

An assessment of how Australian fisheries management plans account for climate change impacts

Electronic Supplementary Materials

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Online Resource 1: Management Documents Included in Content Analysis

The management documents relating to Australian fisheries species were for species previously identified in Fogarty et al. (2019), which compiled a list of 99 species relevant to Australian fisheries from four national climate change and fisheries reports (Caputi et al. 2015; Fulton et al. 2018; Pecl et al. 2011; Welch et al. 2014). We compiled a list of state fisheries management documents (i.e. directive management documents), gathered through searches on Australian state government websites, and individual searches of fisheries and target species (Table 1). Management documents were excluded where the document did not mention “commercial” fisheries, but were included where they alluded to the fact that they included commercial fisheries (i.e. they did not specifically rule out commercial fisheries as included, or they did not state that they were in reference to only non-commercial fisheries), and/or it was already known the document encompassed commercial fisheries. We used the latest available version of each management document, as many had been updated from their original format, and the latest versions were the most likely to include climate-related mentions.

We found 125 Australian state fisheries management documents to include in the first content analysis investigating the extent that climate was considered in current state fisheries management documents. Western Australia had the highest number of management documents assessed in our content analysis, followed by South Australia, Tasmania, New South Wales, Queensland, the Northern Territory, and Victoria (Figure 1). The most recent versions of which were published between 2007 and 2018, with all states having documents published as recently as 2018 (Figure 1A). Of all the current management documents that were analysed in this study, the oldest came from Tasmania, and was written in 2007 (identified as a “policy document”). Among other states, the earliest current documents were from 2009 (Queensland documents) and 2010 (Northern Territory and Victorian documents) (Figure 1A). Overall, the number of management documents assessed tended to increase with increasing year of publication, with 2018 having the greatest number of documents, most published in New South Wales, followed by South Australia (Figure 1A). Meanwhile, most of the management documents assessed were deemed to have a Mid-Level in Document Hierarchy, followed next by Higher-Level documents (Figure 1B). Tasmania held the highest number of Higher-Level management documents within our assessment, while Western Australia had the greatest number of Mid-Level documents, and South Australia had the most

Lower-Level documents (Figure 1B). Tasmania was the only state with no Lower-Level documents, followed by Western Australia with only one Lower-Level document within our assessment, meanwhile Victoria had the least Mid-Level documents, with just one (out of 10) document included (Figure 1B).

Further analysis of the management documents revealed that as the number of documents produced increased over the study period, the proportion of documents mentioning climate decreased even though the actual number of documents mentioning climate increased (Figure 2A, Main Text Figure 4B). Across the documents and in each state, “direct” mentions of climate were slightly more frequent in occurrence than “indirect” climate mentions (44 vs. 35 mentions, Figure 2B, Main Text Table 1). South Australia leads with a standout number of individual Climate Mentions (Figure 2B), which was reflected in the main text as being the state with the most documents with Climate Mentions (Main Text Figure 4D), followed again by Victoria and Queensland (Figure 2B, Main Text Figure 4D).

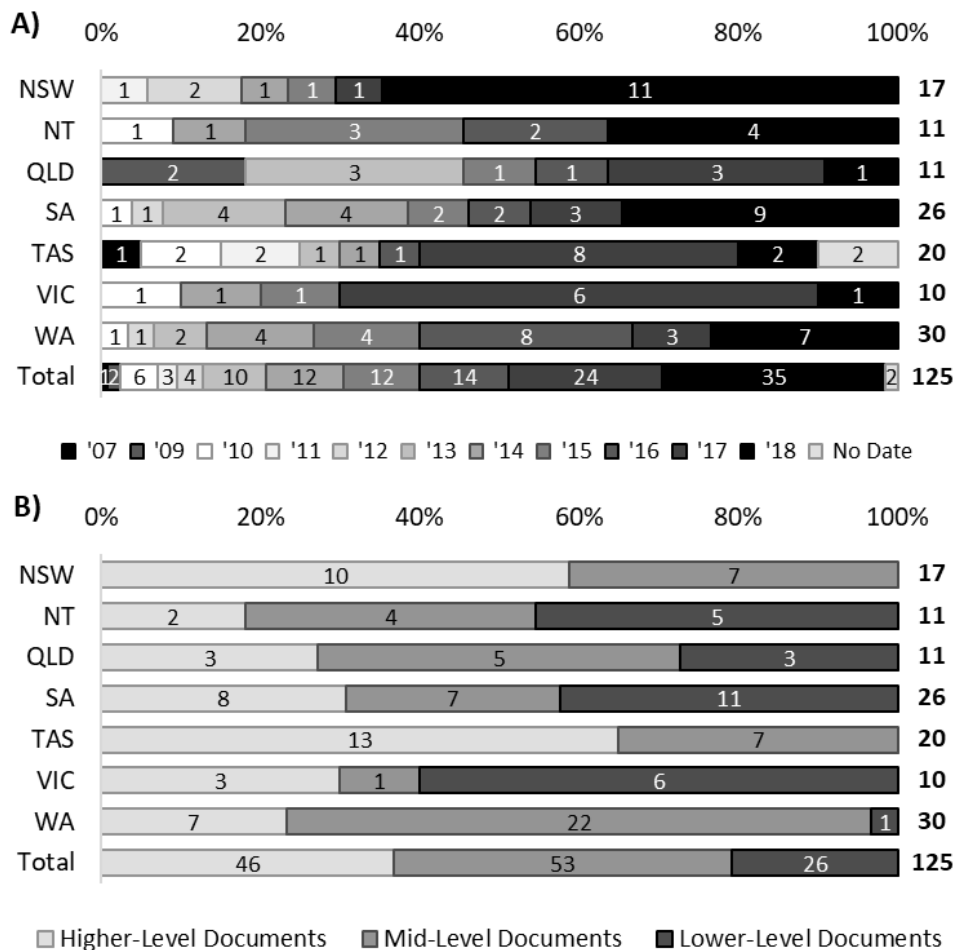


Figure 1 The percentage and count of fisheries management documents included in this study, separated by state of publication, and then; **(A)** the year of publication of current version of document, and **(B)** the hierarchical levels of management documents. Data labels represent the count of documents, with the labels to the right of the bars representing the overall count of management documents in categories. “NSW” = New South Wales, “NT” = Northern Territory, “QLD” = Queensland, “SA” = South Australia, “TAS” = Tasmania, “VIC” = Victoria, “WA” = Western Australia.

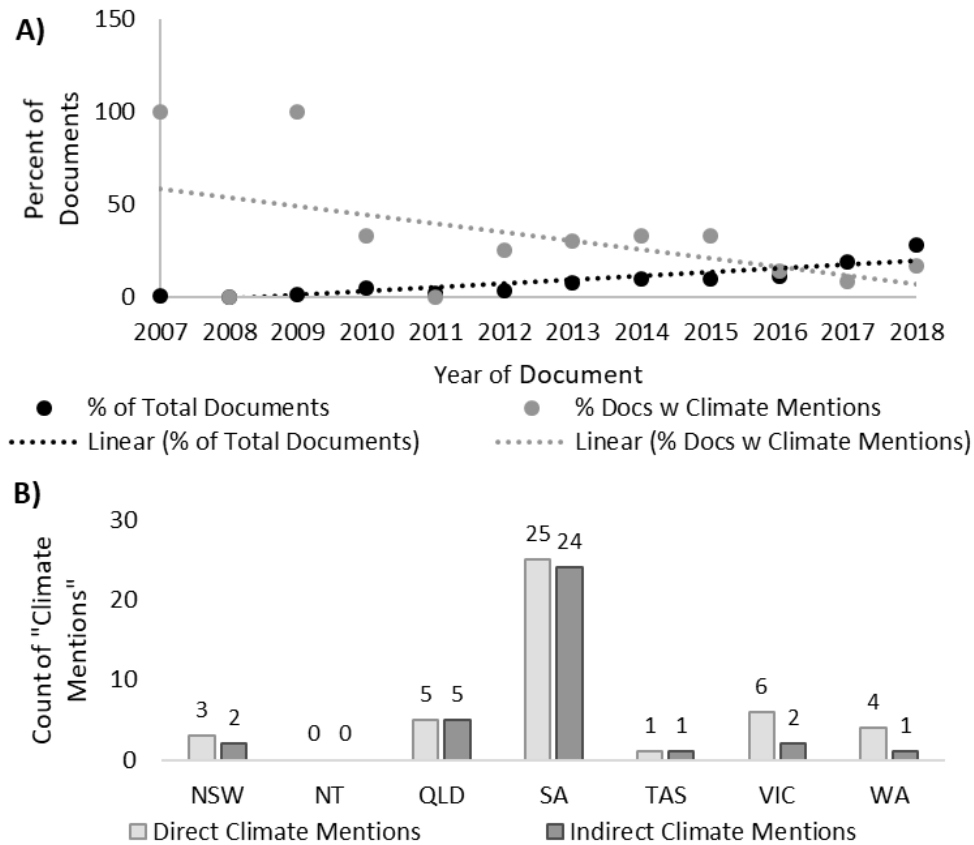


Figure 2 (A) the percentage of fisheries management documents with "Climate Mentions" and the percentage of total fisheries management documents, by year of current version of document. N.B. 2008 had no documents and therefore no climate-related mentions included in this study. (B) The number of direct and indirect "Climate Mentions" extracted from the management documents, separated by state. N.B. does not include climate "actions".

Table 1 The 125 fisheries management documents included in the content analysis.

State	Date of Latest Version	Document Title
NSW	2018	Fisheries Management (Abalone Share Management Plan) Regulation 2000
NSW	2018	Fisheries Management (Estuary General Share Management Plan) Regulation 2006
NSW	2018	Fisheries Management (Estuary Prawn Trawl Share Management Plan) Regulation 2006
NSW	2018	Fisheries Management (General) Regulation 2010
NSW	2018	Fisheries Management (Lobster Share Management Plan) Regulation 2000
NSW	2018	Fisheries Management (Ocean Haul Share Management Plan) Regulation 2006
NSW	2018	Fisheries Management (Ocean Trap and Line Share Management Plan) Regulation 2006
NSW	2018	Fisheries Management (Ocean Trawl Share Management Plan) Regulation 2006
NSW	2018	Fisheries Management (Supporting Plan) Regulation 2006

NSW	2018	Fisheries Management Act 1994
NSW	2018	NSW Commercial Fisheries Administration Guide
NSW	2017	Fisheries advisory groups: Establishment and governance 2017
NSW	2015	Fisheries Resource Sharing in NSW Policy 2015
NSW	2014	Fisheries NSW Strategic Research Plan 2014-2018
NSW	2012	Debt management: Commercial fisheries quota transfer restrictions Policy
NSW	2012	Developmental Fisheries Policy 2012
NSW	2011	NSW Fisheries Compliance Enforcement Policy and Procedure
NT	2018	Barramundi Fishery Management Plan 2018
NT	2018	Fisheries Act 2018
NT	2018	Fisheries Regulations 2018
NT	2018	Mud Crab Fishery Management Plan 2018
NT	2016	Guidelines for implementing the Northern Territory Fisheries Harvest Strategy Policy (2016)
NT	2016	Northern Territory Fisheries Harvest Strategy Policy 2016
NT	2015	NEW - Management Arrangements for the Northern Territory's Demersal Fishery (DF), 2012
NT	2015	NEW - Policy Guidelines for Management of the Northern Territory's Timor Reef Fishery, 2015
NT	2015	Northern territory fishery resource sharing framework 2015
NT	2014	Pearl Oyster Culture Industry Management Plan 2014
NT	2010	Spanish Mackerel Fishery Management Plan 2010
QLD	2018	Fisheries Regulation 2008
QLD	2017	Fisheries (East Coast Trawl) Management Plan 2010
QLD	2017	Fisheries Act 1994
QLD	2017	Queensland Sustainable Fisheries Strategy 2017-2027
QLD	2016	Policy for the Management of the Coral Fishery 2016
QLD	2015	Policy guidelines on the term of authorities
QLD	2013	Fisheries (Coral Reef Fin Fish) Management Plan 2003
QLD	2013	Limited Entry Policy
QLD	2013	Queensland Finfish (Stout Whiting) Trawl Fishery - Statement of Management Arrangements 2013
QLD	2009	A guide to the Queensland Marine Aquarium Fish Fishery and the Queensland Coral Fishery
QLD	2009	Sustainable Planning Act 2009
SA	2018	Blue Crab Fishery Management Plan 2018
SA	2018	Fish Processors Regulations 2017 (?)
SA	2018	Fisheries Management (Fees) Regulations 2017
SA	2018	Fisheries Management (Marine Scalefish Fisheries) Regulations 2017

SA	2018	Fisheries Management (Misc. Developmental Fisheries) Regulations 2013
SA	2018	Fisheries Management (Rock Lobster Fisheries) Regulations 2017
SA	2018	Management Policy for commercial fishing of Giant Crabs in South Australia 2018
SA	2018	Miscellaneous Fishery Regulations 2015 (?)
SA	2018	River Fishery Regulations 2017 (?)
SA	2017	Fisheries Management (General) Regulations 2017
SA	2017	Fisheries Management Act 2007
SA	2017	Gulf St Vincent Prawn Fishery Management Plan 2017
SA	2016	Commercial Lakes and Coorong Fishery Management Plan 2016
SA	2016	Cost Recovery Policy 2016
SA	2015	Harvest Strategy Guidelines 2015
SA	2015	Harvest Strategy Policy 2015
SA	2014	Charter Boat Fishery Management Plan 2014
SA	2014	Commercial Marine Scalefish Fishery, PART B – Management arrangements for the taking of sardines 2014
SA	2014	Northern Zone Rock Lobster Fishery Management Plan 2014
SA	2014	Spencer Gulf Prawn Fishery Management Plan 2014
SA	2013	Co-management Policy 2013
SA	2013	Lake Eyre Basin Fishery Management Plan 2013
SA	2013	Marine Scalefish Fishery Management Plan 2013
SA	2013	Southern Zone Rock Lobster Fishery Management Plan 2013
SA	2012	Abalone Fishery Management Plan 2012
SA	2010	NEW - Management Policy for the Commercial West Coast Prawn Fishery, 2010
TAS	2018	Fisheries (Abalone) Rules 2017
TAS	2018	Tasmanian Rock Lobster Fishery - East Coast Stock Rebuilding Strategy 2013-2023, September 2018
TAS	2017	2017 Update of Policy Document for the Tasmanian Minor Shellfish Fishery, March 2017
TAS	2017	Commercial Abalone Fishery - Operational Information Paper for the 2018 Fishing Year, December 2017
TAS	2017	Fisheries (Marine Plants) Rules 2017
TAS	2017	Fisheries (Rock Lobster) Rules 2011
TAS	2017	Fisheries (Scalefish) Rules 2015
TAS	2017	Fisheries (Shellfish) Rules 2017
TAS	2017	Living Marine Resource Management Act 1995
TAS	2017	Tasmanian Marine Plants Fishery - Policy Document, September 2017
TAS	2016	Fisheries (General and Fees) Regulations 2016
TAS	2014	Fisheries (Commercial Dive) Rules 2011

TAS	2013	Fisheries (Giant Crab) Rules 2013
TAS	2011	Commercial Dive Policy Paper 2011
TAS	2011	Fisheries (Penalty) Regulations 2011
TAS	2010	Fisheries (Processing and Handling) Rules 2010
TAS	2010	Fisheries (Scallop) Rules 2010
TAS	2007	Shellfish Fishery Policy Document, March 2007
TAS		Developmental Fisheries Management Policy Document
TAS	2009	Fisheries (Mackerel) Rules 2009
VIC	2018	NEW - Victorian Pigi Fishery Management Plan, 2018
VIC	2017	Eel Fishery Management Plan 2017
VIC	2017	Fisheries (Fees, Royalties and Levies) Regulations 2008
VIC	2017	Fisheries Act 1995
VIC	2017	Fisheries Regulations 2009
VIC	2017	NEW - Harvest Strategy for the Victorian Wrasse (Ocean) Fishery), 2017
VIC	2017	Rock Lobster Fishery Management Plan 2017
VIC	2015	Wild Harvest Abalone Fishery Management Plan 2015
VIC	2014	NEW - Sea Urchin Fishery Baseline Management Arrangements, 2014
VIC	2010	Giant Crab Fishery Management Plan 2010
WA	2018	Aquatic Resources Management Act 2016
WA	2018	Fish Resources Management Regulations 1995
WA	2018	FMP 265 - Exmouth Gulf Prawn Managed Fishery harvest strategy 2014 – 2019, July 2018.
WA	2018	FMP 286 - Octopus resource of Western Australia harvest strategy 2018 – 2022, April 2018.
WA	2018	FMP 287 - Western Australian Sea Cucumber Resource Harvest Strategy 2018 – 2023, May 2018.
WA	2018	FMP 289 - Pearl Oyster (<i>Pinctada maxima</i>) Resource Allocation Report, July 2018.
WA	2018	FMP 292 - Marine Aquarium Fish Resource of Western Australia Harvest Strategy 2018 – 2022, September 2018.
WA	2017	FMP 283 - Abalone Resource of Western Australia Harvest Strategy 2016 - 2021, February 2017.
WA	2017	FMP 284 - Gascoyne demersal scalefish resource harvest strategy 2017 - 2021, September 2017.
WA	2017	FMP 285 - North Coast demersal scalefish resource harvest strategy 2017 – 2021, November 2017.
WA	2016	Fish Resources Management Act 1994
WA	2016	Fisheries Adjustment Schemes Act 1987
WA	2016	Fishing and Related Industries Compensation (Marine Reserves) Act 1997
WA	2016	Fishing Industry Promotion Training and Management Levy Act 1994

WA	2016	FMP 276 - Western Australian silver-lipped pearl oyster (<i>Pinctada maxima</i>) resource harvest strategy 2016 – 2021 - Version 1.0 - Pearl Oyster Fishery, August 2016.
WA	2016	FMP 279 - Policy on the application of fish size limits in Western Australia, November 2016.
WA	2016	FMP 281 - Integrated fisheries management resource report Pearl oyster (<i>Pinctada maxima</i>) resource, November 2016.
WA	2016	Pearling Act 1990
WA	2015	FMP 271 - Harvest Strategy Policy and Operational Guidelines for the Aquatic Resources of Western Australia, July 2015.
WA	2015	FMP 272 - West Coast Deep Sea Crustacean Resources Harvest Strategy 2015 – 2020, July 2015.
WA	2015	FMP 273 - Blue Swimmer Crab Resource of the Peel-Harvey Estuary Harvest Strategy 2015 - 2020, May 2015.
WA	2015	FMP 274 - Finfish Resources of the Peel-Harvey Estuary Harvest Strategy 2015 - 2020, May 2015.
WA	2014	FMP 264 - West Coast Rock Lobster Harvest Strategy and Control Rules 2014 – 2019, July 2014.
WA	2014	FMP 266 - Exmouth Gulf Prawn Managed Fishery bycatch action plan 2014 – 2019, November 2014.
WA	2014	FMP 267 - Shark Bay Prawn Managed Fishery harvest strategy 2014 – 2019, November 2014.
WA	2014	FMP 268 - Shark Bay Prawn Managed Fishery bycatch action plan 2014 – 2019, November 2014.
WA	2013	FMP 249 - West Coast demersal scalefish allocation report, August 2013.
WA	2013	FMP 261 - Policy on restocking and stock enhancement in Western Australia, July 2013.
WA	2012	FMP 260 - The Houtman Abrolhos Islands Management Plan, November 2012.
WA	2010	FMP 244 - A bycatch action plan for the Pilbara fish trawl interim managed fishery, July 2010.

Online Resource 2: Search Terms for Content Analysis of Management Documents

The content analysis was conducted on the management documents using NVIVO, searching for comments relating to climate or climate change, to determine the frequency of their occurrence within the documents. To help with consistency and robustness of our methods, we used pre-determined terms to search the management documents for climate-related comments, which included:

- “acidi” (i.e. “acidification” or similar)
- “adapt” (i.e. “adaptation”)
- “adverse”
- “bleach” (i.e. “bleaching”)
- “change”
- “climat” (i.e. climate)
- “cool” (i.e. “cooling”)
- “cyclone”
- “danger” (i.e. “dangerous”)
- “decline”
- “decrease”
- “environment”
- “extreme”
- “impact”
- “increase”
- “mitigat” (i.e. “mitigation”)
- “precaution” (i.e. “precautionary”)
- “protect”
- “salinity”
- “sea level”
- “storm”
- “temp” (i.e. “temperature”)
- “varia” (i.e. “variability”)
- “warm” (i.e. “warming”)
- “weather”
- “welling” (i.e. “upwelling” or “downwelling”)
- “wind”

Where these search terms were identified in text, they were then verified as correctly referencing climate and not another topic (for example, “impact” may have been discussing any range of impacts on a fishery or environment, not just climate impacts).

Online Resource 3: FRDC Climate-Related Research Proposals

Investigating the FRDC Calls for Applications of Research Priorities revealed nine priorities that had a reference to climate, determined from the list of climate-related search terms detailed in Online Resource 1. Seven of these priorities were classed as “directly” climate-related, and two were “indirectly” climate-related (Table 2). These priorities came from seven years of Calls (nine Calls), which listed a total of 351 research priority applications by 21 different “jurisdictions”, which were:

- Comm FRAM (Comm RAC)
(Commonwealth)
- SA FRAB (SA RAC)
(South Australia)
- WA FRAB (WA RAC)
(Western Australia)
- NSW FRAB (NSW RAC)
(New South Wales)
- Tas FRAB (Tas RAC)
(Tasmania)
- NT FRAB (NT RAC)
(Northern Territory)
- Q FRAB (Q RAC)
(Queensland)
- Vic FRAB (Vic RAC)
(Victoria)
- SRL IPA
(Southern Rock Lobster)
- SBT IPA
(Southern Bluefin Tuna)
- ACPF IPA
(Australian Council of Prawn Fisheries)
- P IPA
(Pearling)
- AS IPA
(Atlantic Salmon)
- AAHS
(Aquatic Animal Health Subprogram)
- IRG
(Indigenous Reference Group)
- IFS
(Indigenous Fishing Subprogram)
- HDRS (HDR)
(Human Dimensions Research Subprogram)
- RR
(Recfishing Research)
- APFA
(Australian Prawn Farmers’ Association)
- ABFA
(Australian Barramundi Farmers’ Association)
- National

* RAC = Research Advisory Committee, FRAB = Fisheries Research Advisory Body, IPA = Industry Partnership Agreement.

Table 2 Research priority application which had a determined direct or indirect reference to climate.

Year	Jurisdiction	Climate-Related Research Priority
2014	Tasmanian Fisheries Research Advisory Body (Tas FRAB)	(DIRECT) “Priority: Understanding East Coast recruitment collapse – development of pre-recruitment monitoring, simulation of recruitment variation and predicting the impact of climate variation.”
2015	West Australian Fisheries Research Advisory Body (WA FRAB)	(DIRECT) “Priority: Future proofing WA’s iconic Marron fishery – challenges and opportunities. Need: Marron populations throughout the state face a growing range of cumulative stressors such as destruction of riverbank vegetation, increasing salinity, climate change and reduced river flows.”
2015	West Australian Fisheries Research Advisory Body (WA FRAB)	(INDIRECT) “Priority: Understanding the cause of and develop mitigation measures for recruitment variation of prawns and scallops in Shark Bay, Abrolhos Islands and Exmouth Gulf. ... Planned outcomes: Predictive management approaches to extreme events.”

2017	Commonwealth Research Advisory Committee (Comm RAC)	(DIRECT) “Priority: Physics to Fish: Investigate Oceanographic and Environmental Factors Impacting on the Eastern Tuna & Billfish Fishery. ... Planned outcomes: Components may include: 1. Characterise spatial and temporal variability in key “fisheries relevant” environmental factors within the ETBF, including the influence of climateocean system drivers upon those.; ... 3. Assess regional and domestic fisheries and environmental data trends to assess evidence for environmentally driven connectivity/mixing (or separation) This would include assessing questions such as: a) Do within season regional spatial patterns in fish sizes and CPUE suggest movement of fish into the ETBF from adjacent regions and if so under what environmental/climatic conditions?; 4. Based on the above investigations and analyses, develop predictive models to assist management and industry planning (e.g. expected relative shifts in catch levels, spatial patterns, and seasonal trend, under different climate conditions and under long term climate change). This project may benefit and complement the recreational fishery project specified below.”
2017	Northern Territory Research Advisory Committee (NT RAC)	(DIRECT) “Priority: Assessing the relevance of key coastal habitats and habitat-related ecological processes, such as tidal inundation and seasonal flooding, to fisheries production and sustainability. Need: Understanding how habitat architecture and service provision couples with key environmental drivers, particularly in the Gulf of Carpentaria, is important in the short term with regard to acute habitat perturbation (e.g. mangrove dieback and regrowth) and chronic long term changes to coastal regions under climate change.”
2017 Nov	South Australian Research Advisory Committee (SA RAC)	(DIRECT) “Priority: Implications of Gulf St Vincent Productivity Loss: Developing Tools to Optimise MultiFishery Management in a Changing Environment. Planed outcomes: This project is expected to develop a spatially explicit GSV ecosystem model that integrates key environmental times series. These and other key developments will enable complex ecological and spatial use change scenarios to be undertaken, including an assessment of the relative importance of a range of factors (e.g. seagrass loss, pollution, climate change) that may contribute to declining fishery production.”
2017 Nov	Queensland Research Advisory Committee (Q RAC)	(DIRECT) “Priority: Influence of Changes in Reef Habitat Condition and Climate Change on Coral Trout — To Inform Abiotic Drivers of Coral Trout Stocks. Need: Coral trout are the main commercial and recreational species in Queensland’s Coral Reef Finfish Fishery, and also caught in other fisheries in northern Australia. The reef habitats that support coral reef finfish are already being impacted by ongoing climate change, including severe coral bleaching and storm damage, and further environmental deterioration is most likely. Experimental research suggests high vulnerabilities for coral trout from climate change, for example these fish appear to already be living in waters now at the upper end of their thermal tolerance and their physiology is expected to be impaired with further ocean warming. The different life-stages of coral trout also have various dependencies on healthy coral reefs (e.g. for settlement habitat, prey). There is a need to expand this laboratory research into the reef environment to better understand the flow-on effects of changing reef condition and environment on coral reef finfish fisheries. ... Planned outcomes: Adaptation options for industry to allow rapid mitigation efforts in relation to climate risks.”
2018 Apr	Tasmanian Research Advisory Committee (Tas RAC)	(INDIRECT) “Priority: Challenges and opportunities provided by range extending species: understanding population dynamics, ecosystem impacts and management needs. Need: Species-level responses to ocean warming is a priority research area as they underpin the structure and function of marine ecosystems and the productivity of fisheries that operate within them.”

2019 Apr	Victorian Research Advisory Committee (Vic RAC)	(DIRECT) “Priority: Fish stocking – decision tools for native fish outside their range; Need: Stocking fish outside their natural distribution provides a greater level of uncertainty regarding the impact that the stocked fish has on their surroundings. Similarly, recent changes in environment and climate may have impacted species distribution when compared to historical information. Hence, there is the need for the development of decision tools and objective criteria to inform the stocking native fish outside their ranges.”
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Online Resource 4: FRDC Funded Climate-Related Research Projects

We investigated the number of climate-related projects funded by the FRDC, and found 36 complete projects, and 19 projects underway between 2009-19 (Table 3), i.e. the we identified one of the keywords from Online Resource 1, used in the context of climate change, within the project title or description. Our compiled list of climate-related research projects were sourced from:

- FRDC "Marine climate change adaptation projects" (<http://www.frdc.com.au/Industry-and-Environment/Climate-change/Marine-climate-change-adaption-projects>) viewed 10/4/2019.
- FRDC "Climate Adaptation Program" (<http://www.frdc.com.au/en/Industry-and-Environment/Climate-change/Climate-Adaptation-Program>) viewed 10/4/2019.

Table 3 Completed or underway climate-related research projects (between 2009-19), funded by FRDC.

Year	Project Number	Project Title
<i>Completed Project Status</i>		
2009	2009-055	Development and testing of a national integrated climate change adaptation assessment framework
2009	2009-056	Understanding the biophysical implications of climate change in South East Australia: Modelling of physical drivers and future changes
2009	2009-070	Risk Assessment of Impacts of Climate Change for Key Species in South-Eastern Australia- part 1 and part 2
2009	2009-073	Identifying management objectives hierarchies and weightings for four key fisheries in South Eastern Australia
2009	2009-074	Marine Australia: directions for management & further research; building on the findings of the Climate Change Adaptation – Marine Biodiversity & Fisheries R&D initiative
2010	2010-023	Potential futures for Australia's south eastern marine ecosystems, quantitative Atlantis projection
2010	2010-506	Adaptive management of temperate reefs to minimise effects of climate change: Developing new effective approaches for ecological monitoring and predictive modelling
2010	2010-510	Adapting to the effects of climate change on Australia's deep marine reserve
2010	2010-521	Vulnerability of an iconic Australian finfish (Barramundi, Lates calcarifer) and related industries to altered climate across tropical Australia
2010	2010-524	Identification of climate-driven species shifts and adaptation options for recreational fishers: learning general lessons from a data rich case
2010	2010-532	Changing currents in marine biodiversity governance and management: responding to climate change
2010	2010-533	Developing adaptation options for seabirds and marine mammals impacted by climate change
2010	2010-534	Ensuring the Australian Oyster industry adapts to a changing climate: a natural resource and industry spatial information portal for knowledge and informed adaptation frameworks
2010	2010-535	Management implications of climate change effect on fisheries in Western Australia
2010	2010-536	Beach and surf tourism and recreation in Australia: vulnerability and adaptation
2010	2010-542	A marine climate change adaptation blueprint for coastal regional communities

2010	2010-554	Effects of climate change on reproduction, larval development, and population growth of coral trout (<i>Plectropomus</i> spp.)
2010	2010-564	Pre-adapting a Tasmanian coastal ecosystem to ongoing climate change through reintroduction of a locally extinct species
2010	2010-565	Implications of climate change on fisheries resources of northern Australia. Vulnerability assessment and adaptation options
2011	2011-030	Evaluating candidate monitoring strategies, assessment procedures and harvest control rules in the spatially complex Queensland Coral Reef finfish Fishery
2011	2011-037	Implications of climate change for recreational fishers and the recreational fishing industry
2011	2011-039	Preparing fisheries for climate change – assessing alternative adaptive options for four key fisheries in south-eastern Australia
2011	2011-040	Estuarine and near-shore ecosystems – assessing alternative adaptive management strategies for the management of estuarine and coastal ecosystems
2011	2011-070	TSGA IPA: Comparative susceptibility and host responses of endemic fishes and salmonids affected by amoebic gill disease in Tasmania
2011	2011-084	Comparative sequestration and mitigation opportunities across the Australian landscape and its land uses
2011	2011-233	Growth opportunities & critical elements in the supply chain for wild fisheries & aquaculture in a changing climate
2011	2011-503	Climate Change Adaptation: Building community and industry knowledge
2012	2012-024	INFORMD Stage 2: Risk-based tools supporting consultation, planning and adaptive management for aquaculture and other multiple-uses of the coastal waters of southern Tasmania
2012	2012-036	Revitalising Australia's Estuaries
2014	2014-008	Fishery status reports: health-check for Australian fisheries
2014	2014-012	Tasmania's coastal reefs: deep reef habitats and significance for finfish production and biodiversity
2014	2014-019	Developing a fishery independent estimate of biomass for snapper
2014	2014-031	TSGA IPA: Predicting marine currents, nutrients and plankton in the coastal waters of south-eastern Tasmania in response to changing weather patterns
2015	2015-040	ABFA IPA: an assessment of the risk of exotic disease introduction and spread among Australian Barramundi farms from the importation of Barramundi products
2015	2015-406	Oysters Australia IPA: development of a national Pacific Oyster Mortality Syndrome (POMS) response plan
2016	2016-005	eSAMarine – phase 1: the first step towards an operational now-cast/forecast ocean prediction system for Southern Australia
<i>Underway / Current Project Status</i>		
2009	2009-211	Whose fish is it anyway? – Investigation of co-management and self-governance solutions to local issues in Queensland's inshore fisheries
2013	2013-006	The impact of habitat loss and rehabilitation on recruitment to the NSW Eastern King Prawn fishery
2013	2013-205	Beyond engagement: moving towards a co-management model for recreational fishing in South Australia
2013	2013-210	Adapt or Fail: Risk management and business resilience in Queensland commercial fisheries
2013	2013-217	Development of management recommendations to assist in advisories around seafood safety during toxic bloom events in Gippsland Lakes
2014	2014-005	The application, needs, costs and benefits of Habitat Enhancement Structures in Western Australia and cost effective monitoring methods
2014	2014-010	Understanding recruitment collapse of juvenile Abalone in the Eastern Zone Abalone fishery – development of pre-recruitment monitoring, simulation of recruitment variation and predicting the impact of climate variation

2014	2014-023	An industry based mark recapture program to provide stock assessment inputs for the Western Rock Lobster Fishery following introduction of quota management
2014	2014-025	SRL IPA: Developing cost-effective industry-based techniques for monitoring puerulus settlement in all conditions: Phase 2
2014	2014-040	Oysters Australia IPA: Pacific Oyster Mortality Syndrome (POMS) – closing knowledge gaps to continue farming <i>C. gigas</i> in Australia
2014	2014-224	Rebuilding Abalone populations to limit impacts of the spread of urchins, Abalone viral ganglioneuritis and other external impacts
2014	2014-402	Planning, developing and coordinating national/regional research, development and extension (RD&E) for Australia's recreational fishing community
2015	2015-011	Understanding the factors contributing to decreased School Prawn productivity in Camden Haven Estuary and associated lakes, to target ameliorative actions
2015	2015-025	Patterns of interaction between habitat and oceanographic variables affecting the connectivity and productivity of invertebrate fisheries
2015	2015-026	Understanding recruitment variation (including the collapse) of Saucer Scallop stocks in Western Australia and assessing the feasibility of assisted recovery measures for improved management in a changing environment
2015	2015-027	Examining the relationship between fishery recruitment, essential benthic habitats and environmental drivers in Exmouth Gulf
2015	2015-239	Oysters Australia IPA: Pacific Oyster Mortality Syndrome – resistant Oyster breeding for a sustainable Pacific Oyster Industry in Australia

Online Resource 5: FRDC Research Proposal Key Phrases

Investigating the “Topic”, “Objectives”, “Need” and “Background” text from 1208 which research projects funded by the FRDC between 2009-2019, to provide further context of the in-text use of these keywords, we searched for key word combinations (*key phrases*) using the search function (“Ctrl+F”) in Microsoft Word, and noted the most commonly used word combinations and their frequencies. We then took the top two *key phrases* for each of the 36 top *keywords*, and compiled them into a group ordered by their weighted value (the number of uses). Finally, we removed duplicates (e.g. “fisheries-management”, as both “fisheries” and “management were key words), and arrived at list of 63 of the top key phrases relating to variations on the top keywords (Table 4). “Climate-change” was the third highest used key phrase (Table 4). Other key phrases identified which used the word “climate”, included “climate-variation” with 18 uses, “changing-climate” with 16 uses, and “climate-impact(s)” with 13 uses. On a similar theme, key phrases identified using the keywords “environmental” and “sustainable” included “environmental-conditions with 89 uses, and “environmental-change(s)” with 32 uses, as well as “sustainable-development with 88 uses, “ecologically-sustainable” with 73 uses, “sustainable-fish(ing/eries/ery)” with 54 uses, and “sustainable-management” with 48 uses (Table 4).

Table 4 The 63 top key phrases (word combinations) using phrase variations on the top 36 keywords (i.e. keywords including and above “climate”)

Top Key Phrases	Number of Uses (Weight)	Top Key Phrases (continued)	Number of Uses (Weight)
fisheries-management	548	commercial-catch	74
seafood-industr(y/ies)	534	management-plan	73
climate-change	427	ecologically-sustainable	73
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