

**Conservation Services Programme
Protected Coral Medium-Term Research Plan**

December 2022

Conservation Services Programme

Department of Conservation

1. Purpose

The Conservation Services Programme (CSP) undertakes research to understand and address the effects of commercial fishing on protected species in New Zealand waters (for further details see the [CSP Strategic Statement](#)¹). The 2010 amendment of Schedule 7A of the Wildlife Act 1953 protects most corals in New Zealand waters, which are comprised of four main groups: stony corals (all species in the Order Scleractinia), black corals (all species in the Order Antipatharia), gorgonian corals (most species in the Order Alcyonacea), and some hydrocorals (all species in the Family Stylasteridae). Indicative protected species numbers are detailed in Table 1.

This CSP Coral Medium-Term Research Plan (CSP Coral Plan) will be updated annually and used to guide and develop projects for CSP Annual Plans and any other relevant process to deliver on the coral population, mitigation, and interaction research components of CSP. It has been developed as part of the work of the CSP Research Advisory Group ([CSP RAG](#)).

The CSP Coral Plan focuses on deep water corals and the impact of trawling on them, as most interaction data and bycatch samples available stem from these fisheries. Coral taxa found in shallower habitats (e.g., Fiordland, Port Pegasus) or that interact with other fishing methods (e.g. rock lobster potting, bottom long-lining) generally have a lack of observer coverage and interaction data. Broader coral research that relates to threats other than the direct and indirect effects of commercial fishing (e.g., coral disease, ocean acidification) falls outside the scope and mandate of CSP and is not included in this plan.

2. Guiding objectives and risk framework

Unlike protected seabirds and sharks, protected corals do not have a National Plan of Action and associated risk assessment framework to guide management actions and research planning. In the interim until such a Plan is developed, the CSP Coral Plan will act as research guiding framework, aiming to:

- 1) Inform research prioritisation;
- 2) Provide structure to facilitate research synergies; and
- 3) Support improved management of protected corals in New Zealand waters.

Several key documents and processes guide and inform research planning and the CSP Coral Plan. These include the CSP Strategic Statement, the New Zealand Threat Classification System, Te Mana O Te Taiao Aotearoa New Zealand Biodiversity Strategy 2020, and relevant risk assessments. These are described below.

Firstly, research undertaken through the CSP falls into one of three categories (Interaction, Mitigation, or Population categories as outlined in the CSP Strategic Statement), whilst addressing one or several of the **CSP objectives**. These objectives therefore guide the scope of research within this plan:

¹ <https://www.doc.govt.nz/our-work/conservation-services-programme/csp-plans/csp-strategic-statement/>

- **Objective A:** Proven mitigation strategies are in place to avoid or minimise the adverse effects of commercial fishing on protected species across the range of fisheries with known interactions.
- **Objective B:** The nature of direct adverse effects of commercial fishing on protected species is described.
- **Objective C:** The extent of known direct adverse effects of commercial fishing on protected species is adequately understood.
- **Objective D:** The nature and extent of indirect adverse effects of commercial fishing are identified and described for protected species that are at particular risk to such effects.
- **Objective E:** Adequate information on population level and susceptibility to fisheries effects exists for protected species populations identified as at medium or higher risk from fisheries.

The adverse effects and risks referred to in the guiding objectives include direct (being caught, injured or killed by nets, hooks or other fishing gear) and indirect (habitat modification, food competition and behaviour modification) effects - both or either of which may compromise the viability or recovery of protected species populations.

Secondly, the Department of Conservation have updated the New Zealand Biodiversity Strategy 2000-2020 and published **Te Mana O Te Taiao Aotearoa New Zealand Biodiversity Strategy 2020**^{2,3}, TMOTT). The Strategy outlines thirteen objectives to safeguard New Zealand's biodiversity, each of which has specific goals set to achieve five-, ten- and thirty-year targets. The most pertinent 5-year/2025 goals in the Strategy that relate to CSP and to protected corals include ambitious fisheries bycatch reduction goals, goals for the sustainable use of marine resources, and goals to protect marine biodiversity and ecosystems:

10.1.1 Prioritised research is improving baseline information and knowledge of species and ecosystems

10.4.1 Significant progress has been made in identifying, mapping and protecting coastal ecosystems and identifying and mapping marine ecosystems of high biodiversity value

10.7.1 There have been no known human-driven extinctions of indigenous species

12.2.1 The number of fishing-related deaths of protected marine species is decreasing towards zero for all species

By 2030 and 2050, respectively, TMOTT includes bycatch reduction goals aiming that:

12.2.2 The direct effects of fishing do not threaten protected marine species populations or their recovery

12.2.3 The mortality of non-target species from marine fisheries has been reduced to zero

The TMOTT goals serve to provide context for the broader application of CSP coral research into The Department's wider research planning and strategic directions for the next 5 years plus.

² In English: <https://www.doc.govt.nz/globalassets/documents/conservation/biodiversity/anzbs-2020.pdf>

³ In Te Reo: <https://www.doc.govt.nz/globalassets/documents/conservation/biodiversity/anzbs-2020-te-reo-maori.pdf>

Thirdly, the **New Zealand Threat Classification System** (NZTCS, Freeman *et al.*, 2014) has been applied to some coral taxa (Table 3), although there is a substantial lack of data to confidently assess the status of most of the >350 protected coral species. Of these, only 66 species (32 genera) have been classified via the NZTCS; 33 are classified as naturally uncommon, 6 are classified as declining, and 1 is nationally vulnerable (Table 3). The remaining 26 species are classified as data deficient, meaning there is not enough information to confidently determine their threat status. The NZTCS for marine invertebrates is currently being updated and will include additional coral taxa (due early 2022). The lack of data and/or poor confidence in population trends means that coral research is generally not prioritised by (but is a consideration) its NZTCS status.

Fourthly, a **semi-quantitative pilot ecological risk assessment** was conducted in 2014 (Clark *et al.*, 2014, summary results: Table 2). In this pilot assessment, the effect of bottom trawling on the Chatham Rise risk was estimated by a Productivity-Susceptibility-Analysis (PSA) for 15 coral species, which considers the extent of impact due to fishing activity (“susceptibility”), and their potential to recover from the impact (“productivity”). The pilot indicated that most corals analysed are at risk from trawl fisheries on the Chatham Rise (noting that several knowledge gaps and assumptions, including lack of data on cumulative effects, localised impacts, coral abundance and coral productivity, limited the analysis). A fully quantitative **risk assessment** of the effect of commercial fishing on protected coral species in New Zealand waters has not been undertaken yet, although it is recognised as a high research priority in this plan (Table 4).

Finally, in October 2017, a **workshop** on the research needs for New Zealand protected corals was held at the Department of Conservation that identified 58 knowledge gaps within six categories: ‘Biological Gaps’, ‘Environmental Gaps’, ‘Spatial Gaps’, ‘Modelling Gaps’, ‘Threat and Pressure Gaps’, and ‘Data, Management & Communication Gaps’ (Hjorvarsdottir & Tracey 2017, view the meeting minutes and the knowledge gaps [here](#)⁴). This workshop, and a subsequent **report** summarising current knowledge on New Zealand deep-sea corals (Tracey, DM & Hjorvarsdottir, F (eds, comps, 2019)) are documents that also directly guide coral research directions. The report incorporated the findings from the 2017 gaps workshop and updated a preceding review (Consalvey *et al.* 2006).

3. Data Requirements

Understanding of New Zealand coral biology and ecology is incomplete, which restricts our understanding of their susceptibility to impacts from commercial fisheries. The following data gaps and requirements identified through the 2017 protected corals workshop can be grouped thematically to address the main research topics that address the CSP objectives listed above.

THEME 1: SPECIES COMPOSITION AND DISTRIBUTION

Over recent years there have been research efforts to increase the knowledge of the species composition and distribution of corals in New Zealand waters. Due to sampling constraints, this

⁴ <https://www.doc.govt.nz/contentassets/1b230eee4e214f0da8ed6298d0c95add/doc-coral-workshop-minutes-and-gaps-nov-2017-final.pdf>

has been undertaken primarily through Despite these efforts, more data is required in the following areas:

- Biodiversity:
 - i. Improved understanding of the taxonomy of corals found in fisheries bycatch and more broadly in New Zealand, to provide a greater understanding in more detail of fishing impacts on coral biodiversity.
 - ii. Improved understanding of genetic diversity, a proxy indicator of populations particularly unique, isolated, or at risk from fishing impacts.
- Distribution and Abundance:
 - i. density/biomass/abundance data to support analyses and models that better reflect the relative importance of certain species or areas (e.g. biodiversity hot spots);
 - ii. improved understanding of bathyal variation in coral distribution across their depth ranges.
- Connectivity:
 - i. Identification of source and sink coral populations;
 - ii. Improved understanding of effective population sizes to identify potential constraints on the resilience of populations to fishing impacts;
 - iii. Understanding how population connectivity, in part driven by coral productivity and fecundity, determines the vulnerability of species to fishing impacts and their ability to recover from these disturbances

Gaining this knowledge is important to improve knowledge of species and their population connectivity, which can in turn ensure modelling accuracy. In addition, accurate biomass data is essential for performing risk assessments and determining the vulnerability of species and areas to fishing impacts.

THEME 2: CORAL PRODUCTIVITY

There is a significant knowledge gap on coral productivity (age, growth, reproduction). These data are particularly important for risk assessment approaches, and for inferring population sustainability. Data is required in the following areas:

- Improved understanding of reproductive and dispersal capacity, i.e., linking life history traits such as reproductive mode and seasonality with dispersal potential;
- Increased knowledge of larval motility, behaviour and duration to inform potential dispersal distance;
- Improved understanding of the colonisation and settlement patterns of larvae;
- Understanding of genetic and demographic population connectivity; and
- Improved understanding of age and growth characteristics.

THEME 3: CORAL MONITORING

There is a lack of quantitative monitoring data on deep-sea corals to identify changes in their populations/habitats over space and time, in relation to fishing effort. A survey plan is required to:

- Improve the understanding of changes in species distribution, genetic composition, and community structure over time; and
- Identify regions/areas where there is rapid change in response to fishing effort.

Monitoring deep-sea coral populations could enhance our understanding of dispersal, connectivity, and genetic hot spots, and provide quantitative data to feed into risk assessments.

THEME 4: CORAL RECOVERY AND RESILIENCE

Further investigation into the impacts of trawling on protected coral species is required, specifically:

- Improved understanding of survivorship, recovery dynamics following trawling, and if communities recover to their pre-fishing state;
- Improved understanding on what facilitates the recovery of corals/habitat after trawling;
- Further investigation into fishing impacts on ecosystem function/services (e.g. carbon cycling, habitat provision for juveniles, fish etc.); and
- Better understanding on how long spatial closures may need to be in place, and if recovered areas will provide similar ecosystem function/services.

This will increase our understanding of the wider impacts of fishing on corals and their communities and may help direct the design of mitigation measures.

We note for data requirements C and D, that a time series surveys of coral-dominated benthic communities have been carried out on the Chatham Rise at the ‘Graveyard Knolls’ (2001-2015) (Clark *et al.*, 2019), and the ‘Diamond Head’ knolls (2009-2015) (Clark *et al.*, 2009, 2015, 2020). These surveys include seamounts subjected to varying degrees of trawling history and closures, providing insight into spatio-temporal trends of coral responses to trawling. These studies could be used to guide future research aiming to address the data requirements described in points C and D above.

THEME 5: RISK AND IMPACTS OF FISHING ON CORALS

There is currently no comprehensive and fully quantitative ecological risk assessment on the impact of commercial fishing on protected coral species in New Zealand waters. Undertaking this assessment is essential to understand and quantify risk. This information will direct the prioritisation of research, the development of mitigation measures, and provide options for management action.

Current risk and uncertainty

Of the existing information on the risk commercial fishing poses to corals, it appears that generally, larger branching morphotypes are considered more susceptible to impacts than smaller morphotypes. However, in addition to physical damage, other factors such as distribution, abundance, genetic diversity and productivity also determine vulnerability.

It is important to highlight that results of the pilot risk assessment are not an absolute measure of risk and are relative, as some of the criteria are comparative rather than based on definitive thresholds. Those points notwithstanding, the pilot ecological risk assessment classified cup-coral genera, as well as hydrocorals, as relatively low risk, and thus would be a lower priority for mitigation research (Clark *et al.*, 2014, summary results: Table 2). Alternately, all black corals and the octocoral genus *Paragorgia* were identified as high risk, with most other reef-building scleractinians and other octocorals as medium. The classification of scleractinians as medium risk was due to their modelled spatial distribution being larger than the bottom trawl fishery footprint. Although the pilot risk assessment only considered bottom trawling, other fishing methods including bottom longline, dredging and precision seafood harvesting, may also impact corals and these interactions are poorly understood. Once a fuller risk assessment is undertaken, a better understanding of risk will assist with research prioritisation by taxon /taxa groups.

In addition to the pilot risk assessment, a recent CSP research project aiming to improve habitat suitability modelling for protected corals in New Zealand waters ([POP2018-01](#)) provides quantitative data on the overlap between predicted species distributions and the trawl footprint in New Zealand waters. The results of this research, although using presence-absence rather than abundance data, could direct the prioritisation of research through the identification of coral species in areas that are at the highest risk of interacting with fishing gear or need protection from changes in the distribution of fishing effort.

THEME 6: SHALLOW WATER CORALS

Shallow water corals (e.g., 10-40m in Fiordland, Port Pegasus) in New Zealand possibly interact with commercial fishing methods such as potting for crayfish and blue cod. These fisheries operate from small vessels on which observer coverage is virtually non-existent. Currently there is no quantitative data on the interaction between these fisheries and protected coral species. Gaining this data is essential to identifying the potential impacts of these fisheries on the protected corals in these waters.

4. Research priorities

The CSP Coral Plan is intended to be a living document that provides prioritisation guidance for research projects undertaken through the CSP in the near future (1-3 years), as opposed to a fixed-five year plan of research. Table 4 details the CSP coral research priorities that have been developed to meet the following outputs specifically related to the risk from fishing:

1. **Strategic observer placement** to cover all fishery methods with seafloor contact (all trawl fisheries, bottom long line fisheries, dredging, potting and set net fisheries), to maximise the bycatch data collected through the fisheries observer programme. An increase in geo-referenced image-based sampling and the expert identification of bycatch coral taxa will support more specific taxonomic quantitative analysis of bycatch across all New Zealand fisheries.
2. The **collection of tissue samples** from protected coral bycatch by fisheries observers to allow the genetic determination of species diversity as well as to ascertain genetic connectivity between populations. Some such research has recently been undertaken for the black coral species *Bathypathes* spp. through the CSP POP2018-06 project and for selected octocorals CSP INT2019-05 (see Section 6).
3. **Determination of coral age and growth rates** to inform productivity estimation and evaluation of recoverability from fishing impacts. While some information is available for particular species (see summary in Tracey *et al.*, 2018; Marriott *et al.*, 2019), for many species knowledge is limited. Notably, to obtain linear growth rates, complete colonies are required for some species such as black corals, sea fans and octocorals. While the NIWA invertebrate collection currently holds several specimens that may be appropriate for this analysis, investigation into methods to obtain appropriate specimens and determine appropriate ageing techniques for additional species may be required.
4. **Building species distribution models** that predict abundance in addition to presence/absence. This will allow the estimation of biomass distribution which is key for manging population status. This could support work in identifying high value areas, and/or species that have a greater need for protection.
5. Investigation into the **reproductive , dispersal and recruitment capabilities** of coral species to determine the ability of taxa to recolonise and recover from fisheries related disturbance.
6. **Establish a monitoring programme** across several key locations or habitat types within New Zealand's EEZ to measure spatial and temporal trends in coral populations in response to commercial fishing effort (i.e. trawling). This will identify whether a range of different coral populations are being impacted at sustainable levels or increasingly negatively by fishing activities.
7. Investigation into **potential mitigation measures** to minimise the impact of commercial fishing on protected coral species. Such as:

- Trawling in the same trawl footprint to avoid damaging new areas.
 - Finding an alternate fishing method to bottom trawling.
 - Spatial closures: informed by the identification of biodiversity hot spots or source areas (distribution and abundance data), in addition to species biological characteristics
 - The implementation of a network of protected areas linking current individual Benthic Protection Areas and Special Conservation Areas.
8. A formal **quantitative risk assessment** of the impacts of commercial fishing on protected coral species is an essential action. However, this type of assessment requires data input from the research priorities described above in order to ascertain risk accurately. Based on the learnings from the pilot assessment the following recommendations were made:
- The pilot risk assessment was based on the methods of the Ecological Risk Assessment for the Effects of Fishing (ERAEF, Hobday *et al.* 2007, 2011), which is a framework developed in Australia and adopted by the Marine Stewardship Council. It is recommended this framework is used for the formal risk assessment;
 - Compared to the pilot risk assessment which considered the entire Chatham Rise as one spatial unit, it would be more appropriate to examine smaller spatial units or to conduct the analysis in a more spatially explicit way such as has been done for seabirds and marine mammals (e.g., Richards & Abraham 2013); and
 - The pilot risk assessment notified that species within taxonomic groups had different vulnerability to fishing impacts. Thus, it is recommended that risk is assessed at various taxonomic and functional levels.

5. Recent coral related CSP projects

This section lists recent coral-related projects funded through CSP, including those contacted during the 2022-23 financial year. Additional coral-related research, contracted through non-CSP DOC funding or through Fisheries New Zealand, are excluded from this list, so it captures the bulk of the DOC coral-related research relevant to commercial fisheries but is not an exhaustive list.

Population Projects:

POP2022-03: Deep sea protected coral reproduction study

POP2022-04: Deep diving into decades of uncatalogued corals

POP2021-02: Identification of protected coral hotspots using species distribution modelling

POP2020-02: Protected coral ID and awareness

POP2017-07: Ageing methods for protected deep-sea corals: a review and recommendation for an ageing study

POP2017-07: The age and growth of New Zealand protected corals at high risk: *Bathypathes patula*

POP2018-01: Improved habitat suitability modelling for protected corals in New Zealand waters

POP2013-05: Protected coral distribution modelling
POP2018-06: Protected coral connectivity in New Zealand
POP2013-05: Pilot benthic risk assessment final report
POP2011-06: The distribution of protected corals in New Zealand

Interaction projects:

INT2022-03: Identification, storage, and genetics of cold-water coral bycatch specimens
INT2021-02: Characterisation of protected coral interactions
INT2019-05: Coral biodiversity in deep-water fisheries bycatch
INT2019-04: Identification and storage of cold-water coral bycatch specimens
INT2015-03: Identification and storage of cold-water coral bycatch specimens: 1/07/18-30/06/19
INT2015-03: Identification and storage of cold-water coral bycatch specimens: 1/07/17-30/06/18
INT2010-03: Distribution of protected corals in relation to fishing effort and assessment of accuracy of observer identification
INT2009-03: Identification of protected corals 2009/10
INT2008-02: Identification of protected corals 2008/09
INT2007-03: Identification of protected corals 2007/08

Mitigation Projects:

MIT2022-03: DOC Coral Symposium 2022/23
MIT2019-02: Mitigation techniques to reduce benthic impacts of trawling (a review)

6. References

- Clark, M.R.; Tracey, D.M.; Pallentin, A.; Schnabel, K.; Anderson, O.F.; Bowden, D. 2009. Voyage report of a survey of “seamounts” on the northwest and southeast Chatham Rise (TAN0905). 49 p. (unpublished report available from NIWA, Wellington).
- Clark, M.; Tracey, D.; Anderson, O.; Parker, S. 2014. Pilot ecological risk assessment for protected corals. NIWA Client Report 2014-70. Report prepared by the National Institute of Water and Atmospheric Research for the New Zealand Department of Conservation, Wellington. <https://www.doc.govt.nz/globalassets/documents/conservation/marine-and-coastal/marine-conservation-services/meetings/pilot-benthic-risk-assessment.pdf>
- Clark, M.; Bowden, D.; Tracey, D.; Mills, S.; George, S.; Stewart, R.; Hart, A.; Macpherson, D.; Gammon, M.; Holland, L.; Moore, K.; Frontin-Rollett, G. 2015. Factual voyage report of a survey of “seamounts” on the northwest and southeast Chatham Rise (TAN1503). Voyage report provided to MPI. June 2015.
- Clark, M.; Bowden, D.; Rowden, A.; Stewart, R. 2019. Little evidence of benthic community resilience to bottom trawling on seamounts after 15 years. *Frontiers in Marine Science*, 6
- Clark, M.R.; Bowden, D.A.; Rowden, A.A.; Stewart, R.; Schnabel, K.; Quinn, W., Lernbard .B. , Goode, S. L., Davis, A. 2020: Seamount recovery: factual voyage report of a survey of seamounts on the Northwest and Southeast Chatham Rise (Tan2009:August2020). *New Zealand Aquatic Environment and Biodiversity Report* (in press).
- Consalvey, M.; MacKay, K.; Tracey, D. 2006. Information review for protected deep-sea coral species in the New Zealand region. NIWA client report WLG2006-85 prepared for the Department of Conservation. NIWA, Wellington.
- Freeman, D.; Schnabel, K.; Marshall, B.; Gordon, D.; Wing, S.; Tracey D.; Hitchmough R. 2014. New Zealand Threat Classification Series 9. 20 p. ([PDF, 664K \(opens in new window\)](#))
- Hjorvarasdottir, F., Tracey, D. (2017). Workshop on research needs for protected corals in New Zealand waters: Workshop minutes. 18p. <https://www.doc.govt.nz/pagefiles/174857/doc-coral-workshop-minutes-and-gaps-nov-2017-final.pdf>
- Hobday, A.J.; Smith, A.; Webb, H.; Daley, R.; Wayte, S.; Bulman, C.; Dowdney, J.; Williams, A.; Sporcic, M.; Dambacher, J.; Fuller, M.; Walker, T. 2007. Ecological Risk Assessment for the Effects of Fishing: Methodology. Report R04/1072 for AFMA: available here: http://www.afma.gov.au/environment/eco_based/eras/docs/methodology.pdf
- Hobday, A.J.; Smith, A.D.M.; Stobutzki, I.C.; *et al.* 2011. Ecological risk assessment for the effects of fishing. *Fish and Fisheries* 108: 372-384
- Marriott, P.; Tracey, D.; Bostock, H.; Hitt, N.; Fallon, S. (2019). Ageing deep-sea corals black coral *Bathypathes patula*. Final Report prepared by NIWA for the Conservation Services Programme, Department of Conservation. INT2015-03. NIWA Client Report 2019036WN.
- Richard, Y.; Abraham, E.R. 2013. Application of Potential Biological Removal methods to seabird populations. *New Zealand Aquatic Environment and Biodiversity Report* No. 108.

Tracey, D., Bostock, H., Shaffer, M. 2018. Ageing methods for protected deep-sea corals: A review and recommendation for an ageing study. DOC Contract 4527 GMC - Age & Growth of coral (POP2017-07). NIWA Client Report No. 2018035WN

Tracey, DM & Hjørvarisdóttir, F (eds, comps) 2019. The state of knowledge of deep-sea corals in the New Zealand region. NIWA Science and Technology Series No. 84. 140pp.

7. Tables

Table 1. Protected coral taxa found in the New Zealand EEZ. The number of species is indicative as of 2019 (as reported in the 2019 report⁵), and does not include more recent discoveries of species pending description or non-protected taxa.

Order	Common name	Number of species
Order Scleractinia	Stony corals (cup and branching forms)	116
Order Antipatharia	Black corals	33
Order Alcyonacea	Sea fans, sea whips, bubblegum corals (there are at least 12 families containing deep-water structure-forming gorgonian octocorals).	167
Order Anthoathecata: Family Stylasteridae	stylasterids, lace corals	56
	Total	372

Table 2. The overall risk ranking of the 15 coral genera/groups included in the pilot risk assessment for the impact of trawling on protected coral taxa on the Chatham Rise. Adapted from Clark *et al.*, 2014.

Coral Taxa	Observer Code	Overall Risk Ranking
<i>Solenosmilia</i>	SVA	Medium
<i>Goniocorella</i>	GDU	Medium
<i>Madrepora</i>	MOC	Medium
<i>Oculina</i>	OVI	Medium
<i>Enallopsammia</i>	ERO	Medium
Black corals	COB	High
<i>Bathypathes</i>	BTP	High
Gorgonians	GOC	Medium
<i>Paragorgia</i>	PAB	High
<i>Primnoa</i>	PRI	Medium
Bamboo corals	KER-LEP	Medium
<i>Metallogorgia</i>	MTL	Medium
<i>Flabellum</i>	COF	Low
<i>Caryophyllia</i>	CAY	Low
Hydrocorals	COR	Low

⁵ <https://niwa.co.nz/sites/niwa.co.nz/files/Deepsea-corals-NZ-2019-NIWA-SciTechSeries-84.pdf>

Table 3. Protected coral taxa found in New Zealand waters for which the conservation status has been established (Freeman *et al.*, 2014).

Order	Common name	Family	Species name	Conservation Status
Antipatharia	Black coral	Myriopathidae	<i>Antipathella fiordensis</i> (Grange, 1990)	Naturally Uncommon
	Black coral	Antipathidae	<i>Antipathes fruticosa</i> (Gray, 1857)	Data Deficient
	Black coral	Antipathidae	<i>Antipathes n. sp.</i>	Naturally uncommon
	Black coral	Schizopathidae	<i>Lillipathes lillei</i> (Totton, 1923)	Naturally uncommon
Alcyonacea (previously Gorgonacea)	Golden coral	Chrysogorgiidae	<i>Metallogorgia sp.</i>	Declining
	Bamboo coral	Isididae	<i>Chathamisis bayeri</i> (Grant, 1976)	Nationally Vulnerable
	Bamboo coral	Isididae	<i>Mopsea sp.</i>	Data Deficient
	Bamboo coral	Isididae	<i>Peltastisis sp.</i>	Data Deficient
	Bamboo coral	Isididae	<i>Primnoisis sp. C</i>	Data Deficient
	Bamboo coral	Isididae	<i>Acanella spp.</i>	Naturally uncommon
	Bamboo coral	Isididae	<i>Chathamisis spp.</i> (Kermadec Ridge)	Naturally uncommon
	Bamboo coral	Isididae	<i>Echinisis spicata</i> (Hickson, 1907)	Naturally uncommon
	Bamboo coral	Isididae	<i>Echinisis spp.</i>	Naturally uncommon
	Bamboo coral	Isididae	<i>Keratoisis n. sp.</i>	Naturally uncommon
	Bamboo coral	Isididae	<i>Minuisis</i>	Naturally uncommon
	Bamboo coral	Isididae	<i>Sclerisis sp.</i> (NIWA J. Sanchez)	Data Deficient
	Bamboo coral	Isididae	<i>Circinisis circinata</i> (Grant, 1976)	Data Deficient
	Bamboo coral	Isididae	<i>Echinisis spicata</i> (Hickson, 1907)	Naturally Uncommon
	Bamboo coral	Isididae	<i>Keratoisis glaesa</i> (Grant, 1976)	Naturally Uncommon
	Bamboo coral	Isididae	<i>Keratoisis hikurangiensis</i> (Grant, 1976)	Naturally Uncommon
	Bamboo coral	Isididae	<i>Keratoisis projecta</i> (Grant, 1976)	Naturally Uncommon
	Bamboo coral	Isididae	<i>Keratoisis tangentis</i> (Grant, 1976)	Naturally Uncommon
	Bamboo coral	Isididae	<i>Keratoisis zelanica</i> (Grant, 1976)	Naturally Uncommon
	Bamboo coral	Isididae	<i>Primnoisis ambigua</i> (Wright & Studer, 1889)	Data Deficient

	Bamboo coral	Isididae	<i>Primnoisis antarctica</i> (Studer, 1878)	Data Deficient
	Bubblegum coral	Paragorgiidae	<i>Paragorgia alisonae</i> (Sanchez, 2005)	Nationally Vulnerable
	Bubblegum coral	Paragorgiidae	<i>Paragorgia aotearoa</i> Sanchez, 2005	Data Deficient
	Bubblegum coral	Paragorgiidae	<i>Paragorgia arborea</i> (Linnaeus, 1758)	Declining
	Bubblegum coral	Paragorgiidae	<i>Paragorgia kaupeka</i> (Sanchez, 2005)	Data Deficient
	Bubblegum coral	Paragorgiidae	<i>Paragorgia maunga</i> (Sanchez, 2005)	Data Deficient
	Bubblegum coral	Paragorgiidae	<i>Paragorgia wahine</i> (Sanchez, 2005)	Data Deficient
	Bubblegum coral	Paragorgiidae	<i>Paragorgia whero</i> (Sanchez, 2005)	Data Deficient
	Bubblegum coral	Paragorgiidae	<i>Sibogorgia dennisgordoni</i> (Sanchez, 2005)	Data Deficient
	Bubblegum coral	Paragorgiidae	<i>Sibogorgia tautahi</i> (Sanchez, 2005)	Data Deficient
	Sea fan	Primonoidae	<i>Calyptrophora cristata</i> (Cairns, 2012)	Data Deficient
	Sea fan	Primonoidae	<i>Calyptrophora diaphana</i> (Cairns, 2012)	Data Deficient
	Sea fan	Primonoidae	<i>Calyptrophora niwa</i> (Cairns, 2012)	Data Deficient
	Sea fan	Primonoidae	<i>Helicoprinnia fasciola</i> (Cairns, 2012)	Data Deficient
	Sea fan	Primonoidae	<i>Metanarella nannolepis</i> (Cairns, 2012)	Data Deficient
	Sea fan	Primonoidae	<i>Narellodes crinitus</i> (Cairns, 2012)	Data Deficient
	Sea fan	Primonoidae	<i>Calyptrophora cucullata</i> (Cairns, 2012)	Naturally Uncommon
	Sea fan	Primonoidae	<i>Calyptrophora inornata</i> (Cairns, 2012)	Naturally Uncommon
	Sea fan	Primonoidae	<i>Narella mosaica</i> Cairns, 2012	Data Deficient
	Sea fan	Primonoidae	<i>Narella hypsocalyx</i> Cairns, 2012	Naturally Uncommon
	Sea fan	Primonoidae	<i>Narella mesolepis</i> Cairns, 2012	Naturally Uncommon
	Sea fan	Primonoidae	<i>Narella vulgaris</i> Cairns, 2012	Naturally Uncommon
Scleractinia	Stony coral	Dendrophylliidae	<i>Balanophyllia chnous</i> (Squires, 1962)	Naturally Uncommon
	Stony coral	Oculinidae	<i>Madrepora oculata</i> (Linnaeus, 1758)	Declining
	Stony coral	Oculinidae	<i>Oculina virgosa</i> (Squires, 1958)	Naturally Uncommon
	Stony coral	Dendrophylliidae	<i>Craterithea novaezelandiae</i> (Thompson, 1879)	Naturally Uncommon

	Stony cup coral	Flabellidae	<i>Falcatoflabellum raoulensis</i> (Cairns, 1995)	Naturally Uncommon
	Stony cup coral	Turbinoliidae	<i>Sphenotrochus squiresi</i> (Cairns, 1995)	Naturally Uncommon
	Stony branching coral	Dendrophylliidae	<i>Enallopsammia rostrata</i> (Pourtales, 1878)	Declining
	Stony cup coral	Caryophylliidae	<i>Coenocyathus brooki</i> (Cairns, 1995)	Data Deficient
	Stony branching coral	Caryophylliidae	<i>Goniocorella dumosa</i> (Alcock, 1902)	Declining
	Stony branching coral	Caryophylliidae	<i>Solenosmilia variabilis</i> (Duncan, 1873)	Declining
Anthoathecata	Lace coral	Stylasteridae	<i>Errina bicolor</i> (Cairns, 1991)	Naturally Uncommon
	Lace coral	Stylasteridae	<i>Errina chathamensis</i> (Cairns, 1991)	Naturally Uncommon
	Lace coral	Stylasteridae	<i>Errina cheilopora</i> (Cairns, 1983)	Naturally Uncommon
	Lace coral	Stylasteridae	<i>Errina cooki</i> (Hickson, 1912)	Data Deficient
	Lace coral	Stylasteridae	<i>Errina dendyi</i> (Hickson, 1912)	Data Deficient
	Lace coral	Stylasteridae	<i>Errina hicksoni</i> (Cairns, 1991)	Data Deficient
	Lace coral	Stylasteridae	<i>Errina laevigata</i> (Cairns, 1991)	Naturally Uncommon
	Lace coral	Stylasteridae	<i>Errina novaezelandiae</i> (Hickson, 1912)	Naturally Uncommon
	Lace coral	Stylasteridae	<i>Errina reticulata</i> (Cairns, 1991)	Naturally Uncommon
	Lace coral	Stylasteridae	<i>Errina sinuosa</i> (Cairns, 1991)	Naturally Uncommon

Table 4. CSP Research Priorities* for New Zealand Protected Corals.

Research priority	Priority level*
<p>Interaction studies:</p> <ul style="list-style-type: none"> • An updated formal risk assessment estimating the impact of commercial fishing (e.g. trawling) on protected coral populations • Investigate recovery dynamics post trawling impacts • Determine what facilitates the recovery of corals/habitat after trawling • Determine the impact of trawling on ecosystem function/services of deep sea protected corals • Characterisation of the impact of commercial fishing on protected corals in shallow waters (e.g. 10-40m, Fiordland, Port Pegasus) 	<p>High</p> <p>High</p> <p>Medium-High</p> <p>Medium-High</p> <p>High</p>
<p>Population studies:</p> <ul style="list-style-type: none"> • Increase understanding of taxonomy • Determine small effective population sizes and their implication on resilience to fishing impacts • Determine reproductive and dispersal capabilities • Determine larval biology, duration and settlement patterns • Determine population connectivity • Identify source and sink populations • Determine age and growth characteristics • Identification of biodiversity hot spots/ areas of high protection value • Monitor changes in genetic and community structure, as well as species distribution over space and time in relation to fishing effort • Modelling distribution including abundance/ biomass (not just presence/absence) 	<p>Medium-High</p> <p>Medium-High</p> <p>High</p> <p>Medium-High</p> <p>High</p> <p>Medium-High</p> <p>High</p> <p>High</p> <p>High</p> <p>High</p>
<p>Mitigation studies:</p> <ul style="list-style-type: none"> • Analysis of potential mitigation measures to minimise the impact of commercial fishing on protected coral species • Determine the effectiveness of spatial closures; considering design, how long the closure needs to be in place, and if recovered areas will provide similar ecosystem function/services. 	<p>Medium-High</p> <p>Medium-High</p>

*Note: Priority level has been assigned qualitatively by DOC based on the importance of the work (i.e. whether the research addresses significant data gaps and whether it is a prerequisite to another project). Gaps listed here were guided by those identified in the 2017 workshop, by discussion with CSP stakeholders, and by recommendations from CSP projects.