Conservation Services Programme

DRAFT

Coral Medium-Term Research Plan

December 2020

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 fisheries waters (for further details see the CSP Strategic Statement 2018). The 2010 amendment of Schedule 7A of the Wildlife Act 1953 protects all stony corals and some octocorals in New Zealand waters, including: black corals (all species in the Order Antipatharia), gorgonian corals (most species in the Order Alcyonacea), stony corals (all species in the Order Scleractinia) and hydrocorals (all species in the Family Stylasteridae). Those encountered in New Zealand waters and subject to this plan are detailed in Table 1.

The CSP coral medium-term research plan (CSP coral plan) will be updated annually and used as a tool to 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 there are interaction data available for these fisheries. Notably, some coral taxa can also be found in shallower habitats (e.g. Fiordland, Port Pegasus) and may interact with other fishing methods (e.g. rock lobster potting). There is generally a lack of observer coverage and interaction data from these fisheries. Coral research that relates to threats other than the direct and indirect effects of commercial fishing (e.g. research on the effect of ocean acidification on coral skeletal growth) falls outside the scope and mandate of CSP and is not included in this plan.

2. Guiding objectives and risk framework

The CSP coral plan is guided by several key documents and processes. 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, action plans and management plans. These are detailed below.

The relevant CSP objectives that have guided the development of this plan are as follows (for further details see the CSP Strategic Statement 2018):

- **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 risk referred to in the guiding objectives is the risk of direct and indirect fisheries-related impacts, both of which could result in population level effects, to coral taxa found in New Zealand waters (Table 1).

Currently, a quantitative risk assessment of the effect of commercial fishing on protected coral species in New Zealand waters has not been attempted. However, a semi-quantitative pilot ecological risk assessment on the effect of bottom trawling on the Chatham Rise was conducted for 15 coral species in 2014 (Clark *et al.*, 2014, summary results: Table 2). In this pilot assessment, risk is estimated by a Productivity-Susceptibility-Analysis (PSA), which considers the extent of impact on the relevant species due to fishing activity ("susceptibility"), and the potential of the species to recover from the impact ("productivity"). This assessment indicated that most of the coral species analysed are at risk from trawl fisheries on the Chatham Rise. However, although vulnerability was evaluated adequately based on the available data, the assessment also highlighted several knowledge gaps that limited the analysis.

In October 2017, a workshop on the research needs for protected corals in New Zealand waters was held at the Department of Conservation. As a product of this workshop, 58 knowledge gaps were identified within six categories: 'Biological Gaps', 'Environmental Gaps', 'Spatial Gaps', 'Modelling Gaps', 'Threat and Pressure Gaps', and 'Data, Management & Communication Gaps' (View the meeting minutes and a list of the knowledge gaps here).

In 2020, a report summarising current knowledge on New Zealand deep-sea corals was finalised (Tracey, DM & Hjorvarsdottir, F (eds, comps, 2019)). The report incorporated the findings from the 2017 gaps workshop and updated a preceding review (Consalvey *et al.* 2006).

In 2020, the Department of Conservation also updated the New Zealand Biodiversity Strategy 2000-2020 and published Te Mana O Te Taiao Aotearoa New Zealand Biodiversity Strategy 2020. 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 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.

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 objectives. In lieu of this, the CSP coral plan will act as an interim 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.

3. Data Requirements

There is a lack of data on the status of protected coral populations in New Zealand waters, reflected by the limited number of taxa that have a conservation classification. Of the 319 protected coral species found in NZ waters, only 66 species (32 genera) have been classified via the New Zealand Threat Classification System (i.e., 22%, Freeman *et al.*, 2014). Of these 66 species, 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 determine their threat status. Notably, the conservation status of New Zealand marine invertebrates is currently being reviewed and will include additional coral taxa (publication date to be determined). The results of this revision will be reflected in this document when the report becomes available.

Knowledge of cold-water coral biology and ecology is limited, which restricts our understanding of their susceptibility to impacts from commercial fisheries. Of the 58 knowledge gaps identified during the 2017 protected corals workshop, the following data requirements cover the main research needs that align with the CSP objectives:

A. Over recent years there have been research efforts to increase the knowledge of the **species composition and distribution** of corals in New Zealand waters. Despite these efforts, more data is required in the following areas:

    - Abundance/density/biomass data to support analyses and models that better reflect the relative importance of certain species or areas (e.g. biodiversity hot spots);
    - Identification of source and sink coral populations;
    - Improved understanding of small effective population sizes to identify potential constraints on the resilience of populations to fishing impacts; and
    - Improved understanding of the taxonomy of corals found in fisheries bycatch to provide a greater understanding of fishing impacts on coral biodiversity.

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

B. There is a significant knowledge gap on **coral productivity** (age, growth, reproduction). It is important to understand 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. 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.

C. 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.

D. 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.

E. **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.

F. There is currently no comprehensive **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.

4. 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.

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.

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. Several uncertainties and limitations in this assessment were highlighted:

- The understanding of coral productivity is limited, restricting the determination of recovery ability from fishing impacts;

- The risk assessment considered trawling impacts on the Chatham Rise as a whole, however, localised impacts in particular areas may pose much higher risk to corals;

- The risk assessment only considered the impacts of orange roughy bottom trawling on the Chatham Rise, when there may be cumulative effects of other fisheries (e.g. the hoki, hake and ling trawl fishery) that operate at shallower depths; and

- Coral distributions were predicted based on the probability of presence or absence and did not consider abundance. Little is known about the spatial scale of the populations of many coral species.

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 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.

5. Research priorities

Due to the lack of knowledge across the diversity of protected coral species in New Zealand, 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:

A. **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 quantitative analysis of bycatch across all New Zealand fisheries.

B. 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).

C. **Determination of coral age and growth rates** to inform 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 more specimens for additional species may be required.

D. **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.

E. 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.

F. **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 populations are being impacted at sustainable levels or increasingly negatively by fishing activities.

G. 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 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.

H. 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.

6. Recent coral related CSP projects

This section lists recent coral-related projects funded through CSP. Additional coral-related research, contracted through non-CSP DOC funding or through MPI, are excluded from this list.

Population Projects:

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:

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:

MIT2019-02: Mitigation techniques to reduce benthic impacts of trawling (a review)

7. 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. Report prepared by the National Institute of Water and Atmospheric Research for the New Zealand Department of Conservation, Wellington.

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. , Goods, 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 prep).

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))

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 & Hjorvarsdottir, 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.

8. Tables

Table 1. Protected coral taxon found in the New Zealand EEZ.

Order	Common name	Number of species
Order Scleractinia	Stony corals (cup and branching forms)	116
Order Antipatharia	Black corals	33
Order Alcyonacea	Soft corals, stoloniferans, sea fans, sea whips, bubblegum corals (there are at least 12 families containing deep-water structure-forming gorgonian octocorals).	114
Order Anthoathecata	Stylasteridae: stylasterids, lace corals	56
	Total	**319**

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

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	*Antipathella fiordensis* (Grange, 1990)	Naturally Uncommon
	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
Alcyonacea (previously Gorgonacea)	Golden coral	Chrysogorgiidae	*Metallogorgia sp.*	Declining
	Bamboo coral	Isididae	*Chathamisis bayeri* (Grant, 1976)	Nationally Vulnerable
	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*	Naturally uncommon
	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* (Grant, 1976)	Naturally Uncommon
	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

	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	Primonoidae	*Calyptrophora cristata* (Cairns, 2012)	Data Deficient
	Sea fan	Primonoidae	*Calyptrophora diaphana* (Cairns, 2012)	Data Deficient
	Sea fan	Primonoidae	*Calyptrophora niwa* (Cairns, 2012)	Data Deficient
	Sea fan	Primonoidae	*Helicoprimnoa fasciola* (Cairns, 2012)	Data Deficient
	Sea fan	Primonoidae	*Metanarella nannolepis* (Cairns, 2012)	Data Deficient
	Sea fan	Primonoidae	*Narelloides crinitus* (Cairns, 2012)	Data Deficient
	Sea fan	Primonoidae	*Calyptrophora cucullata* (Cairns, 2012)	Naturally Uncommon
	Sea fan	Primonoidae	*Calyptrophora inornata (Cairns, 2012)*	Naturally Uncommon
	Sea fan	Primonoidae	*Narella mosaica Cairns, 2012*	Data Deficient
	Sea fan	Primonoidae	*Narella hypsocalyx Cairns, 2012*	Naturally Uncommon
	Sea fan	Primonoidae	*Narella mesolepis Cairns, 2012*	Naturally Uncommon
	Sea fan	Primonoidae	*Narella vulgaris Cairns, 2012*	Naturally Uncommon
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
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 Research Priorities* for New Zealand Protected Corals.

Research priority	Priority level*
Interaction studies:	
• An updated formal risk assessment estimating the impact of commercial fishing (e.g. trawling) on protected coral populations	Medium-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	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 a time in relation to spatial fishing effort	High
• Modelling distribution including abundance/ biomass (not just presence/absence)	Medium-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).