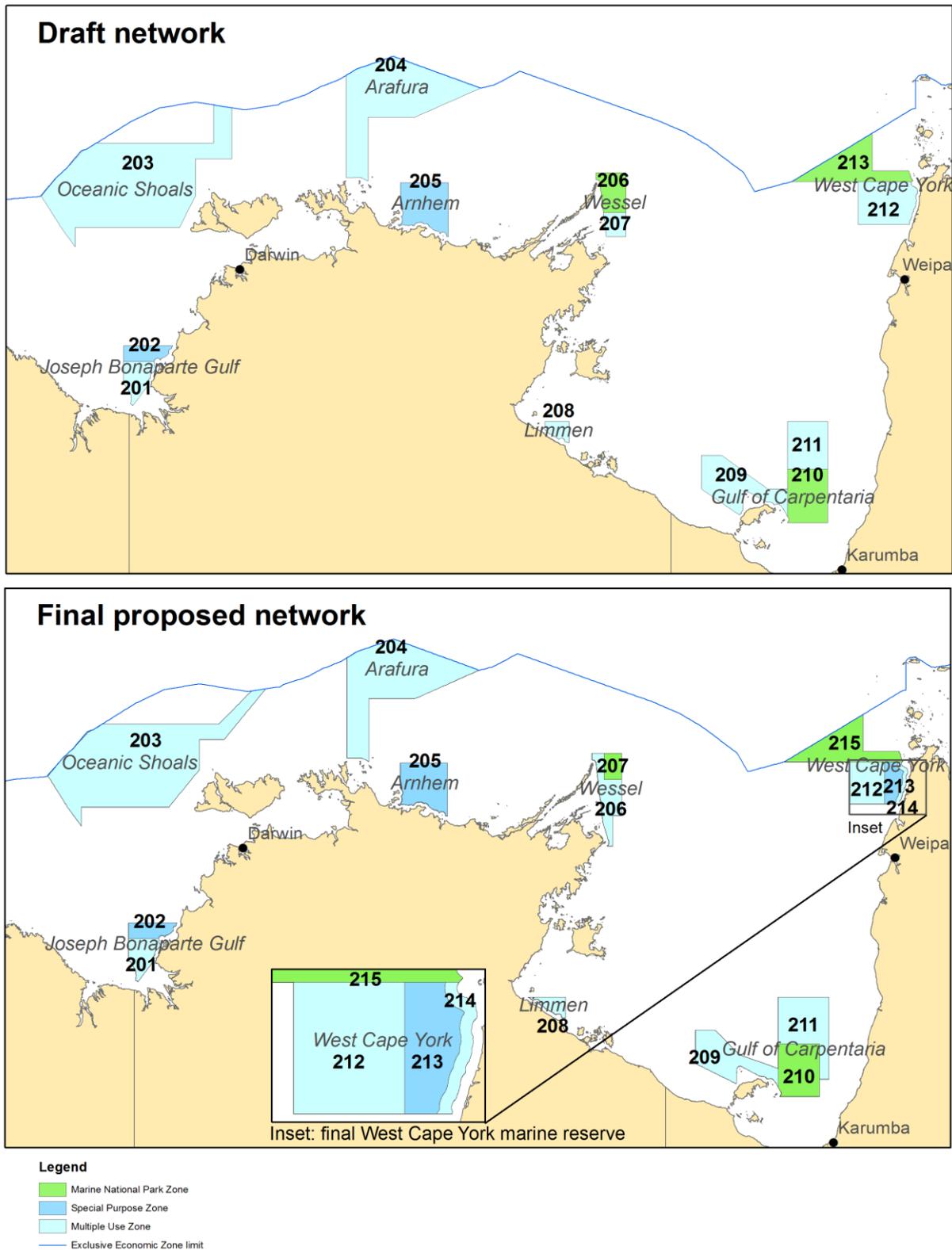
**Table S1 Differences between the draft and final proposed North Commonwealth Marine Reserves Network**

<b>Marine reserves (previous ABARES area number)</b>	<b>Change</b>
Joseph Bonaparte Gulf (Area 201 – 202)	<b>Area:</b> No change <b>Boundaries:</b> No change <b>Zoning:</b> No change
Oceanic Shoals (Area 203)	<b>Area:</b> 4% reduction in total area <b>Boundaries:</b> North-east corner moved to the north-east - South-east corner shifted north-west <b>Zoning:</b> No change
Arafura (Area 204)	<b>Area:</b> No change <b>Boundaries:</b> No change <b>Zoning:</b> No change
Arnhem (Area 205)	<b>Area:</b> No change <b>Boundaries:</b> No change <b>Zoning:</b> No change
Wessel (Area 206 – 207)	<b>Area:</b> 15% increase in total area <b>Boundaries:</b> Marine National Park zone (area 206) contracted to north-east - Multiple Use Zone (area 207) southern boundary extended south <b>Zoning:</b> No change
Limmen (Area 208)	<b>Area:</b> 12% increase in total area <b>Boundaries:</b> Western boundary shifted west <b>Zoning:</b> No change
Gulf of Carpentaria (Area 209 – 211)	<b>Area:</b> 9% increase in total area <b>Boundaries:</b> Northern boundary of area 209 contracted to the south - South-western boundary of area 209 contracted to the north-east - Western boundary of areas 210 and 211 extended to the west - Part of Eastern boundary of areas 210 and 211 extended to the east <b>Zoning:</b> No change
West Cape York (Area 212 – 213)	<b>Area:</b> No change <b>Boundaries:</b> Area 212 split with the creation of a Special Purpose Zone on the eastern side <b>Zoning:</b> Introduction of a Special Purpose Zone within Area 212 - Change to the zoning scheme to allow set mesh net to be used in Special Purpose Zones

Note: ABARES area numbers refer to the draft and final proposed North Commonwealth Marine Reserves Network (Map S1).

Data source: Australian Government Department of Sustainability, Environment, Water, Population and Communities

Map S1 North Marine Region draft (released August 2011) and final proposed (released 14 June 2012) marine reserves networks with zones and area numbering



Data sources: Marine reserve boundaries from Australian Government Department of Sustainability, Environment, Water, Population and Communities; coastline and bathymetry from Geoscience Australia

## Potential displacement of fishing

### Commercial fishing

It is estimated that the final North Commonwealth Marine Reserves Network proposal would displace an annual average of 305–330 tonnes of catch and \$2.03–2.94 million GVP across all fisheries operating in the North Marine Region (Table S1). This represents 1.8–2.6 per cent of the collective GVP of potentially impacted fisheries in the region. The displacement is predominantly from the Commonwealth Northern Prawn Fishery (120–145 t, \$1.18–2.08 million or 1.4–2.4 per cent of the fishery GVP), the Northern Territory Offshore Net and Line Fishery (longline method, data confidential) and the N9 Fishery of the Queensland Gulf of Carpentaria Inshore Fin Fish Fishery (data confidential). These were also the main potentially impacted fisheries under the draft network; however, in all three fisheries the revisions have reduced the potential displacement. The largest absolute displacement was estimated to be from the draft Gulf of Carpentaria marine reserve (predominantly from the Commonwealth Northern Prawn Fishery).

Total catch and GVP potentially displaced by the final proposed network are less than the draft network (Table S1) and equate to a reduction from the draft network of 73–98 tonnes of catch and \$0.77–1.3 million annual average GVP (27.3–30.3 per cent reduction in potentially displaced GVP). This is largely due to reduced impacts on the Commonwealth Northern Prawn Fishery (28–32 per cent reduction to \$1.18–2.08 million) and the N9 Fishery of the Queensland Gulf of Carpentaria Inshore Fin Fish Fishery (53 per cent reduction; data confidential). Other fisheries that would have less GVP displaced are the Northern Territory Spanish Mackerel and Offshore Net and Line (drifting gillnet and longline methods) fisheries, and the N3 sector of the Queensland Gulf of Carpentaria Inshore Fin Fish Fishery.

The largest proportional reductions in impact were to the Northern Territory Spanish Mackerel Fishery (73.0 per cent reduction between the draft and final proposed networks), Queensland N9 Fishery (53.4 per cent reduction), and the Northern Territory Offshore Net and Line Fishery (drifting gillnet; 26.7 per cent reduction) (Table S1).

The impact on the N9 Fishery is thought to be on one operator. Although the final proposed marine reserves network would reduce the impact on this operator, their fishing patterns have changed in recent years and the final proposed network would still preclude activity from a cell that appears to be increasingly used through the reference period. This impact is somewhat masked by the long reference period used.

There were four fisheries where the potential impacts would increase under the final proposed network: the Northern Territory Finfish Trawl, Queensland Gulf of Carpentaria Developmental Fin Fish Trawl, Queensland Fisheries Joint Authority Line and Queensland Gulf of Carpentaria Line fisheries. The displaced GVP for the Northern Territory Finfish Trawl and Queensland Gulf of Carpentaria Developmental Fin Fish Trawl are the second largest displacements for both the Queensland and Northern Territory fisheries (Table S8 to Table S10). There are likely to be cumulative impacts on operators who fish in both of these fisheries.

### Links to other marine regions–fisheries

There may be minor cumulative impacts to the Commonwealth Northern Prawn Fishery by the draft North-west Commonwealth Marine Reserves Network (3.2 t; \$32 500 annual average GVP [ABARES 2012c]). This is relatively small in comparison with estimated displacement from the final North Commonwealth Marine Reserves Network proposal.

Table S1 Comparison of estimates of catch and gross value of production (GVP) potentially displaced by the draft (August 2011) and final proposed (14 June 2012) marine reserves networks in the North Marine Region

<i>Fishery</i>	<b>Total catch displaced (tonnes)</b>		<b>Total GVP displaced (\$'000)</b>			
	<i>Draft network</i>	<i>Final proposed network</i>	<i>Draft network</i>	<i>Final proposed network</i>	<i>Absolute change</i>	<i>Percentage change</i>
<b>Commonwealth</b>						
Northern Prawn Fishery	159.3 to 208.7	119.9 to 144.7	1645.4 to 3061.5	1176.6 to 2081.4	-468.79 to -980.1	-28.5 to -32.0
<i>Commonwealth total</i>	<i>159.3 to 208.7</i>	<i>119.9 to 144.7</i>	<i>1645.4 to 3061.5</i>	<i>1176.6 to 2081.4</i>	<i>-468.79 to -980.1</i>	<i>-28.5 to -32.0</i>
<b>Northern Territory</b>						
A16 Finfish Trawl	*	*	*	*	*	0.2
A4 Spanish Mackerel Fishery	*	*	*	*	*	-73.0
A5 Offshore Net and Line Fishery (drifting gillnet)	*	*	*	*	*	-26.7
A5 Offshore Net and Line Fishery (longline)	*	*	*	*	*	-1.0
<i>Northern Territory total</i>	<i>116.7</i>	<i>112.0</i>	<i>385.2</i>	<i>370.25</i>	<i>-14.91</i>	<i>-3.9</i>
<b>Queensland</b>						
GoC Developmental Finfish Trawl	12.2	12.4	72.1	73.5	1.33	1.8
Line (QFJA)	17.8	20.9	59.8	70.5	10.70	17.9
Line (L4)	4.9*	5.4*	37.9*	42.4*	4.5*	11.9*
Net (N3)	2.8*	2.6*	13.9*	12.7*	-1.2*	-8.6*
Net (N9 and QFJA)	*	*	*	*	*	-53.4
<i>Queensland total</i>	<i>102.4</i>	<i>73.0</i>	<i>768.3</i>	<i>486.6</i>	<i>-281.71</i>	<i>-36.7</i>
<b>Grand total</b>	<b>378 to 428</b>	<b>305 to 330</b>	<b>2799 to 4215</b>	<b>2033 to 2938</b>	<b>-765.41 to -1276.72</b>	<b>-27.3 to -30.3</b>

GoC = Gulf of Carpentaria; QFJA = Queensland Fisheries Joint Authority;

Note: Queensland N9 and QFJA net sectors were not separated in these analyses; however, the displacement is thought to be almost entirely from the N9 Fishery. Estimates are mean annual for the reference period. Confidential data are marked with an asterisk (\*). In some fisheries, only one area is confidential. In these cases, the total does not include the confidential value as it would be possible to back-calculate the displacement from that area. These are denoted by showing the sum of the non-confidential areas followed by an asterisk (e.g. 2.8\*).

## Charter fishing

The final proposed marine reserves network is expected to have a smaller impact on charter operations in the Northern Territory (Table S2) than the draft network. This is because of the change to the Marine National Park Zone in the draft Wessel marine reserve (Map S1). The final proposed marine reserves network proposal is expected to have a marginally larger impact on charter operations in Queensland (Table S3) because of the increased size of the marine national park in the draft Gulf of Carpentaria marine reserve.

**Table S2 Comparison of estimated potential Northern Territory charter fishing displacement between the draft and final proposed marine reserves networks in the North Marine Region**

Northern Territory	Draft network		Final proposed network		
	Estimate	Percentage displaced	Estimate	Percentage displaced	Percentage change
Number of fish caught	235.7	0.1	49.6	<0.1	-79
Number of clients	179.1	0.2	37.6	<0.1	-79

Note: Estimates are based on one degree reporting grids and therefore have low accuracy

**Table S3 Comparison of estimated potential Queensland charter fishing displacement between the draft and final proposed marine reserves networks in the North Marine Region**

Queensland	Draft network		Final proposed network		
	Estimate	Percentage displaced	Estimate	Percentage displaced	Percentage change
Days fished	1.7	0.1	1.8	0.1	7
Catch	41.4	0.1	49.0	0.1	18
Number of fishers	5.1	0.1	5.7	0.1	12

Note: Estimates are based on 6 and 30-minute reporting grids and therefore have medium accuracy

## Prospective fisheries

The assessment of the draft North Marine Reserves Network noted impacts on prospective fishing through expansion of fishery catch and area, development of new fisheries and redevelopment of fisheries. Although the specific examples may change with the final network proposal, given the recent growth of some fisheries in the North Marine Region it is expected that the final reserves network proposal would still impact on prospective fisheries.

## Flow of potential impacts to ports

The final North Marine Reserves network proposal will potentially impact five ports or towns through flow of displaced GVP: Cairns, Karumba, Darwin, Weipa and Gove (in descending order; Table S4)

With the exception of Gove, there was a reduction in potentially displaced GVP to each of the identified ports under the final proposed network (Table S4). The largest changes were to Karumba and Cairns, with the impact reduced by up to 39 per cent and 31 per cent, respectively. These reductions stem from a reduced potential impact to the Commonwealth Northern Prawn Fishery, which lands large amounts of catch in both Karumba and Cairns, and the Queensland N9 Fishery, which primarily lands catch in Karumba.

**Table S4 Comparison of estimates of flow of potentially displaced GVP by the draft and final proposed Commonwealth North Marine Reserves Networks**

Port	Potentially displaced GVP (\$'000)		
	Draft	Final proposed	Absolute change
Cairns	969–1818	756–1249	-213 to -569
Darwin	672–671	551–565	-121 to -106
Gove	27	27	0
Karumba	1080–1647	653–1050	-426 to -597
Weipa	51	46	-5
<b>Total</b>	<b>2799–4215</b>	<b>2033–2938</b>	<b>-765 to -1277</b>

## Town and local area summary

Table S5 presents community exposure, sensitivity and adaptive capacity measures. There were three towns/cities with a potential flow of GVP impact greater than \$50 000 per year (in descending order, Cairns, Karumba and Darwin), and one location with GVP impact per capita greater than \$20 per capita (Karumba).

**Table S5 Community exposure, sensitivity and adaptive capacity–final proposed Commonwealth North Marine Reserves Network**

Town	Population geography	EXPOSURE			SENSITIVITY	ADAPTIVE CAPACITY			
		GVP displaced (\$'000 max)	Population (2006)	GVP displaced per capita (\$)	Fishing industry employment (% of total employment)	Economic diversity index	ARIA remoteness index	Median household income (\$ weekly)	SEIFA index of relative disadvantage
Cairns	Cairns City Part A (statistical subdivision)	1249.0	122 732	10.2	0.39	0.88	2	1284	6
Karumba	Carpentaria (S)	1050.0	519	2023.1	1.33	0.30	4	949	1
Darwin	Darwin City (statistical subdivision)	565.0	66 289	8.5	0.47	0.72	2	1277	6
Weipa	Weipa (T)	46.2	2 833	16.3	0.00	0.45	4	1857	8
Gove Harbour/Nhulunbuy	East Arnhem - Bal	27.4	6 523	4.2	0.00	0.22	4	1070	1

ARIA = Accessibility/Remoteness Index of Australia; GVP = gross value of production; S = Shire; SEIFA = Socio-Economic Indexes For Areas; T = Town.

Note: The 'traffic light' indicators for each measure follow the logic of green being a positive measure through to red being a negative measure. Indicators are based on a measures distribution within the group of localities. Australian Bureau of Statistics population statistics are available for a variety of geographies within the Australian Standard Geographical Classification (ASGC). To reflect the most appropriate representation of a community's population, different geographies have been used to calculate the GVP displaced per capita.

## Karumba

There was an absolute decrease of \$596 879 in potentially displaced GVP flowing into Karumba under the final proposed reserves network. The exposure indicator of potential GVP displacement per capita is \$2023.10, which is the highest of the landing ports in the region. Community sensitivity and adaptive capacity measures show that the statistical local area (SLA) of Carpentaria, in which Karumba is located, has relatively high levels of employment in the consolidated fishing industry compared with other SLAs in the North Marine Region (1.3 per cent). It also has a relatively high level of socioeconomic disadvantage (Socio-Economic Indexes For Areas [SEIFA] decile ranking of 1), a low level of economic diversity (0.30) and a lower median household income (\$949.30 per week compared with the Australian median household

income of \$1026.80/week). The SLA of Carpentaria is in a very remote area (Accessibility/Remoteness Index of Australia [ARIA] score of 4) and is relatively sparsely populated (population for the SLA in 2006 was 1939 usual residents). This assessment indicates that Karumba is still likely to experience a high impact due to displaced GVP from the declaration of the final North Commonwealth Marine Reserves Network proposal and has a relatively low capacity to adapt.

### **Cairns and Darwin**

Under the final proposed marine reserves network there has been an absolute decrease of \$568 895 in potential displaced GVP flowing into Cairns and an absolute decrease of \$106 065 in potentially displaced GVP flowing into Darwin. Cairns has the largest absolute GVP displacement from the final North Commonwealth Marine Reserves Network proposal (\$1 249 000 million annual average GVP). Furthermore, a substantial number of fishing industry supply chain businesses are located in Cairns and Darwin. Cairns and Darwin are potentially subject to cumulative impacts from draft marine reserves in neighbouring marine regions. Darwin is potentially impacted by the draft North-west Commonwealth Marine Reserves Network (\$204 950 potentially displaced GVP by the final proposed reserves network [ABARES 2012c]). Cairns is also potentially impacted by the final proposed Coral Sea Commonwealth marine reserve (\$2.37 million potentially displaced by the final proposed reserve [ABARES 2012b]).

The flow-on impacts to Cairns and Darwin from the final North Commonwealth Marine Reserves Network proposal are expected to be lower than for Karumba due to:

- lower levels of exposure to the draft marine reserves network (lower GVP displacement per capita)
- lower levels of sensitivity (lower percentage of employment in the consolidated fishing industry)
- larger populations
- higher levels of economic diversity
- lower level of remoteness.

### **Links to other marine regions–towns and local areas**

Links to other marine regions may induce cumulative impacts to towns that receive catch that would be displaced by the draft North Commonwealth Marine Reserves Network from displaced flow of GVP from other draft marine reserves networks. This is likely to include Cairns, which receives catch from the Coral Sea marine region (ABARES 2012b), and Darwin, which receives catch from the North-west marine region (ABARES 2012c).

## Economic impact and employment

No new economic modelling was undertaken for the final proposed network. However, it is reasonable to expect aggregate economic and employment impacts to scale linearly with the magnitude of the impact. Under this assumption, it was estimated that the final proposed network would have a net regional economic impact of \$3.3–4.8 million in the short term and would result in the loss of 9–14 jobs (Table S6) in directly affected regions. There are likely to be flow-on impacts in other regions; however, changes in economic activity and employment at the state and national level are negligible in terms of those economies and job markets.

**Table S6 Comparison of the short-term net economic impact and job losses between the draft and final proposed marine reserves networks in the North Marine Region**

	<b>Draft network</b>	<b>Final proposed network</b>
Net regional economic impact (\$ million)	-4.6 to -6.9	-3.3 to -4.8
Regional job loss (full-time equivalent)	-13 to -20	-9 to -14

## Fishing business impacts

ABARES has not undertaken further consultation with potentially displaced or impacted businesses based on the final North Commonwealth Marine Reserves Network proposal. Survey and interview data collected previously were specific to the draft network, and are not necessarily applicable to the final proposed network.

The nature of the potential impacts and broader issues exacerbating impacts identified in the assessment of the draft network are likely to be analogous to those for the final proposed network. Impacts that could be applicable to fishing businesses under the final proposed network include:

- direct displacement impacts on fishing businesses—loss of access, reduction in scale of operation, loss of income, devaluation of licences and capital
- secondary impacts resulting from having to change current fishing activities—potential increased pressure on fish stocks and non-target species outside the draft marine reserves, increased travel time to fishing grounds, increased fuel costs, increased conflict with other fishers, increased time spent looking for new fishing grounds, increased safety issues from fishing in adverse weather conditions, and devaluing of licences, quota and capital resulting from increased uncertainty
- industry-wide impacts on future development of fishing in the North Marine Region—increased business risk; reduced access to finance; devalued licences, quota and capital; reduced investment in future development plans
- broader issues that exacerbate potential impacts—competition from imported fish, prices received for product, exchange rates, input costs, difficulty in accessing labour, changes to fisheries management, and potential creation of state and territory marine parks.

## Personal impacts

ABARES has not undertaken further consultation with potentially displaced or impacted businesses based on the final North Commonwealth Marine Reserves Network proposal. Survey

and interview data collected previously were specific to the draft network, and are not necessarily applicable to the final proposed network.

The personal impacts on people in fishing and other related businesses identified in the assessment of the draft network are likely to be analogous to those for the final proposed network. Personal impacts that could be applicable to individuals under the final proposed network include:

- loss of current income source
- loss of future income source, including superannuation
- increased personal and family stress
- increased work hours
- decreased personal time and quality of life
- decreased time spent with family.

## Case studies

Six case studies were presented in the main report. The likely changes to circumstances identified in the case studies are discussed here, noting that no further consultation occurred following the final proposed network.

### **Impact on a vertically integrated fishing business—Wren Fishing:**

The impact on the Queensland N9 Fishery has been substantially reduced (53 per cent reduction in impact on catch and GVP) by the final proposed marine reserves network, and is expected to reduce the impact on Wren Fishing. As noted above, however, the operator has recently changed the areas they fish with a substantial increase in activity in one reporting cell. The operator was excluded from the cell by the draft network and the final proposed network still excludes activity in a large part of the cell. It is unclear what impact this would have on the operator; however, based on recent fishing trends, it is expected that the full impact is masked by the long reference period used in the analysis.

### **Impact on a community/town—Karumba:**

The potential impact on Karumba is expected to have moderated through the reduced impact on the Commonwealth Northern Prawn Fishery and the Queensland N9 Fishery. However, it is anticipated that Karumba will remain one of the most impacted towns under the final proposed reserves network because of the large amount of catch flowing to it and its low adaptive capacity.

### **Impact on a large fishery—Northern Prawn Fishery:**

The potential impact on the Commonwealth Northern Prawn Fishery has been reduced by the final proposed marine reserve network (28–32 per cent less in terms of potentially displaced GVP). However, the potential displaced GVP is still the highest of any single fishery in the region, representing 1.4–2.4 per cent of the total GVP for the fishery. Monitoring sites used for annual recruitment, spawning trawl surveys and trawl gear trials remain within the final proposed network.

### **Fishery development/prospectivity:**

The potential impact of the final proposed network on the current development of many

fisheries in the North Marine Region is thought to be reduced, but cannot be accurately determined without consulting fishers. The impact on potential future licence value in the Timor Reef Fishery is unlikely to change, because the areas covered by the final proposed and draft network are similar.

**North Marine Region supply chain impacts:**

In general terms, the final proposed reserve network would be expected to have less of an impact to supply chain businesses—notably for some supply chain businesses in Karumba because of the reduced impact to the Queensland N9 Fishery. It is difficult to provide further meaningful commentary without consulting the fishing industry.

**Economic modelling of Darwin and Karumba:**

Economic modelling was used to assess the potential impact of the draft marine reserves network on the Darwin and Carpentaria (encompassing Karumba) subregions. Assuming the impact on the economy and that employment scales linearly with the magnitude of the impact, the short-term regional net economic impact of the final proposed network was estimated to be \$3.3-4.8 million, with job losses of 9–14 full time equivalent positions. This is a 27–30 per cent reduction in estimated economic impact and job loss compared with the draft network, in line with the change in magnitude of the GVP impact.

## Summary tables for final North Commonwealth Marine Reserves Network proposal

Tables s7-s11 provide estimates of catch and GVP potential displacement for each reserve area, fishery and jurisdiction in the final North Marine Reserves Network proposal. No additional fisheries were found to be impacted by the final proposed marine reserves network. Table S11 provides updated summary information on flow of impact to communities and community demographic information.

**Table S7 Estimates of mean annual potential catch and gross value of production (GVP) displaced by the final proposed North Commonwealth Marine Reserves Network from Commonwealth fisheries over the 2001–10 reference period**

Catch (tonnes)	Joseph Bonaparte Gulf		Oceanic Shoals	Arafura	Arnhem	Wessel		Limmen	Gulf of Carpentaria			West Cape York				Total	Percentage of total fishery catch
Fishery	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215		
Northern Prawn Fishery - Demersal trawl	*	*	3.9	4.3	2.0	2.3	0.2	1.7	50-60	44-59	8-8	2.1	0.1	*	0.2	120-145	1.8-2.2%

GVP (\$,000)	Joseph Bonaparte Gulf		Oceanic Shoals	Arafura	Arnhem	Wessel		Limmen	Gulf of Carpentaria			West Cape York				Total	Percentage of total fishery GVP
Fishery	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215		
Northern Prawn Fishery - Demersal trawl	*	*	42.5	66.9	20.8	33.7	2.8	25.9	378-999	484-765	78-80	31	2	*	1.9	1,177-2,081	1.4-2.4%

Note: Catch and GVP estimates are mean annual for the reference period. Confidential data are marked with an asterisk (\*). For an explanation of the methodology used for the range of potential displacement, caveats and limitations of the data, refer to Appendix B: Fisheries data processing methods.



Table S8 Estimates of mean annual potential catch and gross value of production (GVP) displaced by the final proposed North Commonwealth Marine Reserves Network from Northern Territory fisheries within the period 2001–10

Catch (tonnes)		Joseph Bonaparte Gulf		Oceanic Shoals	Arafura	Arnhem	Wessel		Limmen	Total	Percentage of total fishery catch	Rank order
Fishery	Method	201	202	203	204	205	206	207	208			
A16 Finfish Trawl	Trawling				*	*	*	*		*	*	2
A4 Spanish Mackerel Fishery	Trolling							*		*	*	4
A5 Offshore Net and Line Fishery	Drifting gillnet	*		*	*		*	*	*	*	*	3
A5 Offshore Net and Line Fishery	Longline	*	*	*	*	*	*	*	*	*	*	1
<b>Total</b>		*	*	*	*	*	*	*	*	<b>112.0</b>		
Rank order		7	8	1	5	3	4	2	6			

GVP (\$,000)		Joseph Bonaparte Gulf		Oceanic Shoals	Arafura	Arnhem	Wessel		Limmen	Total	Percentage of total fishery GVP	Rank order
Fishery	Method	201	202	203	204	205	206	207	208			
A16 Finfish Trawl	Trawling				*	*	*	*		*	*	2
A4 Spanish Mackerel Fishery	Trolling							*		*	*	4
A5 Offshore Net and Line Fishery	Drifting gillnet	*		*	*		*	*	*	*	*	3
A5 Offshore Net and Line Fishery	Longline	*	*	*	*	*	*	*	*	*	*	1
<b>Total</b>		*	*	*	*	*	*	*	*	<b>370.3</b>		
Rank order		7	8	1	4	3	5	2	6			

Marine National Park Zone
Special Purpose Zone
Multiple Use Zone

Note: Catch and GVP estimates are mean annual for the reference period. Confidential data are marked with an asterisk (\*). For an explanation of the methodology used to estimate potential displacement, reference period used for individual fisheries, caveats and limitations of the data, refer to Appendix B: Fisheries data processing methods.

**Table S9 Estimates of mean annual potential catch and gross value of production (GVP) displaced by the final proposed North Commonwealth Marine Reserves Network from Queensland fisheries over the 2000–10 reference period**

<b>Catch (tonnes)</b>		Gulf of Carpentaria			West Cape York				<b>Total</b>	% of total sector
Fishing Type	Method	209	210	211	212	213	214	215		
GoC Developmental Finfish Trawl	Fish trawling	*		*	*	0.1		4.2	<b>12.4</b>	2.5%
Line (QFJA)	Longline/trotline/dropline	5.2	4.8	*	*	*		*	<b>20.9</b>	11.7%
Line (L4)	Line fishing		5.4					*	<b>5.4*</b>	2.6%*
Net (N3)	Set meshnet (gillnet)	0.2	<0.1				2.3	*	<b>2.6*</b>	0.2%*
Net (N9 and QFJA net)	Set meshnet (gillnet)	*	*	*	*		*	*	<b>*</b>	*
<b>Total</b>		<b>6.2</b>	<b>10.2*</b>	<b>*</b>	<b>*</b>	<b>0.1*</b>	<b>2.3*</b>	<b>12.4</b>	<b>73.0</b>	

<b>GVP (\$,000)</b>		Gulf of Carpentaria			West Cape York				<b>Total</b>	% of total sector
Fishing Type	Method	209	210	211	212	213	214	215		
GoC Developmental Finfish Trawl	Fish trawling	*		*	*	0.4		25.0	<b>73.5</b>	2.3%
Line (QFJA)	Longline/trotline/dropline	15.5	19.9	*	*	*		*	<b>70.5</b>	12.8%
Line (L4)	Line fishing		42.4					*	<b>42.4*</b>	2.9%*
Net (N3)	Set meshnet (gillnet)	1.0	<0.1				11.7	*	<b>12.7*</b>	0.2%*
Net (N9 & QFJA net)	Set meshnet (gillnet)	*	*	*	*		*	*	<b>*</b>	*
<b>Total</b>		<b>23.8</b>	<b>62.3*</b>	<b>*</b>	<b>*</b>	<b>0.4*</b>	<b>11.7*</b>	<b>97.4</b>	<b>486.6</b>	

Marine National Park Zone	Special Purpose Zone	Multiple Use Zone
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GoC = Gulf of Carpentaria; QFJA = Queensland Fisheries Joint Authority

Note: Catch and GVP estimates are mean annual for the reference period. Confidential data are marked with an asterisk (\*). In some fisheries, only one area is confidential. In these cases, the total does not include the confidential value because it would be possible to back-calculate the displacement from that area. These are denoted by showing the sum of the non-confidential areas followed by an asterisk (e.g. 2.8\*). For an explanation of the methodology used to estimate potential displacement, caveats and limitations of the data, refer to Appendix B: Fisheries data processing methods.

**Table S10 Estimates of mean annual potential gross value of production displaced by the final proposed North Commonwealth Marine Reserves Network from Queensland fisheries over the 2000–10 reference period**

GVP (\$,000)		Gulf of Carpentaria			West Cape York				Total	% of total sector
Fishing Type	Method	209	210	211	212	213	214	215		
GoC Developmental Finfish Trawl	Fish trawling	*		*	*	0.4		25.0	<b>73.5</b>	2.3%
Line (QFJA)	Longline/Trotline/Dropline	15.5	19.9	*	*	*		*	<b>70.5</b>	12.8%
Line (L4)	Line fishing		42.4					*	<b>42.4*</b>	2.9%*
Net (N3)	Set Meshnet (gillnet)	1.0	<0.1				11.7	*	<b>12.7*</b>	0.2%*
Net (N9 & QFJA net)	Set Meshnet (gillnet)	*	*	*	*		*	*	<b>*</b>	*
	<b>Total</b>	<b>23.8</b>	<b>62.3*</b>	<b>*</b>	<b>*</b>	<b>0.4*</b>	<b>11.7*</b>	<b>97.4</b>	<b>486.6</b>	

GoC = Gulf of Carpentaria; QFJA = Queensland Fisheries Joint Authority

Note: Estimates are mean annual for the reference period. Confidential data are marked with an asterisk (\*). In some fisheries, only one area is confidential. In these cases, the total does not include the confidential value because it would be possible to back-calculate the displacement from that area. These are denoted by showing the sum of the non-confidential areas followed by an asterisk (e.g. 2.8\*). For an explanation of the methodology used to estimate potential displacement, caveats and limitations of the data, refer to Appendix B: Fisheries data processing methods.

Marine National Park Zone	Special Purpose Zone	Multiple Use Zone
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Supplementary Report: North Marine Region social and economic assessment–ABARES

Table S11 Updated summary information on flow of impacts, supply chains and demographics of communities for towns–final proposed North Commonwealth Marine Reserves Network

Data source		Logbook	Survey			State	ABARES	Census							
			Home port	Number of potentially impacted input businesses	Number of potentially impacted output businesses			Seafood processors*	Vulnerability index	Fishing industry employment (% of total employment)	SEIFA index of relative disadvantage	Economic diversity index	ARIA remoteness index	Median household income (\$/week)	Population
Town	Population geography	GVP displaced final (\$'000 max)													
Albany	Albany (C) - Central					9		0.26	3	0.97	2	728	15 977		
Atherton	Atherton (S)			1	1			0.09	4	0.79	2	762	10 912		
Augusta	Augusta-Margaret River (S)			2		1		0.33	7	0.73	2	922	10 352		
Borroloola	Borroloola (CGC)			2	1			1.42	1	0.24	4	1012	775		
Bowen	Bowen (S)			2				0.76	2	0.40	2	826	12 381		
Bundaberg	Bundaberg (C)							0.29	2	0.96	1	676	45 806		
Carnarvon	Carnarvon (S)					6		4.23	2	0.53	3	858	5 683		
Dampier	Roebourne (S)			1	1	3		0.11	7	0.19	3	2010	16 421		
Edmonton	Cairns (C) - Trinity			1				0.36	5	0.95	2	1074	33 847		
Exmouth	Exmouth (S)					1		6.24	6	0.82	4	1059	2 064		
Geraldton	Geraldton (C)			3		10		2.17	2	0.91	2	783	18 915		
Georgetown	Etheridge (S)			1				0.00	5	0.13	4	642	850		
Gove Harbour/ Nhulunbuy	East Arnhem - Bal	27.4	2	1			0.00	0.00	1	0.22	4	1070	6 523		
Hervey Bay	Hervey Bay (C) - Pt A		2	3	2			0.60	3	0.89	1	655	48 155		
Humpty Doo	Litchfield (S) - Pt B			2				0.68	7	0.84	2	1313	14 321		
Innisfail	Johnstone (S)							0.45	3	0.72	2	817	18 251		
Ingham	Hinchinbrook (S)			1				0.24	3	0.51	2	750	11 559		
Inverleigh	Golden Plains (S) - South-East							0.16	8	0.78	1	1083	9 014		
Karumba	Carpentaria (S)	1050.0	28	19	4		0.82	1.33	1	0.30	4	949	519		
Normanton	Carpentaria (S)			3	1			1.33	1	0.30	4	949	1 939		
Kunda Park	Maroochy (S) - Buderim			1				0.28	9	0.94	0	1039	39 910		
Kurrimine Beach	Johnstone (S)		1	1				0.45	3	0.72	2	817	18 251		
Mackay	Mackay (C) - Pt A			1				0.10	6	0.71	1	1144	72 847		
Mareeba	Mareeba (S)			2				0.32	2	0.63	2	743	18 209		
Mooloolaba	Maroochy (S) - Mooloolabah							0.43	6	0.85	0	941	10 243		
Rockhampton	Rockhampton (C)			1				0.03	3	0.93	1	914	58 749		
Weipa	Weipa (T)	46.2	2	7	3		0.50	0.00	8	0.45	4	1857	2 833		
Winnellie	Winnellie				1			1.68	3	0.79	2	878	304		
Yeppoon	Livingstone (S) - Pt B				1			0.00	9	0.81	1	1452	3 905		

Supplementary Report: North Marine Region social and economic assessment–ABARES

Data source	Logbook	Survey			State	ABARES	Census							
		GVP displaced final (\$'000 max)	Home port	Number of potentially impacted input businesses			Number of potentially impacted output businesses	Seafood processors*	Vulnerability index	Fishing industry employment (% of total employment)	SEIFA index of relative disadvantage	Economic diversity index	ARIA remoteness index	Median household income (\$/week)
Town	Population geography													
Gold Coast	Gold Coast (statistical division)			1				0.11	7	0.87	0	1267.2	482 326	
Brisbane	Brisbane (statistical division)			10	1			0.13	7	0.91	0	1255.6	1 763 124	
Townsville	Northern SD Bal (statistical division)		1	13				0.08	4	0.53	2	1289.0	53 344	
Cairns	Cairns City Part A (statistical subdivision)	1249.0	18	64	10		0.50	0.39	6	0.88	2	1283.8	122 732	
Darwin	Darwin City (statistical subdivision)	565.0	38	63	15		0.50	0.47	6	0.72	2	1276.7	66 289	
Hobart	Greater Hobart (statistical subdivision)			1				0.59	5	0.88	1	1266.1	200 516	
Perth	Central Metropolitan (statistical subdivision)		1	12				0.11	9	0.75	0	1258.7	124 949	
Adelaide	Adelaide (statistical division)			1		6		0.08	6	0.93	0	1272.0	1 105 846	

ARIA = Accessibility/Remoteness Index of Australia; C = city; GVP = gross value of production; S = Shire; SEIFA =Socio-Economic Indexes For Areas; T = town

Note: The 'traffic light' indicators for each measure follow the logic of green being a positive measure through to red being a negative measure. Indicators are based on a measures distribution within the group of localities. Australian Bureau of Statistics population statistics are available for a variety of geographies within the Australian Standard Geographical Classification (ASGC). To reflect the most appropriate representation of a community’s population, different geographies have been used to calculate the GVP displaced per capita. This assessment includes towns that do not have a GVP displacement and therefore do not have a vulnerability ranking; however, these towns were identified as locations of input and output business through the survey and therefore may potentially be impacted. The vulnerability index is calculated on the draft and final GVP scenarios for all impacted towns in the region. The global scaling approach enables comparison of ranked scores across the two GVP scenarios.

