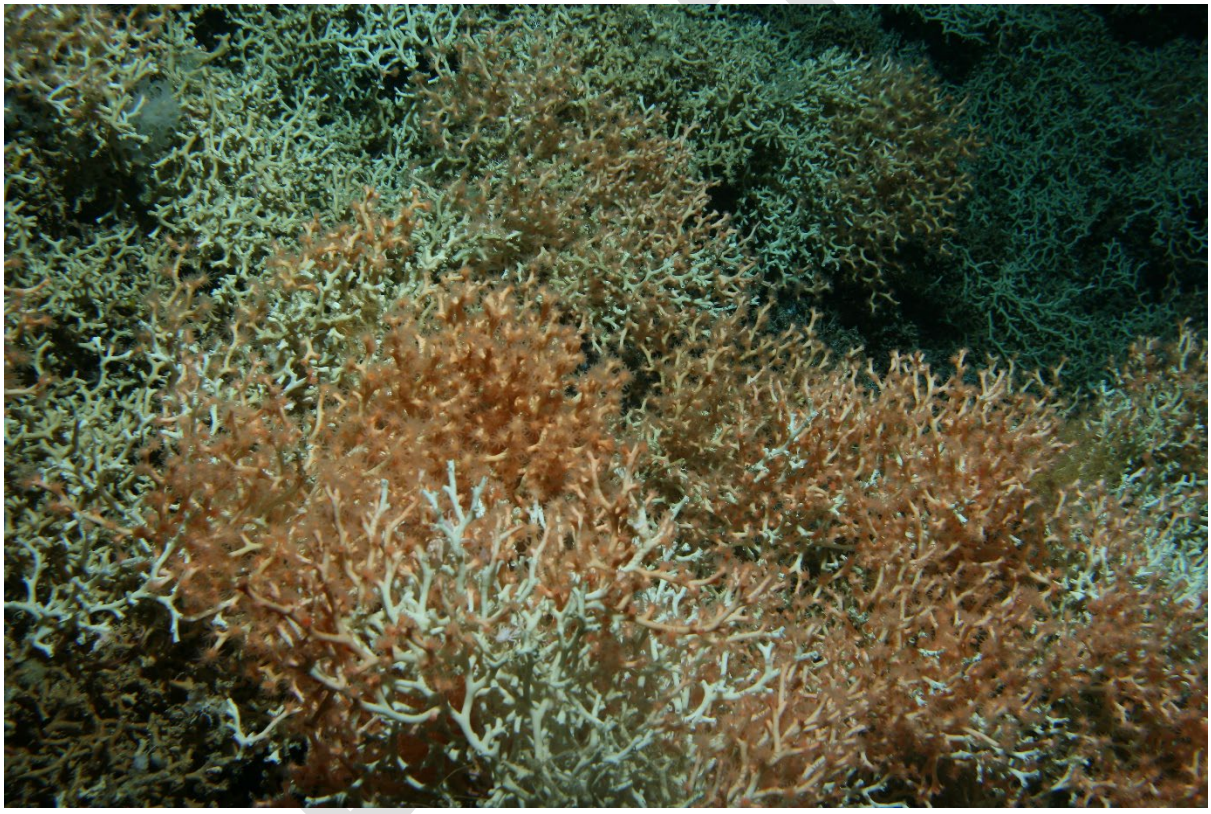
Conservation Services Programme

Protected Coral Medium-Term Research Plan



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Contents

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[2]). 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 primarily focuses on deep water corals and the impact of bottom trawling on them, as most interaction data and bycatch samples available stem from these fisheries, although the distribution of protected corals in New Zealand waters overlaps with multiple fisheries. Corals are also found in shallower habitats (e.g., Fiordland, Port Pegasus) where they may interact with other fishing methods (e.g. potting, bottom long-lining). 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, but is sometimes crown funded and may be incorporated into CSP planning processes as it may also guide CSP coral management considerations.

2. Guiding objectives and risk framework

Unlike protected seabirds and sharks, protected corals do not yet have a National Plan of Action, Threat Management Plan, or associated risk assessment framework to guide management actions and research planning (although a risk assessment is currently underway through project INT2022-04). In the interim until such a Plan is developed, this 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 previous CSP reports. 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

[2] https://www.doc.govt.nz/our-work/conservation-services-programme/csp-plans/csp-strategic-statement/

addressing one or several of the **CSP objectives.** These objectives guide the scope of research within this plan:

- **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 coral populations.

Secondly, **Te Mana O Te Taiao Aotearoa the New Zealand Biodiversity Strategy 2020**[3],[4], TMOTT) outlines thirteen objectives to safeguard New Zealand's biodiversity, each of which has specific goals set to achieve five-, ten- and thirty-year targets. Relevant 5-year/2025 goals in the Strategy that relate to protected corals include goals to reduce fisheries bycatch, for the sustainable use of marine resources, and for protection of 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

[3] In English: https://www.doc.govt.nz/globalassets/documents/conservation/biodiversity/anzbs-2020.pdf
[4] In Te Reo: https://www.doc.govt.nz/globalassets/documents/conservation/biodiversity/anzbs-2020-te-reo-maori.pdf

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

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 and there remains low confidence in the assignments for those species that have undergone assessment. The threat status of numerous marine invertebrates was updated in 2021 (Funnell *et al.* 2023). At the time of updating this MTRP, 101 species of coral have been classified via the NZTCS; 11 are classified as not threatened, 34 are classified as naturally uncommon, 15 are classified as at risk: declining, and 1 is classed as threatened: nationally vulnerable. The remaining 40 species are classified as data deficient, meaning there is not enough information to confidently determine their threat status. The lack of data and/or poor confidence in population trends means that coral research is generally not prioritised by its NZTCS status, although it is a consideration.

Fourthly, a **semi-quantitative pilot ecological risk assessment** was conducted in 2014 (Clark *et al.*, 2014), focusing on the Chatham Rise, in which the effect of bottom trawling risk was estimated by a Productivity-Susceptibility-Analysis (PSA) for 15 coral species (Table 2). This approach considers the extent of impact on corals due to fishing activity ("susceptibility"), and their potential to recover from the impact ("productivity"). Although relative, the pilot indicated that most corals analysed are at medium or high 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). Following the pilot study, CSP has increased effort to improve information on, for example, coral distribution and productivity (Section 5). As such, a fully quantitative **risk assessment** of the effect of commercial fishing on protected coral species in New Zealand waters is currently underway (CSP project INT2022-04). This project is assessing risk for a select subset of coral taxa representative of the four protected coral groups and utilising best and most recently-available data; it is expected that outcomes from this project will guide CSP research in the coming years.

Finally, in October 2017, a **workshop** on the research needs for New Zealand protected corals was held at the Department of Conservation where 58 knowledge gaps within six categories were identified: '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[5]). 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 and that inform this MTRP. The report incorporated the findings from the 2017 gaps workshop and updated a preceding review (Consalvey *et al.* 2006).

[5] https://www.doc.govt.nz/contentassets/1b230eee4e214f0da8ed6298d0c95add/doc-coral-workshop-minutes-and-gaps-nov-2017-final.pdf

3. Data Requirements

Understanding of New Zealand coral biology and ecology for multiple taxa and at various spatial scales 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 categorise research that can be aligned to the CSP objectives (Section 2).

THEME 1: SPECIES COMPOSITION AND DISTRIBUTION

Over recent years, CSP has focused effort to increase the knowledge of coral species composition and distribution in New Zealand waters. This has been undertaken primarily through modelling approaches underpinned by physical and observational records, and video survey footage (e.g., projects POP2021-02, POP2022-04). As such, we currently have more information about coral distribution in New Zealand than we ever have. However, 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 distributions and their population connectivity, to improve understanding of overlap with fisheries, which can in turn can define areas for targeted management. 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 inferring population vulnerability, resilience, and sustainability and for application to risk assessment approaches. 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 New Zealand corals to identify changes in their populations/habitats over space and time, in relation to fishing effort; furthermore, in many cases, baseline data are unavailable. 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 enable assessment of fishing impacts and 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 the data requirements listed above 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. This research, and similar repeat studies, could be used to guide future research aiming to address the data requirements described for Theme 4.

THEME 5: RISK AND IMPACTS OF FISHING ON CORALS

The first quantitative risk assessment of protected corals in New Zealand waters is underway (CSP project INT2022-04). 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

From an earlier pilot study (POP2013-05), the existing information on the risk commercial fishing poses to corals suggests 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 (Clark *et al*., 2014, summary results: Table 2). Alternately, all black corals and the octocoral genus *Paragorgia* (bubblegum corals) 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, Danish seine and potting may also impact corals; these interactions are poorly understood. After the fuller risk assessment is complete, improved understanding of risk across fisheries is expected.

In addition to risk assessment, recent CSP research aiming to improve knowledge of overlap and impacts of fishing includes improving habitat suitability modelling for protected corals in New Zealand waters to include abundance estimates (POP2021-02 coral hotspots), updating and characterising risk by fishery and taxon (INT2021-02 coral bycatch characterisation), and using presence-based records from multiple sources to improve distribution information (POP2022-04). The results of this research could direct the prioritisation of research and management efforts through the identification of coral species in areas that are at the highest risk of interacting with fishing gear.

THEME 6: SHALLOW WATER CORALS

Shallow water corals (e.g., 10-80m in Fiordland) in New Zealand representative of the four protected coral groups (black corals, stony corals, gorgonians and stylasterid hydrocorals) overlap in range with commercial fisheries, such as potting for crayfish and blue cod. Furthermore, multiple bycatch records for corals are from inshore fisheries, including trawling. Currently there is no quantitative data on the interaction between these fisheries and protected coral species, and usually very little coverage (and hence data collection) by fisheries observers. Gaining information is essential to identifying the potential impacts of these fisheries on the protected corals in these waters. Specific data gaps include:

- Baseline distribution data for the four protected corals groups in Fiordland, inclusive of depth limits, in relation to fishing effort
- Baseline data on shallow water coral distribution in other areas subject to inshore commercial fishing.
- Understanding of the extent of and physical impacts of fishing gear on protected corals, and potential for coral recovery, in shallow waters.

4. Research priorities

This 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 (1-5 years). 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, bottom longline, 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 coral bycatch will support more detailed 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 diversity estimation and connectivity between populations.

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 determine appropriate ageing techniques for multiple species and specimen acquisition 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 and to inform productivity and vulnerability estimates.

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. For example:
    - 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 high-value areas for coral biodiversity, abundance, or uniqueness
    - The implementation of a network of effective and well-connected marine protected areas (ie benthic closures).

8. A formal **quantitative risk assessment** of the impacts of commercial fishing on protected coral species is an essential action. To ascertain risk accurately, this type of assessment requires data input from the research priorities described above. Based on the learnings from the pilot assessment the following recommendations will be implemented in INT2022-04:

    - 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. This framework is being used in the current CSP 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[6]

[6] Project reports can be found here: CSP reports (doc.govt.nz)

Recent coral-related projects administered through CSP are listed below.

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:

INT2023-10 Understanding coral bycatch – assessing large catches
INT2023-09 Understanding the extent and usage of coral rubble reporting codes by fisheries observers
INT2023-07 Expert identification of protected corals
INT2023-05 High-resolution estimation of species diversity for a protected coral family commonly occurring as trawl bycatch
INT2022-03: Identification, storage, and genetics of cold-water coral bycatch specimens
INT2022-04 Risk Assessment for Protected Corals
INT2022-04 Determining the resilience of Fiordland corals to fisheries impacts
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 2024
MIT2019-02: Mitigation techniques to reduce benthic impacts of trawling (a review)

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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 report[7]), 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
Solenosmilia	SVA	Medium
Goniocorella	GDU	Medium
Madrepora	MOC	Medium
Oculina	OVI	Medium
Enallopsammia	ERO	Medium
Black corals	COB	High
Bathypathes	BTP	High
Gorgonians	GOC	Medium
Paragorgia	PAB	High
Primnoa	PRI	Medium
Bamboo corals	KER-LEP	Medium
Metallogorgia	MTL	Medium
Flabellum	COF	Low
Caryophyllia	CAY	Low
Hydrocorals	COR	Low

[7] 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, Funnell *et al.* 2021).

Order	Common name	Family	Species name	Conservation Status
Antipatharia	Black coral	Myriopathidae	*Antipathella fiordensis* (Grange, 1990)	Not Threatened
	Black coral	Antipathidae	*Antipathes fruticosa* (Gray, 1857)	Data Deficient
	Black coral	Antipathidae	*Antipathes n. sp.*	Naturally Uncommon
	Black coral	Schizopathidae	*Lillipathes lillei* (Totton, 1923)	Naturally Uncommon
	Black coral	Aphanipathidae	*Asteriopathes octocrada* Opresko, 2015	Data Deficient
	Black coral	Schizopathidae	*Parantipathes dodecasticha* Opresko, 2015	Data Deficient
	Black coral	Schizopathidae	*Parantipathes robusta* Opresko, 2015	Data Deficient
	Black coral	Aphanipathidae	*Phanopathes zealandica* Opresko, 2015	Data Deficient
	Black coral	Antipathidae	*Antipathes leptocrada* Opresko, 2015	Naturally Uncommon
	Black coral	Schizopathidae	*Alternatipathes alternata* (Brook, 1889)	Not Threatened
Alcyonacea (previously Gorgonacea)	Golden coral	Chrysogorgiidae	*Metallogorgia sp.*	Declining
	Bamboo coral	Isididae	*Chathamisis bayeri* (Grant, 1976)	Declining
	Bamboo coral	Isididae	*Mopsea sp.*	Data Deficient
	Bamboo coral	Isididae	*Peltastisis sp.*	Data Deficient
	Bamboo coral	Isididae	*Primnoisis sp. C*	Data Deficient
	Bamboo coral	Isididae	*Acanella spp.*	Naturally Uncommon
	Bamboo coral	Isididae	*Chathamisis spp.* (Kermadec Ridge)	Naturally Uncommon
	Bamboo coral	Isididae	*Echinisis spicata* (Hickson, 1907)	Naturally Uncommon
	Bamboo coral	Isididae	*Echinisis spp.*	Naturally Uncommon
	Bamboo coral	Isididae	*Keratoisis n. sp.*	Naturally Uncommon
	Bamboo coral	Isididae	*Minuisis*	Declining
	Bamboo coral	Isididae	*Sclerisis sp.* (NIWA J. Sanchez)	Data Deficient
	Bamboo coral	Isididae	*Circinisis circinata* (Grant, 1976)	Data Deficient
	Bamboo coral	Isididae	*Echinisis spicata* (Hickson, 1907)	Naturally Uncommon
	Bamboo coral	Isididae	*Keratoisis glaesa* (Grant, 1976)	Naturally Uncommon
	Bamboo coral	Isididae	*Keratoisis hikurangiensis*	Naturally Uncommon

			(Grant, 1976)	
	Bamboo coral	Isididae	*Keratoisis projecta* (Grant, 1976)	Naturally Uncommon
	Bamboo coral	Isididae	*Keratoisis tangentis* (Grant, 1976)	Naturally Uncommon
	Bamboo coral	Isididae	*Keratoisis zelanica* (Grant, 1976)	Naturally Uncommon
	Bamboo coral	Isididae	*Primnoisis ambigua* (Wright & Studer, 1889)	Data Deficient
	Bamboo coral	Isididae	*Primnoisis antarctica* (Studer, 1878)	Data Deficient
	Bamboo coral	Isididae	*Acanella arbuscula* (Johnson, 1862)	Data Deficient
	Bamboo coral	Isididae	*Acanella rigida* Wright & Studer, 1889	Data Deficient
	Bamboo coral	Isididae	*Sclerisis macquariana* Bayer & Stefani, 1987	Data Deficient
	Bamboo coral	Isididae	*Primnoisis chatham* Moore, Alderslade & Miller, 2016	Naturally Uncommon
	Bamboo coral	Isididae	*Primnoisis erymna* Moore, Alderslade & Miller, 2016	Not Threatened
	Bubblegum coral	Paragorgiidae	*Paragorgia alisonae* (Sanchez, 2005)	Nationally Vulnerable
	Bubblegum coral	Paragorgiidae	*Paragorgia aotearoa* Sanchez, 2005	Data Deficient
	Bubblegum coral	Paragorgiidae	*Paragorgia arborea* (Linnaeus, 1758)	Declining
	Bubblegum coral	Paragorgiidae	*Paragorgia kaupeka* (Sanchez, 2005)	Data Deficient
	Bubblegum coral	Paragorgiidae	*Paragorgia maunga* (Sanchez, 2005)	Data Deficient
	Bubblegum coral	Paragorgiidae	*Paragorgia wahine* (Sanchez, 2005)	Data Deficient
	Bubblegum coral	Paragorgiidae	*Paragorgia whero* (Sanchez, 2005)	Data Deficient
	Bubblegum coral	Paragorgiidae	*Sibogagorgia dennisgordoni* (Sanchez, 2005)	Data Deficient
	Bubblegum coral	Paragorgiidae	*Sibogagorgia tautahi* (Sanchez, 2005)	Data Deficient
	Sea fan	Primnoidae	*Calyptrophora cristata* (Cairns, 2012)	Data Deficient
	Sea fan	Primnoidae	*Calyptrophora diaphana* (Cairns, 2012)	Data Deficient
	Sea fan	Primnoidae	*Calyptrophora niwa* (Cairns, 2012)	Data Deficient
	Sea fan	Primnoidae	*Helicoprimnoa fasciola* (Cairns, 2012)	Data Deficient
	Sea fan	Primnoidae	*Metanarella nannolepis* (Cairns, 2012)	Data Deficient
	Sea fan	Primnoidae	*Narelloides crinitus* (Cairns, 2012)	Data Deficient
	Sea fan	Primnoidae	*Calyptrophora cucullata* (Cairns, 2012)	Naturally Uncommon

	Sea fan	Primnoidae	*Calyptrophora inornata (Cairns, 2012)*	Naturally Uncommon
	Sea fan	Primnoidae	*Narella mosaica Cairns, 2012*	Data Deficient
	Sea fan	Primnoidae	*Narella hypsocalyx Cairns, 2012*	Naturally Uncommon
	Sea fan	Primnoidae	*Narella mesolepis Cairns, 2012*	Naturally Uncommon
	Sea fan	Primnoidae	*Narella vulgaris Cairns, 2012*	Naturally Uncommon
	Sea fan	Primnoidae	*Callogorgia histoclados* (Cairns, 2016)	Data deficient
	Sea fan	Primnoidae	*Loboprimnoa exotica* Cairns, 2016	Data deficient
	Sea fan	Primnoidae	*Metafannyella polita* Cairns, 2016	Data deficient
	Sea fan	Primnoidae	*Narelloides traceyae* Cairns, 2016	Data deficient
	Sea fan	Primnoidae	*Pachyprimnoa asakoae* Cairns, 2016	Data deficient
	Sea fan	Primnoidae	*Perissogorgia rigida* Cairns, 2016	Data deficient
	Sea fan	Primnoidae	*Callogorgia dichotoma* Cairns, 2016	Naturally Uncommon
	Sea fan	Primnoidae	*Callozostron pinnatum* Cairns, 2016	Naturally Uncommon
	Sea fan	Primnoidae	*Primnoella insularis* Cairns, 2016	Naturally Uncommon
	Sea fan	Primnoidae	*Callogorgia tessellata* Cairns, 2016	Not Threatened
	Sea fan	Primnoidae	*Metafannyella chathamensis* Cairns, 2016	Not Threatened
	Sea fan	Primnoidae	*Plumarella cordilla* Cairns, 2016	Not Threatened
Scleractinia	Stony coral	Dendrophylliidae	*Balanophyllia chnous* (Squires, 1962)	Naturally Uncommon
	Stony coral	Oculinidae	*Madrepora oculata* (Linnaeus, 1758)	Declining
	Stony coral	Oculinidae	*Oculina virgosa* (Squires, 1958)	Naturally Uncommon
	Stony coral	Dendrophylliidae	*Crateritheca novaezelandiae (Thompson, 1879)*	Naturally Uncommon
	Stony cup coral	Flabellidae	*Falcatoflabellum raoulensis* (Cairns, 1995)	Naturally Uncommon
	Stony cup coral	Turbinoliidae	*Sphenotrochus squiresi* (Cairns, 1995)	Naturally Uncommon
	Stony branching coral	Dendrophylliidae	*Enallopsammia rostrata* (Pourtales, 1878)	Declining
	Stony cup coral	Caryophylliidae	Coenocyathus brooki (Cairns, 1995)	Data Deficient
	Stony branching coral	Caryophylliidae	*Goniocorella dumosa* (Alcock, 1902)	Declining

	Stony branching coral	Caryophylliidae	*Solenosmilia variabilis* (Duncan, 1873)	Declining
	Stony cup coral	Flabellidae	*Flabellum cinctutum* Cairns & Polonio, 2013	Data deficient
Anthoathecata	Lace coral	Stylasteridae	*Errina bicolor* (Cairns, 1991)	Naturally Uncommon
	Lace coral	Stylasteridae	*Errina chathamensis* (Cairns, 1991)	Naturally Uncommon
	Lace coral	Stylasteridae	*Errina cheilopora* (Cairns, 1983)	Naturally Uncommon
	Lace coral	Stylasteridae	*Errina cooki* (Hickson, 1912)	Data Deficient
	Lace coral	Stylasteridae	*Errina dendyi* (Hickson, 1912)	Data Deficient
	Lace coral	Stylasteridae	*Errina hicksoni* (Cairns, 1991)	Data Deficient
	Lace coral	Stylasteridae	*Errina laevigata* (Cairns, 1991)	Naturally Uncommon
	Lace coral	Stylasteridae	*Errina novaezelandiae* (Hickson, 1912)	Naturally Uncommon
	Lace coral	Stylasteridae	*Errina reticulata* (Cairns, 1991)	Naturally Uncommon
	Lace coral	Stylasteridae	*Errina sinuosa* (Cairns, 1991)	Naturally Uncommon

Table 4. CSP coral research priorities*, guided by the 2017 workshop.

Research priority	**Priority level***
Interaction studies:	
• An updated formal risk assessment estimating the impact of commercial fishing (e.g. trawling) on protected coral populations	High
• Investigate recovery dynamics post trawling impacts	High
• Determine what facilitates the recovery of corals/habitat after trawling	Medium-High
• Determine the impact of trawling on ecosystem function/services of deep sea protected corals	Medium-High
• Characterisation of the impact of commercial fishing on protected corals in shallow waters (e.g. 10-40m, Fiordland, Port Pegasus)	High
Population studies:	
• Increase understanding of taxonomy	Medium-High
• Determine small effective population sizes and their implication on resilience to fishing impacts	Medium-High
• Determine reproductive and dispersal capabilities	High
• Determine larval biology, duration and settlement patterns	Medium-High
• Determine population connectivity	High
• Identify source and sink populations	Medium-High
• Determine age and growth characteristics	High
• Identification of biodiversity hot spots/ areas of high protection value	High
• Monitor changes in genetic and community structure, as well as species distribution over space and time in relation to fishing effort	High
• Modelling distribution including abundance/ biomass (not just presence/absence)	High
Mitigation studies:	
• Analysis of potential mitigation measures to minimise the impact of commercial fishing on protected coral species	Medium-High
• 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.	Medium-High

*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.