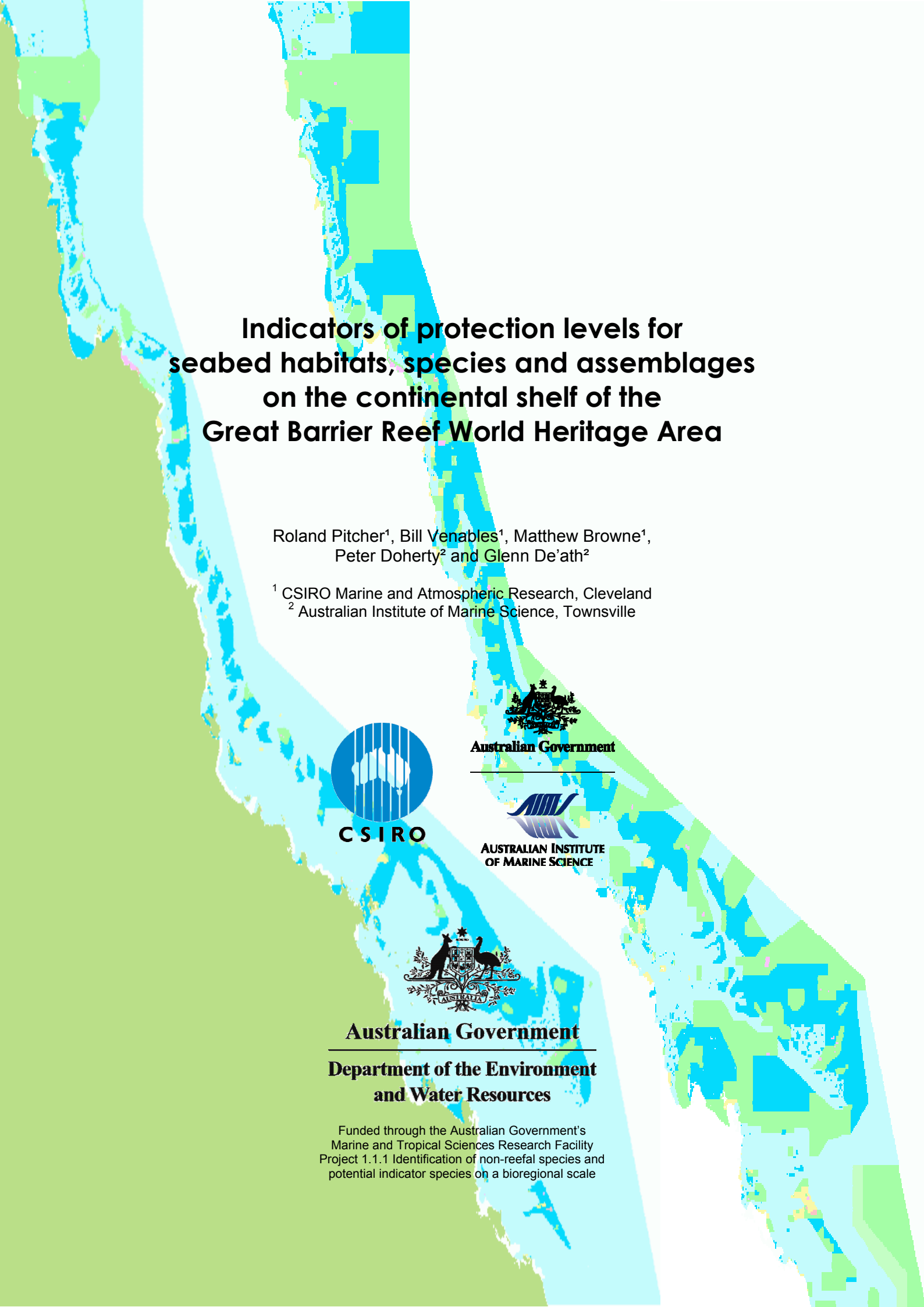

Indicators of protection levels for seabed habitats, species and assemblages on the continental shelf of the Great Barrier Reef World Heritage Area

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Summary

The Great Barrier Reef is a unique World Heritage Area of national and international significance. As a multiple use Marine Park, activities such as fishing and tourism occur along with conservation goals. Managers need information on levels of protection of biodiversity and habitats to ensure adequate conservation. The information required to conduct such assessments for the seabed has recently become available from the GBR Seabed Biodiversity Project, which mapped seabed habitats and their associated biodiversity across the length and breadth of the continental shelf in the Marine Park by sampling seabed species at a total of >1200 sites with a small epibenthic sled and scientific trawl, and videoing mobile fishes with baited remote underwater video stations (BRUVS) and characterising seabed habitat with towed video and still camera transect.

The objectives of this project were to develop indicators of protection levels for seabed species, assemblages and habitats for the zoning plans in effect both before and after 1 July 2004, and identify the change in protection levels coinciding with the Representative Areas Program (RAP) re-zoning. The indicators were considered in relation to areas available to trawling, ie. General Use zones compared with all other zones with higher protection combined. The project has conducted these assessments and produced all of the outputs as proposed and confirmed during consultations.

The information provided by GBR Seabed Biodiversity Project included: (1) maps of the abundance distribution of about 850 more frequent seabed species from a wide variety of biota such as algae, sponges, echinoderms, ascidians, cnidarians, molluscs, fishes, bryozoans, seagrasses and crustaceans; (2) maps of the abundance distribution of 38 species-groups, where the constituent species had correlated distributions in the GBR region; (3) a map of 16 seabed species-assemblages in which the mix of biota was as homogeneous as possible and in some way distinct from the mix in other assemblages; and (4) a map of 9 broad seabed biological habitat types.

The protection indicators estimated for ~840 seabed species showed that prior to the RAP re-zoning, 160 of the species analysed had <20% of their predicted biomass in zones with higher protection, whereas after the re-zoning all species analysed had >20% of their predicted biomass in zones with higher protection; the average increase in protection over all species analysed was 29%. An additional 10 species not covered by sled & trawl data were provided by the BRUVS and, prior to RAP, five of these 10 species had <20% of their predicted occurrence in zones with higher levels of protection, whereas post RAP, all of these species had >20% in zones with higher levels of protection; the average increase in protection was 31%.

The protection indicators estimated for the 38 species-groups showed that prior to RAP, 10 of these species-groups had <20% of their predicted biomass in zones with higher levels of protection, whereas post RAP all groups had >20% of their biomass in zones with higher levels of protection; the average increase in protection was 27%.

The protection indicators estimated for the 16 seabed species-assemblages showed that prior to RAP, 7 of these assemblages had <20% of their predicted area in zones with higher levels of protection, whereas post RAP, all of these assemblages had >20% of their area in zones with higher levels of protection; the average increase in protection was 36%.

The protection indicators estimated for the 9 broad seabed biological habitat types showed that prior to RAP, 4 of habitat types had <20% of their predicted area in zones with higher levels of protection, whereas post RAP one of these habitat types had 20% of area in zones

with higher levels of protection and all others had >20%; the average increase in protection was 31%.

While there are uncertainties in these estimates of protection level indicators, the underlying dataset is the most extensive and detailed available and the estimates are likely to be robust at the scale of the entire continental shelf in the GBR region. From these indicators, it appears clear that the 20% protection level target of the RAP re-zoning has been achieved for all aspects of seabed biodiversity analysed: seabed species, seabed assemblages, and seabed habitats.

1. Introduction

Following the Representative Areas Program (RAP) re-zoning of the GBR WHA, which became effective 1 July 2004, there was a need to quantify the expected benefits to seabed habitats, assemblages and biodiversity, in terms of increased levels of protection. The recent completion of the GBR Seabed Biodiversity Project — the most extensive quantification and mapping of seabed habitats, assemblages and biodiversity yet undertaken (Pitcher *et al*. 2007) — provided outputs that could be used as a basis for estimating indicators of protection levels under the zoning plans.

The priority of this work was affirmed by stakeholders and end-users during the development of the year one annual research plan (ARP) of the MTSRF.

Objectives

As indicated in the proposal, the objectives of the project were clarified during collaborative workshops with GBRMPA staff. The agreed objectives were:

- Develop indicators of protection levels for seabed species, assemblages and habitats under the zoning plans, both before and after 1 July 2004.
- Identify the change in protection levels coinciding with the RAP re-zoning, with particular emphasis on seabed biodiversity in relation to areas available to trawling.

2. Methods

The project team collaborated with GBRMPA staff and used the Seabed Biodiversity dataset and outputs to develop indicators of biodiversity protection levels for seabed species, habitats and assemblages, and investigated seabed biological habitat/species assemblage information and documented these for the GBR continental shelf. While example indicators were suggested in the proposal, the intention was to clarify the indicators to be investigated in discussions with GBRMPA.

Two meetings were conducted with GBRMPA staff. The first held in Townsville on 28 March 2007, with the objective of presenting relevant background information from CRC C1.1.2 and clarifying the indicators to be investigated, had the following agenda:

> **Desired outcome:** Exploration of the possible indicators and approaches and agreement on those to be developed – within the scope of the proposal, feasibility and resourcing.
>
> **Background material:** Pre-draft summary of the Seabed Biodiversity Project outcomes and MTSRF schedule for Project 1.1.1
>
> 1. Update on Seabed Biodiversity Project outputs, with a focus on seabed habitat/species and assemblage information and exposure indicators.
> 2. Overview of MTSRF 1.1.1 project
> 3. Discussion of possible indicators of biodiversity protection levels for seabed species, habitats and assemblages.

It was agreed that indicators to be investigated would be in line with those proposed: i.e. estimates of levels of protection expressed in terms of percent biomass by zone for species and species groups, and percent area by zone for species assemblages and habitats. An aggregation of the zones was to be assessed; initially suggested as General Use, Habitat Protection and all other zones combined. The indicators would be estimated and reported for both before and after the 2004 re-zoning. This would identify the change in protection levels coinciding with the re-zoning. Given that the major human use of the non-reef seabed was trawling, the perspective of the indicators of levels of protection would be in relation to General Use Zone. That is, all zones other than General Use would be considered 'protected'.

The procedure for estimating the indicators of levels of protection would involve a spatial intersection of the zoning plans, both pre and post 1 July 2004, with the maps of predicted biodiversity distribution delivered by the GBR Seabed Biodiversity Project. These maps included:

1. A large number of individual seabed species, frequent enough for analyses;
2. Species-groups, comprising aggregations of species with correlated biomass distributions;
3. Species-assemblages, comprising areas of seabed with similar mixtures of species abundances; and
4. Seabed habitats, comprising areas of seabed with similar mixtures of biological habitat facies.

A second workshop was conducted with GBRMPA staff on 6 June 2007 and explored the data and methods underlying the four types of biodiversity maps produced by the Seabed Biodiversity Project, the preliminary results of the indicator development for these four types, and finalised the desired format of the indicators of protection levels to be delivered by this project.

The details of data and methods underlying the outputs from the Seabed Biodiversity Project, which were used in this project as a basis for estimating indicators of protection levels, are reported in Pitcher *et al*. 2007. In brief, the Seabed Project characterised the major patterns in the seabed biodiversity and habitats of the Great Barrier Reef, at spatial scales relevant to regional conservation and management needs. The information included seabed species and habitat distribution in inter-reef areas, and physical attributes that may drive patterns within the region. The approach was to collate and integrate the available biological, habitat, physical and bottom-water data; analyse bio-physical relationships to identify important environmental variables; stratify the GBR seabed based on these variables weighted by their biological importance; design sampling for representative coverage of environmental gradients and habitats; conduct a series of seabed surveys sampling with towed video cameras, baited remote underwater video stations (BRUVS), epibenthic sled and scientific trawl; sort and identify samples and analyse data to produce predictive maps of biodiversity, assemblages and habitats, which formed the basis of seabed spatial characterisation and ecological risk assessments for the trawl fishery in the region. An outline description of the approaches leading to each of the four types of biodiversity maps are provided below along with the results for protection indicators.

3. Results

The basic approach to the indicators involved estimating the proportion of area or biomass of an assemblage, species group or species in various zones of the GBRMP. The study area on the continental shelf of the GBRMP (excluding islands, coral reefs and shallow shoals < ~12 m, coastal shallows < ~7 m, and slope and abyss deeper than ~80 m) was almost 200,000 km², of which 44% is now zoned General Use (down from 75%), 28% is now zoned Habitat Protection (up from 20%), 28% is now zoned Marine National Park (and Conservation Park) (up from 5%), and <1% was Preservation (Table 3-1). With respect to change from General Use to higher levels of zoning, the overall increase in protection of the continental shelf seabed has been about 31%.

Table 3-1: Total area and percentage of the study area on the continental shelf of the GBRMP in various management Zones considered for estimating ecological risk indicators.

ZONE	General Use	Habitat Protection	Marine National Park	Preservation	TOTAL
Pre-RAP zoning					
Area km²	149,037	39,551	10,884	170	199,644
Area %	75	20	5	<1	100
Post-RAP zoning					
Area km²	87,016	56,709	55,535	383	199,644
Area %	44	28	28	<1	100
% Change	-31	8	23	<1	

Individual Species

Species sampled by epibenthic sled and scientific trawl

The GBR epibenthic sled and research trawl dataset comprised 121,334 site-by-species records of 5,344 species (or morpo-species equivalent OTUs) from 1190 sites sampled by the sled and 457 sites (mostly overlapping) sampled by the trawl. The biota were from more than 15 phyla of marine plants, invertebrates and vertebrates. Taking into account that sorting of hydroids, annelids, crinoids and ascidians was not completed due to resourcing, this was a highly species rich biota of sponges, fishes, molluscs, crustaceans, echinoderms, corals, algae and bryozoans dominated in biomass by algae, sponges, echinoderms, ascidians, cnidarians, molluscs, fishes, bryozoans, seagrasses, and crustaceans.

The distribution of the biomass of 840 individual species that occurred at >25 sites was analysed separately in relation to a selection of available physical environment variables that could be used as potential predictors of species distributions. This approach assumes that the observed geo-spatial distribution of each species may be adequately explained by an underlying physical environment gradient(s). Each species could be expected to have its own preferred habitat range and tolerance for various physical parameters, and the spatial variation in physical variables may structure the observed spatial distributions of the identified taxa.

The analysis of each species involved two-stage generalized linear modelling (GLM), with step-wise selection of predictor variables based on BIC, and was implemented in the 'R' statistical computing environment (www.R-project.org). The first stage modelled the probability of presence of a given species and the second, conditional on the species being

present, modelled the distribution of the biomass with log-link. The potential predictor variables included 27 physical environment variables and two spatial variables (Across: coast to shelf-break; Along: northern GBR boundary to southern GBR boundary). The 27 physical environment variables are listed in 6. Appendices Table 6-1 as a correlation matrix showing significant correlation between a number of variable combinations, which leads to caution in interpreting the selection of any given variable by the models — often one or more alternative variables may be valid surrogates — correlation does not imply causality.

In addition to the physical environment variables, where a given species was represented by specimens from both the sled and trawl, an additional term was included in the models to account for the likely different relative sampling rate of the different devices. Further, many species were known to have various temporal patterns to their availability, such as day/night, crepuscular, lunar, tidal, and/or seasonal — accordingly, variables for each of these cycles were included and could potentially be selected by the modelling if justified by the data.

Based on application of the GLM models to a full GBR coverage of the physical variables, biomass distribution maps were generated for the 840 species that were sampled at >25 sites. Occurrence at less than 25 sites was considered inadequate to estimate the array of measurement, temporal, physical and spatial effects considered in this study. One example single-species map, of the many possible, is re-presented in this report — in this case for the relatively prevalent fish species *Nemipterus theodoei* (6. Appendices, Figure 6-1). The results of the intersection of the pre- and post-RAP zoning plans with all ~840 such distribution maps are detailed in 6. Appendices, Table 6-4 and summarized at the taxonomic Class level in Table 3-2. Overall, prior to RAP, the average proportion of species biomass in General Use Zones was 71% (min=32%, max=99%) with 29% in zones with higher protection (min=1%, max=68%), whereas post RAP, the average proportion of species biomass in General Use Zones was 42% (min=9%, max=70%) with 58% in zones with higher protection (min=30%, max=91%). Prior to RAP, 160 of the ~840 modelled species had <20% of their predicted biomass in zones with higher protection, whereas post RAP, all modelled species had >20% of their predicted biomass in zones with higher protection. The average increase in protection over all modelled species was 29%, which was very close to the areal change in zoning, with min=6% and max=88%.

Table 3-2: Summary at class level of Indicators of Protection of 840 species sampled by sled and/or trawl, showing number of modeled species in each class, percentage of modeled biomass represented by each class, minimum average and maximum percentage of biomass of all modeled species in each class in old and new General Use Zones and for all other zones combined both before and after RAP, and overall minimum average and maximum change in level of protection due to the 1 July 2004 re-zoning. Levels of protection <20% are shaded.

PHYLUM	CLASS	Common name	Number of species	% Biomass		Old %GU	Old % Other	New %GU	New % Other	Change in % protection
Annelida		Worms	unsorted	1	Min	88	12	49	51	30
					Ave	76	24	42	58	34
					Max	67	33	34	66	39
Arthropoda	Crustacea	Crustaceans	146	7	Min	99	1	67	33	20
					Ave	74	26	43	57	31
					Max	43	57	9	91	88
Bryozoa		Bryozoans	124	5	Min	86	14	59	41	16
					Ave	66	34	36	64	30
					Max	43	57	19	81	45
Chlorophyta	Chlorophyceae	Green algae	32	8	Min	80	20	52	48	17
					Ave	63	37	38	62	24
					Max	39	61	21	79	42
Chordata	Actinopterygii	Fishes	173	19	Min	99	1	70	30	14
					Ave	76	24	46	54	30
					Max	41	59	12	88	74
Chordata	Ascidiacea	Ascideans	unsorted	1	Min	62	38	32	68	30
					Ave	62	38	32	68	30
					Max	62	38	32	68	30
Cnidaria	Anthozoa	Corals	39	4	Min	78	22	57	43	6
					Ave	67	33	37	63	29
					Max	36	64	18	82	45
Cnidaria	Hydrozoa	Hydroids	unsorted	<1	Min	57	43	26	74	31
					Ave	57	43	26	74	31
					Max	57	43	26	74	31
Echinodermata	Asteroidea	Starfish	22	2	Min	87	13	58	42	21
					Ave	70	30	42	58	28
					Max	56	44	19	81	37
Echinodermata	Crinoidea	Feather stars	unsorted	1	Min	52	48	32	68	19
					Ave	52	48	32	68	19
					Max	52	48	32	68	19
Echinodermata	Echinoidea	Urchins	27	2	Min	84	16	56	44	15
					Ave	67	33	41	59	26
					Max	32	68	12	88	43
Echinodermata	Holothuroidea	Sea cucumbers	18	4	Min	89	11	69	31	18
					Ave	69	31	42	58	26
					Max	47	53	27	73	41
Echinodermata	Ophiuroidea	Brittle stars	16	1	Min	83	17	47	53	18
					Ave	66	34	36	64	30
					Max	36	64	18	82	47
Magnoliophyta	Liliopsida	Seagrasses	5	5	Min	76	24	53	47	19
					Ave	72	28	48	52	23
					Max	65	35	41	59	25
Mollusca	Bivalvia	Bivalves	52	3	Min	91	9	61	39	19
					Ave	75	25	45	55	31
					Max	54	46	22	78	49
Mollusca	Cephalopoda	Cuttlefish, squid, octopus	17	1	Min	83	17	52	48	23
					Ave	71	29	44	56	27
					Max	59	41	30	70	35
Mollusca	Gastropoda	Sea snails	47	1	Min	92	8	64	36	15
					Ave	71	29	44	56	27
					Max	46	54	24	76	34
Phaeophyta	Phaeophyceae	Brown algae	11	7	Min	85	15	57	43	23
					Ave	74	26	49	51	26
					Max	56	44	33	67	32
Porifera		Sponges	68	14	Min	90	10	59	41	21
					Ave	67	33	35	65	31
					Max	37	63	11	89	54
Rhodophyta	Rhodophyceae	Red algae	25	14	Min	83	17	55	45	19
					Ave	72	28	45	55	26
					Max	62	38	34	66	33

Species observed in BRUVS video

The BRUVS dataset consisted of 366 sites and 39,989 individuals from 347 species of fishes, sharks, rays and seasnakes. The bony fishes were from 10 orders, dominated by Perciformes (267 species), Tetraodontiformes (27), Anguilliformes (6), Aulopiformes (3), Scorpaeniformes, Clupeiformes, Beryciformes with 2 species, and Siluriformes, Pleuronectiformes and Gasterosteiformes each with a single species. The chondrichthyians were well represented by the Carcharhiniformes (15 species), Rajiformes (13) and Orectolobiformes (3). There were 5 species of seasnakes from the family Hydrophiidae. Most of the 347 species recorded were rare or uncommon, occurring in only a very small percentage of the sites surveyed. Only 25 fish species were frequent enough for analyses and of these, 10 species were not covered by sled & trawl data summarized in the previous section so are presented individually here.

The BRUVS data consist of "MaxN" count data — ie, the maximum number of individuals of a given species observed in any video frame during the ~45 minutes deployment time. Each species was treated as a univariate response and, using boosted trees with a binomial loss function, its presence-absence was predicted from the best 20 variables from the same suite of physical environmental variables used for the sled and trawl species.

Based on application of the boosted tree models models to a full GBR coverage of the physical variables, probability-of-presence distribution maps were generated for the frequent species. As noted, the maps for 10 species are presented here (Figure 6-2 to Figure 6-4). The results of the intersection of the pre- and post-RAP zoning plans with the maps for each of these 10 species is summarized in Table 3-3. Overall, prior to RAP, five species of these 10 species had <20% of their predicted occurrence in zones with higher levels of protection and the average proportion of species occurrence in such zones was 21% (min=10%, max=35%), whereas post RAP, all of these species had >20% in zones with higher levels of protection and the average proportion of species occurrence in such zones was 52% (min=46%, max=62%). The average increase in protection was 31%, which was the same as the areal change in zoning, with min=23% and max=38%.

Table 3-3: Indicators of protection of 10 species observed in BRUVS not covered by the analysis of Sled and Trawl species above, showing frequency of occurrence of each species at observed sites, percentage of predicted occurrence of each species in old and new General Use Zones and for all other zones combined both before and after RAP, and change in level of protection due to the 1 July 2004 re-zoning. Levels of protection <20% are shaded grey.

Genus	species	Freq%		Old %GU	Old %Other		New %GU	New %Other		Change in % protection
Echeneis	*naucrates*	46		79	21		54	46		25
Scomberomorus	*queenslandicus*	44		83	17		52	48		30
Seriolina	*nigrofasciata*	41		86	14		51	49		35
Carangoides	*coeruleopinnatus*	30		83	17		47	53		36
Carangoides	*fulvoguttatus*	27		65	35		38	62		27
Decapterus	*russelli*	26		82	18		44	56		38
Gymnothorax	*minor*	21		90	10		54	46		36
Carangoides	*gymnostethus*	18		74	26		44	56		30
Gnathanodon	*speciosus*	14		65	35		42	58		23
Alepes	*apercna*	13		79	21		52	48		26
			Min		10			46		23
			Max		35			62		38
			Ave		21			52		31

Species Groups

Another output from the Seabed Project was identification of groups of species with similar distributions in the GBR physical environment and predictive models and maps for the biomass of these groups. Such grouping of species was useful to organise a very large number of species into fewer, common entities with similar distributional characteristics and so was a convenient method for quantitatively summarising the variation in species distributions through a much smaller set of grouped models.

It was noted that taxonomic relationships (such as the Class level summary in Table 3-2) generally did not provide a suitable basis for forming groups with distributional similarity — related species typically had quite different distributions and occurred in different distributional species-groups.

Clustering methods for forming such groups are well developed; nevertheless there are a wide variety of techniques each with numerous options all of which may affect the outcome to some extent. In this application, the desired outcome was to reduce ~840 species distributions down to a more manageable number, where the species in each group had highly correlated distributions, rather than attempt to identify any particular number of characteristic and distinct types of distributions. Given these objectives, clustering was based on a correlation matrix between species calculated on the predicted log-biomass at the sampled sites and used hierarchical clustering with Ward's linkage. The predicted biomasses at sites were used account for factors such as sampling method, swept area and the temporal covariates which were inseparable from the raw data. The resulting cluster dendrogram was used to form 38 groups, such that the average correlation between species distributions within groups was high (>0.5). This number of groups was considerably larger than would be suggested by the diagnostics typically used to guide the selection of characteristic/distinct clusters, had that been the objective.

Once the groups were determined, the subsequent modelling was based on the raw species data summed for each group. As for the individual species, the analysis of species-groups involved two-stage GLM with step-wise selection of predictor variables based on BIC, and again, the GLM models were applied to the full GBR coverage of the physical variables to produce biomass distribution maps for each of the 38 species-groups. These species-groups maps are re-presented in this report (6. Appendices, Figure 6-5 to Figure 6-14) and the species membership of each group is tabulated in Table 6-4. The results of the intersection of the pre- and post-RAP zoning plans with all 38 species-groups maps is presented in Table 3-4. Overall, prior to RAP, 10 of the 38 species-groups had <20% of their predicted biomass in zones with higher levels of protection and the average proportion of group biomass in such zones was 30% (min=7%, max=58%), whereas post RAP, all of these groups had >20% of their biomass in zones with higher levels of protection and the average proportion of species biomass in such zones was 57% (min=35%, max=77%). The average increase in protection was 27%, which was similar to the areal change in zoning, with min=16% and max=46%.

Site-Group Assemblages

Another goal of the Seabed Project was to identify various areas of seabed in the GBR study area in which the mix of biota was as homogeneous as possible and in some way distinct from the mix in other areas. These different, approximately homogeneous, mixtures can be called "assemblages". Any individual assemblage may be expressed in several disjoint geographical regions; there was no requirement that they be spatially contiguous. A further property was that, at the broad scale, these assemblages would be characterised using and predicted by the available full-coverage physical variables. The biotic data used were the

biomasses of identified fauna and flora at sites sampled by the epibenthic sled and research trawl.

Table 3-4: Indicators of Protection for 38 species-groups of biota sampled by the Sled and Trawl, showing for each group the number of modeled species in the group, percentage of modeled biomass represented by each group, percentage of predicted biomass of each group in old and new General Use Zones and for all other zones combined both before and after RAP, and change in level of protection due to the 1 July 2004 re-zoning. Levels of protection <20% are shaded.

Species group	Number of species	% Biomass		Old %GU	Old %Other		New %GU	New %Other		Change in % protection
16	80	4		48	52		25	75		24
23	60	11		54	46		27	73		27
1	39	6		70	30		46	54		24
10	39	15		79	21		58	42		21
17	39	10		61	39		38	62		22
2	29	18		42	58		26	74		16
37	29	0		68	32		32	68		36
4	28	1		63	37		41	59		22
3	27	0		62	38		23	77		39
5	26	0		58	42		33	67		25
20	25	2		61	39		41	59		21
9	23	2		80	20		55	45		25
18	23	4		52	48		32	68		20
21	23	4		74	26		50	50		23
22	23	2		87	13		62	38		25
7	22	5		77	23		55	45		23
29	22	1		84	16		56	44		28
32	22	0		58	42		26	74		32
6	21	0		66	34		36	64		30
8	20	0		70	30		50	50		20
15	20	1		74	26		36	64		38
13	19	0		86	14		55	45		31
25	18	1		68	32		45	55		23
31	17	1		79	21		47	53		32
11	16	0		85	15		59	41		27
14	16	1		72	28		48	52		24
24	12	2		93	7		47	53		46
34	12	2		86	14		44	56		42
12	11	0		87	13		46	54		41
19	11	2		74	26		52	48		22
36	11	1		67	33		39	61		28
30	10	0		57	43		26	74		31
26	8	0		56	44		31	69		24
28	8	1		58	42		39	61		19
33	8	1		93	7		65	35		28
27	5	0		83	17		53	47		30
35	4	0		67	33		43	57		24
38	3	0		71	29		41	59		30
		Min			7			35		16
		Max			58			77		46
		Ave			30			57		27

A number of strategies were possible to achieve this result. One strategy would involve three separate steps, each with a number of options regarding method: partition the study sites into groups based on the biological data alone, then develop a model to predict these groups from the physical variables alone, and use the predictive model to classify the entire GBR region. The strategy adopted combined the above partitioning, modelling and prediction steps into a single procedure, using a tree-modelling method. In outline this procedure was as follows: based on the predicted species biomass at sites transformed by 8^{th} root, a Bray-Curtis dissimilarity matrix between the sampled sites was constructed, a deviance measure on any clustering of sites based on the minimum span of biological distance matrix was defined, a decision tree using the available physical variables with the resulting terminal nodes of the decision tree defining the site groups was implemented in the 'R' package "`rpart`", and the decision tree was use to classify the entire GBR study grid and the result was mapped. Again, the predicted species biomasses at sites were used in order to account for the factors sampling method, swept area and temporal covariates. The 8^{th} root transformation was used as it is like a log transformation for large biomasses, but for small biomasses is approximately linear and, unlike log, was not adversely affected by zeros. The tree made recursive binary partitions of the dissimilarity matrix by selecting the optimal split variable and threshold to achieve the greatest reduction in deviance of the span of Bray-Curtis distances, until (typically) any further splits would not reduce the deviance by more than 1%. In this way, 16 groups were produced.

The resulting decision tree is shown graphically in Figure 6-15. The primary split was at 25% mud fraction, and mud or another sediment attribute accounted for several other splits, suggesting the importance of sediment grain size composition in structuring seabed assemblages. Given the correlation between variables and that other variables may be good surrogates to split at each node, caution is necessary in interpreting the importance of variables. Nevertheless, percent mud and other sediment attributes were often the most frequently selected in a wide range of biophysical analyses. Other variables likely to be important included bathymetry, oxygen variability, current stress, chlorophyll and/or light attenuation (K490), nutrients and temperature.

While the decision tree did split a Bray-Curtis biological dissimilarity matrix to group together sites with similar biota, nevertheless, the splits were on physical variables and so constrained the tree structure and may not necessarily have represented the structure of biological similarities between the 16 site groups. A representation of the biological similarities among the site groups, by hierarchical clustering of the Bray-Curtis dissimilarities of the mediod sites using Ward's method, demonstrated a similar structure, particularly the first split between site-groups 1–9 and 10–16, and within site-groups 1-9 (Figure 6-16). However, the biological similarities of the site mediods within site-groups 10–16 were rather different from the structure of the decision tree, with groups 10–11 and 12–13 being placed biologically close and 11–12 moderately dissimilar. It is important to note that the GBR seabed assemblages are not distinct, but have fuzzy gradients of biotic composition and different transformations, distance metrics, and clustering methods will produce somewhat different results — sometimes even transposing some site-groups across the primary mud split. Nevertheless, low-mud and high-mud site-groups typically were separated.

The set of decision rules for splitting physical variables, defined on data from ~1200 sites, was applied to the remaining >170,000 grids cells of the GBR study area and the result mapped (Figure 6-17). Overall, several rather distinct regions with little if any assemblage representation elsewhere were apparent, including: the Capricorn Section, the Capricorn Channel, Shoalwater Bay & Broadsound, Swains & Pompey Reefs regions, central/Townsville area, and the northern GBR from about Hinchinbrook Is/Cairns. The composition of the site-group assemblages is discussed in more detail in Table 6-2.

In addition to defining site-groups assemblages, it was also useful to examine the extent of associations between these site groups and species biomass distributions, to provide some characterisation of the assemblages. If a species was strongly associated with one site group and only weakly associated with others, such a species could be described as an indicator species for that site group assemblage. The approach taken was to define an *affinity distance* between each species and each site-group, which had values in the range 0–1, and was zero only if the species was entirely within the site group and uniformly distributed, and unity if the species distribution was entirely outside the site group. The affinity distances helped identify species that most characterised each assemblage (Table 6-2).

Further, as there were ~840 species, a more concise means of describing the broad patterns of species associations for site-group assemblages was also sought, as follows. A dissimilarity matrix of species affinities for the site-group assemblages was calculated as ordinary Euclidean distances between all pairs of species. This distance matrix was used as a basis for standard hierarchical clustering, using Ward's linkage, to group together species with similar affinity patterns for the 16 site-group assemblages. For purposes of this analysis, twelve species affinity groups (A–L) were defined. A summary dendrogram, based on mean affinities, was produced to show the similarities among these species groups in terms of their affinity for site-group assemblages (Figure 6-18). The relative biomass of each species affinity group within each site-group assemblage was also plotted (Figure 6-19) to provide additional information to describe the site-group assemblages (Table 6-2).

The distribution and composition of the site-group assemblages are described in more detail in Table 6-2. In general, there appear to be about 4–7 relatively distinct mixtures over the 16 site-group assemblages on the basis of summary patterns of relative biomasses of about five sets of the 12 species affinity groups (Figure 6-19). Most distinctive was site-group #8, which was dominated by species affinity group #L — most similar was site-group #6. The coastal/inshore muddy site-groups 11, 12, 13 were characterised primarily by species affinity groups E, G and C. Another, less distinct group of (deeper) muddy sites comprised site-groups 10, 15, 16 and 14 and 5, which were characterised primarily by species affinity groups D, F, H. The remaining site-groups were less distinctly structured; nevertheless, site-groups #1–2 were most similar, characterised primarily by the low biomass of species affinity groups G, E. Next were site-groups #4 & 7, characterised primarily by the species affinity groups K, I, B. Site-group #6 was somewhat similar to #1, 7, 8. Site-groups #9, 3 had the highest abundance of affinity group J.

The results of the intersection of the pre- and post-RAP zoning plans with the distribution of the 16 site-group assemblages (Figure 6-17)) are shown in Table 3-5. Overall, prior to RAP, 7 of the 16 assemblages had <20% of their predicted area in zones with higher levels of protection and the average proportion of assemblage area in such zones was 23% (min=0%, max=57%), whereas post RAP, all of these assemblages had >20% of their area in zones with higher levels of protection and the average proportion of assemblage area in such zones was 58% (min=27%, max=58%). The average increase in protection was 36%, which was slightly more than the areal change in zoning, with min=14% and max=95%.

Table 3-5: Indicators of protection for 16 site-group assemblages of biota sampled by the Sled and Trawl, showing for each assemblage number the map colour in Figure 6-17, the percentage of GBR seabed area represented by each assemblage, percentage of predicted area of each assemblage in old and new General Use Zones and for all other zones combined both before and after RAP, and change in level of protection due to the 1 July 2004 re-zoning. Levels of protection <20% are shaded.

Map Colour	Assemblage number	% Area		Old %GU	Old %Other		New %GU	New %Other		Change in % protection
	1	7		77	23		51	49		26
	2	14		62	38		38	62		25
	3	7		47	53		16	84		31
	4	5		89	11		70	30		19
	5	3		100	0		55	45		45
	6	8		72	28		51	49		21
	7	6		94	6		69	31		25
	8	7		43	57		29	71		14
	9	5		74	26		16	84		58
	10	11		86	14		56	44		30
	11	12		76	24		57	43		19
	12	2		74	26		57	43		17
	13	2		90	10		73	27		17
	14	1		54	46		10	90		44
	15	7		99	1		16	84		83
	16	2		100	0		5	95		95
			Min		0			27		14
			Max		57			95		95
			Ave		23			58		36

Habitats

The towed video camera yielded two forms of data. On the vessel, during the video transect, an operator recorded both the substratum type and the habitat forming biota currently in view, and all habitat changes along the length of the transect. The habitat components recorded at the within transect scale were termed habitat facies (listed in Table 6-3). Also, later, in the laboratory, individual frames from the video were scored for substratum and habitat biota in a much more detailed way, though not on a continuous basis but as a sample of about 30 frames from each transect. To the extent possible with the towed video camera data, analyses were conducted to provide statistical characterisation of the broad habitat types in the GBR study area, in terms of distinct characteristic mixtures of the small-scale habitat facies.

The data from the post-analysis of random video frames in the laboratory was used to provide more detailed information on seabed habitats and is re-presented in this report (6. Appendices) in the form of summary point maps along with selected seabed photos as descriptive additions to the statistical habitat characterisation.

The video data showed that inshore areas along much of the length of the GBR were muddy or silty (Figure 6-20, Figure 6-22a) — often comprised of terrestrial sediments. Typically, with distance across the shelf, the substratum became sandier or even coarser (Figure 6-20, Figure 6-22d) — typically comprised of carbonate of biological origin. In offshore areas, coralline outcrops, reefs and shoals may occur in deep areas between emergent coral reefs (Figure 6-22k). The strong tidal current areas among the dense reef matrix offshore in the central-southern GBR were rubbly or stony, with rocks and limestone bedrock often exposed. Much of the rubble in these areas is formed by encrusting bryozoans (Figure 6-22o). The

inshore strong tide areas of Broad Sound and Shoalwater Bay are also very coarse or rocky. Between these lies the Capricorn Channel, a wide area of GBR lagoon with a very silty and muddy seabed. The south-eastern entrance to this channel is the deepest area on the GBR shelf, at 100-130 m. The Capricorn Region, the southernmost part of the GBR, is typically sandy right across the shelf. It lies at the northern end of the Great Sandy Region, just beyond Fraser Island, the source of large quantities of terrestrial sand.

The majority of the seabed in the GBR was devoid of visible biological habitat attached to the surface of the substratum; however, most of these areas were bioturbated indicating the activity of animals in the sediments (Figure 6-21, white and grey areas; Figure 6-22 cf. bm). In offshore sandy areas with medium currents, crinoid feather stars were sometimes extremely abundant on the seabed (Figure 6-22n). Marine plants form dominant cover over large areas of the GBR shelf (Figure 6-23, eg. Figure 6-22f). A long band of mixed algae and patchy seagrass (primarily *Halophila spinulosa*) occurs along the mid-shelf off Townsville (Figure 6-21). Dense beds of *H. spinulosa* also occur over much of the shelf in the Capricorn region (Figure 6-22e) as well as around the Turtle & Howick Is Groups in the central northern GBR (Figure 6-24). Vast banks of *Halimeda* algae (Figure 6-22g) occur just inside the outer barrier reef near Lizard Is, also in the central northern GBR, as well as in the far northern GBR (Figure 6-23). These *Halimeda* banks may be up to 15 m thick, comprised of the deposited carbonate skeletons of these algae. Other types of algae, including crustose corallines, are prolific along some sections of the outer shelf in water up to 80-100 m deep (Figure 6-23, Figure 6-22eh). Epibenthic fauna such as alcyonarian soft corals, whips & gorgonians and sponges may occur in patchy gardens (Figure 6-21, Figure 6-22ij, Figure 6-27, Figure 6-26, Figure 6-25), particularly in medium-strong current areas; Bryozoans are important in similar areas (Figure 6-28). Hard corals may grow on some of the hard ground areas, typically offshore (Figure 6-22, Figure 6-29).

The statistical characterization of the towed video data followed a similar procedure as the site-group assemblages (Section 3.3). Based on the observed proportions of transect cover of various habitat facies (Table 6-3), a Manhattan distance (which for data in the form of proportions is equivalent to the Bray-Curtis metric) matrix between the videoed sites was constructed, a decision tree was used to optimise splitting of the available physical variables by minimizing deviance of the distance matrix, and the decision tree was use to classify the entire GBR study grid and the result was mapped. The stopping rules (1% reduction in deviance) of the `rpart` algorithm terminated the Manhattan (Bray-Curtis) tree at 9 groups. The resulting decision tree is shown graphically in Figure 6-30. The primary split was at 15.5% mud fraction, and other sediment attributes accounted for three of the remaining seven splits, suggesting the importance of sediment composition in structuring seabed biological habitats. Other variables likely to be important included current stress, oxygen, and benthic irradiance. Information on the biological habitat character of these 9 groups was obtained from the group centroids and are shown as horizontal bar graphs in Figure 6-31. The predictions of node membership on the entire GBR covariate grid, based on the splits of the Manhattan (Bray-Curtis) tree, are shown in Figure 6-32.

With reference to the Manhattan (Bray-Curtis) tree (Figure 6-30), the habitat group profiles (Figure 6-31), and the distribution map (Figure 6-32), the habitat group were broadly characterised as follows: Cluster 1 represented the most barren seabed type, almost entirely bare and bioturbated with very little biohabitat, distributed in muddy areas of the inshore and midshelf and the deep end of the Capricorn Channel. Cluster 2 was also very barren, with some bioturbation and very little epibenthos or algae, distributed in muddy-sand areas of the southern midshelf and far north. Cluster 3 had significant patches of epibenthic gardens separated by tracts of bare seabed, distributed in low mud higher current areas, primarily in the southern GBR. Cluster 4 was similar to cluster 3, but with more algae, and distributed in similar low mud higher current areas with higher benthic irradiance, in both the southern and far northern GBR. Cluster 5 represented mostly bioturbated and bare seabed with a little

algae and seagrass habitat distributed over much of the shelf in the central and northern sections of the GBR. Cluster 6 represented seagrass and algal habitat distributed along much of the inner half of the shelf in the southern Capricorn section of the GBR. Cluster 7 represented similar patchy seagrass and algal habitat distributed along the mid-shelf from Cape Upstart to Innisfail. Cluster 8 represented much of the *Halimeda* algal habitat, as well as some other algae and epibenthos, distributed in various patches along the outer shelf, including the *Halimeda* banks inside the ribbon reefs near Lizard Is and in the far north. Cluster 9 represented patchy algae (including some *Halimeda*) with some bioturbation and a little other biohabitat, distributed primarily in the outer-shelf offshore from Townsville.

The results of the intersection of the pre- and post-RAP zoning plans with the 9 groups of biological habitat facies (Figure 6-32) are shown in Table 3-6. Overall, prior to RAP, 4 of the 9 habitat groups had <20% of their predicted area in zones with higher levels of protection and the average proportion of habitat group area in such zones was 24% (min=2%, max=51%), whereas post RAP, one of these habitat groups had 20% of area in zones with higher levels of protection and all others had >20%; the average proportion of habitat group area in such zones was 55% (min=20%, max=88%). The average increase in protection was 31%, which was the same as the areal change in zoning, with min=15% and max=46%.

Table 3-6: Indicators of protection for 9 groups of biological habitat facies observed by the towed video camera, showing for each habitat group number the map colour in Figure 6-32, the percentage of GBR seabed area represented by each habitat group, percentage of predicted area of each habitat group in old and new General Use Zones and for all other zones combined both before and after RAP, and change in level of protection due to the 1 July 2004 re-zoning. Levels of protection <20% are shaded.

Map Colour	Habitat group number	% Area		Old %GU	Old %Other		New %GU	New %Other		Change in % protection
	1	8		90	10		44	56		46
	2	17		91	9		45	55		45
	3	15		59	41		32	68		27
	4	16		59	41		34	66		25
	5	27		75	25		47	53		27
	6	7		96	4		80	20		15
	7	3		98	2		74	26		25
	8	3		49	51		12	88		37
	9	4		68	32		36	64		31
			Min		2			20		15
			Max		51			88		46
			Ave		24			55		31

4. Discussion

The GBR Seabed Biodiversity Project has provided key outputs that could be used as a basis for estimating indicators of protection levels for seabed species, assemblages and habitats on the continental shelf of the GBR region. These indicators were estimated for the zoning plans in effect both before and after 1 July 2004, and the changes in protection levels coinciding with the RAP re-zoning. The indicators were considered in relation to areas available to trawling, ie. General Use zones compared with all other zones combined.

The indicators were estimated for ~840 species of >5,300 sampled by the sled and trawl surveys conducted by the Seabed Project, that were sufficiently abundant for modelling and mapping of their biomasses. Prior to the RAP re-zoning, 160 of the ~840 modelled species had <20% of their predicted biomass in zones with higher protection, whereas after the re-zoning, all modelled species had >20% of their predicted biomass in zones with higher protection; the average increase in protection over all modelled species was 29%. An additional 10 species not covered by sled & trawl data were provided by the BRUVS, and, prior to RAP, five species of these 10 species had <20% of their predicted occurrence in zones with higher levels of protection, whereas post RAP, all of these species had >20% in zones with higher levels of protection; the average increase in protection was 31%.

The ~840 sled and trawl species were clustered into 38 species-groups, where the constituent species had correlated distributions in the GBR region, and the biomasses of these groups was modelled and mapped. Prior to RAP, 10 of these 38 species-groups had <20% of their predicted biomass in zones with higher levels of protection, whereas post RAP, all groups had >20% of their biomass in zones with higher levels of protection; the average increase in protection was 27%.

The ~1200 sites sampled by the Seabed Project data were statistically separated into 16 groups where the assemblage of the ~840 modelled species was as homogeneous as possible, and which were mapped to the region on the basis of their biophysical relationships. Area-based indicators were estimated for these assemblages. Prior to RAP, 7 of the 16 assemblages had <20% of their predicted area in zones with higher levels of protection, whereas post RAP, all of these assemblages had >20% of their area in zones with higher levels of protection; the average increase in protection was 36%.

The data from coding habitat facies along seabed video transects were used to statistically separate sites into 9 habitat mixture groups that were mapped to the region on the basis of their biophysical relationships. Area-based trawl exposure indicators were estimated for these habitat groups. Prior to RAP, 4 of the 9 habitat groups had <20% of their predicted area in zones with higher levels of protection, whereas post RAP, one of these habitat groups had 20% of area in zones with higher levels of protection and all others had >20%; the average increase in protection was 31%.

It should be noted that there are uncertainties in these estimates of protection level indicators, which arise from sampling variability, measurement and interpolation of the physical predictor covariates, and the modelling of species biomass, assemblage and habitat distributions. Nevertheless, the GBR Seabed Biodiversity dataset is the most extensive and detailed available and the estimates are likely to be robust at the scale of the entire continental shelf in the GBR region. From these indicators, it appears clear that the 20% protection level target of the RAP re-zoning has been achieved for all aspects of seabed biodiversity analysed: benthic species, assemblages, and habitats.

The project has produced all of the outputs as proposed and as clarified and agreed subsequently with end-users. Preliminary outputs were presented during workshops

conducted the course of the project. The indicators estimated here have documented the current levels of protection for seabed species, assemblages and habitats in the region and will raise the level of stakeholder knowledge of the nature and protection of the region's ecosystems. These assessments have provided a quantitative regional context that will benefit managers needing to respond effectively to industry and community concerns and achieve an objective balance between human uses and needs for conservation in a multiple-use environment. The community will be informed and benefit from independent information on levels of protection of the seabed. The outputs will facilitate assessment of spatial management in the region and will benefit future planning and regional ecosystem management.

5. References

Pitcher, C.R., Doherty, P., Arnold, P., Hooper, J., Gribble, N., Bartlett, C., Browne, M., Campbell, N., Cannard, T., Cappo, M., Carini, G., Chalmers, S., Cheers, S., Chetwynd, D., Colefax, A., Coles, R., Cook, S., Davie, P., De'ath, G., Devereux, D., Done, B., Donovan, T., Ehrke, B., Ellis, N., Ericson, G., Fellegara, I., Forcey, K., Furey, M., Gledhill, D., Good, N., Gordon, S., Haywood, M., Jacobsen, I., Johnson, J., Jones, M., Kinninmoth, S., Kistle, S., Last, P., Leite, A., Marks, S., McLeod, I., Oczkowicz, S., Rose, C., Seabright, D., Sheils, J., Sherlock, M., Skelton, P., Smith, D., Smith, G., Speare, P., Stowar, M., Strickland, C., Sutcliffe, P., Van der Geest, C., Venables, W., Walsh, C., Wassenberg, T., Welna, A., Yearsley, G. (2007). Seabed Biodiversity on the Continental Shelf of the Great Barrier Reef World Heritage Area. AIMS/CSIRO/QM/QDPI CRC Reef Research Task Final Report. 317 pp.

6. Appendices

Figures

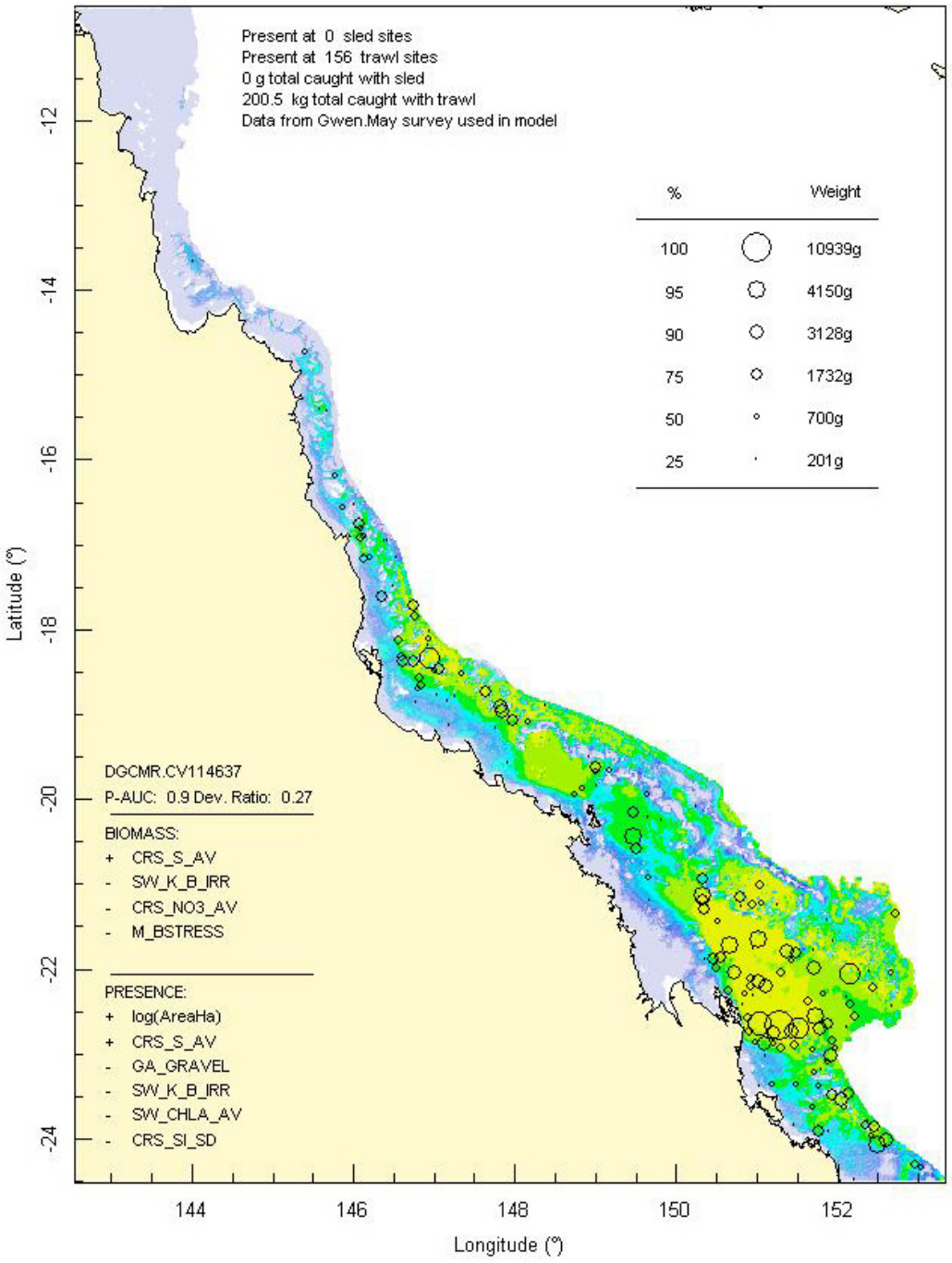
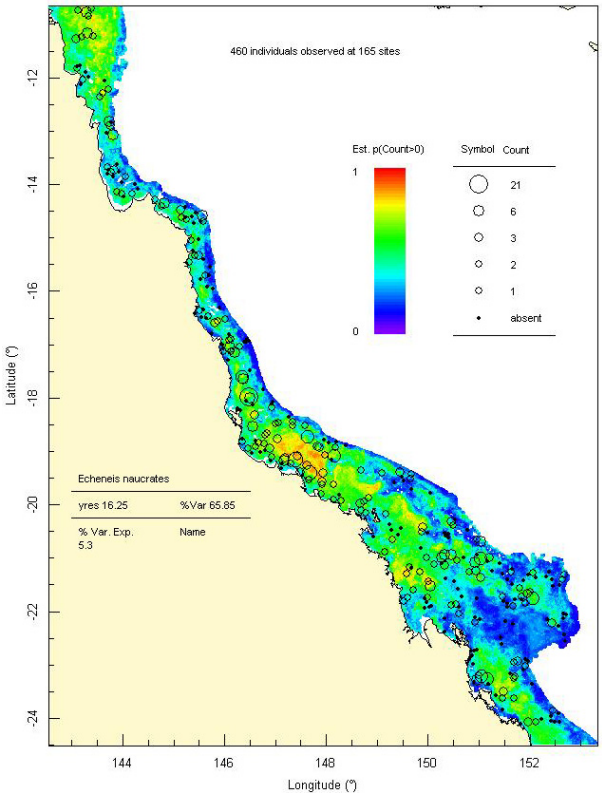
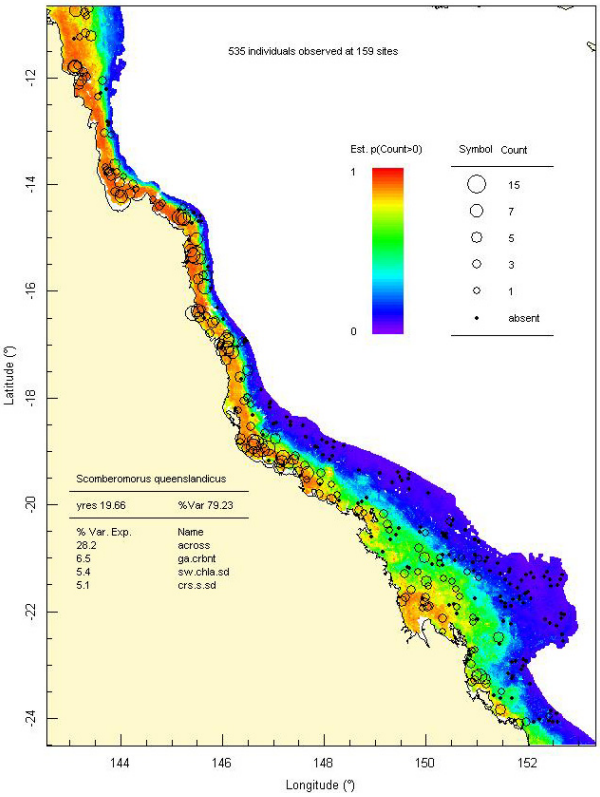


Figure 6-1: Example of a single species distribution map, for Actinopterygii: *Nemipterus theodoei*. Circles indicate the relative size of the sample at each of the survey sites. P-AUC indicates area-under-the-curve performance of the presence model (range 0.5-1) and Deviance Ratio indicates relative deviance explained by the biomass model (range 0-1).

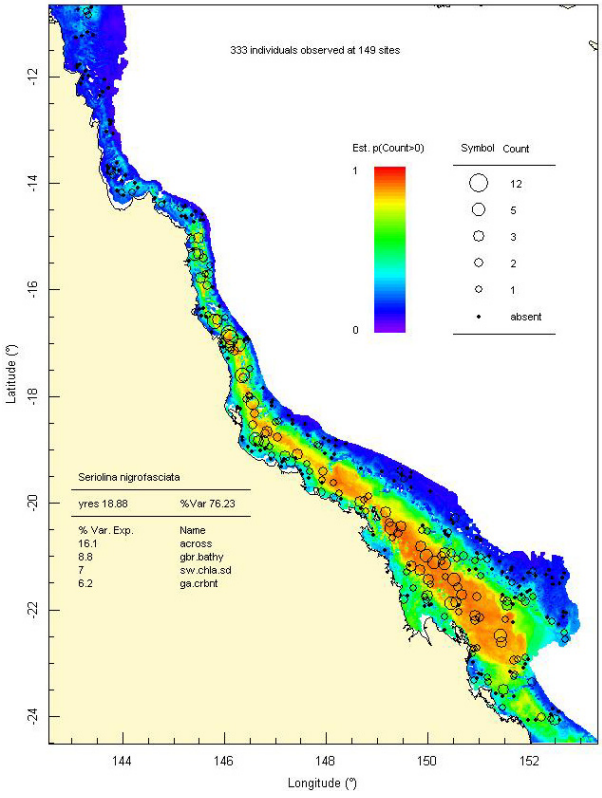
(a) Actinopterygii: *Echeneis naucrates*



(b) Actinopterygii: *Scomberomorus queenslandicus*



(c) Actinopterygii: *Seriolina nigrofasciata*



(d) Actinopterygii: *Carangoides coeruleopinnatus*

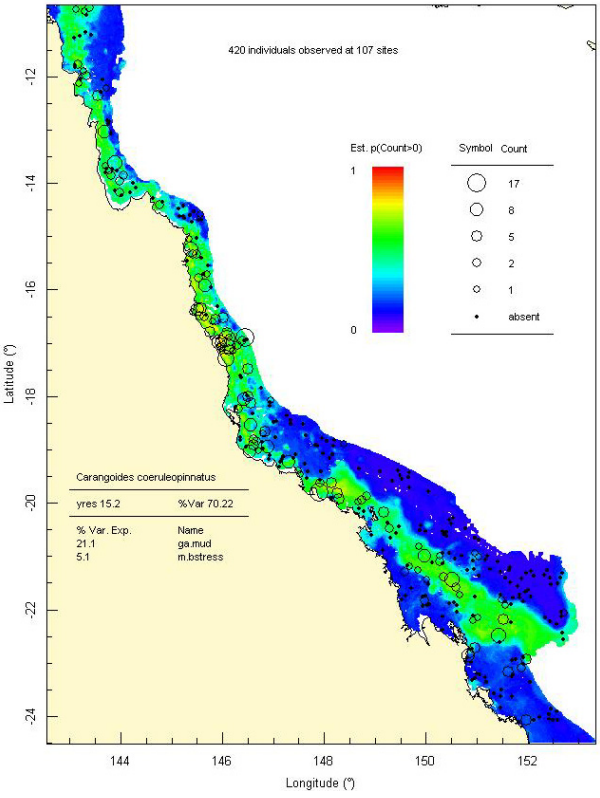
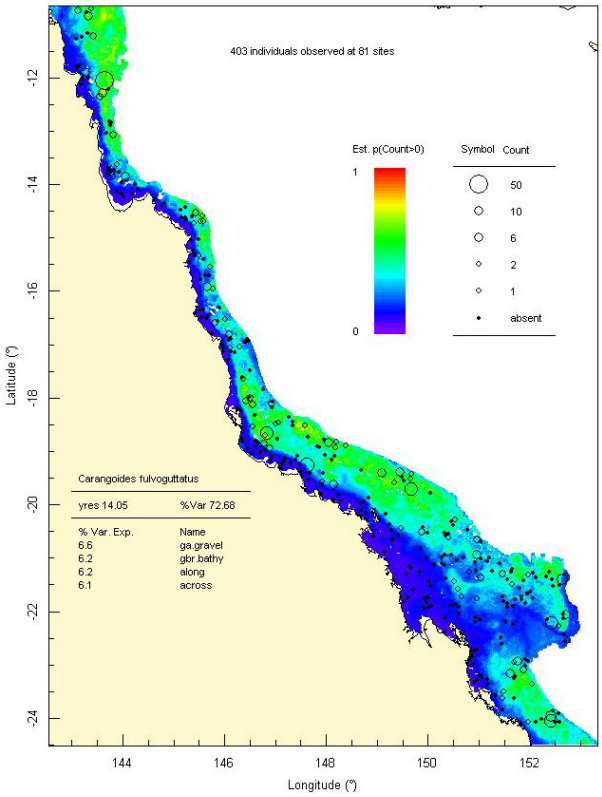
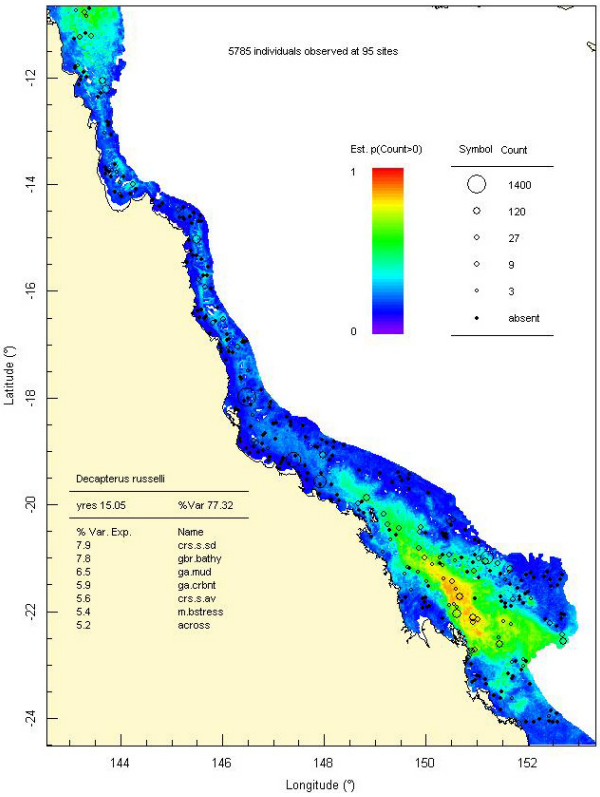


Figure 6-2 Predicted biomass of selected species of fishes, observed requently in BRUVS. Circles represent observed abundance (untransformed) and influential covariates are listed in the inset panels. "%XVar" describes the percentage of the variation in the presence/absence of the species accounted for by the gbm model. "yres" is (1-%prediction error).

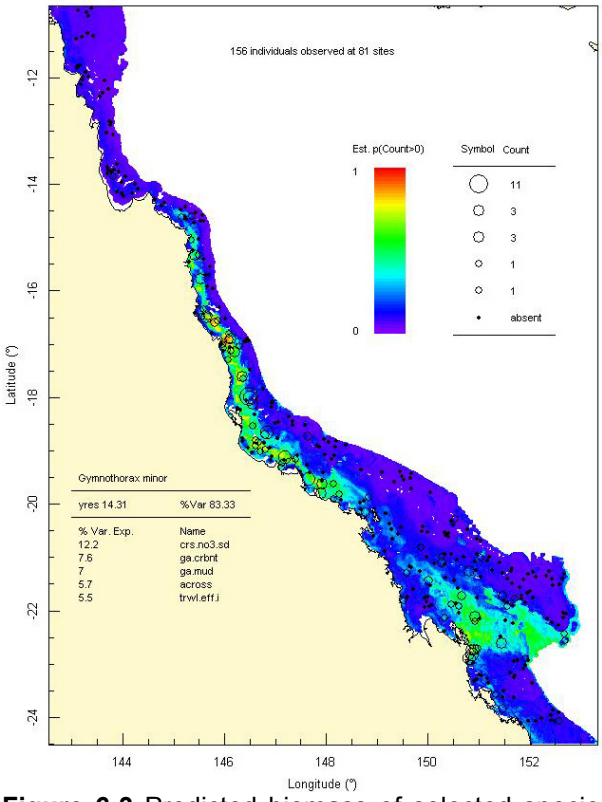
(a) Actinopterygii: *Carangoides fulvoguttatus*



(b) Actinopterygii: *Decapterus russelli*



(c) Actinopterygii: *Gymonthorax minor*



(d) Actinopterygii: *Carangoides gymnostethus*

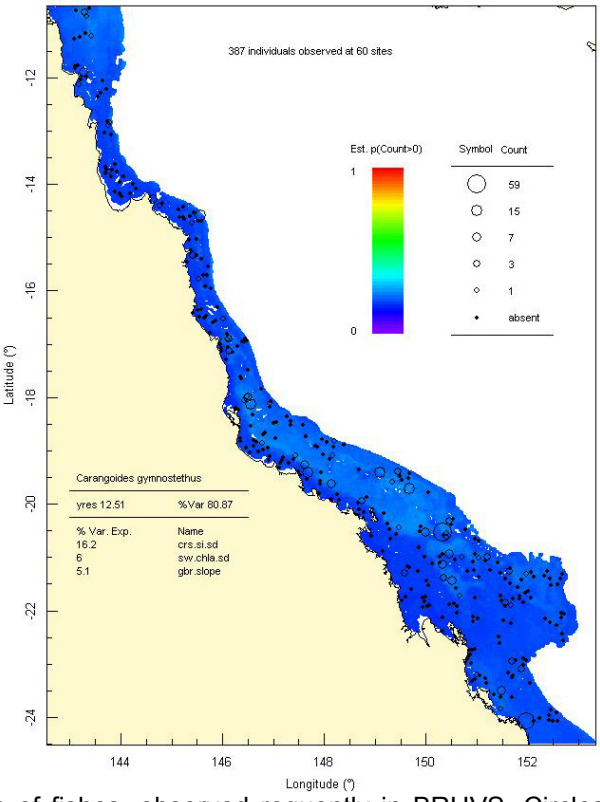


Figure 6-3 Predicted biomass of selected species of fishes, observed requently in BRUVS. Circles represent observed abundance (untransformed) and influential covariates are listed in the inset panels. "%XVar" describes the percentage of the variation in the presence/absence of the species accounted for by the gbm model. "yres" is (1-%prediction error).

(a) Actinopterygii: *Gnathanodon speciosus*

(b) Actinopterygii: *Alepes apercna*

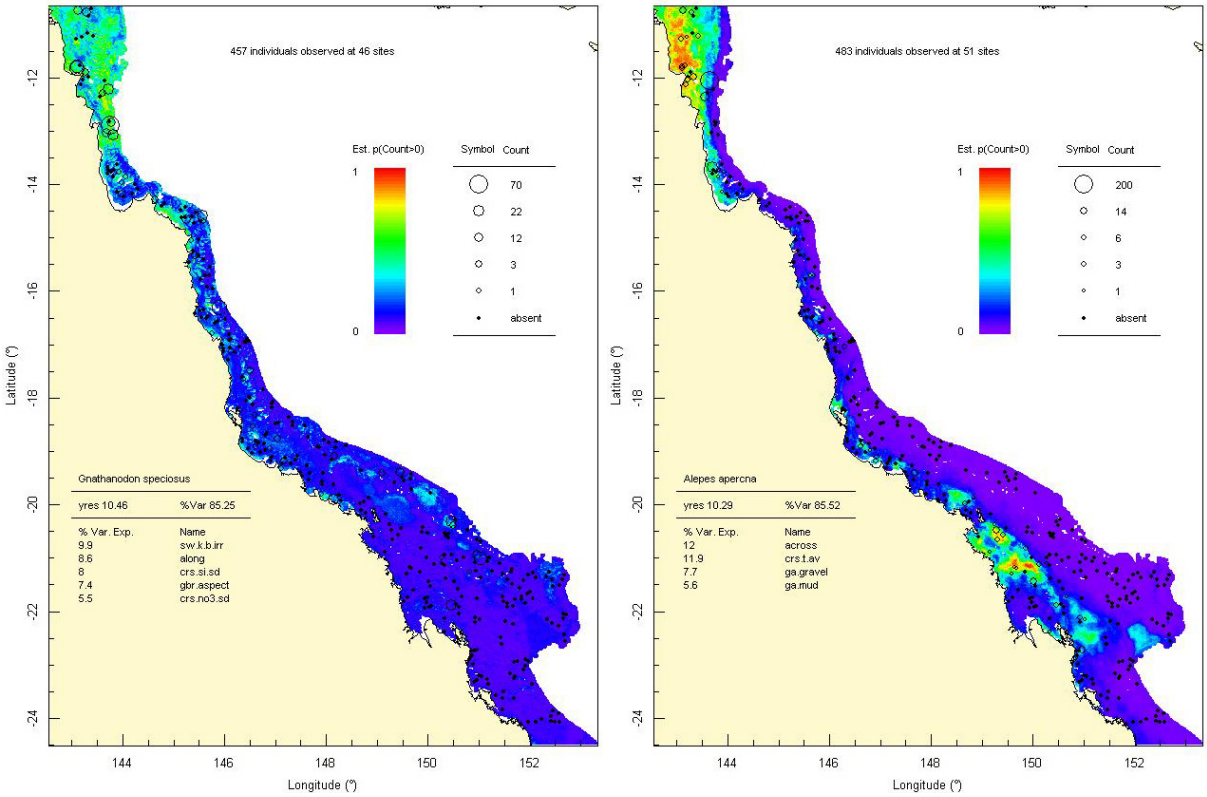


Figure 6-4 Predicted biomass of selected species of fishes, observed requently in BRUVS. Annotations as above.

(a) Group 1

(b) Group 2

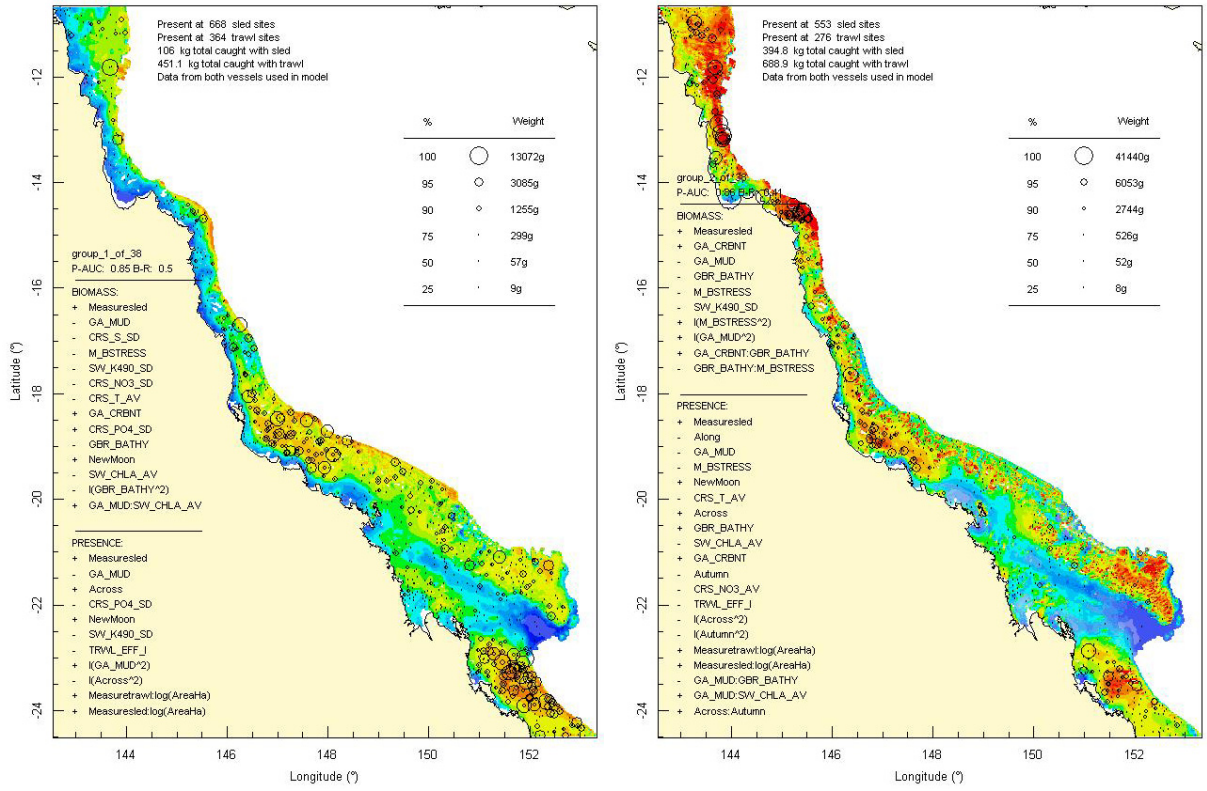


Figure 6-5: Model distribution maps of species groups. Annotations as Figure 6-1

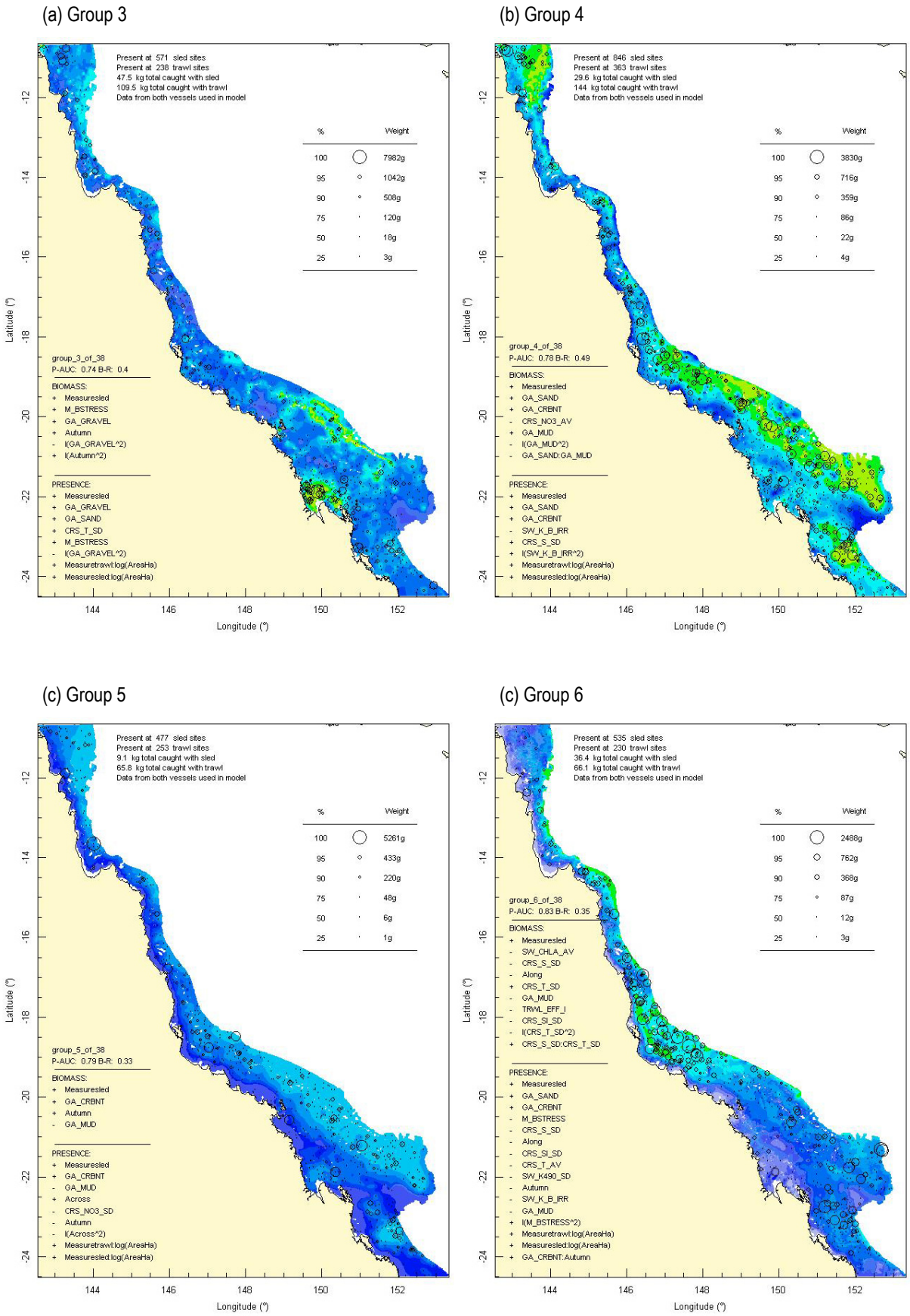


Figure 6-6: Model distribution maps of species groups.

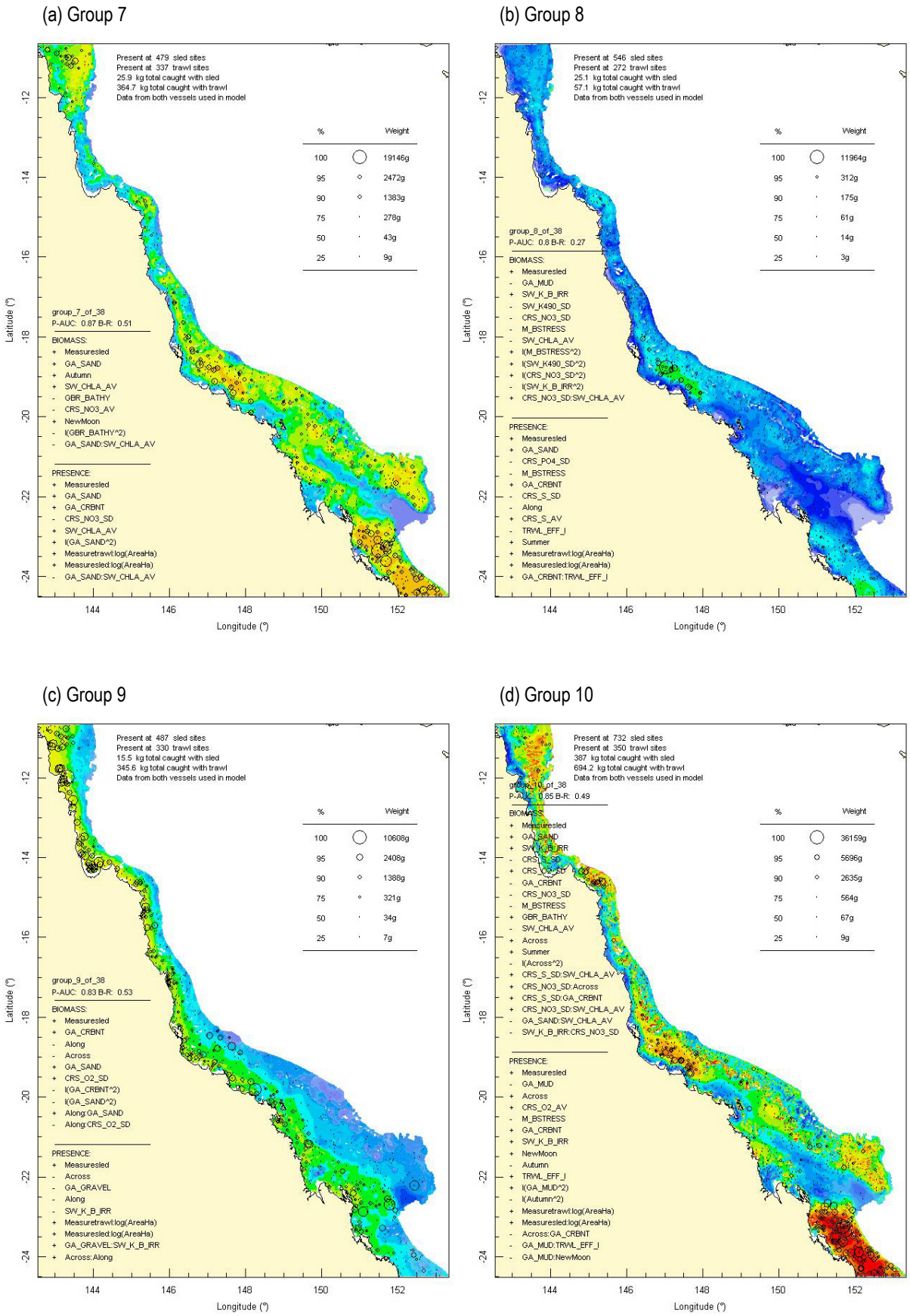


Figure 6-7: Model distribution maps of selected species groups.

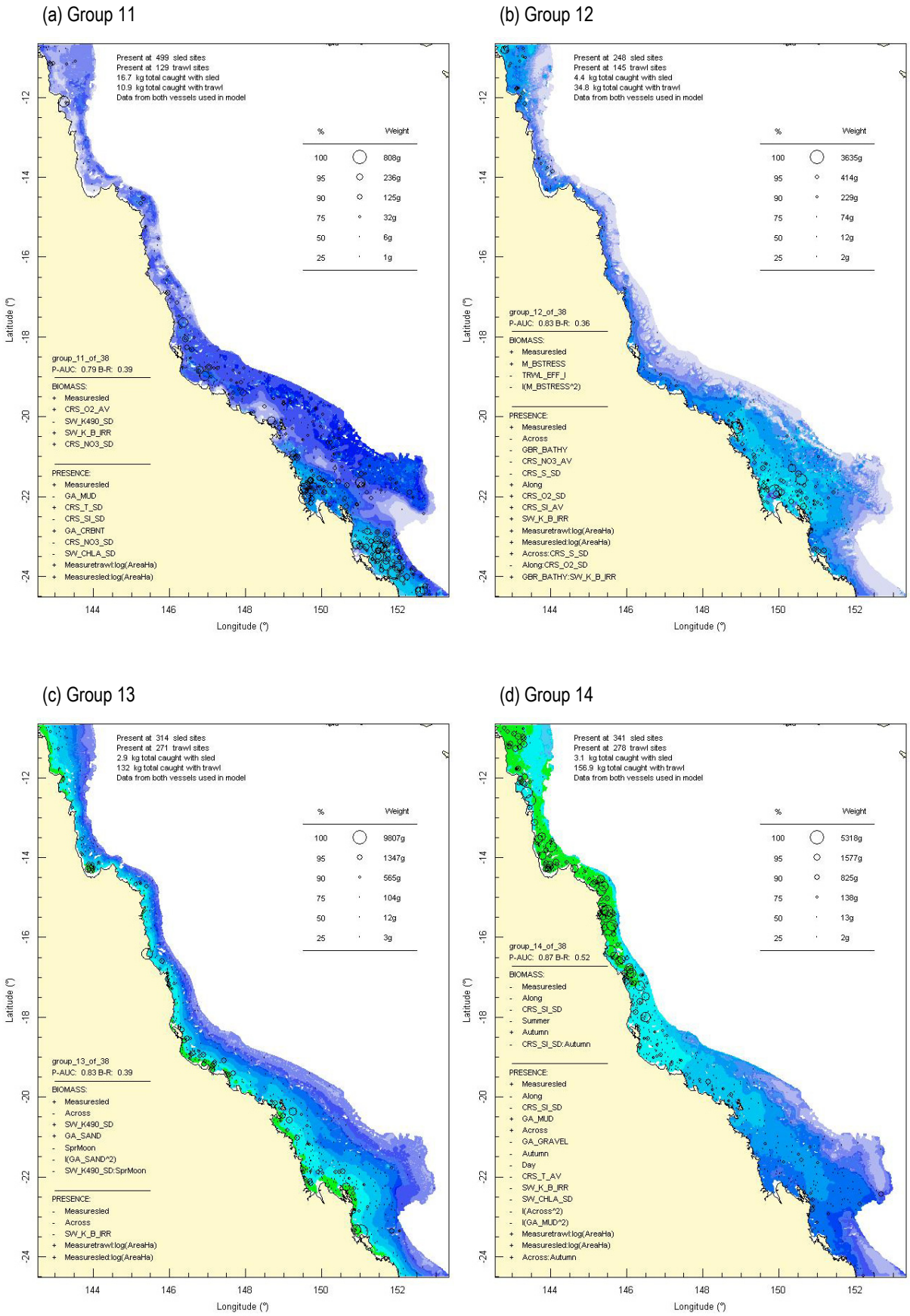


Figure 6-8: Model distribution maps of selected species groups.

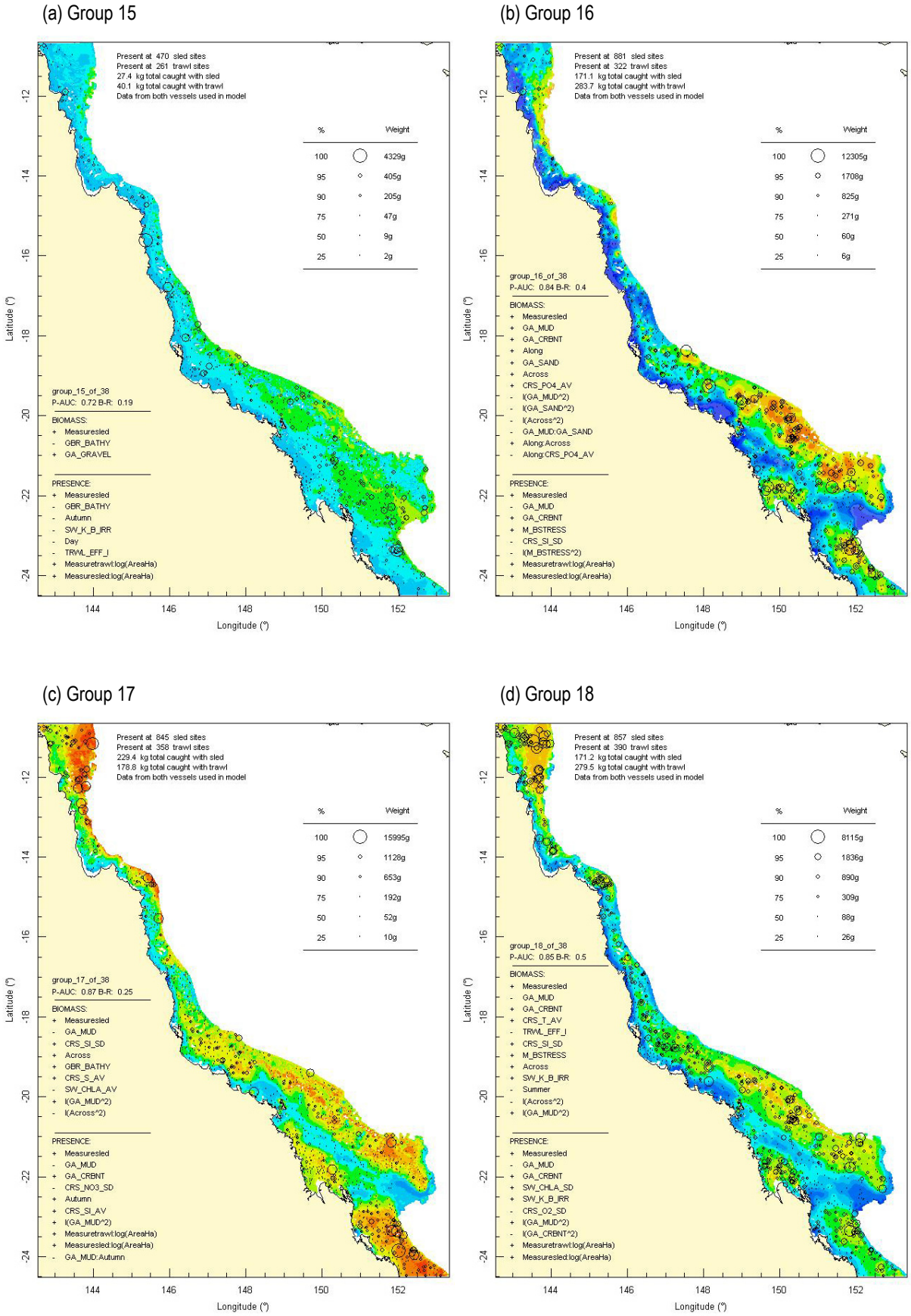


Figure 6-9: Model distribution maps of selected species groups.

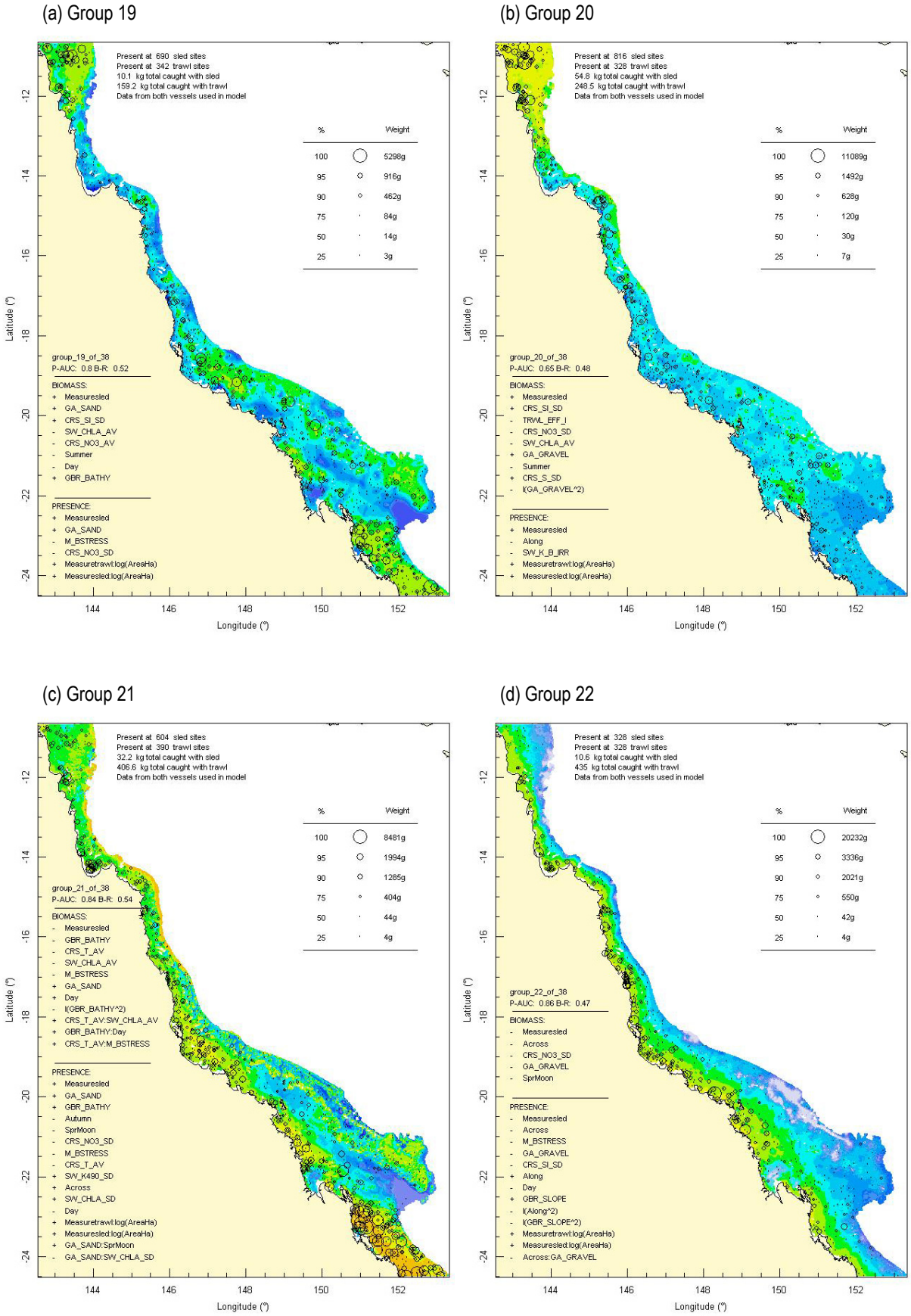


Figure 6-10: Model distribution maps of selected species groups.

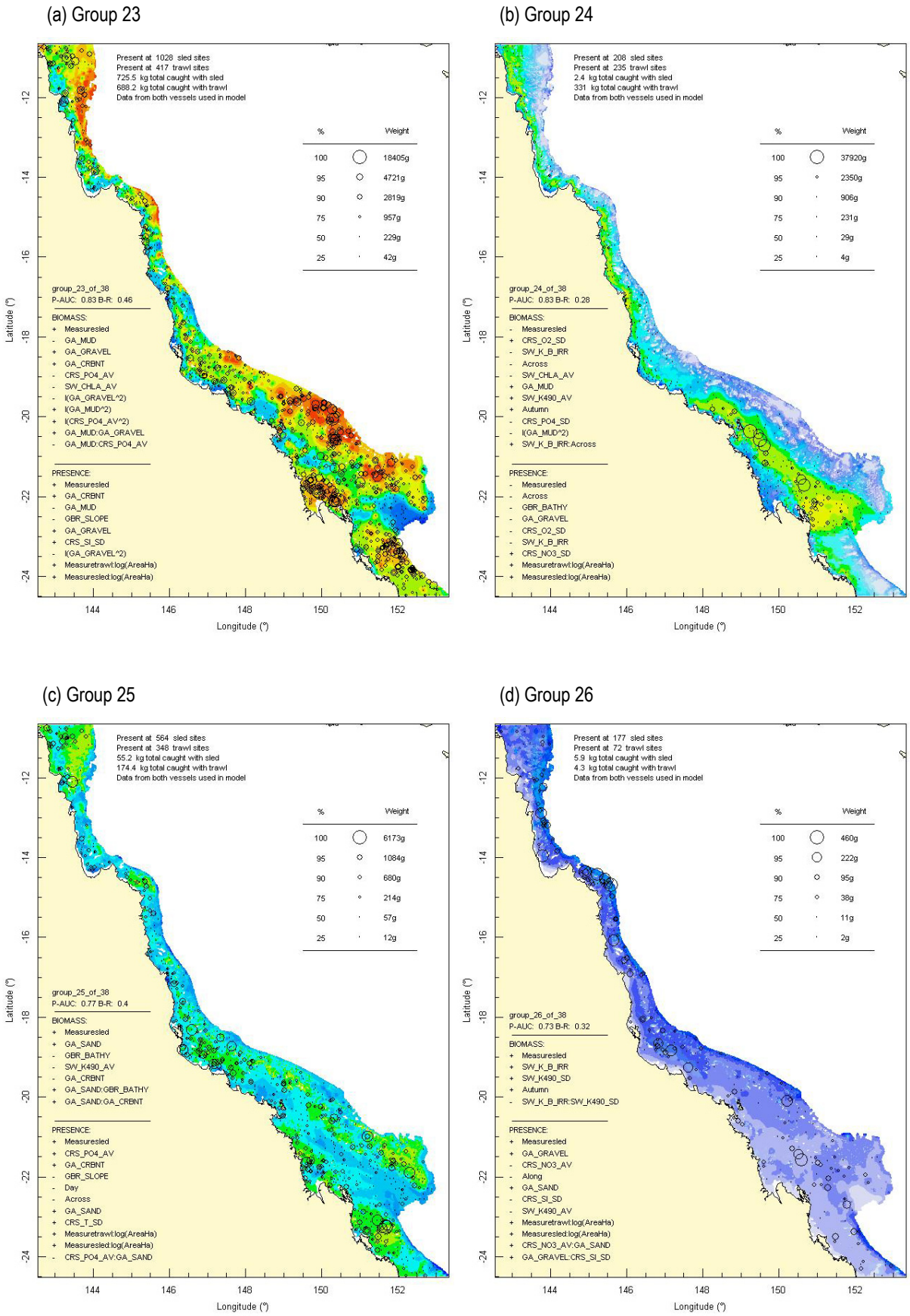


Figure 6-11: Model distribution maps of selected species groups.

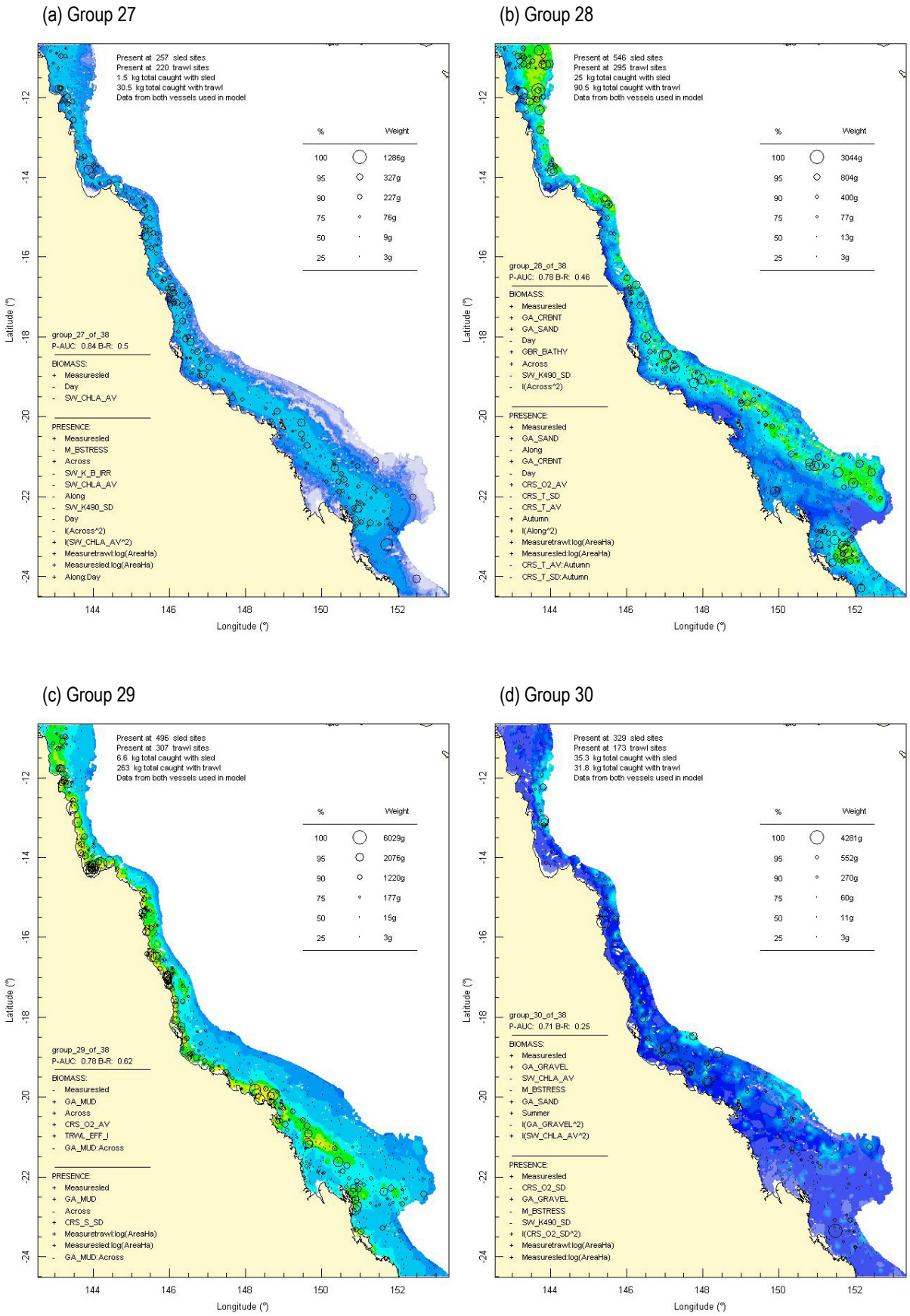


Figure 6-12: Model distribution maps of selected species groups.

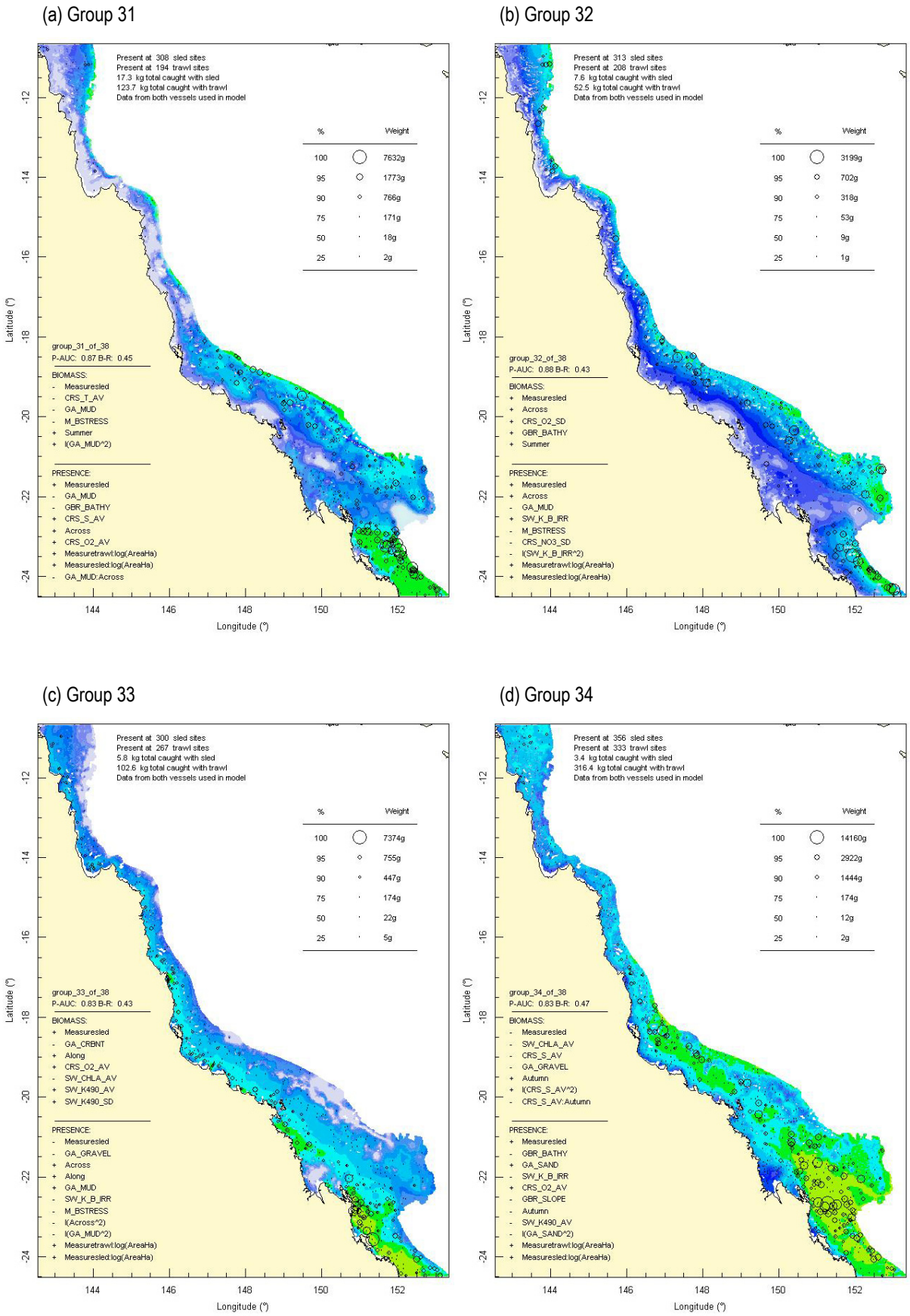


Figure 6-13: Model distribution maps of selected species groups.

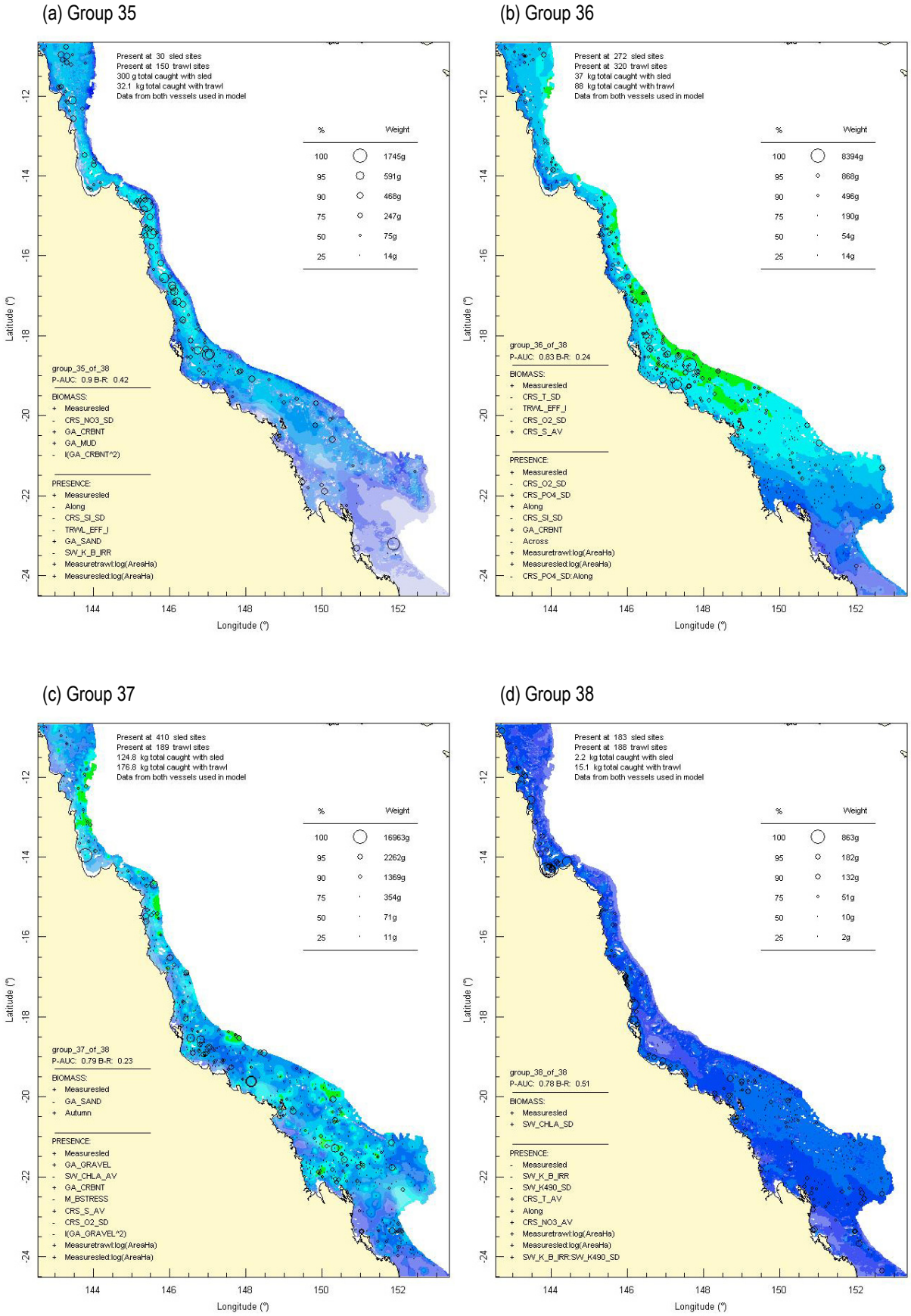


Figure 6-14: Model distribution maps of selected species groups.

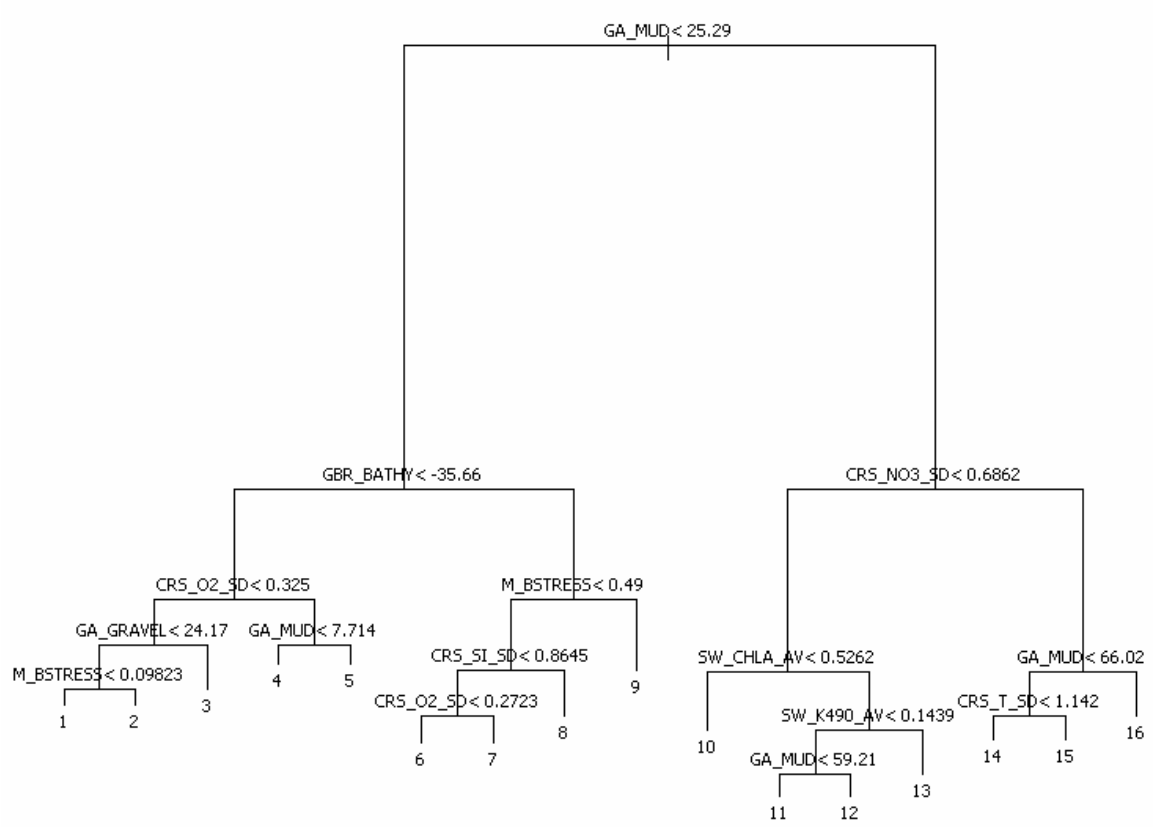


Figure 6-15: Recursive decision tree partitioning the sites into 16 groups, corresponding to the terminal nodes. The labels indicate the split variable and threshold for the group corresponding to the left hand branch in each case. The distances used were Bray-Curtis dissimilarities on 1/8th root transforms of the predicted site species biomass data.

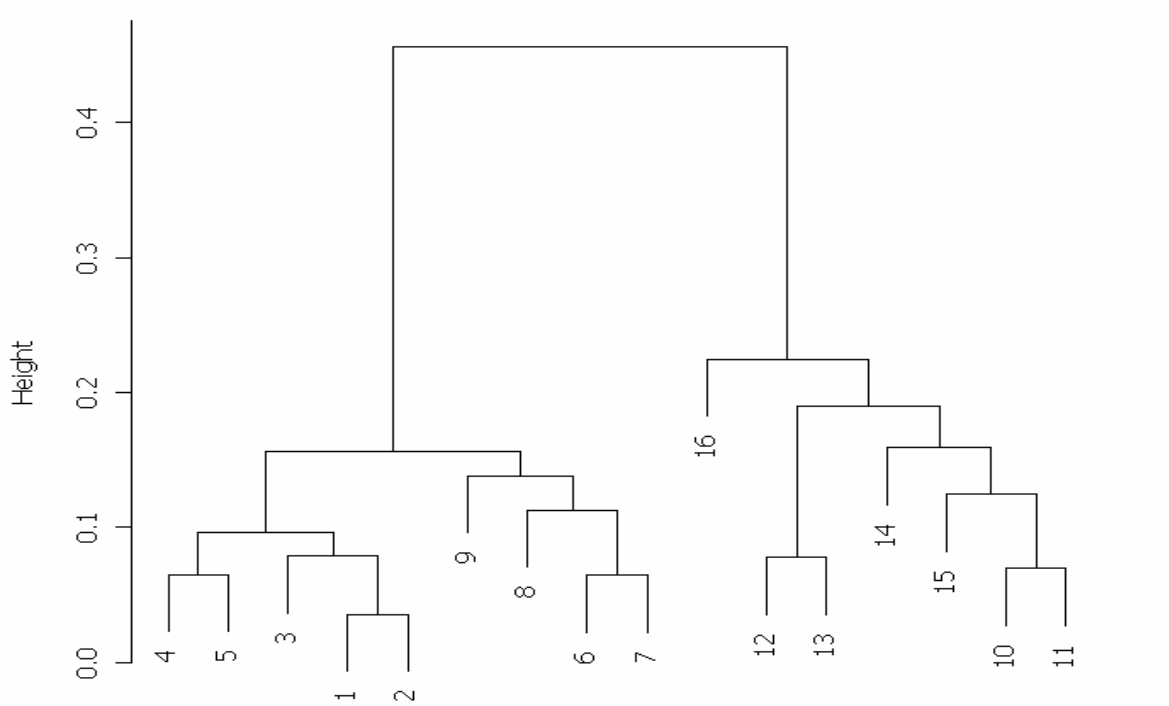


Figure 6-16: Dendrogram of biological similarities between the ***medoids*** of the 16 site group assemblages, as defined by the tree Figure 6-15, based on hierarchical clustering of Bray-Curtis dissimilarities using Ward's method.

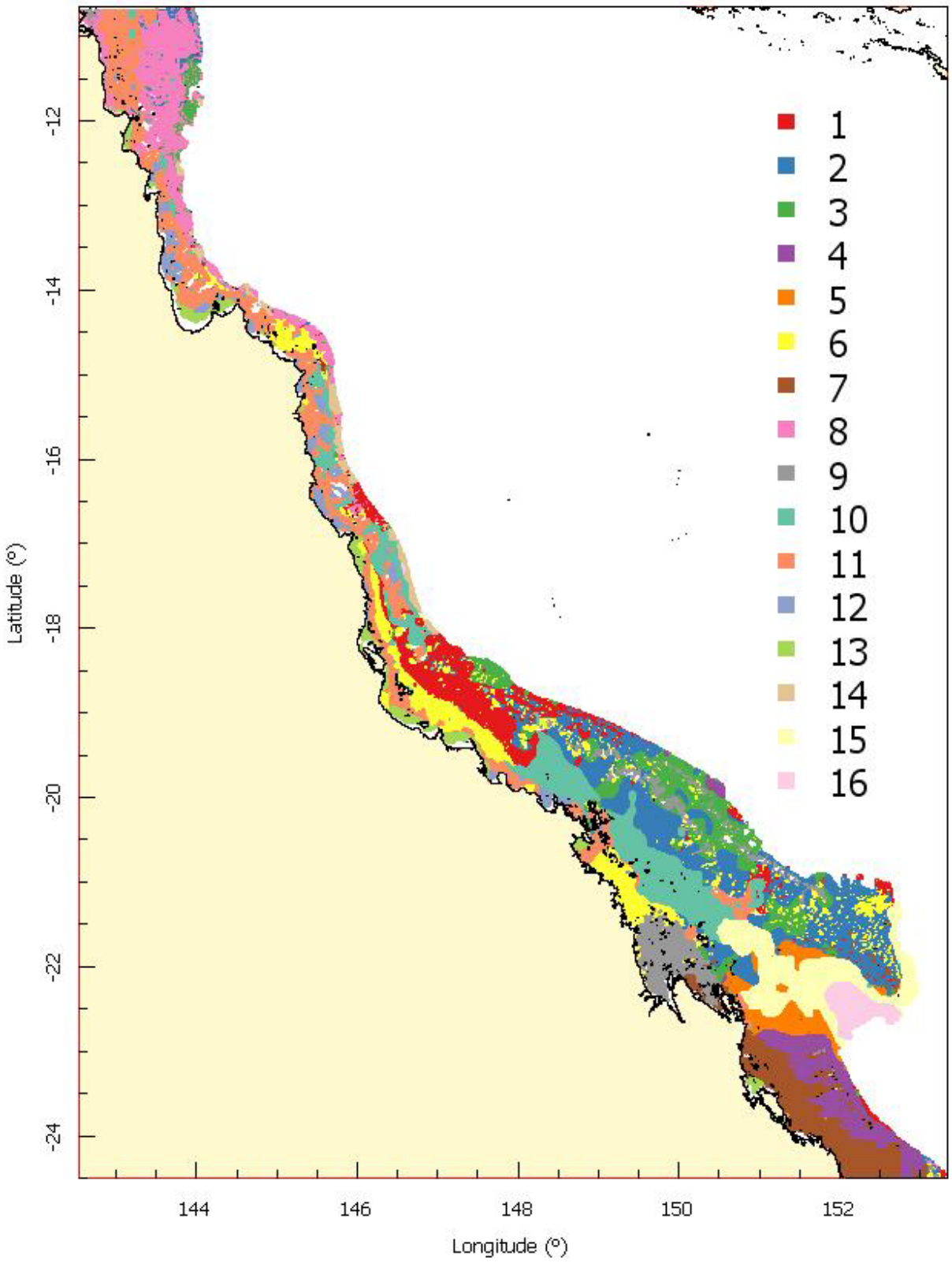


Figure 6-17: Map of predicted distributions of 16 seabed assemblages (site groups clusters).

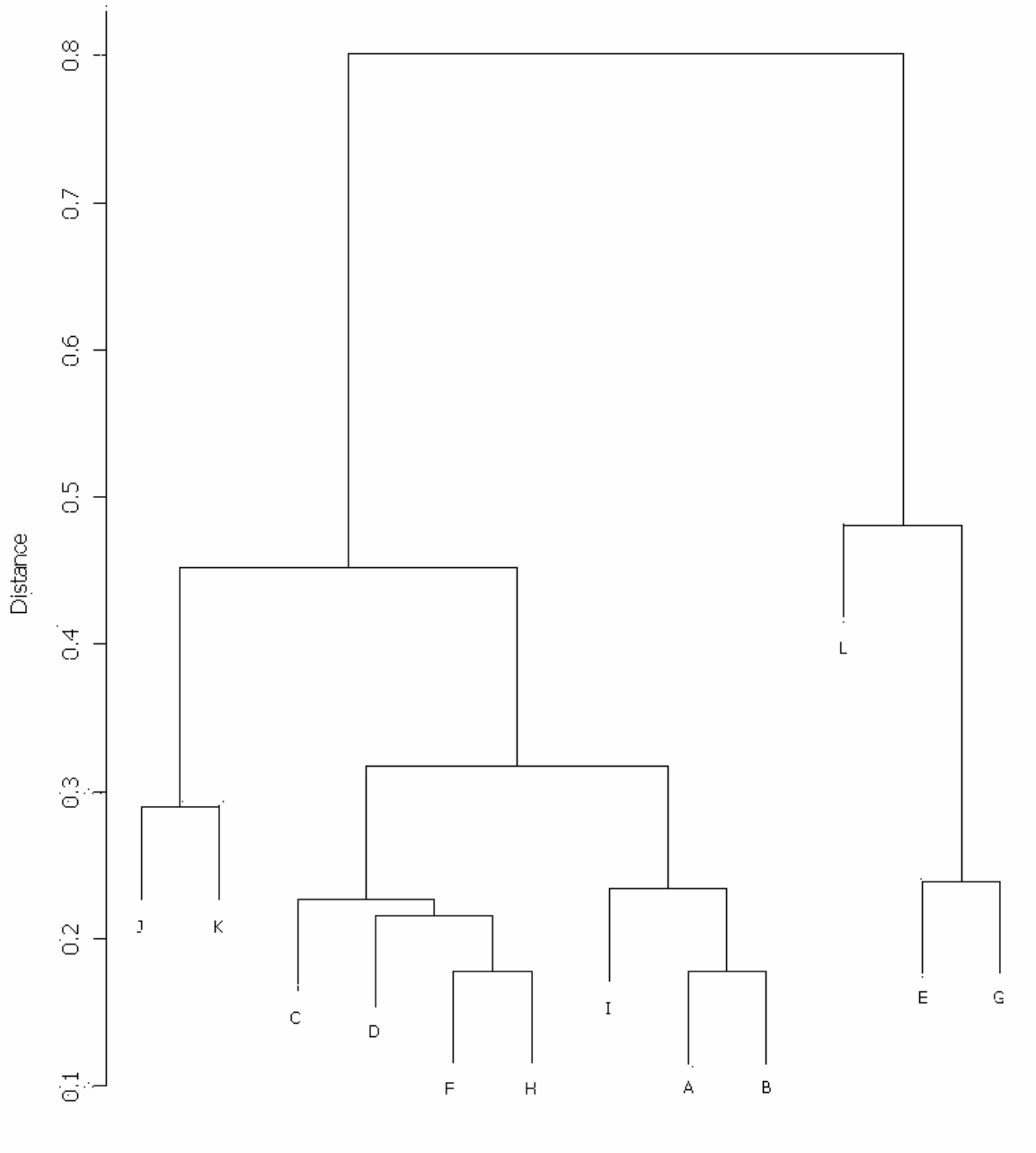


Figure 6-18: Summary dendrogram of similarities among twelve species-groups (A–L) in terms of mean affinities of species for 16 site-group assemblages.

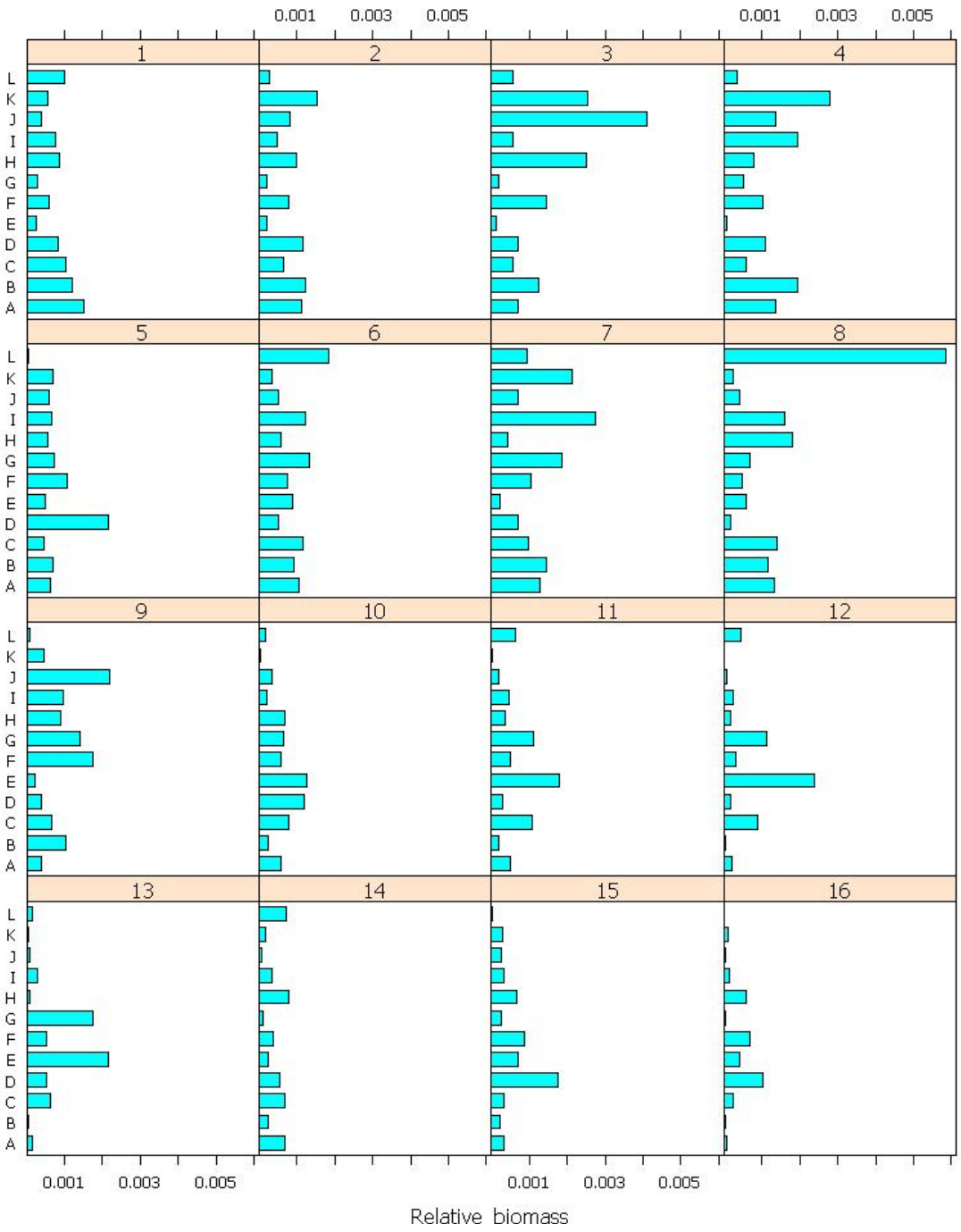


Figure 6-19: Plot of relative biomass of 12 species affinity groups (A–L) across the 16 site-group assemblages mapped in Figure 6-17.

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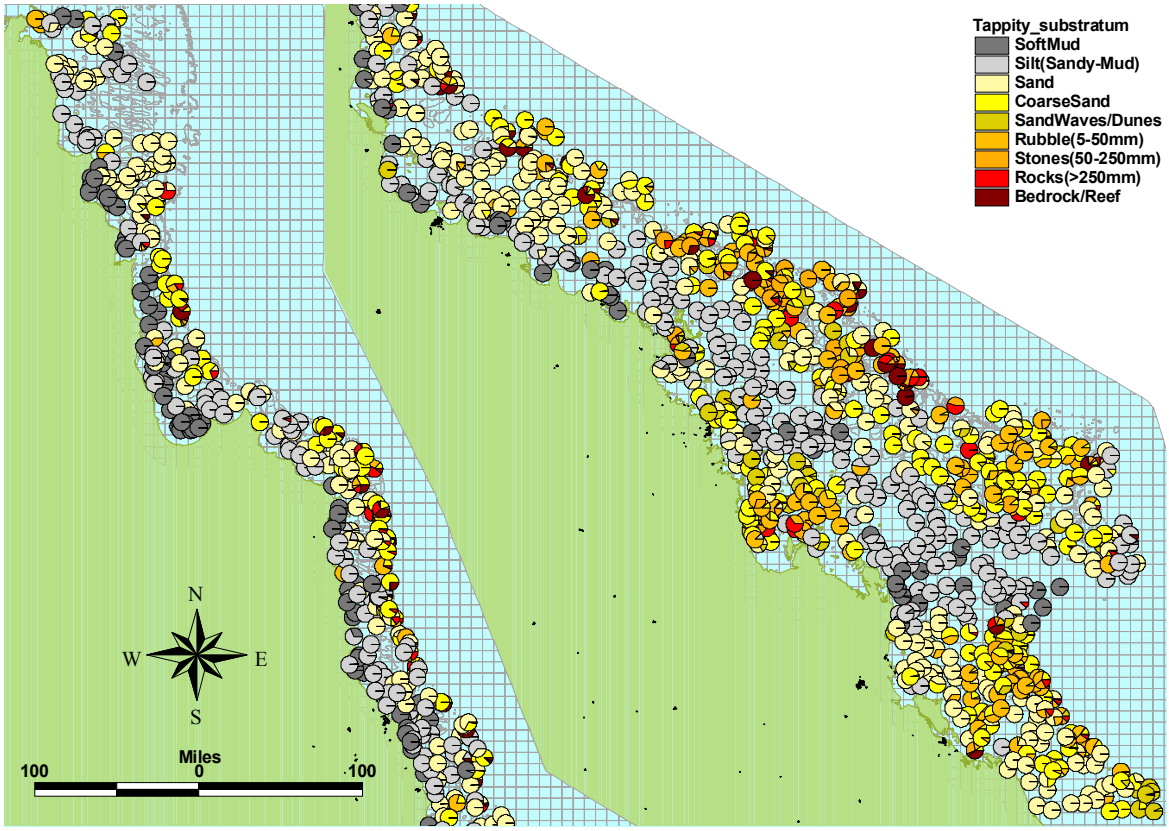


Figure 6-20: Map of the distribution of broad seabed substratum types summarized as percent of transect length observed by towed video camera.

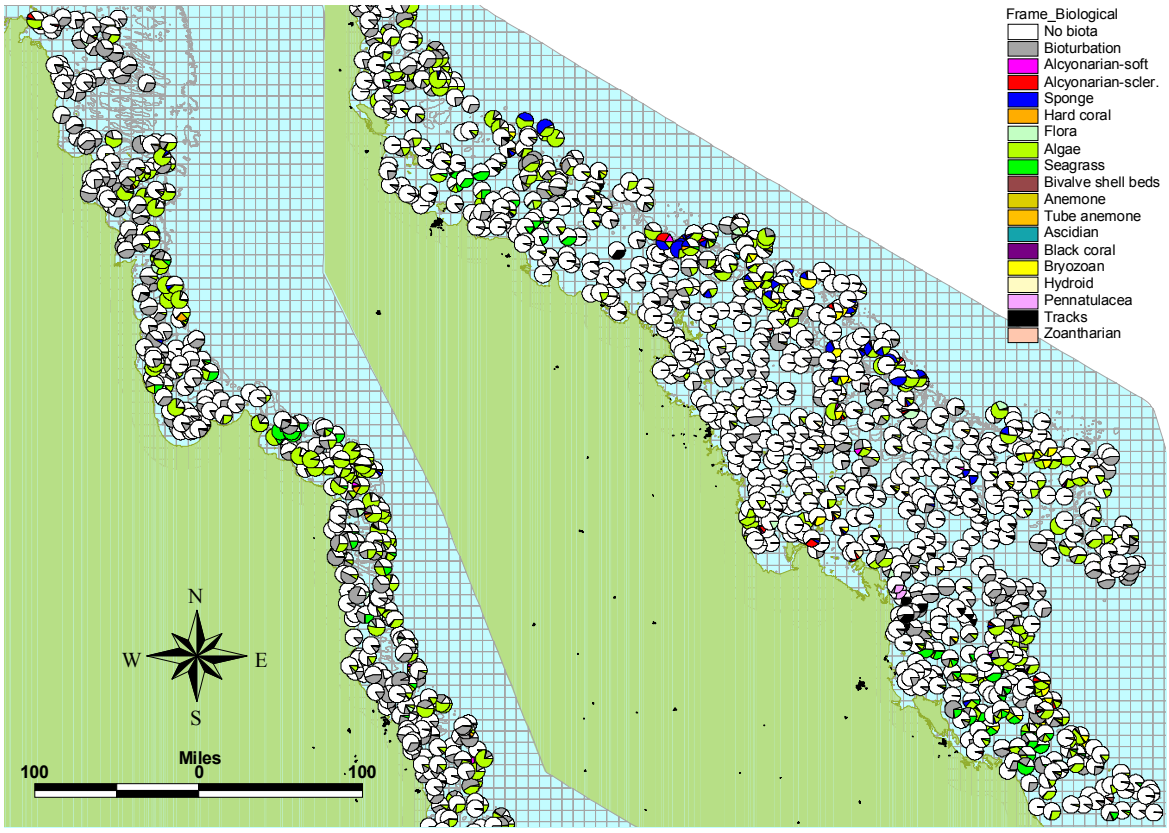
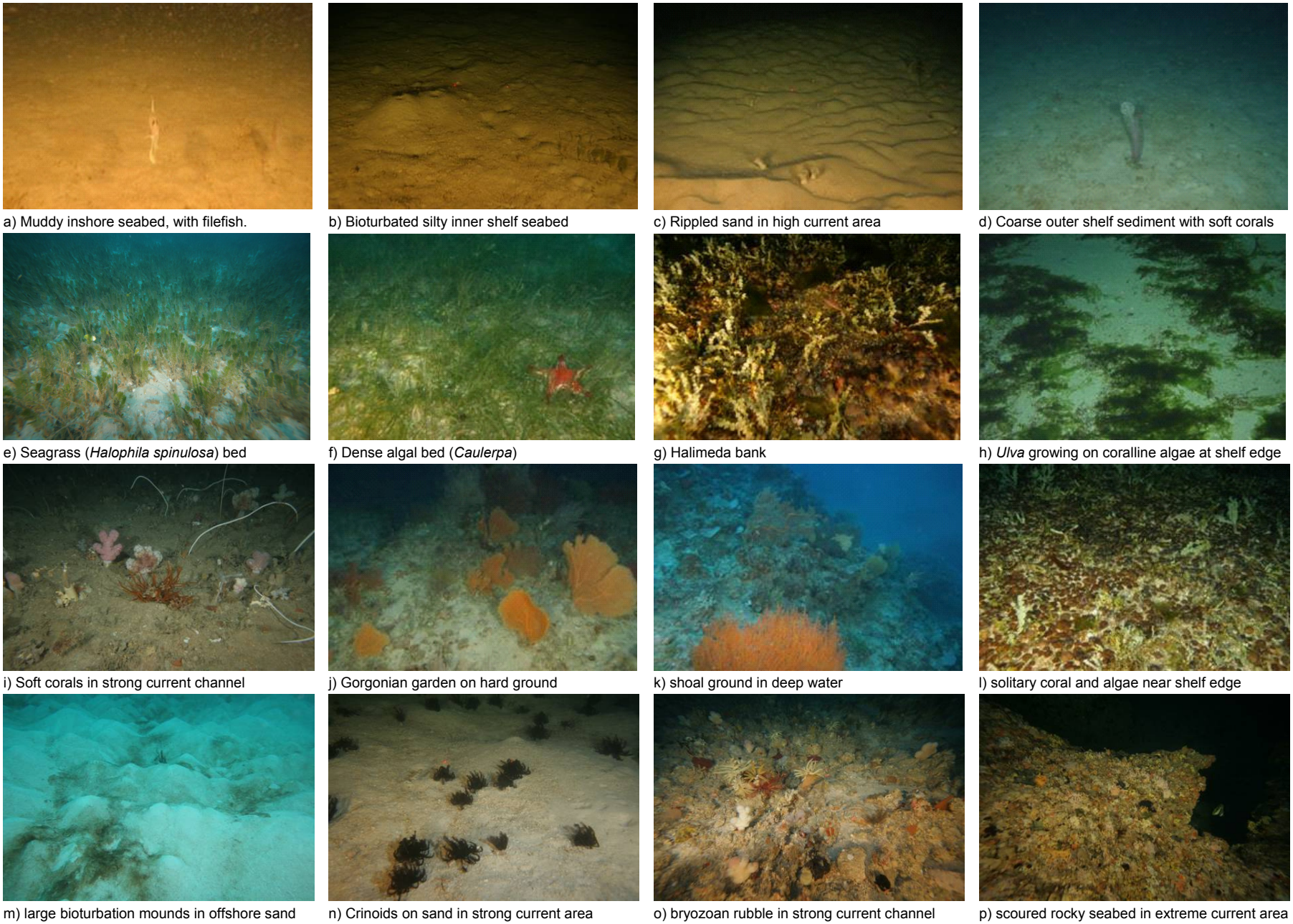


Figure 6-21: Map of the distribution of broad biological seabed habitat features summarised as mean percent cover of video frames observed during post-analysis of towed camera video.



a) Muddy inshore seabed, with filefish.
b) Bioturbated silty inner shelf seabed
c) Rippled sand in high current area
d) Coarse outer shelf sediment with soft corals
e) Seagrass (*Halophila spinulosa*) bed
f) Dense algal bed (*Caulerpa*)
g) Halimeda bank
h) *Ulva* growing on coralline algae at shelf edge
i) Soft corals in strong current channel
j) Gorgonian garden on hard ground
k) shoal ground in deep water
l) solitary coral and algae near shelf edge
m) large bioturbation mounds in offshore sand
n) Crinoids on sand in strong current area
o) bryozoan rubble in strong current channel
p) scoured rocky seabed in extreme current area

Figure 6-22: Photos of some example habitat types observed by towed video camera.

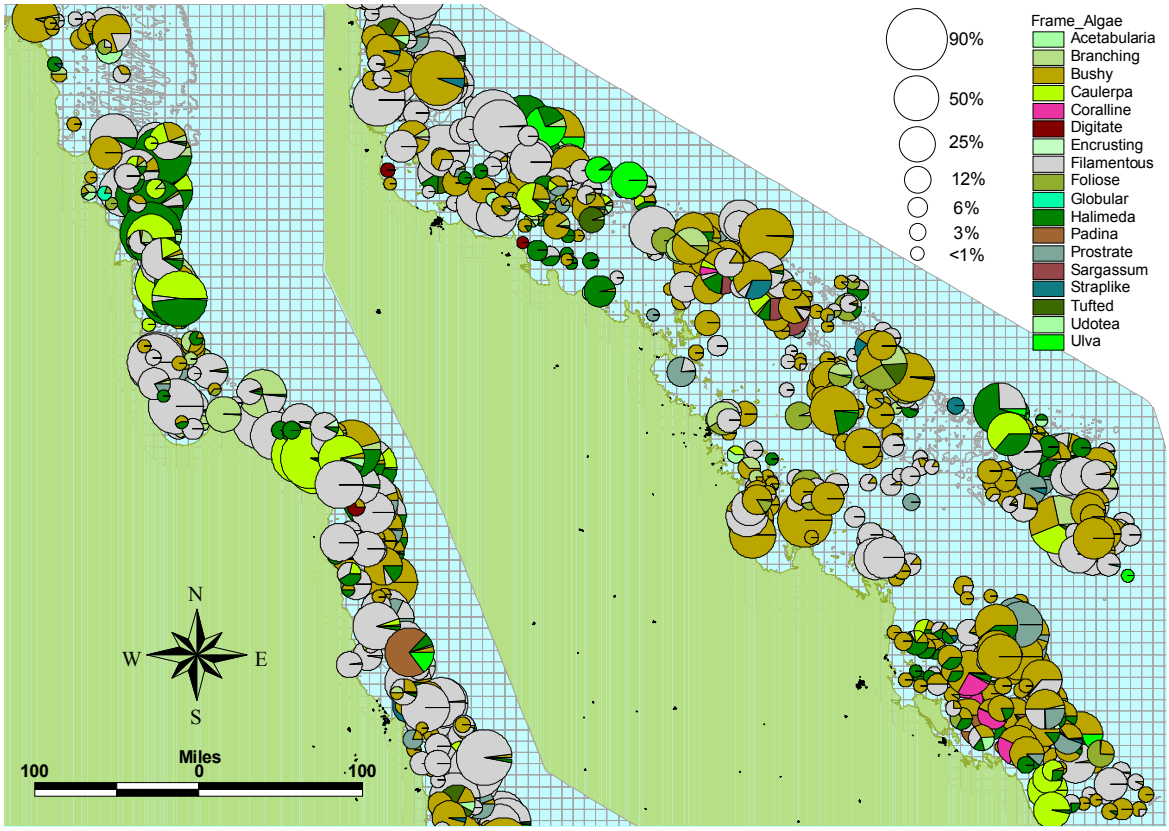


Figure 6-23: Map of the distribution and cover of conspicuous genera and other morpho-types of algae.

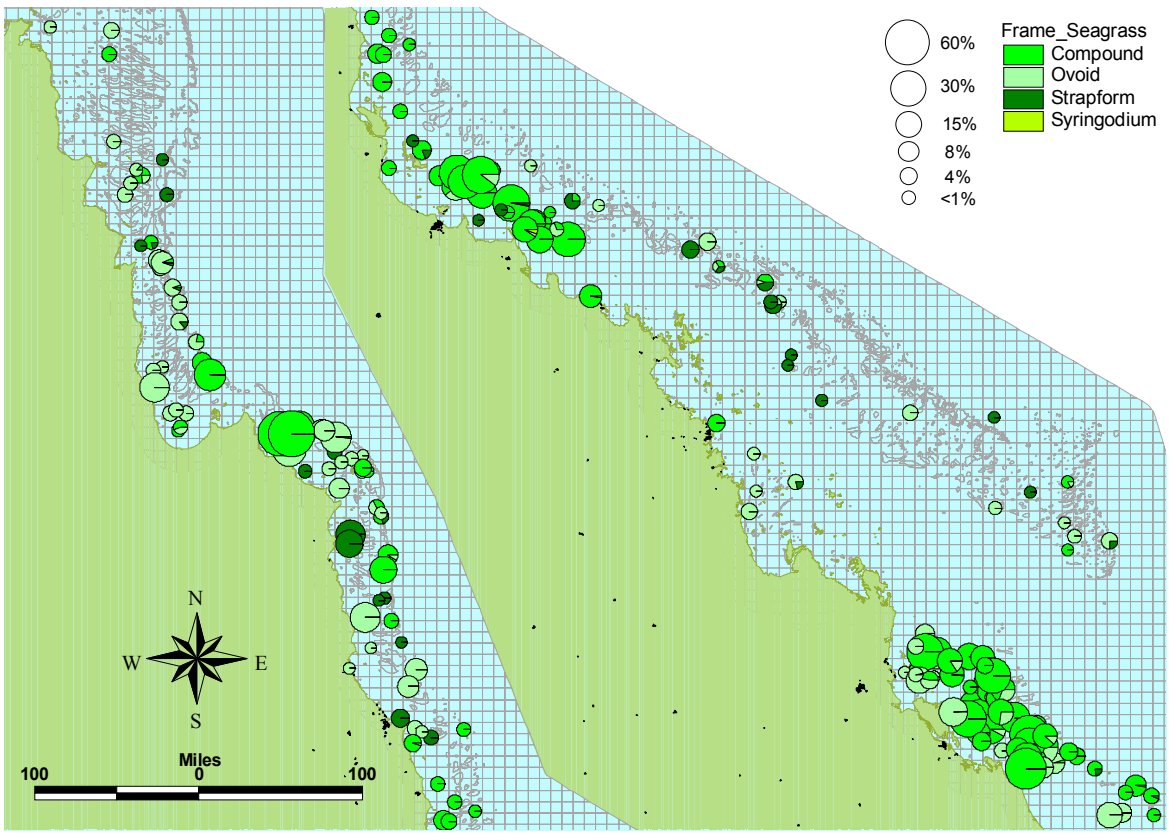


Figure 6-24: Map of the distribution and cover of morpho-types of seagrasses.

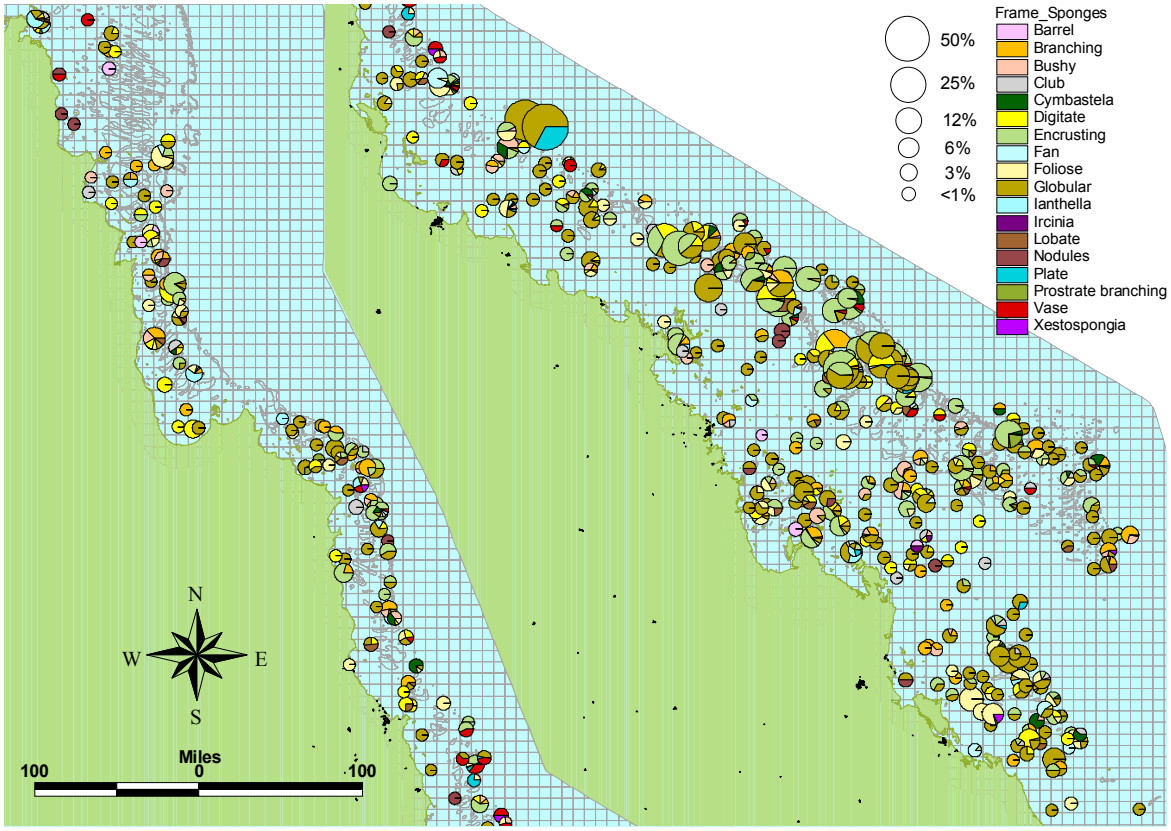


Figure 6-25: Map of the distribution and cover of conspicuous genera and other morpho-types of sponges.

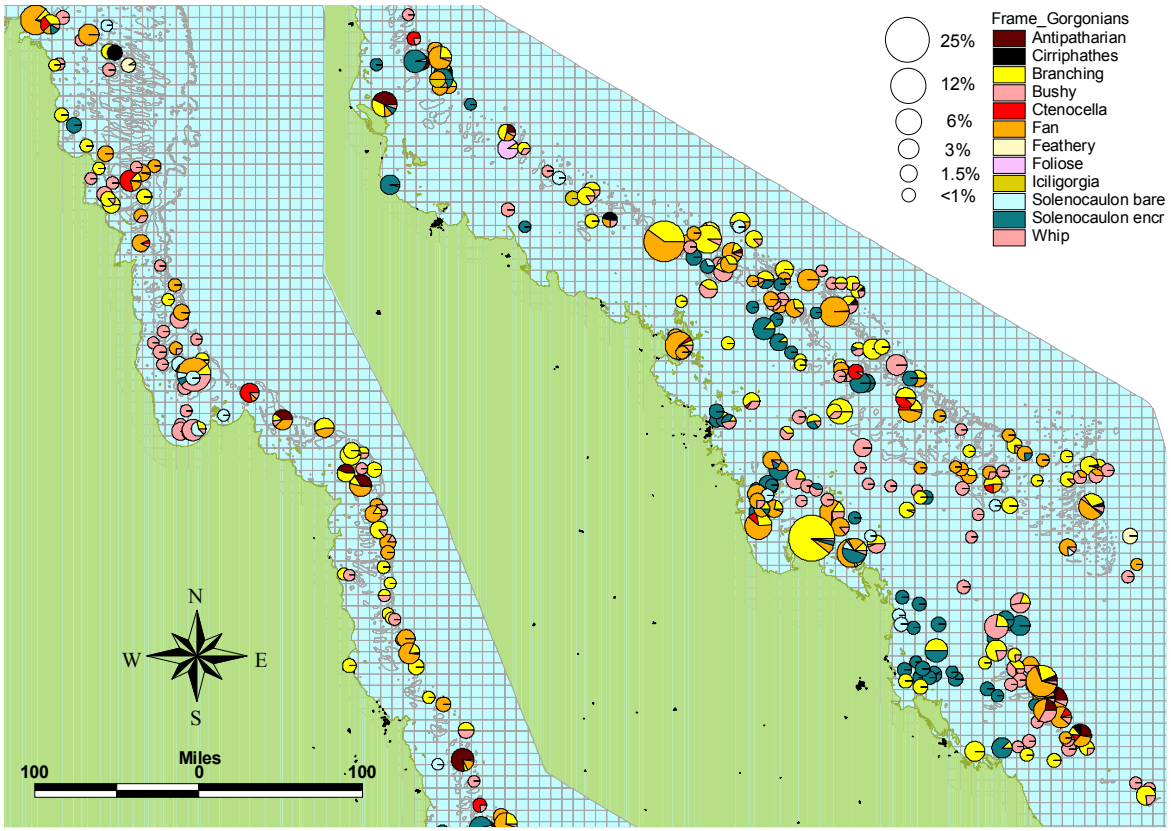


Figure 6-26: Map of the distribution and cover of conspicuous genera and other morpho-types of gorgonians.

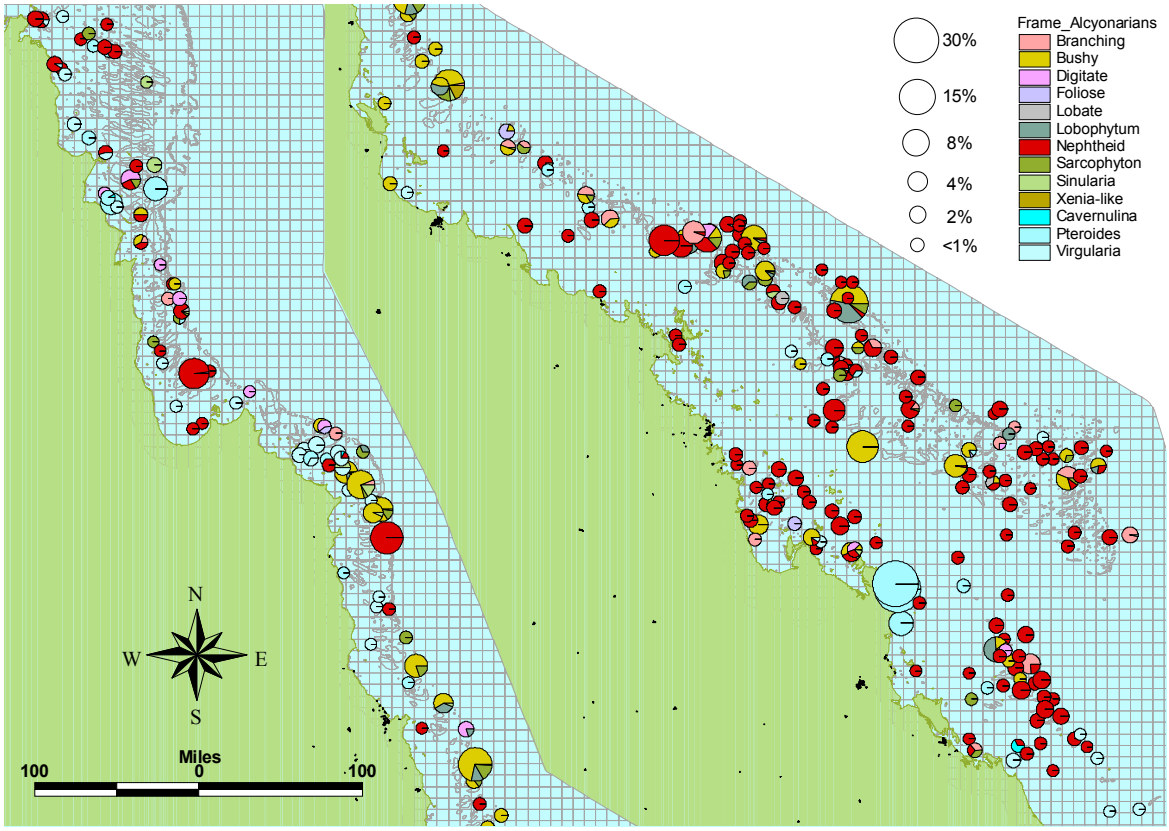


Figure 6-27: Map of the distribution and cover of conspicuous genera and other morpho-types of alcyonarian soft-corals.

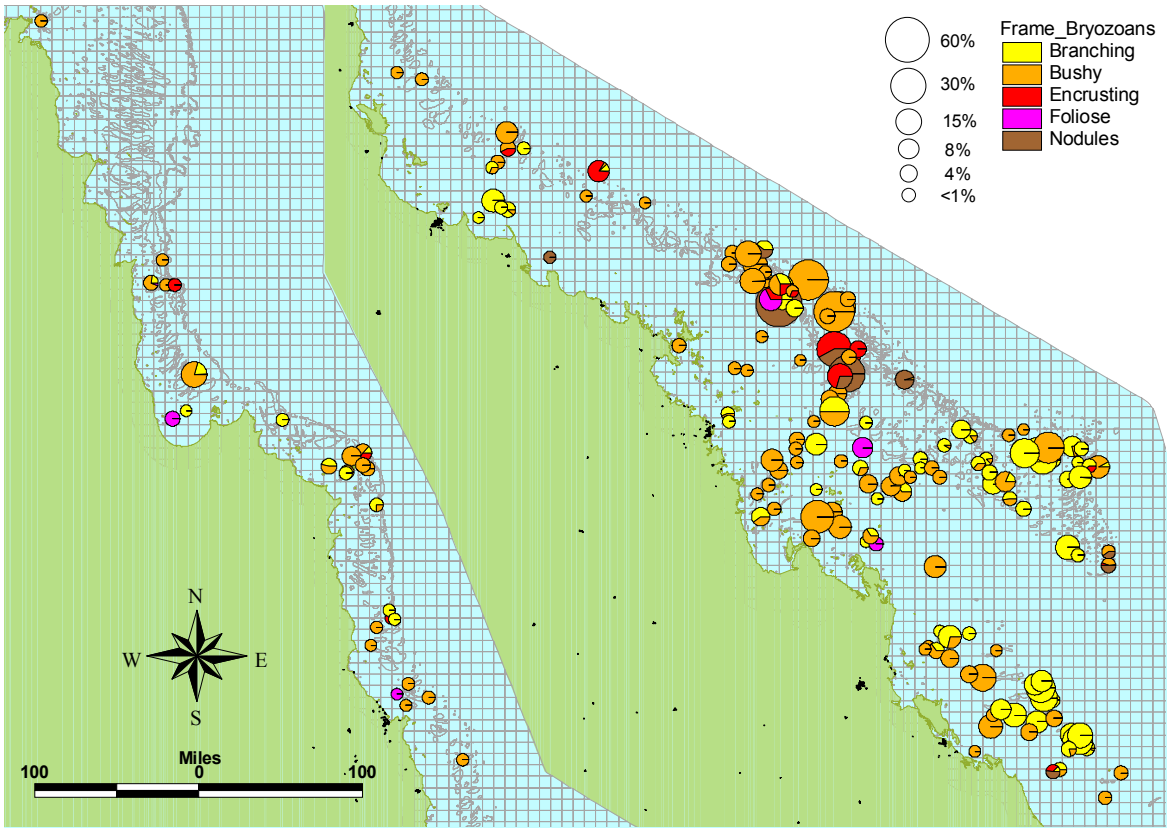


Figure 6-28: Map of the distribution and cover of morpho-types of bryozoans.

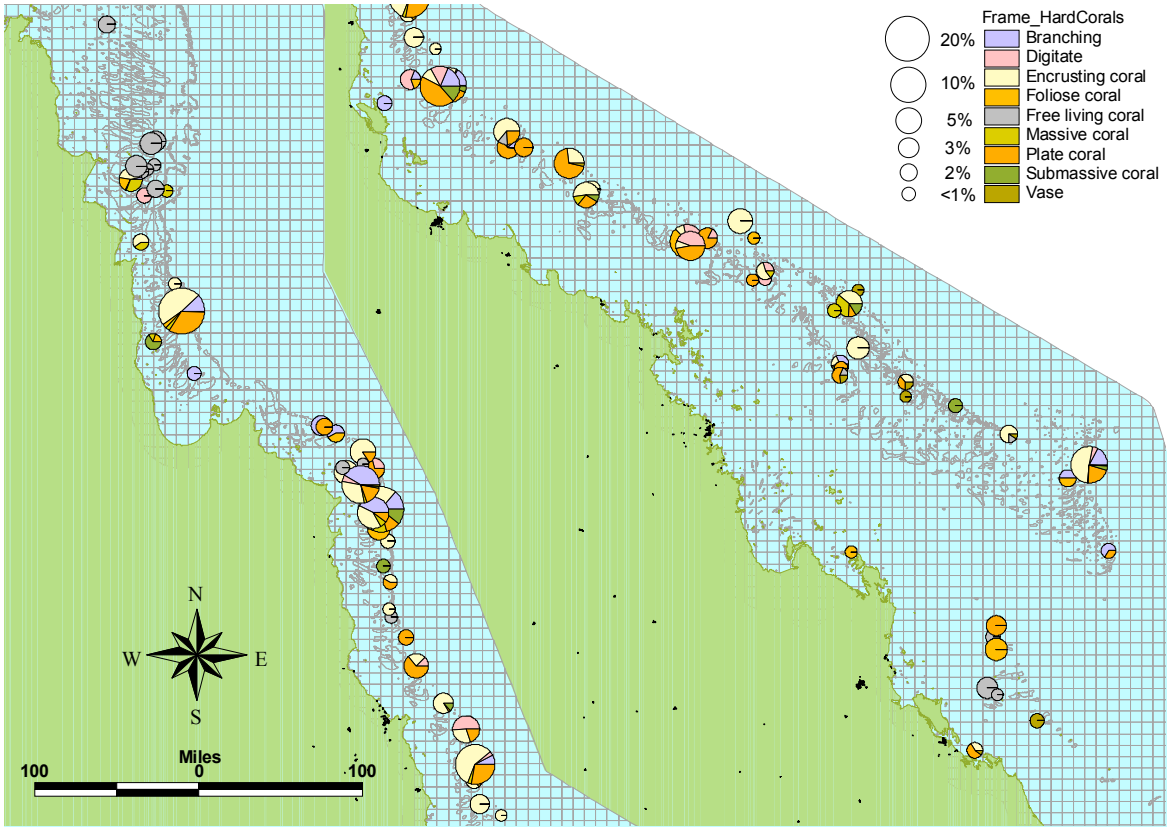


Figure 6-29: Map of the distribution and cover of morpho-types of hardcorals.

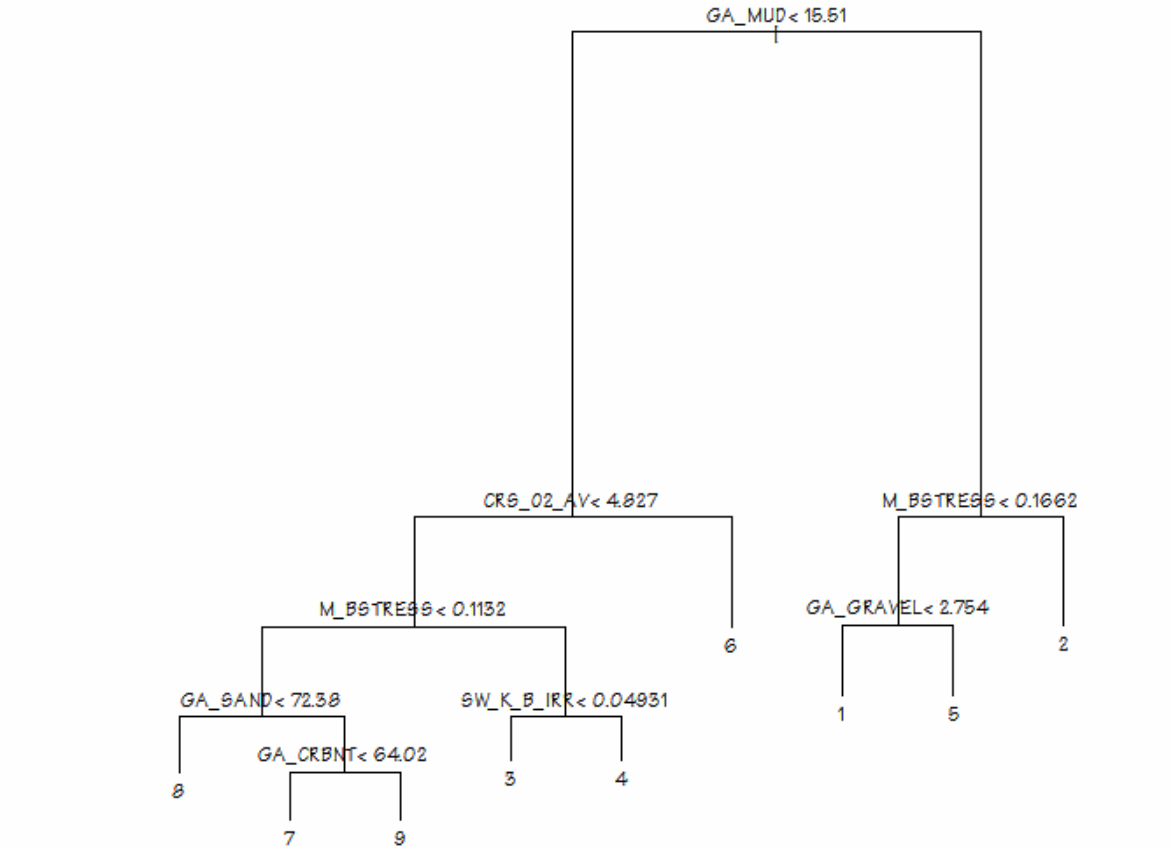


Figure 6-30: Recursive partitioning of sites based on the grouped vessel biological cover proportions, the Manhattan (Bray-Curtis) distance metric and the medoid partitioning algorithm.

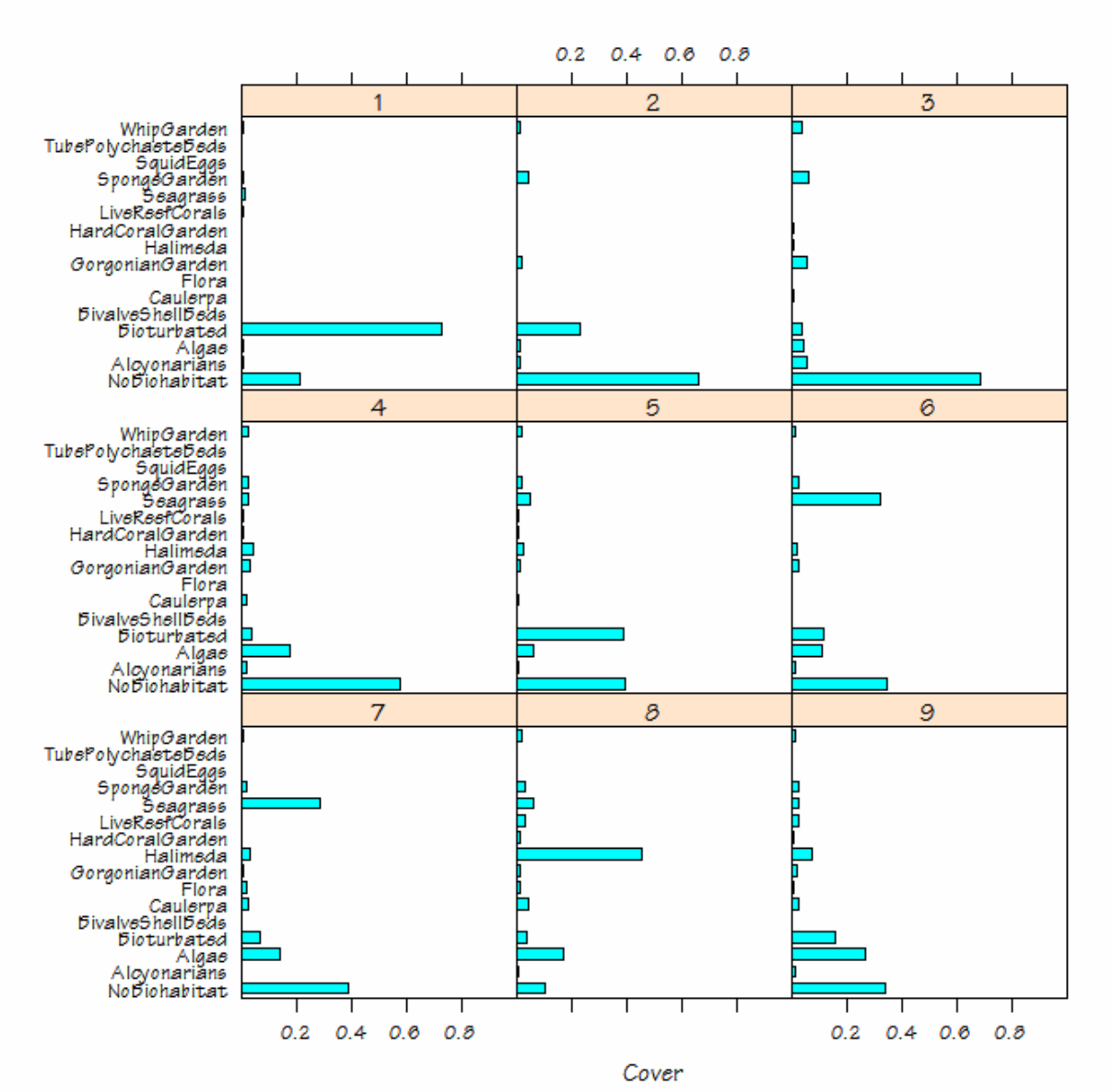


Figure 6-31: Mean profiles (centroids) of the nine site groups as defined by the recursive partitioning algorithm.

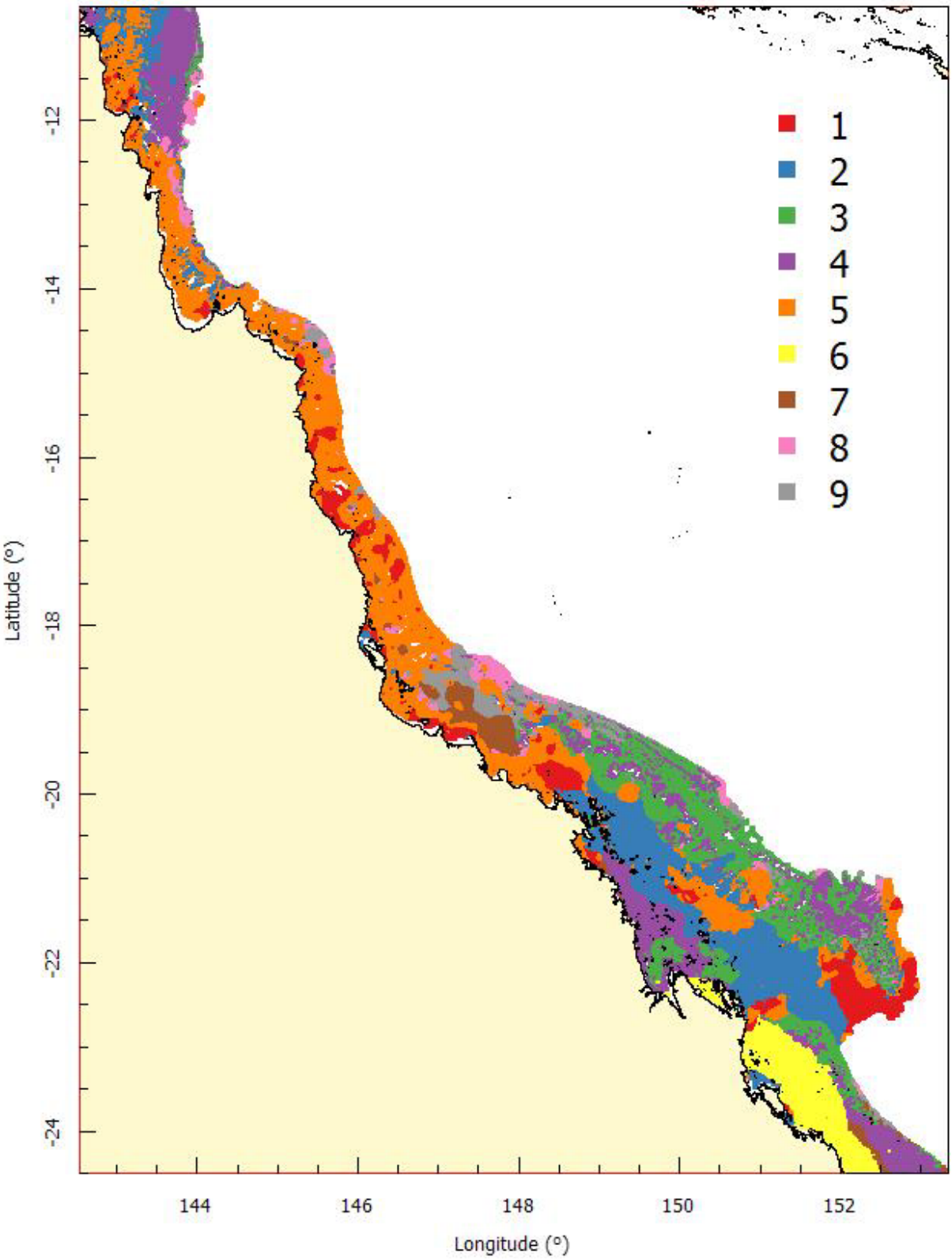


Figure 6-32: Map of predictions of group membership to the entire GBR grid. The groups are those from the medoid algorithm with grouped vessel biological data and Manhattan distances shown in (Figure 6-30).

Tables

Table 6-1. Correlation matrix of physical environmental covariates. Non-significant correlations are greyed; larger **positive** and **negative** correlations >0.05 are highlighted.

Variable	Bathy	Aspect	Slope	B Stress	Crbnt	Gravel	Sand	Mud	NO_3 Av	NO_3 sd	O_2 Av	O_2 sd	PO_4 Av	PO_4 sd	Si Av	Si sd	S Av	S sd	T Av	T sd	Chla Av	Chla sd	K_{490} Av	K_{490} sd	Ben Irr	Trwl Eff	Topo
Bathy	1.000																										
Aspect	-0.125	1.000																									
Slope	-0.201	0.084	1.000																								
B Stress	0.075	0.123	0.123	1.000																							
Crbnt	-0.479	0.239	0.309	0.158	1.000																						
Gravel	0.059	0.086	0.156	**0.522**	0.330	1.000																					
Sand	-0.033	0.048	0.024	-0.031	0.003	-0.302	1.000																				
Mud	-0.009	-0.106	-0.133	-0.335	-0.234	-0.411	**-0.745**	1.000																			
NO_3 Av	-0.271	0.054	0.212	-0.146	0.217	0.103	-0.155	0.077	1.000																		
NO_3 Sd	**-0.617**	0.068	0.135	-0.125	0.177	-0.075	-0.102	0.150	**0.667**	1.000																	
O_2 Av	**0.590**	-0.074	-0.224	0.205	-0.419	0.015	0.215	-0.216	**-0.682**	**-0.725**	1.000																
O_2 Sd	-0.247	0.022	-0.114	0.017	-0.205	-0.131	0.113	-0.016	0.050	**0.559**	-0.023	1.000															
PO_4 Av	-0.300	0.051	0.213	-0.142	0.230	0.110	-0.127	0.044	**0.984**	**0.658**	**-0.698**	0.022	1.000														
PO_4 Sd	**-0.540**	0.044	0.086	-0.154	0.125	-0.128	-0.106	0.191	**0.506**	**0.925**	**-0.702**	**0.585**	**0.512**	1.000													
Si Av	0.139	0.068	0.071	-0.074	0.139	0.128	-0.109	0.015	**0.754**	0.271	-0.317	-0.095	**0.727**	0.182	1.000												
Si Sd	0.260	0.062	-0.008	-0.090	0.134	0.029	-0.095	0.071	0.312	0.076	-0.163	-0.039	0.276	0.197	**0.681**	1.000											
S Av	**-0.541**	0.008	-0.004	0.110	0.032	-0.036	0.273	-0.236	0.012	0.424	-0.080	**0.530**	0.062	0.339	-0.335	**-0.594**	1.000										
S Sd	**0.547**	-0.023	-0.193	0.021	-0.227	-0.023	-0.183	0.191	-0.315	-0.353	0.303	0.008	-0.360	-0.177	0.131	**0.556**	**-0.570**	1.000									
T Av	0.387	-0.012	-0.128	-0.012	-0.046	-0.099	-0.078	0.144	**-0.755**	**-0.661**	0.388	-0.363	**-0.776**	-0.457	-0.368	0.167	**-0.556**	**0.618**	1.000								
T Sd	0.234	-0.067	-0.231	0.303	-0.428	0.076	0.062	-0.113	-0.342	-0.074	**0.554**	0.467	-0.351	-0.077	-0.291	-0.305	0.385	0.176	-0.107	1.000							
Chla Av	**0.513**	-0.111	-0.133	0.192	-0.362	0.105	-0.268	0.183	-0.198	-0.289	0.339	-0.040	-0.233	-0.246	-0.036	0.017	-0.314	0.396	0.224	0.340	1.000						
Chla Sd	0.381	-0.090	-0.057	-0.017	-0.236	-0.008	-0.232	0.227	-0.087	-0.209	0.204	-0.073	-0.139	-0.186	0.024	0.033	-0.288	0.322	0.224	0.069	**0.597**	1.000					
K_{490} Av	0.412	-0.112	-0.115	0.098	-0.332	0.034	-0.218	0.185	-0.170	-0.237	0.251	-0.051	-0.201	-0.204	-0.044	0.025	-0.304	0.340	0.209	0.264	**0.920**	0.397	1.000				
K_{490} Sd	0.318	-0.107	-0.097	-0.042	-0.231	-0.051	-0.212	0.239	-0.100	-0.158	0.170	-0.009	-0.143	-0.127	-0.001	0.015	-0.221	0.316	0.205	0.075	**0.547**	**0.891**	0.377	1.000			
Ben Irr	**0.609**	-0.037	-0.121	-0.159	-0.318	-0.093	0.102	-0.032	-0.104	-0.290	0.272	-0.110	-0.122	-0.223	0.108	0.229	-0.316	0.283	0.211	0.003	-0.049	0.025	-0.088	0.019	1.000		
Trwl Eff	0.214	-0.095	-0.129	-0.130	-0.206	-0.116	-0.127	0.203	-0.112	-0.148	0.102	-0.009	-0.130	-0.098	-0.047	0.042	-0.202	0.200	0.186	0.005	0.104	0.071	0.112	0.094	0.123	1.000	
Topo	0.138	0.096	0.150	0.007	0.175	0.074	0.035	-0.085	0.056	-0.041	-0.054	-0.123	0.049	-0.012	0.135	0.224	-0.184	0.042	0.088	-0.166	-0.060	-0.034	-0.050	-0.037	0.195	-0.061	1.000

Table 6-2. Description of site-group assemblages 1–16 in terms of distribution, relative biomass of species affinity groups, and species with highest affinity for each assemblage.

Assemblage	Description
#1	Occurred in low mud, deep, low gravel, low current stress areas (Figure 6-15) represented by the red areas in Figure 6-17, primarily on the outer shelf off Townsville. No particular species group stood-out in terms of relative biomass associated with assemblage#1 areas, except perhaps A — and lack of G, E, J. Similarly, no particular species had very strong affinities for assemblage#1; those most aligned were Asteroidea: *Poraster superbus* (species affinity group A), Crustacea: *Portunus argentatus* (group A) and Gastropoda: *Atys cylindricus* cf (L).
#2	Occurred in low mud, deep, low gravel, slightly higher current stress areas (Figure 6-15) represented by the dark blue areas primarily on the outer shelf of the southern GBR. Assemblage#2 areas were also characterised by lack of species groups, but groups A, K, B, D had some affinity and slightly higher relative biomass associated with Assemblage#2. A number of species had moderately strong affinities for assemblage#2; those most aligned were: Gymnolaemata: *Retiflustra* spp (A), *Hippopetraliella magna* cf (A), *Tetraplaria immerse* (K), *Nellia tenella* cf (D), Echinoidea: Temnopleuridae sp2_QMS (A), Ophiuroidea: *Euryale asperum* (B), Crustacea: *Parthenope* sp32091 (K), *Takedana eriphioides* (A), *Myrine kesslerii* (A), Actinopterygii: *Samaris cristatus* (A), *Hippocampus queenslandicus* (A), *Engyprosopon maldivensis* (B), *Kanekonia queenslandica* (B), Bivalvia: *Cardita* sp1 (A).
#3	Occurred in low mud, deep, high gravel areas (Figure 6-15) represented by the dark green areas in Figure 6-17, primarily on the outer shelf offshore from the Whitsundays and Mackay, with a patch occurring on the shelf edge offshore from Townsville. Species groups J, H, K stood-out in having higher affinity and/or relative biomass associated with assemblage#3 areas. At the species level, some of strongest affinities were seen for assemblage#3; those most aligned were: Gymnolaemata: *Adenifera armata* (H), *Hippomenella avicularis* (H), *Celleporaria* spp (J), *Euthyrisella obtecta* (J), *Macropora* spp (K), *Sinupetraliella* spp (H), Calcarea: *Clathrina sp1* (H), Demospongiae: *Demospongiae* sp10 (H), *Demospongiae* sp26 (J), *Callyspongia* sp26 (J), *Demospongiae* sp27 (H).
#4	Occurred in very low mud, deep areas (Figure 6-15) represented by the purple areas in Figure 6-17, primarily on the outer shelf of the Capricorn Section of the GBR. Species groups K, B, I stood-out in having higher affinitiy and/or relative biomass distributed in assemblage#4 areas. A number of species had moderate affinities for assemblage#2; those most aligned were: Gymnolaemata: *Orthoscuticella* spp (K), *Arachnopusia* spp (K), *Scuticella plagiostoma* (K), Actinopterygii: *Ambiserrula jugosa* (K), Demospongiae *Xenospongia patelliformis* (K).
#5	Occurred in intermediate low mud, deeper areas (Figure 6-15) represented by the orange areas in Figure 6-17, on the flanks of the Capricorn Channel in the southern GBR. Species group D had the highest affinitiy and relative biomass distributed in assemblage#5 areas. At the species level, some of weakest affinities were seen for assemblage#5; those most aligned were: Actinopterygii: *Lepidotrigla calodactyla* (D), Foraminifera: *Discobotellina biperforata* (K).
#6	Occurred in low mud, shallower, low current stress areas (Figure 6-15) represented by the yellow areas in Figure 6-17, primarily on the inner/mid shelf off Townsville from Cape Upstart to Fitzroy Island, the inner shelf of the Mackay Coast, the mid shelf from Lizard Is to Turtle Is, and smaller scattered areas of the outer shelf and Swains. Although these were some of the more vegetated areas in the GBR, no particular species group stood-out in terms of affinity with assemblage#6, but L had elevated relative biomass. Again, at the species level, some of weakest affinities were seen for assemblage#6; those most aligned were: Actinopterygii: *Scorpaenopsis furneauxi* (G), Chlorophyceae: *Caulerpa taxifolia* (L), *Avrainvillea* sp1 (A), *Udotea flabellum* (A), Gastropoda: *Strombus campbelli* (G), *Dolabella* sp1 (I), Liliopsida: *Halophila spinulosa* (I).
#7	Occurred in somewhat similar areas as #6 (Figure 6-15), but primarily on the inner shelf of the Capricorn Coast indicated by the brown areas in Figure 6-17. These were also some of the more vegetated areas in the GBR, and species groups I, K, G stood-out in terms of affinity and/or relative biomass associated with assemblage#7. A number of species had moderate affinities for assemblage#7; those most aligned were: Crustacea: *Portunus sanguinolentus* (K), Asteroidea: *Oreasteridae* sp1 (I), Holothuroidea: *Holothuria* sp2 (I), Actinopterygii: *Ambiserrula jugosa* (K), *Suezichthys gracilis* (K), *Aploactis aspera* (I), *Paramonacanthus otisensis* (I), Rhodophyceae: *Chondrophycus* sp1 (K), Phaeophyceae: *Padina* sp. (K).
#8	Occurred in low mud, shallower, low current stress areas (Figure 6-15) represented by the pink areas in Figure 6-17, primarily on the outer shelf of the far northern GBR, extending south inside the barrier to about Lizard Island; the coastal silica sand strip from Shelbourne Bay norh was also included. Some of the most

Assemblage	Description
	extensive Halimeda banks occurred in some of these areas. Species group L was a stand-out in having higher affinity and relative biomass associated with assemblage#8 areas; followed by species groups H, I and C, A. A number of species had moderate-high affinities for assemblage#8; those most aligned were: Chlorophyceae: *Dictyosphaeria cavernosa* (L), *Halimeda gigas* (L), *Halimeda opuntia* (L), *Caulerpa sertularioides* (L), *Caulerpa serrulata* (L), Actinopterygii: *Pseudorhombus argus* (L), Gastropoda: *Terebellum terebellum* (L), *Atys* sp1, Echinoidea: *Breynia desorii* (L), *Peronella lesueuri* (H), Anthozoa: *Heteropsammia cochlea* (L).
#9	Occurred in low mud, shallower, high current stress areas (Figure 6-15) represented by the grey areas in Figure 6-17, primarily in the vicinity of Broadsound and Shoalwater Bay, but including offshore narrow inter-reef channels and the approaches to Torres Strait. Some of the most extensive epibenthic faunal gardens occurred in some of these areas. Species group J stood-out clearly in terms of relative biomass associated with assemblage#9, followed by F, G. At the species level, some the strongest affinities were seen for assemblage#9; those most aligned were: Actinopterygii: *Centrogenys vaigiensis* (G), *Inegocia harrisii* (G), Crustacea: *Metapenaeopsis novaeguineae* (G), *Paradorippe australiensis* (G), *Hyastenus elatus* (J), Gymnolaemata: *Micropora angusta* cf (J), Bivalvia: *Arca navicularis* (J), *avellana*_MTQ (J), Asteroidea: *Goniasteridae* sp5 (J), Demospongiae: *Callyspongia schultzi* (F), Anthozoa: *Melithaea* sp2 (J), *Mopsella* sp2 (J).
#10	Occurred in high mud, low nitrate variability, low chlorophyll areas (Figure 6-15) represented by the aqua-blue areas in Figure 6-17, primarily in the mid-Lagoon of the Whitsunday region and re-occuring on the outer shelf offshore from Hinchinbrook to Cape Flattery. Some of the most barren habitats occurred in some of these areas, although the sled and trawl revealed significant biodiversity. Species groups E, D had the highest relative biomass in this assemblage, but none had high affinity. At the species level, weak affinities were seen for assemblage#10; those most aligned with were: Actinopterygii: *Nemipterus hexodon* (E), Crustacea: *Cloridina chlorida* (E), *Iphiculus spongiosus* (E), Demospongiae: *Fascaplysinopsis* sp3 (H), *Anadara ferruginea* cf (E).
#11, 12, 13	Occurred in high mud, low nitrate variability, high chlorophyll areas (Figure 6-15), with 12 being in the muddiest habitats and 13 in the most turbid, represented respectively by the salmon, grey-blue and pale-green areas in Figure 6-17, primarily in shallower inner shelf areas extending from ~Whitsunday Islands to Torres Strait, and broader north of about Cairns. Again, some of the most barren habitats occurred in some of these areas, although the sled and trawl revealed significant biodiversity. Species groups E, G were associated with these assemblages. At the species level, the affinities were moderate-weak (weakest for assemblage#12); those most aligned with assemblage #11 were: Actinopterygii: *Scolopsis taeniopterus* (E), *Terapon theraps* (E), *Leiognathus leuciscus* (E), Crustacea: *Charybdis truncata* (E), Crustacea: *Metapenaeus endeavouri* (E); those most aligned with assemblage #12 were: Crustacea: *Cryptolutea arafurensis* (E), Actinopterygii: *Saurida argentea/tumbil* (E); and those most aligned with assemblage #13 were: Actinopterygii: *Leiognathus splendens* (E), *Leiognathus moretoniensis* (G), *Gerres filamentosus* (G), *Tripodichthys angustifrons* (E), *Terapon puta* (E), *Apogon poecilopterus* (E), Crustacea: *Trachypenaeus anchoralis* (G), Crustacea *Metapenaeus ensis* (E), *Penaeus semisulcatus* (E).
#14, 15, 16	Occurred in high mud, high nitrate variability areas (Figure 6-15) represented by the deeper pale-khaki, pale-yellow and pale-pink areas in Figure 6-17 . Assemblage #14 was located along the far outer shelf offshore from Hinchinbrook to Cairns; #15, 16 occurred near the entrance of the Capricorn Channel. Some of the most barren habitats occurred in some of these areas, although the sled and trawl revealed significant biodiversity. No species group or individual species had a clear association with Assemblage #14 in terms of relative biomass or affinity. Species groups D, F showed somewhat higher relative biomass in assemblages 15, 16, and D had some affinity with 15. Affinities were weak at the species level; those most aligned with assemblage#15 were: Crustacea: *Arcania heptacantha* (D), *Solenocera choprai* (D), Actinopterygii: *Upeneus moluccensis* (D), *Lepidotrigla calodactyla* (D), *Elates ransonnetii* (E); and those most aligned with assemblage#16 were: Crustacea: *Solenocera choprai* (D), Actinopterygii: *Upeneus moluccensis* (D).

Table 6-3: Substratum and Biological habitat facies types and animal events types entered in real time to annotate the video transect. Note, 'sparse', 'medium' and 'high' cover classes of epibenthic garden feature types were amalgamated for statistical analyses.

Substratum	Biological habitat		Animal events
Soft Mud	Bioturbated		Anemone
Silt (Sandy-Mud)	Bivalve Shell Beds		Ascidian
Sand	Alcyonarians:	Sparse Medium Dense	Bryozoan
Coarse Sand			Commercial Fish
Sand Waves / Dunes	Whip Garden:	Sparse Medium Dense	Crab
Rubble (5-50 mm)			Crinoid
Stones (50-250 mm)			Gastropod
Rocks (> 250 mm)	Gorgonian Garden:	Sparse Medium Dense	Holothurian
Bedrock / Reef			Hydroid
	Sponge Garden:	Sparse Medium Dense	Non Commercial Fish
			Sea Pen
	Hard Coral Garden:	Sparse Medium Dense	Solitary Coral
			Starfish
	Live Reef Corals		Urchin
	Flora:		
	Seagrass		
	Algae:	Caulerpa Halimeda	
	No BioHabitat		

Table 6-4: Indicators of Protection for 840 species sampled by sled and/or trawl, showing species-group membership 1-to-38 (see distribution maps), average biomass (g/Ha), percentage of biomass in old and new General Use Zones and for all other zones combined both before and after RAP, and change in level of protection due to the 1 July 2004 re-zoning. Levels of protection <20% are shaded.

Species Group	Phylum	Class	Genus	Species	ave. g/Ha	Old %GU	Old % Other	New %GU	New% Other	Change in % protection
20	Annelida	Annelida	Annelida	spp	261.97	74	26	43	57	30
33	Annelida	Polychaeta	Chloeia	flava	0.79	88	12	49	51	39
16	Annelida	Polychaeta	Polychaete	spp	0.32	67	33	34	66	33
	Arthropoda	Crustacea	Alpheidae	sp2434	0.01	75	25	44	56	31
15	Arthropoda	Crustacea	Carid	sp4931	0.04	81	19	32	68	49
28	Arthropoda	Crustacea	Calappa	sp 1984	0.82	58	42	33	67	25
9	Arthropoda	Crustacea	Calappa	sp44	0.55	87	13	57	43	30
24	Arthropoda	Crustacea	Calappa	terraereginae	0.52	88	12	45	55	43
4	Arthropoda	Crustacea	Jonas	luteanus	2.48	74	26	44	56	29
18	Arthropoda	Crustacea	Pontocaris	orientalis	0.78	66	34	41	59	25
1	Arthropoda	Crustacea	Dardanus	callichela	3.32	64	36	37	63	28
7	Arthropoda	Crustacea	Dardanus	callichela var	1.46	75	25	52	48	23
17	Arthropoda	Crustacea	Diogenidae	sp2	3.49	57	43	35	65	23
14	Arthropoda	Crustacea	Diogenidae	sp356-1	0.02	69	31	45	55	24
5	Arthropoda	Crustacea	Diogenidae	sp379	0.02	54	46	30	70	24
22	Arthropoda	Crustacea	Paguristes	sp2358-2	1.55	87	13	52	48	35
21	Arthropoda	Crustacea	Dorippe	quadridens	0.18	90	10	63	37	26
9	Arthropoda	Crustacea	Dorippe	sp7142-12	30.10	72	28	45	55	28
3	Arthropoda	Crustacea	Paradorippe	australiensis	0.14	91	9	49	51	42
2	Arthropoda	Crustacea	Dromidiopsis	edwardsi	1.36	71	29	46	54	25
17	Arthropoda	Crustacea	Petalomera	pulchra	0.02	70	30	42	58	28
1	Arthropoda	Crustacea	Allogalathea	elegans	0.15	77	23	49	51	28
25	Arthropoda	Crustacea	Gonodactylaceus	graphurus	0.34	82	18	49	51	33
13	Arthropoda	Crustacea	Eucrate	affinis	0.11	85	15	48	52	37
4	Arthropoda	Crustacea	Isopoda	sp1	0.51	75	25	45	55	30
27	Arthropoda	Crustacea	Nursilia	sp nov	0.19	87	13	50	50	36
12	Arthropoda	Crustacea	Urnalana	whitei	2.09	88	12	47	53	41
8	Arthropoda	Crustacea	Arcania	elongata	0.56	79	21	47	53	31
15	Arthropoda	Crustacea	Arcania	gracilis	0.71	77	23	39	61	37
15	Arthropoda	Crustacea	Arcania	heptacantha	0.05	98	2	23	77	75
12	Arthropoda	Crustacea	Ebalia	lambriformis	0.05	94	6	52	48	42
29	Arthropoda	Crustacea	Iphiculus	spongiosus	0.02	85	15	43	57	42
21	Arthropoda	Crustacea	Ixa	inermis	0.13	86	14	62	38	24
7	Arthropoda	Crustacea	Leucosia	formosensis	0.07	75	25	53	47	22
6	Arthropoda	Crustacea	Leucosia	magna	0.67	70	30	36	64	34
13	Arthropoda	Crustacea	Leucosia	ocellata	0.68	91	9	59	41	31
11	Arthropoda	Crustacea	Myra	australis	6.95	74	26	45	55	29
34	Arthropoda	Crustacea	Myra	eudactyla	0.26	85	15	42	58	43
11	Arthropoda	Crustacea	Myra	mammillaris	1.26	82	18	46	54	36
22	Arthropoda	Crustacea	Myra	tumidospina	0.74	84	16	57	43	27
4	Arthropoda	Crustacea	Myrine	kesslerii	0.06	65	35	39	61	27
5	Arthropoda	Crustacea	Oreophorus	reticulatus	4.50	67	33	37	63	30
17	Arthropoda	Crustacea	Achaeus	sp5993	0.10	67	33	41	59	26
3	Arthropoda	Crustacea	Austrolabidia	gracilipes	0.65	75	25	33	67	42
12	Arthropoda	Crustacea	Austrolibinia	gracilipes	0.08	83	17	49	51	34
18	Arthropoda	Crustacea	Camposcia	retusa	0.65	65	35	41	59	24
17	Arthropoda	Crustacea	Hyastenus	campbelli	2.20	71	29	41	59	30
16	Arthropoda	Crustacea	Hyastenus	convexus	0.18	67	33	40	60	27
3	Arthropoda	Crustacea	Hyastenus	elatus	0.94	75	25	33	67	42
17	Arthropoda	Crustacea	Hyastenus	sebae	0.01	72	28	43	57	29
17	Arthropoda	Crustacea	Micippa	philyra	7.79	64	36	39	61	25
32	Arthropoda	Crustacea	Naxoides	sp53287	0.11	64	36	20	80	44
6	Arthropoda	Crustacea	Naxoides	taurus	0.15	56	44	26	74	30
6	Arthropoda	Crustacea	Oncinopus	aranea	0.43	52	48	23	77	29
	Arthropoda	Crustacea	Phalangipus	australiensis	0.52	75	25	44	56	31
15	Arthropoda	Crustacea	Phalangipus	filiformis	1.53	79	21	44	56	35
16	Arthropoda	Crustacea	Thacanophrys	longispinus	0.05	68	32	39	61	30
17	Arthropoda	Crustacea	Thacanophrys	sp165	0.04	60	40	25	75	35
1	Arthropoda	Crustacea	Thacanophrys	sp245	1.66	72	28	43	57	29
16	Arthropoda	Crustacea	Thacanophrys	sp879	0.02	70	30	39	61	31
4	Arthropoda	Crustacea	Izanami (matuta)	inermis	11.95	63	37	39	61	25
16	Arthropoda	Crustacea	Barnacle	sp1	250.90	50	50	23	77	27
19	Arthropoda	Crustacea	Pagurid	sp17	0.10	72	28	47	53	25
13	Arthropoda	Crustacea	Pagurid	sp2358-1	0.80	79	21	44	56	35

Species Group	Phylum	Class	Genus	Species	ave. g/Ha	Old %GU	Old % Other	New %GU	New% Other	Change in % protection
10	Arthropoda	Crustacea	Paguridae	sp213	2.69	68	32	42	58	27
32	Arthropoda	Crustacea	Paguridae	sp444	0.17	52	48	22	78	31
6	Arthropoda	Crustacea	Neopalicus	jukesii	0.62	74	26	47	53	27
6	Arthropoda	Crustacea	Palicoides	whitei	0.50	68	32	39	61	29
15	Arthropoda	Crustacea	Pandalidae	sp916	0.56	75	25	38	62	36
13	Arthropoda	Crustacea	Cryptopodia	queenslandi	0.26	85	15	54	46	31
17	Arthropoda	Crustacea	Parthenope	harpax	0.07	71	29	42	58	28
3	Arthropoda	Crustacea	Parthenope	hoplonotus	0.26	82	18	43	57	39
34	Arthropoda	Crustacea	Parthenope	longimanus	0.42	85	15	49	51	36
17	Arthropoda	Crustacea	Parthenope	longispinus	0.62	62	38	38	62	24
11	Arthropoda	Crustacea	Parthenope	sp 67	10.12	73	27	43	57	30
16	Arthropoda	Crustacea	Parthenope	sp32091	0.06	46	54	25	75	21
6	Arthropoda	Crustacea	Parthenope	turriger	0.11	66	34	27	73	40
1	Arthropoda	Crustacea	Metapenaeopsis	lamellata	13.21	61	39	39	61	22
28	Arthropoda	Crustacea	Metapenaeopsis	metapenaeopsis sp	49.28	64	36	42	58	22
3	Arthropoda	Crustacea	Metapenaeopsis	novaeguineae	0.85	97	3	9	91	88
17	Arthropoda	Crustacea	Metapenaeopsis	rosea	22.28	72	28	50	50	23
14	Arthropoda	Crustacea	Metapenaeus	endeavouri	26.76	73	27	52	48	22
29	Arthropoda	Crustacea	Metapenaeus	ensis	1.56	92	8	67	33	25
16	Arthropoda	Crustacea	Parapenaeopsis	venusta	0.50	72	28	51	49	21
	Arthropoda	Crustacea	Penaeid unknown	penaeid unknown	0.13	75	25	44	56	31
9	Arthropoda	Crustacea	Penaeus	esculentus	51.67	87	13	62	38	25
21	Arthropoda	Crustacea	Penaeus	latisulcatus	11.80	81	19	59	41	21
4	Arthropoda	Crustacea	Penaeus	longistylus	100.06	59	41	38	62	21
10	Arthropoda	Crustacea	Penaeus	plebejus	6.50	91	9	54	46	37
29	Arthropoda	Crustacea	Penaeus	semisulcatus	20.34	84	16	64	36	20
13	Arthropoda	Crustacea	Trachypenaeus	anchoralis	2.26	93	7	64	36	29
4	Arthropoda	Crustacea	Trachypenaeus	curvirostris	28.34	71	29	41	59	30
35	Arthropoda	Crustacea	Trachypenaeus	fulvus	0.13	76	24	42	58	34
27	Arthropoda	Crustacea	Trachypenaeus	granulosus	21.26	83	17	50	50	33
29	Arthropoda	Crustacea	Cryptolutea	arafurensis	0.02	85	15	57	43	28
3	Arthropoda	Crustacea	Lisoporcellana	sp3194	0.02	80	20	43	57	37
25	Arthropoda	Crustacea	Porcellanid	sp4154	0.03	77	23	49	51	28
23	Arthropoda	Crustacea	Charybdis	jaubertensis	3.84	66	34	31	69	36
14	Arthropoda	Crustacea	Charybdis	truncata	21.91	73	27	48	52	25
20	Arthropoda	Crustacea	Lupocyclus	rotundatus	3.69	70	30	44	56	26
6	Arthropoda	Crustacea	Lupocyclus	tugelae	1.12	65	35	30	70	35
6	Arthropoda	Crustacea	Portunus	argentatus	23.55	68	32	38	62	30
9	Arthropoda	Crustacea	Portunus	gracilimanus	10.49	86	14	56	44	30
8	Arthropoda	Crustacea	Portunus	granulatus	1.07	70	30	46	54	24
22	Arthropoda	Crustacea	Portunus	hastatoides	0.26	75	25	55	45	20
21	Arthropoda	Crustacea	Portunus	pelagicus	108.84	83	17	60	40	23
7	Arthropoda	Crustacea	Portunus	rubromarginatus	296.24	78	22	55	45	23
33	Arthropoda	Crustacea	Portunus	sanguinolentus	51.03	98	2	65	35	32
14	Arthropoda	Crustacea	Portunus	spinipes	0.25	73	27	35	65	38
2	Arthropoda	Crustacea	Portunus	tenuipes	95.72	64	36	42	58	21
22	Arthropoda	Crustacea	Portunus	tuberculatus	0.06	76	24	46	54	30
14	Arthropoda	Crustacea	Portunus	tuberculosus	0.02	74	26	47	53	26
	Arthropoda	Crustacea	Thalamita	hanseni	2.73	75	25	44	56	31
23	Arthropoda	Crustacea	Thalamita	intermedia	0.17	58	42	22	78	35
26	Arthropoda	Crustacea	Thalamita	parvidens	5.63	43	57	20	80	23
2	Arthropoda	Crustacea	Thalamita	sima	2.46	62	38	39	61	23
19	Arthropoda	Crustacea	Scyllarus	demani	6.78	81	19	55	45	25
8	Arthropoda	Crustacea	Scyllarus	martensii	0.34	73	27	50	50	22
14	Arthropoda	Crustacea	Scyllarus	sp3418	1.47	68	32	38	62	30
7	Arthropoda	Crustacea	Thenus	australiensis	151.24	72	28	46	54	27
9	Arthropoda	Crustacea	Thenus	parindicus	25.98	78	22	55	45	23
8	Arthropoda	Crustacea	Sicyonia	lancifer	4.01	67	33	43	57	24
7	Arthropoda	Crustacea	Sicyonia	rectirostris	0.01	78	22	56	44	21
15	Arthropoda	Crustacea	Solenocera	choprai	6.25	99	1	26	74	74
6	Arthropoda	Crustacea	Solenocera	pectinata	0.70	70	30	29	71	41
30	Arthropoda	Crustacea	Carinosquilla	australiensis	3.36	49	51	28	72	22
5	Arthropoda	Crustacea	Carinosquilla	carita	0.52	61	39	38	62	23
36	Arthropoda	Crustacea	Carinosquilla	redacta	2.25	70	30	41	59	29
20	Arthropoda	Crustacea	Carinosquilla	thailandensis	4.37	70	30	48	52	22
12	Arthropoda	Crustacea	Clorida	obtusa	0.30	87	13	45	55	42
14	Arthropoda	Crustacea	Cloridina	chlorida	0.02	82	18	29	71	53
22	Arthropoda	Crustacea	Erugosquilla	woodmasoni	0.98	89	11	66	34	24
38	Arthropoda	Crustacea	Oratosquillina	gravieri	2.43	87	13	48	52	39
12	Arthropoda	Crustacea	Oratosquillina	quinquedentata	3.15	91	9	49	51	42

Species Group	Phylum	Class	Genus	Species	ave. g/Ha	Old %GU	Old % Other	New %GU	New% Other	Change in % protection
15	Arthropoda	Crustacea	Quollastria	gonypetes	1.06	79	21	31	69	48
30	Arthropoda	Crustacea	Quollastria	subtilis	0.29	66	34	36	64	30
1	Arthropoda	Crustacea	Actaea	jacquelinae	0.05	73	27	46	54	27
23	Arthropoda	Crustacea	Actaea	Tuberculosa	0.32	58	42	28	72	30
32	Arthropoda	Crustacea	Actumnus	setifer	0.08	59	41	32	68	27
8	Arthropoda	Crustacea	Actumnus	squamosus	0.05	78	22	54	46	25
29	Arthropoda	Crustacea	Ceratoplax	ciliata	0.03	81	19	42	58	39
37	Arthropoda	Crustacea	Gaillardiellus	rueppelli	0.28	67	33	35	65	33
29	Arthropoda	Crustacea	Liagore	rubromaculata	2.48	95	5	48	52	47
8	Arthropoda	Crustacea	Pilumnus	longicornis	0.12	78	22	46	54	32
3	Arthropoda	Crustacea	Pilumnus	semilanatus	0.27	84	16	40	60	44
15	Arthropoda	Crustacea	Pilumnus	spinicarpus	0.08	78	22	26	74	53
29	Arthropoda	Crustacea	Pronotonyx	leavis	0.02	81	19	46	54	35
4	Arthropoda	Crustacea	Takedana	eriphioides	0.17	59	41	33	67	26
11	Arthropoda	Crustacea	Bathypilumnus	pugilator	0.59	73	27	46	54	27
16	Brachiopoda	Brachiopoda	Brachiopoda	sp1_MTQ	4.00	63	37	41	59	22
17	Bryozoa	Gymnolaemata	Adeonella	lichenoides cf	4.21	72	28	40	60	32
16	Bryozoa	Gymnolaemata	Adeonellopsis	pentapora	0.37	69	31	34	66	35
17	Bryozoa	Gymnolaemata	Aetea	capillaris	0.07	71	29	45	55	26
31	Bryozoa	Gymnolaemata	Arachnopusia	spp	0.87	74	26	34	66	40
31	Bryozoa	Gymnolaemata	Beania	discodermiae cf	0.03	78	22	40	60	38
16	Bryozoa	Gymnolaemata	Beania	plurispinosa cf	0.07	64	36	38	62	25
16	Bryozoa	Gymnolaemata	Beania	regularis	0.04	68	32	38	62	30
23	Bryozoa	Gymnolaemata	Beania	spp	0.23	75	25	43	57	31
16	Bryozoa	Gymnolaemata	Metroperiella	spp	0.31	62	38	33	67	29
16	Bryozoa	Gymnolaemata	Schizomavella	australis cf	0.45	66	34	37	63	29
15	Bryozoa	Gymnolaemata	Schizomavella	inclusa cf	0.18	77	23	33	67	43
30	Bryozoa	Gymnolaemata	Schizomavella	spp	0.12	64	36	39	61	25
16	Bryozoa	Gymnolaemata	Schizomavella	triquetra cf	0.07	58	42	34	66	24
16	Bryozoa	Gymnolaemata	Bugula	dentata cf	10.63	60	40	29	71	30
5	Bryozoa	Gymnolaemata	Bugula	robusta cf	0.12	59	41	33	67	26
5	Bryozoa	Gymnolaemata	Bugula	spp	0.12	58	42	34	66	24
23	Bryozoa	Gymnolaemata	Adenifera	armata	9.83	51	49	19	81	32
17	Bryozoa	Gymnolaemata	Antropora	spp	0.03	70	30	42	58	28
4	Bryozoa	Gymnolaemata	Cranosina	coronata	0.00	64	36	46	54	18
31	Bryozoa	Gymnolaemata	Crassimarginatella	spp	0.01	61	39	27	73	33
32	Bryozoa	Gymnolaemata	Amastigia	rudis	0.17	66	34	34	66	32
23	Bryozoa	Gymnolaemata	Caberea	spp	0.78	66	34	30	70	36
37	Bryozoa	Gymnolaemata	Canda	spp	1.36	72	28	33	67	39
16	Bryozoa	Gymnolaemata	Scrupocellaria	spp	0.65	67	33	36	64	32
23	Bryozoa	Gymnolaemata	Catenicella	sp1_CMR	2.34	77	23	34	66	43
16	Bryozoa	Gymnolaemata	Catenicella	spp	2.21	71	29	34	66	37
31	Bryozoa	Gymnolaemata	Orthoscuticella	spp	1.33	80	20	48	52	32
31	Bryozoa	Gymnolaemata	Scuticella	plagiostoma	11.69	81	19	48	52	33
16	Bryozoa	Gymnolaemata	Cellaria	spp	2.12	71	29	39	61	32
5	Bryozoa	Gymnolaemata	Celleporidae	spp	0.07	62	38	33	67	29
16	Bryozoa	Gymnolaemata	Celleporina	spp	0.28	65	35	38	62	27
23	Bryozoa	Gymnolaemata	Turbicellepora	laevis	32.50	65	35	25	75	39
31	Bryozoa	Gymnolaemata	Telopora	spp	0.02	56	44	28	72	28
16	Bryozoa	Gymnolaemata	Chaperia	spp	0.01	67	33	39	61	29
32	Bryozoa	Gymnolaemata	Chaperiopsis	spp	0.00	53	47	25	75	28
34	Bryozoa	Gymnolaemata	Exostesia	didomatia	17.44	78	22	43	57	35
16	Bryozoa	Gymnolaemata	Retelepralia	mosaica	0.00	70	30	45	55	24
16	Bryozoa	Gymnolaemata	Hippaliosina	spp	3.00	52	48	25	75	26
23	Bryozoa	Gymnolaemata	Hippomenella	avicularis	0.00	62	38	27	73	35
5	Bryozoa	Gymnolaemata	Conescharellina	spp	0.03	68	32	41	59	27
16	Bryozoa	Gymnolaemata	Crepidacantha	spp	0.03	72	28	39	61	32
34	Bryozoa	Gymnolaemata	Cribralaria	spp	0.22	76	24	42	58	35
16	Bryozoa	Gymnolaemata	Figularia	clithridiata cf	0.06	59	41	33	67	26
23	Bryozoa	Gymnolaemata	Puellina	spp	0.01	58	42	30	70	29
23	Bryozoa	Gymnolaemata	Bicrisia	spp	0.00	71	29	30	70	40
23	Bryozoa	Gymnolaemata	Crisia	elongata cf	8.80	64	36	32	68	32
32	Bryozoa	Gymnolaemata	Filicrisia	geniculata	0.05	61	39	32	68	29
23	Bryozoa	Gymnolaemata	Cyclostomata	spp	0.02	62	38	33	67	29
16	Bryozoa	Gymnolaemata	Didymosellidae	spp	8.67	61	39	35	65	26
23	Bryozoa	Gymnolaemata	Synnotum	spp	0.02	71	29	39	61	32
23	Bryozoa	Gymnolaemata	Euthyrisella	obtecta	9.61	58	42	24	76	35
16	Bryozoa	Gymnolaemata	Escharoides	longirostris	0.77	66	34	27	73	39
31	Bryozoa	Gymnolaemata	Exochella	conjuncta cf	0.15	72	28	40	60	32
4	Bryozoa	Gymnolaemata	Didymozoum	spp	0.16	70	30	49	51	21

Species Group	Phylum	Class	Genus	Species	ave. g/Ha	Old %GU	Old % Other	New %GU	New% Other	Change in % protection
16	Bryozoa	Gymnolaemata	Elzerina	blainvillii cf	0.04	54	46	30	70	24
4	Bryozoa	Gymnolaemata	Retiflustra	spp	1.66	58	42	36	64	22
1	Bryozoa	Gymnolaemata	Cosciniopsis	spp	0.03	55	45	32	68	23
11	Bryozoa	Gymnolaemata	Hiantopora	intermedia cf	0.05	74	26	44	56	30
23	Bryozoa	Gymnolaemata	Hippopodina	feegeensis cf	0.10	64	36	32	68	32
23	Bryozoa	Gymnolaemata	Thornleya	spp	1.62	70	30	30	70	40
5	Bryozoa	Gymnolaemata	Codonellina	montferrandii	0.00	59	41	34	66	25
8	Bryozoa	Gymnolaemata	Hippothoa	distans	0.02	83	17	55	45	28
16	Bryozoa	Gymnolaemata	Trypostega	spp	0.07	69	31	38	62	30
16	Bryozoa	Gymnolaemata	Lacernidae	sp2	0.02	60	40	33	67	28
16	Bryozoa	Gymnolaemata	Calyptotheca	spp	11.44	70	30	41	59	29
10	Bryozoa	Gymnolaemata	Calyptotheca	wasinensis cf	6.10	82	18	52	48	30
32	Bryozoa	Gymnolaemata	Parmularia	spp	0.13	57	43	30	70	27
10	Bryozoa	Gymnolaemata	Robertsonidra	spp	0.62	81	19	50	50	32
23	Bryozoa	Gymnolaemata	Celleporaria	sp1_AIM	27.46	56	44	26	74	30
23	Bryozoa	Gymnolaemata	Celleporaria	sp1_QMS	10.67	70	30	36	64	34
23	Bryozoa	Gymnolaemata	Celleporaria	sp2_QMS	4.40	69	31	28	72	41
23	Bryozoa	Gymnolaemata	Celleporaria	spp	782.51	60	40	31	69	29
16	Bryozoa	Gymnolaemata	Lepralia	elimata	0.06	70	30	44	56	26
16	Bryozoa	Gymnolaemata	Macropora	spp	0.67	64	36	34	66	29
23	Bryozoa	Gymnolaemata	Margaretta	spp	2.19	57	43	30	70	27
3	Bryozoa	Gymnolaemata	Biflustra	savartii	0.10	79	21	36	64	43
16	Bryozoa	Gymnolaemata	Conopeum	spp	0.03	71	29	37	63	34
16	Bryozoa	Gymnolaemata	Calloporina	sigillata	0.40	59	41	32	68	27
23	Bryozoa	Gymnolaemata	Fenestrulina	spp	1.88	71	29	40	60	31
23	Bryozoa	Gymnolaemata	Microporella	spp	0.08	65	35	33	67	31
17	Bryozoa	Gymnolaemata	Mimosella	verticillata cf	0.11	70	30	42	58	28
23	Bryozoa	Gymnolaemata	Nolella	spp	0.08	70	30	39	61	32
16	Bryozoa	Gymnolaemata	Smittipora	abyssicola cf	0.10	65	35	37	63	28
5	Bryozoa	Gymnolaemata	Hippopetraliella	concinna	0.34	60	40	34	66	26
4	Bryozoa	Gymnolaemata	Hippopetraliella	magna cf	0.53	48	52	31	69	17
16	Bryozoa	Gymnolaemata	Mucropetraliella	serrata cf	8.40	64	36	38	62	26
23	Bryozoa	Gymnolaemata	Sinupetraliella	spp	0.20	55	45	30	70	25
10	Bryozoa	Gymnolaemata	Iodictyum	spp	0.90	71	29	56	44	16
16	Bryozoa	Gymnolaemata	Phidoloporidae	sp1	0.51	61	39	28	72	32
17	Bryozoa	Gymnolaemata	Plesiocleidochasma	spp	3.11	72	28	42	58	30
1	Bryozoa	Gymnolaemata	Reteporella	spp	0.85	63	37	41	59	21
16	Bryozoa	Gymnolaemata	Rhynchozoon	spp	4.99	68	32	40	60	29
17	Bryozoa	Gymnolaemata	Triphyllozoon	spp	7.55	59	41	34	66	25
16	Bryozoa	Gymnolaemata	Porina	vertebralis cf	0.06	65	35	34	66	31
4	Bryozoa	Gymnolaemata	Nellia	tenella cf	1.21	67	33	40	60	27
11	Bryozoa	Gymnolaemata	Nelliella	spp	0.79	71	29	45	55	27
32	Bryozoa	Gymnolaemata	Savignyella	spp	0.01	65	35	37	63	28
16	Bryozoa	Gymnolaemata	Arthropoma	spp	0.01	68	32	35	65	33
16	Bryozoa	Gymnolaemata	Emballotheca	spp	30.35	68	32	43	57	25
1	Bryozoa	Gymnolaemata	Escharina	pesanseris	0.25	74	26	43	57	31
16	Bryozoa	Gymnolaemata	Phonicosia	circinata	0.00	73	27	34	66	39
16	Bryozoa	Gymnolaemata	Smittoidea	incucula cf	0.02	70	30	37	63	33
16	Bryozoa	Gymnolaemata	Stylopoma	spp	0.67	52	48	24	76	28
3	Bryozoa	Gymnolaemata	Micropora	angusta cf	0.07	70	30	24	76	45
16	Bryozoa	Gymnolaemata	Micropora	variperforata cf	0.74	67	33	40	60	27
21	Bryozoa	Gymnolaemata	Selenaria	maculata cf	14.47	86	14	59	41	26
16	Bryozoa	Gymnolaemata	Parasmittina	spp	7.13	66	34	38	62	28
16	Bryozoa	Gymnolaemata	Pleurocodonellina	laciniosa cf	0.83	58	42	35	65	23
16	Bryozoa	Gymnolaemata	Pleurocodonellina	spp	0.07	66	34	39	61	27
16	Bryozoa	Gymnolaemata	Smittina	spp	0.09	67	33	43	57	24
23	Bryozoa	Gymnolaemata	Steginoporella	magnilabris	2.16	43	57	20	80	23
18	Bryozoa	Gymnolaemata	Steginoporella	spp	0.66	52	48	33	67	19
32	Bryozoa	Gymnolaemata	Cigclisula	spp	0.11	56	44	26	74	30
16	Bryozoa	Gymnolaemata	Tetraplaria	immersa	1.52	55	45	29	71	25
20	Bryozoa	Gymnolaemata	Tetraplaria	ventricosa cf	0.45	59	41	36	64	23
6	Bryozoa	Gymnolaemata	Teuchopora	verrucosa cf	0.06	65	35	39	61	25
21	Bryozoa	Gymnolaemata	Thalamoporella	spp	2.84	83	17	53	47	29
16	Bryozoa	Gymnolaemata	Tubulipora	spp	0.04	65	35	36	64	29
38	Bryozoa	Gymnolaemata	Amathia	crispa	1.14	46	54	27	73	19
16	Bryozoa	Gymnolaemata	Amathia	spp	33.50	64	36	35	65	28
16	Bryozoa	Gymnolaemata	Vesicularia	papuensis_AIM	4.38	72	28	40	60	32
16	Bryozoa	Stenolaemata	Mesonea	radians	0.00	69	31	37	63	32
5	Bryozoa	Stenolaemata	Nevianipora	spp	0.16	69	31	40	60	29
16	Bryozoa	Stenolaemata	Mecynoecia	spp	0.14	71	29	40	60	31

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1	Chlorophyta	Chlorophyceae	Ventricaria	ventricosa	0.10	59	41	36	64	23
6	Chlorophyta	Chlorophyceae	Phyllodictyon	sp1	2.40	64	36	38	62	26
6	Chlorophyta	Chlorophyceae	Caulerpa	brachypus	1.36	68	32	39	61	29
1	Chlorophyta	Chlorophyceae	Caulerpa	cupressoides	30.01	59	41	39	61	20
32	Chlorophyta	Chlorophyceae	Caulerpa	racemosa	24.33	51	49	25	75	26
2	Chlorophyta	Chlorophyceae	Caulerpa	serrulata	17.33	43	57	25	75	18
2	Chlorophyta	Chlorophyceae	Caulerpa	sertularioides	13.32	57	43	37	63	20
10	Chlorophyta	Chlorophyceae	Caulerpa	sp2	30.59	67	33	44	56	22
2	Chlorophyta	Chlorophyceae	Caulerpa	taxifolia	2.46	67	33	47	53	20
8	Chlorophyta	Chlorophyceae	Chaetomorpha	crassa	18.06	77	23	52	48	24
7	Chlorophyta	Chlorophyceae	Cladophora	sp	1.98	78	22	52	48	25
8	Chlorophyta	Chlorophyceae	Avrainvillea	sp1	0.92	64	36	39	61	25
10	Chlorophyta	Chlorophyceae	Codium	geppii	11.23	80	20	52	48	28
1	Chlorophyta	Chlorophyceae	Codium	sp2	5.35	71	29	44	56	27
2	Chlorophyta	Chlorophyceae	Halimeda	bikensis	351.05	53	47	31	69	22
2	Chlorophyta	Chlorophyceae	Halimeda	borneenses	507.12	69	31	45	55	24
7	Chlorophyta	Chlorophyceae	Halimeda	cuneata	0.28	69	31	43	57	26
18	Chlorophyta	Chlorophyceae	Halimeda	discoidea	3.55	61	39	36	64	25
2	Chlorophyta	Chlorophyceae	Halimeda	gigas	161.51	48	52	29	71	18
17	Chlorophyta	Chlorophyceae	Halimeda	gracilis	292.48	62	38	36	64	25
2	Chlorophyta	Chlorophyceae	Halimeda	opuntia	13.47	42	58	25	75	17
10	Chlorophyta	Chlorophyceae	Halimeda	sp2	23.91	72	28	46	54	26
2	Chlorophyta	Chlorophyceae	Penicillus	nodulosus	47.92	54	46	33	67	21
8	Chlorophyta	Chlorophyceae	Udotea	argentea	39.33	76	24	51	49	25
6	Chlorophyta	Chlorophyceae	Udotea	flabellum	32.17	69	31	44	56	25
20	Chlorophyta	Chlorophyceae	Udotea	glaucescens	70.25	65	35	42	58	23
2	Chlorophyta	Chlorophyceae	Udotea	orientalis	42.19	53	47	34	66	19
7	Chlorophyta	Chlorophyceae	Bornetella	sphaerica	12.20	73	27	50	50	23
2	Chlorophyta	Chlorophyceae	Dictyosphaeria	cavernosa	71.66	39	61	21	79	18
1	Chlorophyta	Chlorophyceae	Microdictyon	sp1	34.57	68	32	42	58	26
31	Chlorophyta	Chlorophyceae	Microdictyon	umbilicatum	64.40	72	28	31	69	42
32	Chlorophyta	Chlorophyceae	Struvea	elegans	1.29	57	43	21	79	36
1	Chordata	Actinopterygii	Antennarius	striatus	1.56	77	23	44	56	34
4	Chordata	Actinopterygii	Tathicarpus	butleri	3.18	65	35	42	58	22
12	Chordata	Actinopterygii	Adventor	elongatus	0.57	89	11	44	56	45
10	Chordata	Actinopterygii	Aploactis	aspera	1.07	86	14	66	34	21
7	Chordata	Actinopterygii	Kanekonia	queenslandica	0.21	62	38	42	58	21
25	Chordata	Actinopterygii	Paraploactis	kagoshimensis	0.95	84	16	62	38	22
32	Chordata	Actinopterygii	Apogon	9(dg)	3.12	65	35	33	67	32
23	Chordata	Actinopterygii	Apogon	brevicaudatus	6.29	49	51	28	72	21
32	Chordata	Actinopterygii	Apogon	capricornis	3.67	56	44	21	79	36
13	Chordata	Actinopterygii	Apogon	cavitiensis	0.40	74	26	47	53	27
23	Chordata	Actinopterygii	Apogon	cf fuscomaculatus	9.82	64	36	32	68	32
29	Chordata	Actinopterygii	Apogon	fasciatus	11.19	78	22	43	57	35
6	Chordata	Actinopterygii	apogon	kiensis	1.07	77	23	45	55	32
10	Chordata	Actinopterygii	Apogon	nigripinnis	2.97	95	5	65	35	29
38	Chordata	Actinopterygii	Apogon	poecilopterus	6.06	89	11	50	50	39
32	Chordata	Actinopterygii	Apogon	septemstriatus	2.37	67	33	31	69	36
5	Chordata	Actinopterygii	Apogon	sp juv/unident	0.59	65	35	36	64	29
4	Chordata	Actinopterygii	Apogon	timorensis	6.19	62	38	38	62	24
36	Chordata	Actinopterygii	Apogon	truncatus	35.81	72	28	41	59	31
5	Chordata	Actinopterygii	Siphamia	versicolor	0.71	52	48	27	73	25
16	Chordata	Actinopterygii	Abalistes	stellatus	38.40	74	26	35	65	40
10	Chordata	Actinopterygii	Batrachomoeus	dubius/trispinosus	6.25	71	29	43	57	27
24	Chordata	Actinopterygii	Arnoglossus	waitei	0.12	90	10	37	63	53
8	Chordata	Actinopterygii	Asterorhombus	intermedius	7.73	82	18	61	39	21
34	Chordata	Actinopterygii	Bothidae	sp juv/unident	6.68	80	20	42	58	38
32	Chordata	Actinopterygii	Crossorhombus	howensis	3.82	46	54	22	78	24
19	Chordata	Actinopterygii	Engyprosopon	grandisquama	65.45	78	22	57	43	21
32	Chordata	Actinopterygii	Engyprosopon	latifrons	0.67	65	35	29	71	36
32	Chordata	Actinopterygii	Engyprosopon	maldivensis	22.26	68	32	38	62	31
5	Chordata	Actinopterygii	Engyprosopon	sp juv/unident	0.71	63	37	34	66	29
1	Chordata	Actinopterygii	Grammatobothus	pennatus	99.63	75	25	46	54	30
27	Chordata	Actinopterygii	Grammatobothus	polyophthalmus	17.95	84	16	59	41	26
9	Chordata	Actinopterygii	Calliurichthys	grossi	8.61	74	26	54	46	19
7	Chordata	Actinopterygii	Calliurichthys	ogilbyi	6.17	74	26	53	47	21
21	Chordata	Actinopterygii	Dactylopus	dactylopus	3.18	79	21	54	46	25
7	Chordata	Actinopterygii	Orbonymus	rameus	6.59	68	32	44	56	24
13	Chordata	Actinopterygii	Repomucenus	belcheri	4.92	90	10	64	36	26
10	Chordata	Actinopterygii	Repomucenus	limiceps	13.39	91	9	52	48	39

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12	Chordata	Actinopterygii	Repomucenus	sublaevis	5.98	93	7	44	56	49
20	Chordata	Actinopterygii	Carangidae	sp juv/unident	0.98	51	49	38	62	14
22	Chordata	Actinopterygii	Caranx	bucculentus	61.95	87	13	64	36	23
9	Chordata	Actinopterygii	Selaroides	leptolepis	29.39	76	24	56	44	20
21	Chordata	Actinopterygii	Centriscus	scutatus	1.00	85	15	57	43	28
7	Chordata	Actinopterygii	Cynoglossus	maccullochi	1.61	80	20	59	41	21
9	Chordata	Actinopterygii	Cynoglossus	maculipinnis	3.95	80	20	60	40	20
3	Chordata	Actinopterygii	Cynoglossus	ogilbyi	1.43	86	14	44	56	42
9	Chordata	Actinopterygii	Cynoglossus	sp 1 punctate	4.04	83	17	56	44	28
13	Chordata	Actinopterygii	Cynoglossus	sp juv/unident	0.74	85	15	54	46	31
24	Chordata	Actinopterygii	Cynoglossus	sp kopsi group	2.92	93	7	53	47	41
34	Chordata	Actinopterygii	Cynoglossus	sp4	23.37	82	18	49	51	34
32	Chordata	Actinopterygii	Dactyloptena	orientalis	8.44	61	39	29	71	32
34	Chordata	Actinopterygii	Dactyloptena	papilio	16.30	86	14	42	58	45
25	Chordata	Actinopterygii	Tragulichthys	jaculiferus	31.92	74	26	47	53	27
32	Chordata	Actinopterygii	Fistularia	commersoni	0.41	64	36	31	69	32
14	Chordata	Actinopterygii	Fistularia	petimba	6.78	73	27	44	56	29
22	Chordata	Actinopterygii	Gerres	filamentosus	4.22	76	24	56	44	20
29	Chordata	Actinopterygii	Pentaprion	longimanus	3.10	87	13	62	38	25
6	Chordata	Actinopterygii	Goby	sp juv/unident	0.05	71	29	34	66	37
35	Chordata	Actinopterygii	Yongeichthys	nebulosus	3.33	68	32	42	58	27
5	Chordata	Actinopterygii	Diagramma	pictum labiosum	9.31	63	37	35	65	28
13	Chordata	Actinopterygii	Pomadasys	maculatus	77.27	94	6	65	35	29
21	Chordata	Actinopterygii	Choerodon	cephalotes	21.13	70	30	46	54	24
6	Chordata	Actinopterygii	Choerodon	frenatus	4.81	70	30	37	63	33
12	Chordata	Actinopterygii	Choerodon	monostigma	14.29	91	9	36	64	55
5	Chordata	Actinopterygii	Choerodon	sp juv/unident	0.15	65	35	36	64	29
20	Chordata	Actinopterygii	Choerodon	sugillatum	26.31	71	29	46	54	25
16	Chordata	Actinopterygii	Choerodon	venustus	19.38	64	36	36	64	29
2	Chordata	Actinopterygii	Oxycheilinus	bimaculatus	2.45	42	58	19	81	22
10	Chordata	Actinopterygii	Suezichthys	gracilis	0.74	83	17	61	39	21
24	Chordata	Actinopterygii	Leiognathus	bindus	3.81	94	6	42	58	51
13	Chordata	Actinopterygii	Leiognathus	cf bindus	1.15	89	11	59	41	30
9	Chordata	Actinopterygii	Leiognathus	leuciscus	8.60	74	26	59	41	14
13	Chordata	Actinopterygii	Leiognathus	moretoniensis	2.37	83	17	52	48	30
22	Chordata	Actinopterygii	Leiognathus	splendens	13.53	71	29	54	46	17
10	Chordata	Actinopterygii	Lethrinus	genivittatus	310.45	68	32	45	55	23
31	Chordata	Actinopterygii	Lutjanus	adetii	52.22	70	30	33	67	37
20	Chordata	Actinopterygii	Lutjanus	vitta	15.87	62	38	37	63	25
8	Chordata	Actinopterygii	Brachaluteres	taylori	3.03	74	26	50	50	24
25	Chordata	Actinopterygii	Chaetodermis	penicilligera	5.96	85	15	59	41	27
24	Chordata	Actinopterygii	Paramonacanthus	filicauda	395.01	94	6	41	59	53
1	Chordata	Actinopterygii	Paramonacanthus	lowei	28.35	71	29	43	57	28
2	Chordata	Actinopterygii	Paramonacanthus	oblongus	6.97	68	32	41	59	27
21	Chordata	Actinopterygii	Paramonacanthus	otisensis	20.18	83	17	58	42	25
1	Chordata	Actinopterygii	Paramonacanthus	sp juv/unident	3.96	72	28	45	55	27
34	Chordata	Actinopterygii	Pseudomonacanthus	peroni	5.54	83	17	44	56	39
18	Chordata	Actinopterygii	Parupeneus	heptacanthus	16.59	55	45	23	77	31
21	Chordata	Actinopterygii	Upeneus	asymmetricus	18.40	85	15	60	40	25
31	Chordata	Actinopterygii	Upeneus	filifer	24.08	80	20	45	55	35
20	Chordata	Actinopterygii	Upeneus	luzonius	29.27	55	45	36	64	18
15	Chordata	Actinopterygii	Upeneus	moluccensis	16.89	92	8	25	75	67
25	Chordata	Actinopterygii	Upeneus	sp juv/unident	0.27	73	27	48	52	25
22	Chordata	Actinopterygii	Upeneus	sulphureus	36.23	91	9	70	30	22
9	Chordata	Actinopterygii	Upeneus	sundaicus	18.58	80	20	63	37	17
25	Chordata	Actinopterygii	Upeneus	tragula complex	42.27	70	30	47	53	24
21	Chordata	Actinopterygii	Nemipteridae	sp juv/unident	0.39	79	21	52	48	27
20	Chordata	Actinopterygii	Nemipterus	furcosus	200.98	66	34	50	50	16
29	Chordata	Actinopterygii	Nemipterus	hexodon	71.19	94	6	52	48	42
14	Chordata	Actinopterygii	Nemipterus	nematopus	34.74	68	32	37	63	31
22	Chordata	Actinopterygii	Nemipterus	peronii	67.91	89	11	64	36	25
22	Chordata	Actinopterygii	Nemipterus	sp juv/unident	0.33	76	24	47	53	29
34	Chordata	Actinopterygii	Nemipterus	theodorei	266.82	83	17	35	65	48
14	Chordata	Actinopterygii	Scolopsis	taeniopterus	50.91	74	26	51	49	23
24	Chordata	Actinopterygii	Sirembo	imberbis	4.60	96	4	34	66	62
23	Chordata	Actinopterygii	Rhynchostracion	nasus	28.96	78	22	45	55	33
20	Chordata	Actinopterygii	Pseudorhombus	argus	17.71	54	46	38	62	16
21	Chordata	Actinopterygii	Pseudorhombus	arsius	16.51	93	7	68	32	25
4	Chordata	Actinopterygii	Pseudorhombus	diplospilus	15.43	68	32	42	58	26
34	Chordata	Actinopterygii	Pseudorhombus	dupliciocellatus	82.99	81	19	44	56	37

Species Group	Phylum	Class	Genus	Species	ave. g/Ha	Old %GU	Old % Other	New %GU	New% Other	Change in % protection
33	Chordata	Actinopterygii	Pseudorhombus	elevatus	38.86	95	5	67	33	28
19	Chordata	Actinopterygii	Pseudorhombus	spinosus	48.54	83	17	58	42	25
1	Chordata	Actinopterygii	Eurypegasus	draconis	0.97	82	18	46	54	36
21	Chordata	Actinopterygii	Pegasus	volitans	3.00	74	26	44	56	30
15	Chordata	Actinopterygii	Parapriacanthus	ransonneti	10.56	70	30	23	77	47
16	Chordata	Actinopterygii	Pentapodus	nagasakiensis	56.70	49	51	23	77	26
18	Chordata	Actinopterygii	Pentapodus	paradiseus	131.00	54	46	34	66	20
13	Chordata	Actinopterygii	Parapercis	diplospilus	0.19	90	10	59	41	31
10	Chordata	Actinopterygii	Parapercis	nebulosa	35.36	78	22	47	53	30
6	Chordata	Actinopterygii	Parapercis	snyderi	0.25	54	46	31	69	23
10	Chordata	Actinopterygii	Ambiserrula	jugosa	25.11	88	12	68	32	20
24	Chordata	Actinopterygii	Elates	ransonnetii	21.60	99	1	30	70	68
3	Chordata	Actinopterygii	Inegocia	harrisii	12.15	97	3	23	77	73
9	Chordata	Actinopterygii	Inegocia	japonica	54.94	82	18	60	40	22
16	Chordata	Actinopterygii	Onigocia	cf macrolepis	8.37	58	42	33	67	25
18	Chordata	Actinopterygii	Onigocia	sp b	2.27	69	31	40	60	28
18	Chordata	Actinopterygii	Onigocia	sp juv/unident	6.27	72	28	44	56	28
5	Chordata	Actinopterygii	Rogadius	patriciae	27.91	66	34	40	60	26
35	Chordata	Actinopterygii	Rogadius	pristiger	22.43	59	41	34	66	25
7	Chordata	Actinopterygii	Sorsogona	tuberculata	66.75	74	26	53	47	21
22	Chordata	Actinopterygii	Suggrundus	macracanthus	28.02	95	5	59	41	36
29	Chordata	Actinopterygii	Euristhmus	nudiceps	68.84	84	16	56	44	28
13	Chordata	Actinopterygii	Polydactylus	multiradiatus	20.97	56	44	30	70	26
1	Chordata	Actinopterygii	Pristotis	obtusirostris	46.46	68	32	43	57	25
24	Chordata	Actinopterygii	Priacanthus	tayenus	78.99	90	10	45	55	45
22	Chordata	Actinopterygii	Psettodes	erumei	18.09	84	16	61	39	23
27	Chordata	Actinopterygii	Pseudochromis	quinquedentatus	0.10	81	19	54	46	27
4	Chordata	Actinopterygii	Samaris	cristatus	7.61	69	31	43	57	26
33	Chordata	Actinopterygii	Apistus	carinatus	53.77	86	14	56	44	30
32	Chordata	Actinopterygii	Dendrochirus	brachypterus	2.48	60	40	27	73	33
23	Chordata	Actinopterygii	Liocranium	praepositum	4.08	64	36	37	63	28
21	Chordata	Actinopterygii	Paracentropogon	longispinus	4.51	70	30	49	51	22
1	Chordata	Actinopterygii	Pterois	russelii (e form)	6.64	74	26	44	56	30
25	Chordata	Actinopterygii	Scorpaenopsis	furneauxi	0.11	92	8	60	40	32
3	Chordata	Actinopterygii	Centrogenys	vaigiensis	1.02	71	29	23	77	48
29	Chordata	Actinopterygii	Epinephelus	sexfasciatus	14.30	92	8	48	52	45
13	Chordata	Actinopterygii	Siganus	canaliculatus	18.91	68	32	42	58	26
22	Chordata	Actinopterygii	Sillago	burrus	15.42	68	32	46	54	22
21	Chordata	Actinopterygii	Sillago	ingenuua	20.05	75	25	48	52	27
29	Chordata	Actinopterygii	Brachirus	muelleri	4.02	90	10	69	31	21
4	Chordata	Actinopterygii	Zebrias	craticula	10.35	71	29	49	51	23
10	Chordata	Actinopterygii	Erosa	erosa	8.81	76	24	47	53	28
10	Chordata	Actinopterygii	Inimicus	caledonicus	35.62	86	14	65	35	22
36	Chordata	Actinopterygii	Minous	trachycephalus	32.52	69	31	47	53	22
33	Chordata	Actinopterygii	Minous	versicolor	4.62	95	5	58	42	37
18	Chordata	Actinopterygii	Halicampus	grayi	0.44	60	40	39	61	21
4	Chordata	Actinopterygii	Hippocampus	queenslandicus	0.45	62	38	37	63	25
29	Chordata	Actinopterygii	Saurida	argentea/tumbil	55.60	85	15	58	42	27
21	Chordata	Actinopterygii	Saurida	grandi/undo	405.83	84	16	56	44	28
7	Chordata	Actinopterygii	Synodus	tectus group	35.46	73	27	49	51	24
31	Chordata	Actinopterygii	Trachinocephalus	myops	51.51	80	20	53	47	27
21	Chordata	Actinopterygii	Pelates	quadrilineatus	6.50	94	6	69	31	25
29	Chordata	Actinopterygii	Terapon	puta	3.02	73	27	56	44	17
22	Chordata	Actinopterygii	Terapon	theraps	18.03	84	16	63	37	21
18	Chordata	Actinopterygii	Canthigaster	rivulata	1.60	41	59	12	88	29
36	Chordata	Actinopterygii	Lagocephalus	sceleratus	10.55	69	31	44	56	25
7	Chordata	Actinopterygii	Torquigener	cf pallimaculatus	17.97	76	24	52	48	24
7	Chordata	Actinopterygii	Torquigener	sp1 (gloerfelt-tarp)	36.79	79	21	57	43	22
22	Chordata	Actinopterygii	Torquigener	whitleyi	7.54	79	21	52	48	26
16	Chordata	Actinopterygii	Cottapistus	cottoides	2.29	74	26	50	50	25
2	Chordata	Actinopterygii	Richardsonichthys	leucogaster	2.35	60	40	37	63	23
29	Chordata	Actinopterygii	Tripodichthys	angustifrons	2.20	64	36	45	55	19
13	Chordata	Actinopterygii	Trixiphichthys	weberi	2.96	90	10	56	44	34
24	Chordata	Actinopterygii	Lepidotrigla	calodactyla	43.78	99	1	25	75	74
34	Chordata	Actinopterygii	Lepidotrigla	japonica-like	53.83	78	22	43	57	35
23	Chordata	Ascidiacea	Ascidiacea	spp	301.49	62	38	32	68	30
	Chordata	Chondrichthyes	Dasyatis	leylandi	8.85	75	25	44	56	31
31	Cnidaria	Actinaria	Anemone	sp9	0.33	74	26	39	61	35
32	Cnidaria	Anthozoa	Acanthogorgia	sp1	0.53	61	39	27	73	33
17	Cnidaria	Anthozoa	Actiniaria	spp	19.90	71	29	43	57	29

Species Group	Phylum	Class	Genus	Species	ave. g/Ha	Old %GU	Old % Other	New %GU	New% Other	Change in % protection
20	Cnidaria	Anthozoa	Alertigorgia	orientalis	1.67	62	38	50	50	12
17	Cnidaria	Anthozoa	Iciligorgia	sp1	6.46	63	37	31	69	32
16	Cnidaria	Anthozoa	Solenocaulon	sp1	12.24	65	35	40	60	26
5	Cnidaria	Anthozoa	Solenocaulon	sp2	0.18	67	33	37	63	29
20	Cnidaria	Anthozoa	Antipatharia	spp	1.15	66	34	36	64	30
1	Cnidaria	Anthozoa	Caryophyllia	spp	0.57	69	31	42	58	27
19	Cnidaria	Anthozoa	Heterocyathus	sulcatus cf	20.41	74	26	46	54	28
3	Cnidaria	Anthozoa	Carijoa	sp1	2.96	74	26	31	69	43
28	Cnidaria	Anthozoa	Heteropsammia	cochlea	1.13	36	64	30	70	6
17	Cnidaria	Anthozoa	Turbinaria	spp	432.70	71	29	42	58	29
16	Cnidaria	Anthozoa	Dichotella	gemmacea	1.08	70	30	35	65	35
16	Cnidaria	Anthozoa	Dichotella	sp1	3.63	69	31	38	62	30
31	Cnidaria	Anthozoa	Junceella	juncea	3.25	76	24	45	55	30
16	Cnidaria	Anthozoa	Junceella	sp2	6.89	63	37	28	72	34
4	Cnidaria	Anthozoa	Truncatoflabellum	spp	2.30	69	31	42	58	26
2	Cnidaria	Anthozoa	Cycloseris	cyclolites	5.63	66	34	55	45	11
28	Cnidaria	Anthozoa	diaseris	distorta cf	0.06	60	40	37	63	23
23	Cnidaria	Anthozoa	Melithaea	sp2	3.08	67	33	22	78	45
23	Cnidaria	Anthozoa	Mopsella	sp1	4.09	73	27	32	68	41
23	Cnidaria	Anthozoa	Mopsella	sp2	1.32	70	30	24	76	45
2	Cnidaria	Anthozoa	Scolymia	spp	0.73	60	40	34	66	26
18	Cnidaria	Anthozoa	Dendronephthya	spp	64.48	55	45	30	70	25
16	Cnidaria	Anthozoa	Umbellulifera	sp1	38.83	63	37	32	68	31
5	Cnidaria	Anthozoa	Nephthyigorgia	sp1	0.36	61	39	35	65	25
20	Cnidaria	Anthozoa	Studeriotes	sp2	0.59	60	40	41	59	19
22	Cnidaria	Anthozoa	Sea pen	sp1	0.03	78	22	57	43	21
23	Cnidaria	Anthozoa	Echinogorgia	sp3	5.56	58	42	18	82	39
23	Cnidaria	Anthozoa	Echinogorgia	sp5	0.55	61	39	26	74	35
3	Cnidaria	Anthozoa	Euplexaura	sp6	24.24	72	28	36	64	36
	Cnidaria	Anthozoa	Pteroides	sp1	1.15	75	25	44	56	31
	Cnidaria	Anthozoa	Pteroides	sp2	0.46	75	25	44	56	31
20	Cnidaria	Anthozoa	Pteroides	sp3	4.55	67	33	42	58	25
17	Cnidaria	Anthozoa	Sphenopus	marsupialis	46.26	74	26	48	52	25
31	Cnidaria	Anthozoa	Subergorgia	suberosa	0.70	70	30	32	68	38
2	Cnidaria	Anthozoa	Trachyphyllia	geoffroyi	158.87	68	32	46	54	21
2	Cnidaria	Anthozoa	Virgularia	sp1	0.12	72	28	41	59	31
17	Cnidaria	Anthozoa	Zoanthidae	spp	0.25	69	31	42	58	28
23	Cnidaria	Hydrozoa	Hydroida	spp	16.95	57	43	26	74	31
23	Cnidaria	Octocorallia	Octocorallia	spp	3.57	65	35	34	66	30
17	Crustacea	Crustacea	Crustacea	spp	0.18	71	29	43	57	29
26	Cyanophyta	Cyanophyceae	Lyngbya	sp	2.55	41	59	21	79	21
5	Echinodermata	Asteroidea	Anseropoda	rosacae cf	1.73	61	39	33	67	28
9	Echinodermata	Asteroidea	Astropecten	granulatus cf	0.84	72	28	46	54	27
9	Echinodermata	Asteroidea	Astropecten	sp4_AIM	0.56	69	31	45	55	24
26	Echinodermata	Asteroidea	Astropecten	sp4_QMS	0.58	72	28	42	58	30
20	Echinodermata	Asteroidea	Astropecten	spp	3.85	65	35	45	55	21
20	Echinodermata	Asteroidea	Astropecten	zebra	0.61	76	24	54	46	21
18	Echinodermata	Asteroidea	Metrodira	subulata	2.98	72	28	45	55	27
23	Echinodermata	Asteroidea	Goniasteridae	sp5	0.21	56	44	19	81	37
17	Echinodermata	Asteroidea	Goniasteridae	spp	0.69	71	29	43	57	28
16	Echinodermata	Asteroidea	Iconaster	longimanus	0.86	63	37	33	67	30
25	Echinodermata	Asteroidea	Stellaster	equestris cf	102.98	73	27	49	51	24
33	Echinodermata	Asteroidea	Luidia	hardwicki	1.34	87	13	58	42	29
18	Echinodermata	Asteroidea	Luidia	maculata	18.30	67	33	41	59	27
16	Echinodermata	Asteroidea	Ophidiasteridae	sp1	0.64	61	39	34	66	27
16	Echinodermata	Asteroidea	Tamaria	sp3	1.15	58	42	30	70	29
25	Echinodermata	Asteroidea	Tamaria cf	sp3	3.34	74	26	43	57	31
11	Echinodermata	Asteroidea	Anthenea	sp1_AIM	3.65	79	21	51	49	28
23	Echinodermata	Asteroidea	Goniodiscaster	rugosus cf	4.53	75	25	41	59	34
10	Echinodermata	Asteroidea	Oreasteridae	sp1	141.00	78	22	56	44	22
23	Echinodermata	Asteroidea	Pentaceraster	gracilis	140.81	68	32	40	60	28
36	Echinodermata	Asteroidea	Poraster	superbus	47.04	69	31	41	59	27
16	Echinodermata	Asteroidea	Euretaster	insignis	10.27	74	26	40	60	34
18	Echinodermata	Crinoidea	Crinoidea	spp	121.49	52	48	32	68	19
32	Echinodermata	Echinoidea	Echinodiscus	tenuissimus	5.85	66	34	40	60	27
9	Echinodermata	Echinoidea	Brissopsis	luzonica	69.01	78	22	46	54	32
3	Echinodermata	Echinoidea	Prionocidaris	bispinosa	10.52	64	36	29	71	35
28	Echinodermata	Echinoidea	Clypeaster	sp3	49.24	71	29	53	47	17
22	Echinodermata	Echinoidea	Chaetodiadema	granulatum	4.02	73	27	48	52	25
5	Echinodermata	Echinoidea	Asthenosoma	sp1	37.39	54	46	29	71	25

Species Group	Phylum	Class	Genus	Species	ave. g/Ha	Old %GU	Old % Other	New %GU	New% Other	Change in % protection
20	Echinodermata	Echinoidea	Laganidae	sp3	9.54	75	25	44	56	31
21	Echinodermata	Echinoidea	Laganum	depressum	114.03	77	23	50	50	26
20	Echinodermata	Echinoidea	Peronella	lesueuri	18.57	65	35	45	55	20
17	Echinodermata	Echinoidea	Peronella	macroproctes cf	6.79	67	33	43	57	24
19	Echinodermata	Echinoidea	Peronella	orbicularis cf	1.63	76	24	50	50	26
20	Echinodermata	Echinoidea	Breynia	desorii	8.52	61	39	46	54	15
15	Echinodermata	Echinoidea	Lovenia	elongata	4.64	84	16	41	59	43
20	Echinodermata	Echinoidea	Ova	lacunosus	6.83	65	35	44	56	21
30	Echinodermata	Echinoidea	Mespilia	globulus	1.14	32	68	12	88	21
18	Echinodermata	Echinoidea	Salmaciella	oligopora	5.04	62	38	38	62	24
23	Echinodermata	Echinoidea	Salmacis	belli	52.38	70	30	37	63	33
7	Echinodermata	Echinoidea	Salmacis	sphaeroides	17.17	82	18	56	44	25
4	Echinodermata	Echinoidea	Temnopleuridae	sp2_QMS	1.57	61	39	36	64	25
18	Echinodermata	Echinoidea	Temnopleuridae	sp5	2.06	56	44	38	62	18
16	Echinodermata	Echinoidea	Temnopleurus	alexandri	2.88	58	42	31	69	27
16	Echinodermata	Echinoidea	Temnotrema	bothryoides	2.06	63	37	38	62	25
11	Echinodermata	Echinoidea	Temnotrema	sp3	3.63	75	25	44	56	31
10	Echinodermata	Echinoidea	Gymnechinus	epistichus	65.12	70	30	47	53	23
17	Echinodermata	Echinoidea	Nudechinus	sp4_MTQ	6.67	68	32	38	62	30
17	Echinodermata	Echinoidea	Nudechinus	spp	0.46	70	30	42	58	28
4	Echinodermata	Echinoidea	Pseudoboletia	indiana	2.28	73	27	43	57	30
23	Echinodermata	Holothuroidea	Cercodermas	anceps	4.78	58	42	33	67	25
23	Echinodermata	Holothuroidea	Pseudocolochirus	violaceus	114.30	66	34	36	64	30
2	Echinodermata	Holothuroidea	Actinopyga	spinea cf	255.81	55	45	29	71	26
10	Echinodermata	Holothuroidea	Bohadschia	marmorata cf	13.56	89	11	69	31	21
1	Echinodermata	Holothuroidea	Holothuria	dofleinii	47.97	58	42	37	63	22
22	Echinodermata	Holothuroidea	Holothuria	ocellata	43.02	76	24	52	48	25
21	Echinodermata	Holothuroidea	Holothuria	sp2	5.52	85	15	64	36	21
25	Echinodermata	Holothuroidea	Holothuroidea	sp2	2.25	73	27	50	50	23
12	Echinodermata	Holothuroidea	Holothuroidea	sp22	55.76	85	15	51	49	33
23	Echinodermata	Holothuroidea	Holothuroidea	sp30	55.63	47	53	27	73	20
16	Echinodermata	Holothuroidea	Holothuroidea	sp36	0.22	63	37	37	63	26
23	Echinodermata	Holothuroidea	Holothuroidea	sp38	3.43	60	40	30	70	30
16	Echinodermata	Holothuroidea	Holothuroidea	sp43	3.52	59	41	32	68	27
31	Echinodermata	Holothuroidea	Holothuroidea	sp44	1.91	78	22	37	63	41
19	Echinodermata	Holothuroidea	Holothuroidea	sp46	20.88	72	28	43	57	29
36	Echinodermata	Holothuroidea	Holothuroidea	spp	64.37	69	31	43	57	26
1	Echinodermata	Holothuroidea	Stichopus	horrens	107.46	74	26	46	54	29
2	Echinodermata	Holothuroidea	Stichopus	ocellatus	121.02	67	33	49	51	18
9	Echinodermata	Ophiuroidea	Dougaloplus	echinata	0.13	75	25	47	53	28
15	Echinodermata	Ophiuroidea	Euryalida	fragment	2.40	77	23	40	60	37
16	Echinodermata	Ophiuroidea	Euryale	asperum	45.37	64	36	36	64	28
4	Echinodermata	Ophiuroidea	Ophiacantha	indica cf	1.99	76	24	44	56	32
24	Echinodermata	Ophiuroidea	Ophiopsila	pantherina	0.23	83	17	36	64	47
18	Echinodermata	Ophiuroidea	Ophiarachnella	infernalis cf	1.78	64	36	37	63	27
18	Echinodermata	Ophiuroidea	Ophiarachnella	paucigranula cf	0.78	36	64	18	82	18
18	Echinodermata	Ophiuroidea	Ophiochasma	stellatum	47.56	68	32	42	58	26
37	Echinodermata	Ophiuroidea	Ophiopeza	spinosa cf	0.02	58	42	26	74	32
18	Echinodermata	Ophiuroidea	Ophiopsammus	yoldii	43.75	69	31	41	59	28
15	Echinodermata	Ophiuroidea	Ophionereis	semoni cf	0.37	67	33	30	70	37
2	Echinodermata	Ophiuroidea	Ophiomaza	cacaotica cf	0.57	60	40	37	63	23
25	Echinodermata	Ophiuroidea	Ophiothrix	sp14	0.24	72	28	46	54	26
17	Echinodermata	Ophiuroidea	Ophiothrix	sp6	0.14	64	36	36	64	28
23	Echinodermata	Ophiuroidea	Placophiothrix	sp2	0.17	61	39	29	71	32
5	Echinodermata	Ophiuroidea	Ophiuroidea	spp	0.61	67	33	38	62	30
33	Foraminifera	Foraminifera	Discobotellina	biperforata	7.58	99	1	58	42	40
4	Magnoliophyta	Liliopsida	Halophila	capricorni	3.85	65	35	41	59	24
21	Magnoliophyta	Liliopsida	Halophila	decipiens	196.65	75	25	50	50	25
10	Magnoliophyta	Liliopsida	Halophila	ovalis	205.05	70	30	51	49	19
10	Magnoliophyta	Liliopsida	Halophila	spinulosa	678.61	76	24	53	47	22
14	Magnoliophyta	Liliopsida	Halophila	tricostata	45.66	71	29	45	55	25
14	Mollusca	Bivalvia	Anadara	ferruginea cf	0.59	72	28	46	54	26
3	Mollusca	Bivalvia	Arca	avellana_MTQ	16.32	74	26	29	71	45
3	Mollusca	Bivalvia	Arca	navicularis	0.36	63	37	22	78	41
17	Mollusca	Bivalvia	Arca	sp1	11.21	71	29	43	57	28
25	Mollusca	Bivalvia	Barbatia	parvillosa cf	0.06	73	27	49	51	24
9	Mollusca	Bivalvia	Trisidos	semitortata	20.15	66	34	47	53	19
8	Mollusca	Bivalvia	Ctenocardia	virgo cf	0.34	79	21	54	46	24
2	Mollusca	Bivalvia	Fragum	retusum	0.17	72	28	47	53	25
14	Mollusca	Bivalvia	Fulvia	scalata	0.19	65	35	40	60	26

Species Group	Phylum	Class	Genus	Species	ave. g/Ha	Old %GU	Old % Other	New %GU	New% Other	Change in % protection
26	Mollusca	Bivalvia	Fulvia	undatopicta	0.73	57	43	24	76	33
15	Mollusca	Bivalvia	Nemocardium	bechei	0.71	75	25	37	63	38
4	Mollusca	Bivalvia	Cardita	sp1	8.04	61	39	39	61	22
11	Mollusca	Bivalvia	Chama	pulchella	43.81	81	19	46	54	35
1	Mollusca	Bivalvia	Chama	sp3	9.12	72	28	49	51	24
10	Mollusca	Bivalvia	Chama	spp	0.68	84	16	50	50	35
29	Mollusca	Bivalvia	Corbula	fortisulcata	0.32	78	22	43	57	35
9	Mollusca	Bivalvia	Corbula	macgillvrayi	10.31	75	25	47	53	28
29	Mollusca	Bivalvia	Corbula	sp2	41.50	77	23	48	52	29
12	Mollusca	Bivalvia	Cucullaea	labiata	11.95	81	19	43	57	38
29	Mollusca	Bivalvia	Enisiculus	cultellus	0.05	83	17	61	39	23
17	Mollusca	Bivalvia	Glycymeris	hedleyi	9.34	73	27	42	58	31
9	Mollusca	Bivalvia	Melaxinaea	vitrea	8.61	80	20	59	41	20
3	Mollusca	Bivalvia	Parahyotissa	imbricata	2.63	82	18	42	58	40
1	Mollusca	Bivalvia	Laternulidae	sp1	30.75	71	29	44	56	27
16	Mollusca	Bivalvia	Lima	sp1	1.56	67	33	40	60	27
16	Mollusca	Bivalvia	Lima	vulgaris	1.09	56	44	30	70	26
19	Mollusca	Bivalvia	Lomopsis	sp1	3.06	76	24	51	49	25
23	Mollusca	Bivalvia	Malleus	albus	15.60	54	46	31	69	23
9	Mollusca	Bivalvia	Modiolus	elongatus	1.97	80	20	56	44	24
3	Mollusca	Bivalvia	Modiolus	sp1	103.43	74	26	39	61	36
27	Mollusca	Bivalvia	Leionucula	superba	0.28	89	11	56	44	33
10	Mollusca	Bivalvia	Amusium	balloti	122.89	80	20	51	49	29
9	Mollusca	Bivalvia	Amusium	pleuronectes cf	41.31	82	18	60	40	22
10	Mollusca	Bivalvia	Annachlamys	flabellata	14.52	83	17	51	49	31
10	Mollusca	Bivalvia	Annachlamys	kuhnholtzi	18.31	78	22	48	52	29
11	Mollusca	Bivalvia	Chlamys	sp2	0.79	79	21	46	54	33
34	Mollusca	Bivalvia	Mimachlamys	gloriosa	1.25	81	19	44	56	37
10	Mollusca	Bivalvia	Plicatula	chinensis cf	154.43	76	24	47	53	29
3	Mollusca	Bivalvia	Pteria	coturnix cf	0.09	78	22	38	62	40
13	Mollusca	Bivalvia	Solen	siphons only	3.48	85	15	49	51	36
13	Mollusca	Bivalvia	Solen	sp3	1.77	83	17	45	55	37
11	Mollusca	Bivalvia	Spondylus	wrightianus	5.16	82	18	50	50	33
9	Mollusca	Bivalvia	Antigona	lamellaris	1.17	69	31	45	55	24
4	Mollusca	Bivalvia	Circe	sp1	4.66	67	33	40	60	26
29	Mollusca	Bivalvia	Dosinia	altenai	9.59	84	16	50	50	33
4	Mollusca	Bivalvia	Dosinia	histrio cf	13.68	69	31	43	57	25
12	Mollusca	Bivalvia	Globivenus	embrithes cf	5.71	91	9	42	58	49
5	Mollusca	Bivalvia	Liochonca	polita	0.55	68	32	37	63	31
24	Mollusca	Bivalvia	Paphia	undulata cf	0.40	90	10	45	55	44
24	Mollusca	Bivalvia	Pitar	sp2	0.40	89	11	41	59	48
25	Mollusca	Bivalvia	Placamen	sp2	6.00	70	30	44	56	25
29	Mollusca	Bivalvia	Placamen	tiara	0.16	78	22	55	45	22
25	Mollusca	Cephalopoda	Cephalopoda	spp	37.61	72	28	47	53	24
37	Mollusca	Cephalopoda	Loligo	sp1	4.38	66	34	30	70	35
23	Mollusca	Cephalopoda	Photololligo	chinensis	17.58	60	40	37	63	23
35	Mollusca	Cephalopoda	Photololligo	sp1	6.35	59	41	32	68	26
17	Mollusca	Cephalopoda	Octopodidae	spp	61.72	66	34	42	58	24
17	Mollusca	Cephalopoda	Sepiadariidae	sp2	3.74	69	31	44	56	25
7	Mollusca	Cephalopoda	Sepiadariidae	sp5	0.85	78	22	52	48	25
4	Mollusca	Cephalopoda	Sepiadarium	austrinum	5.91	72	28	43	57	29
1	Mollusca	Cephalopoda	Sepioloidea	lineolata	8.90	71	29	42	58	29
1	Mollusca	Cephalopoda	Metasepia	pfefferi	6.28	74	26	44	56	30
29	Mollusca	Cephalopoda	Sepia	elliptica	7.95	83	17	51	49	32
1	Mollusca	Cephalopoda	Sepia	papuensis	18.23	66	34	40	60	25
14	Mollusca	Cephalopoda	Sepia	pharaonis	6.98	74	26	51	49	23
1	Mollusca	Cephalopoda	Sepia	plangon	65.29	68	32	40	60	28
17	Mollusca	Cephalopoda	Sepia	smithi	33.30	72	28	45	55	27
1	Mollusca	Cephalopoda	Sepia	whitleyana	24.73	81	19	50	50	30
7	Mollusca	Cephalopoda	Sepiidae	spp	39.71	73	27	49	51	24
22	Mollusca	Gastropoda	Aplysia	sp1_QMS	22.56	74	26	51	49	23
2	Mollusca	Gastropoda	Dolabella	sp1	94.28	76	24	51	49	24
19	Mollusca	Gastropoda	Phos	senticosus	7.31	73	27	46	54	26
22	Mollusca	Gastropoda	Bufonaria	rana	0.96	88	12	56	44	32
37	Mollusca	Gastropoda	Ceratosoma	tenue	0.79	68	32	36	64	32
10	Mollusca	Gastropoda	Conus	ammiralis	0.89	79	21	51	49	28
14	Mollusca	Gastropoda	Vexillum	obeliscus cf	0.12	66	34	44	56	23
37	Mollusca	Gastropoda	Cypraea	walkeri cf	0.29	69	31	37	63	32
18	Mollusca	Gastropoda	Fusinus	colus	23.23	71	29	42	58	29
5	Mollusca	Gastropoda	Latirus	paetelianus cf	1.06	63	37	35	65	28

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3	Mollusca	Gastropoda	Scutus	unguis	0.64	66	34	33	67	32
11	Mollusca	Gastropoda	Gastropoda	eggs	68.12	77	23	46	54	30
18	Mollusca	Gastropoda	Gastropoda	spp	4.31	67	33	41	59	26
28	Mollusca	Gastropoda	Atys	cylindricus cf	0.25	72	28	49	51	24
2	Mollusca	Gastropoda	Atys	naucum	1.17	59	41	40	60	19
28	Mollusca	Gastropoda	Atys	sp1	1.63	61	39	42	58	19
9	Mollusca	Gastropoda	Lamellaria	sp1	0.29	71	29	46	54	25
18	Mollusca	Gastropoda	Chicoreus	banksii cf	2.61	59	41	37	63	22
1	Mollusca	Gastropoda	Chicoreus	sp1	26.71	71	29	40	60	30
5	Mollusca	Gastropoda	Chicoreus	spp	2.50	57	43	32	68	25
37	Mollusca	Gastropoda	Chicoreus	territus cf	0.80	56	44	31	69	26
5	Mollusca	Gastropoda	Haustellum	tweedianum	0.62	64	36	35	65	29
13	Mollusca	Gastropoda	Murex	brevispina	0.24	92	8	61	39	31
6	Mollusca	Gastropoda	Murex	tenuirostrum cf	32.49	75	25	42	58	33
33	Mollusca	Gastropoda	Nassarius	conoidalis cf	0.13	83	17	52	48	30
22	Mollusca	Gastropoda	Nassarius	cremmatus cf	1.80	75	25	55	45	20
25	Mollusca	Gastropoda	Nassarius	glans cf	1.99	73	27	48	52	25
13	Mollusca	Gastropoda	Natica	vitellus	0.43	86	14	53	47	33
7	Mollusca	Gastropoda	Volva	volva	0.43	68	32	46	54	22
15	Mollusca	Gastropoda	Distorsio	reticulata	2.87	78	22	44	56	34
	Mollusca	Gastropoda	Philine	angasi	0.29	75	25	44	56	31
10	Mollusca	Gastropoda	Philine	sp1	0.41	82	18	54	46	28
11	Mollusca	Gastropoda	Biplex	pulchellum	2.97	76	24	47	53	29
4	Mollusca	Gastropoda	Cymatium	caudatum	0.32	68	32	41	59	27
20	Mollusca	Gastropoda	Cymatium	pfeifferanium	0.22	61	39	37	63	24
25	Mollusca	Gastropoda	Strombus	campbelli	1.12	90	10	64	36	25
8	Mollusca	Gastropoda	Strombus	dilatatus	4.62	75	25	53	47	22
8	Mollusca	Gastropoda	Strombus	variabilis	0.34	71	29	47	53	24
7	Mollusca	Gastropoda	Strombus	vittatus	2.81	80	20	57	43	23
26	Mollusca	Gastropoda	Terebellum	terebellum	0.03	46	54	31	69	15
1	Mollusca	Gastropoda	Tudivasum	armigera	4.05	73	27	44	56	28
31	Mollusca	Gastropoda	Bolma	aureola	2.40	50	50	24	76	26
22	Mollusca	Gastropoda	Gemmula	sp2	0.36	76	24	46	54	30
14	Mollusca	Gastropoda	Lophiotoma	acuta	0.22	81	19	54	46	26
8	Mollusca	Gastropoda	Xenophora	cerea cf	14.52	57	43	30	70	27
8	Mollusca	Gastropoda	Xenophora	indica	1.25	76	24	44	56	32
30	Mollusca	Gastropoda	Xenophora	solarioides	1.86	73	27	47	53	25
	Mollusca	Mollusca	Mollusca	eggs	0.92	75	25	44	56	31
11	Phaeophyta	Phaeophyceae	Dictyopteris	sp2	65.49	78	22	52	48	26
1	Phaeophyta	Phaeophyceae	Dictyota	sp1	4.15	70	30	46	54	23
17	Phaeophyta	Phaeophyceae	Dictyota	sp2	7.55	56	44	33	67	23
10	Phaeophyta	Phaeophyceae	Distromium	flabellatum	172.58	72	28	42	58	30
1	Phaeophyta	Phaeophyceae	Lobophora	sp	331.37	85	15	53	47	32
10	Phaeophyta	Phaeophyceae	Lobophora	variegata	733.33	77	23	54	46	23
10	Phaeophyta	Phaeophyceae	Padina	sp.	32.99	82	18	56	44	25
7	Phaeophyta	Phaeophyceae	Dictyotales	sp	21.73	77	23	53	47	25
16	Phaeophyta	Phaeophyceae	Sargassum	sp	51.38	60	40	35	65	25
10	Phaeophyta	Phaeophyceae	Sporochnus	comosus	75.89	80	20	57	43	23
11	Phaeophyta	Phaeophyceae	Sporochnus	moorei	140.10	80	20	53	47	27
16	Porifera	Calcarea	Calcarea	calcareous sp4	2.10	68	32	37	63	32
37	Porifera	Calcarea	Calcarea	calcareous sp5	1.42	67	33	37	63	30
23	Porifera	Calcarea	Clathrina	sp1	1.24	53	47	19	81	34
20	Porifera	Demospongiae	Disyringa	sp1	0.45	72	28	46	54	26
2	Porifera	Demospongiae	Reniochalina	stalagmitis	25.07	67	33	41	59	25
3	Porifera	Demospongiae	Callyspongia	schultzi	22.61	85	15	31	69	54
26	Porifera	Demospongiae	Callyspongia	sp2	1.39	69	31	40	60	30
23	Porifera	Demospongiae	Callyspongia	sp23	4.40	76	24	39	61	38
23	Porifera	Demospongiae	Callyspongia	sp26	6.42	60	40	25	75	35
36	Porifera	Demospongiae	Callyspongia	sp6	3.51	69	31	43	57	26
37	Porifera	Demospongiae	Chondrilla	sp1	0.89	69	31	29	71	40
8	Porifera	Demospongiae	Crella	1525	4.08	76	24	55	45	21
23	Porifera	Demospongiae	Dendrilla	sp4	0.57	67	33	37	63	30
37	Porifera	Demospongiae	Dendrilla	sp5	3.64	66	34	32	68	34
3	Porifera	Demospongiae	Dendrilla	sp6	12.20	60	40	29	71	31
37	Porifera	Demospongiae	Demospongiae	conglomerate	22.17	72	28	34	66	37
5	Porifera	Demospongiae	Demospongiae	fragment	0.12	60	40	34	66	26
23	Porifera	Demospongiae	Demospongiae	sp10	9.26	48	52	18	82	30
37	Porifera	Demospongiae	Demospongiae	sp109	6.01	53	47	25	75	29
6	Porifera	Demospongiae	Demospongiae	sp11	2.41	66	34	40	60	26
6	Porifera	Demospongiae	Demospongiae	sp13	15.13	62	38	31	69	31

Species Group	Phylum	Class	Genus	Species	ave. g/Ha	Old %GU	Old % Other	New %GU	New% Other	Change in % protection
37	Porifera	Demospongiae	Demospongiae	sp14	0.77	63	37	37	63	26
15	Porifera	Demospongiae	Demospongiae	sp146	0.34	68	32	31	69	37
15	Porifera	Demospongiae	Demospongiae	sp16	1.28	75	25	44	56	31
36	Porifera	Demospongiae	Demospongiae	sp17	0.93	70	29	45	55	25
23	Porifera	Demospongiae	Demospongiae	sp26	1.12	51	49	21	79	30
23	Porifera	Demospongiae	Demospongiae	sp27	0.64	64	36	26	74	38
37	Porifera	Demospongiae	Demospongiae	sp53	22.18	68	32	31	69	36
37	Porifera	Demospongiae	Demospongiae	sp6	43.76	61	39	30	70	32
3	Porifera	Demospongiae	Demospongiae	sp61	15.18	71	29	40	60	31
37	Porifera	Demospongiae	Demospongiae	sp88	4.24	70	30	38	62	32
36	Porifera	Demospongiae	Demospongiae	sp89	3.19	80	20	50	50	30
36	Porifera	Demospongiae	Sponge substrate	substrate	2.54	67	33	42	58	24
30	Porifera	Demospongiae	Dendroceratid	sp1	4.31	54	46	32	68	21
37	Porifera	Demospongiae	Acanthella	cavernosa	1.87	70	30	35	65	34
37	Porifera	Demospongiae	Dysidea	arenaria	13.41	61	39	26	74	35
37	Porifera	Demospongiae	Dysidea	sp10	1.20	69	31	36	64	32
26	Porifera	Demospongiae	Dysidea	sp3	2.53	58	42	28	72	30
30	Porifera	Demospongiae	Dysidea	sp5	4.51	61	39	32	68	29
17	Porifera	Demospongiae	Ianthella	quadrangulata	1181.07	73	27	45	55	28
2	Porifera	Demospongiae	Ircinia	1255	374.78	69	31	46	54	23
36	Porifera	Demospongiae	Ircinia	2710	534.58	70	30	43	57	27
3	Porifera	Demospongiae	Ircinia	spp	12.47	66	34	37	63	30
37	Porifera	Demospongiae	Coelocarteria	singaporensis	5.51	37	63	11	89	27
23	Porifera	Demospongiae	Clathria	sp9	3.59	76	24	45	55	32
37	Porifera	Demospongiae	Clathria (thalysias)	vulpina	50.68	66	34	34	66	32
1	Porifera	Demospongiae	Mycale	sp9	81.81	71	29	47	53	23
8	Porifera	Demospongiae	Mycale	mirabilis	20.11	71	29	45	55	26
28	Porifera	Demospongiae	Gelliodes	sp1	3.72	54	46	31	69	23
30	Porifera	Demospongiae	Niphates	sp17	15.38	57	43	33	67	23
37	Porifera	Demospongiae	Oceanapia	sp21	262.29	63	37	25	75	38
3	Porifera	Demospongiae	Oceanapia	tubes only	0.18	76	24	33	67	43
23	Porifera	Demospongiae	Pseudoceratina	sp6	9.47	80	20	40	60	39
15	Porifera	Demospongiae	Raspailia	sp2	32.50	78	22	38	62	40
15	Porifera	Demospongiae	Spirastrella	sp2	26.46	77	23	35	65	42
20	Porifera	Demospongiae	Spirastrella	sp3	3.41	65	35	41	59	24
6	Porifera	Demospongiae	Hippospongia	elastica	36.42	70	30	42	58	28
37	Porifera	Demospongiae	Hyattella	intestinalis	22.75	73	27	40	60	33
30	Porifera	Demospongiae	Hyattella	intestinalis (form b)	29.03	60	40	38	62	22
16	Porifera	Demospongiae	Hyattella	sp2	20.45	69	31	38	62	31
37	Porifera	Demospongiae	Hyrtios	sp6	3.92	67	33	38	62	29
37	Porifera	Demospongiae	Tethya	sp2	0.79	66	34	32	68	34
26	Porifera	Demospongiae	Tethya	sp3	0.88	59	41	28	72	31
31	Porifera	Demospongiae	Xenospongia	patelliformis	0.03	90	10	59	41	32
37	Porifera	Demospongiae	Cinachyrella	australiensis	6.29	61	39	20	80	41
37	Porifera	Demospongiae	Cinachyrella	sp1	166.67	64	36	25	75	39
37	Porifera	Demospongiae	Fascaplysinopsis	sp1	18.40	63	37	35	65	28
37	Porifera	Demospongiae	Fascaplysinopsis	sp3	19.06	74	26	39	61	35
10	Rhodophyta	Rhodophyceae	Griffithsia	sp.	0.54	73	27	52	48	21
1	Rhodophyta	Rhodophyceae	Haloplegma	duperreyi	174.04	76	24	44	56	32
16	Rhodophyta	Rhodophyceae	Hydrolithon	reinboldii	466.48	66	34	38	62	28
10	Rhodophyta	Rhodophyceae	Lithophyllum	sp1	1056.22	76	24	50	50	25
3	Rhodophyta	Rhodophyceae	Cryptonemia	sp	1.95	66	34	34	66	33
10	Rhodophyta	Rhodophyceae	Dasya	sp	18.30	76	24	49	51	27
8	Rhodophyta	Rhodophyceae	Dasya	sp1	3.05	83	17	55	45	28
11	Rhodophyta	Rhodophyceae	Heterosiphonia	muelleri	54.27	79	21	52	48	28
1	Rhodophyta	Rhodophyceae	Hypoglossum	sp1	25.62	72	28	43	57	29
10	Rhodophyta	Rhodophyceae	Gracilaria	sp1	73.90	71	29	48	52	23
21	Rhodophyta	Rhodophyceae	Gracilaria	sp2	48.86	72	28	48	52	24
17	Rhodophyta	Rhodophyceae	Hypnea	sp1	6.84	68	32	42	58	26
20	Rhodophyta	Rhodophyceae	Amansia	glomerata	95.29	69	31	41	59	27
10	Rhodophyta	Rhodophyceae	Chondrophycus	sp1	1.46	73	27	54	46	19
1	Rhodophyta	Rhodophyceae	Laurencia	sp1	150.48	72	28	44	56	28
19	Rhodophyta	Rhodophyceae	Laurencia	sp2	12.99	73	27	50	50	23
17	Rhodophyta	Rhodophyceae	Laurencia	sp3	0.68	71	29	43	57	29
17	Rhodophyta	Rhodophyceae	Laurencia	sp4	11.63	70	30	43	57	28
1	Rhodophyta	Rhodophyceae	Lenormandiopsis	lorentzii	144.14	75	25	45	55	30
21	Rhodophyta	Rhodophyceae	Osmundaria	fimbriata	127.34	71	29	48	52	23
25	Rhodophyta	Rhodophyceae	Polysiphonia	sp1	1.83	75	25	54	46	21
1	Rhodophyta	Rhodophyceae	Rhodophyceae	sp3	508.73	74	26	45	55	29
17	Rhodophyta	Rhodophyceae	Coelarthrum	sp1	46.29	71	29	42	58	29

Species Group	Phylum	Class	Genus	Species	ave. g/Ha		Old %GU	Old % Other		New %GU	New% Other		Change in % protection
30	Rhodophyta	Rhodophyceae	Peyssonnelia	inamoena	48.83		65	35		38	62		27
2	Rhodophyta	Rhodophyceae	Peyssonnelia	sp1	119.19		62	38		37	63		25
					Min		32	1		9	30		6
					Max		99	68		70	91		88
					Ave		71	29		42	58		29