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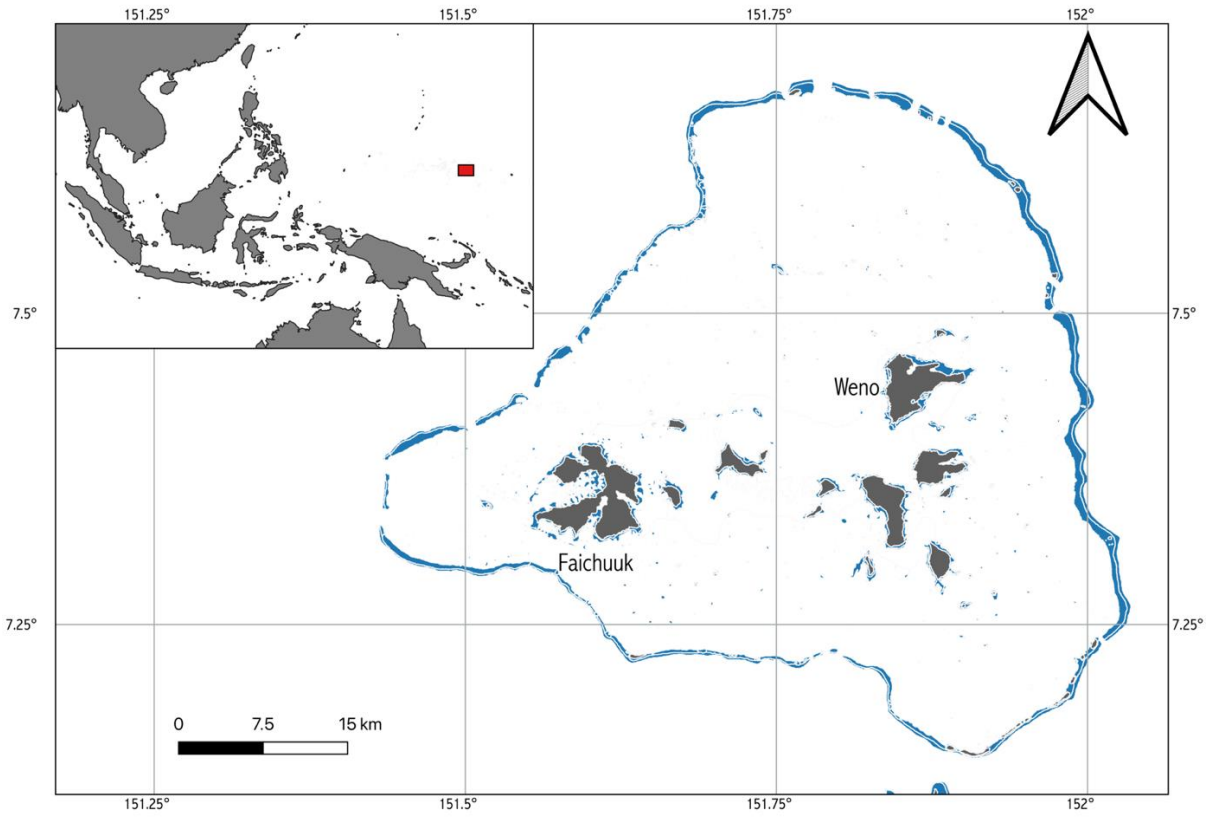
Supporting Information



Appendix S1. Chuuk Lagoon reef area (blue) and key islands (grey) inset with location in the Western Pacific (Houk et al., 2015; UNEP-WCMC, 2018).

Appendix S2. List of food fish families:

Acanthuridae, Scaridae, Serranidae, Carangidae, Labridae, Lethrinidae, Lutjanidae, Balistidae, Kyphosidae, Mullidae, Holocentridae and Carcharhinidae

Appendix S3. Fish and coral survey details

Food fish species abundance and size were recorded with 12 stationary point counts per site, equally spaced across 5x50m transects (Houk et al., 2015; Houk et al., 2016), at 3-5m (inner reefs) or 6-8m depth (channel, outer and patch reefs). It is important to note therefore that habitat type is confounded with depth at shallow inner reef surveys. At each station, species and size were documented for all food fish within a 5m radius over three minutes. Fish sizes

were binned in to 5cm groupings and converted to biomass with local-length weight coefficients where possible (Cuetos-Bueno & Hernandez-Ortiz, 2017), from other regional sources when not available for Chuuk (Houk et al., 2017), or from Fishbase (Froese & Pauly, 2019). Coral surveys consisted of 10x1m^2 quadrats per site placed across the 5x50m transects. Colonies were identified and diameter recorded for all corals in the quadrat, and percent cover calculated for each site (Houk et al., 2015).

Appendix S4. Calculation of landings data

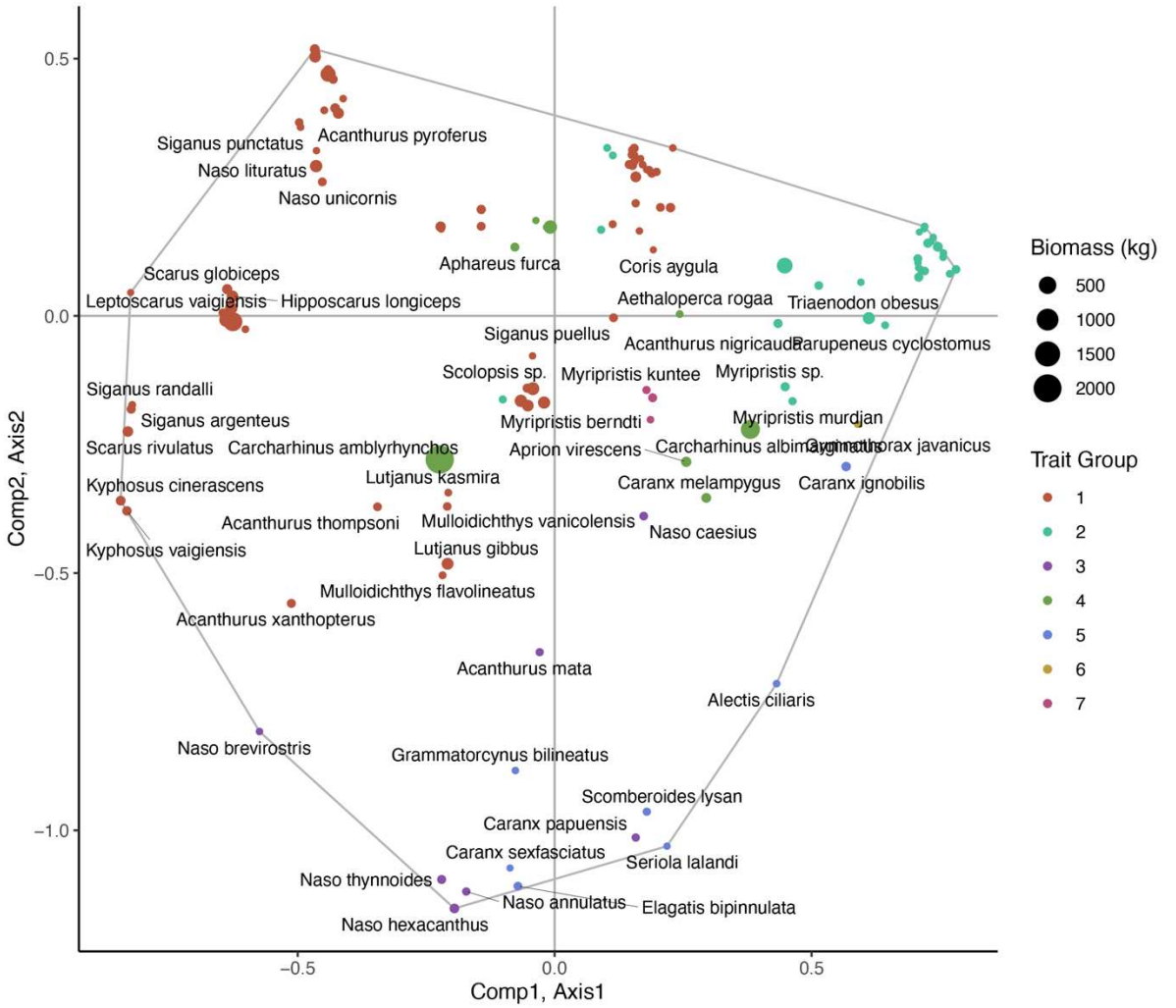
Total annual landings and the number of fishing trips were estimated by multiplying mean daily landings, means landings frequency, and operational weeks of fishing from the daily purchase records of 13 fish markets, and fisher interviews. Geographical distribution of landings was determined using catch location recorded during interviews (Cuetos-Bueno et al., 2018). We used these catch locations to attribute landings data to the nearest food-fish survey sites (metres).

Appendix S5. Fish trait groupings

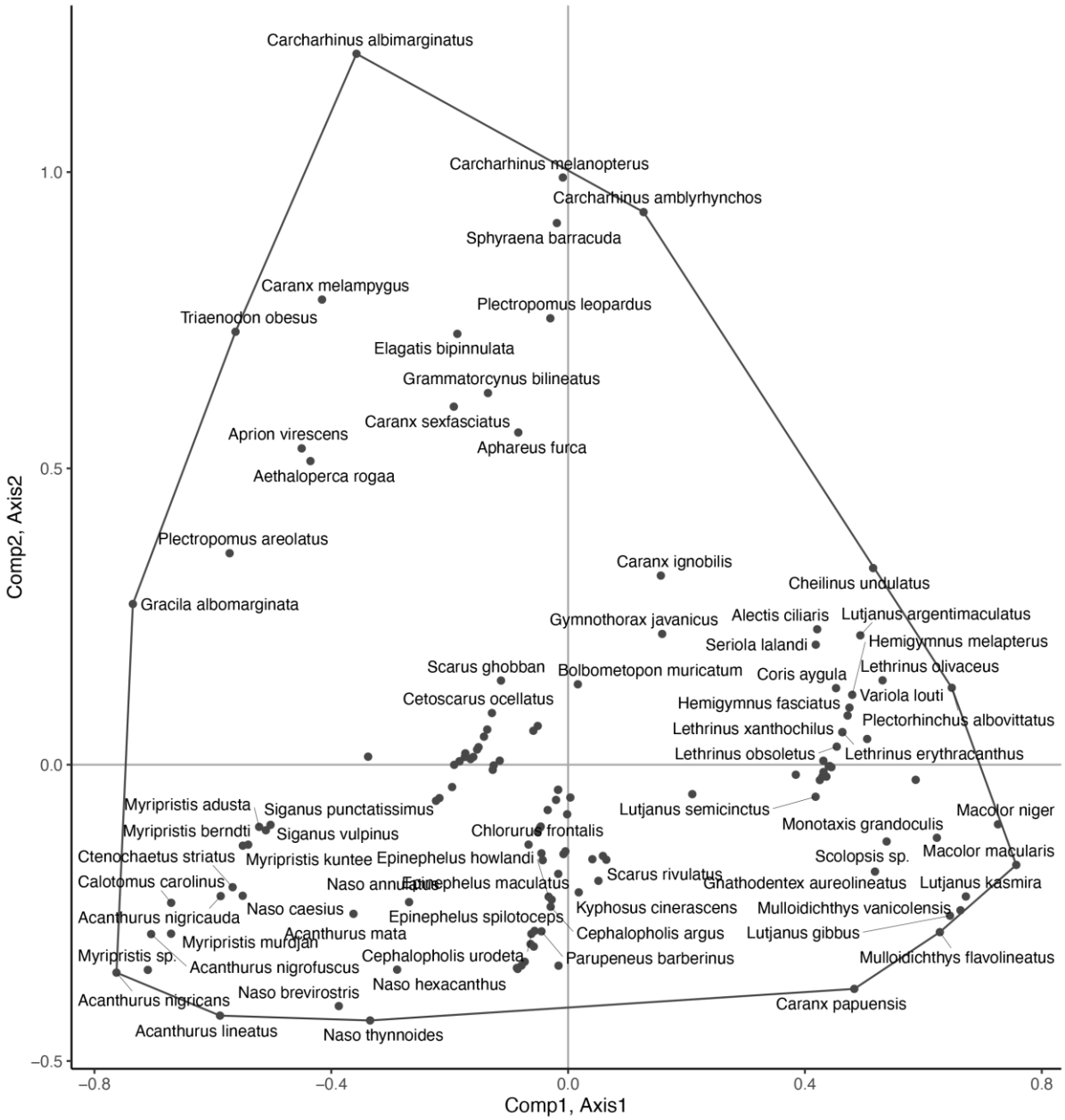
To identify clusters of similar species based on shared traits, we assembled a Gower dissimilarity matrix with a cailliez correction (for non-euclidean distances) from the traits (Laliberté & Legendre, 2010). We used a 2-norm quality criterion to establish the best clustering method (cl_dissimilarity in package *clue*) (Hornik, 2005; Maire et al., 2015), and carried out hierarchical average clustering of the dissimilarity matrix to create a dendrogram of the trait-based proximity of different species (hclust) (R Development Core Team, 2019). Multiple cut-off heights were run to produce between six and ten groups, with the final cut-off height for eight trait groups decided based on expert opinion and assessments of cluster stability (clusterboot in package *fpc*) (Hennig, 2018). The relative importance of each trait in clustering was calculated with a boosted regression tree (1000 iterations) (gbm in package *gbm*) (Darling et al., 2012; Greenwell et al., 2019).

Appendix S6. Trait groups and species present in each (n=131).

Trait Group	Species List
1	*Acanthurus blochii, Acanthurus olivaceus, Acanthurus pyroferus, Acanthurus thompsoni, Acanthurus xanthopterus, Balistapus undulatus, Balistoides viridescens, Bolbometopon muricatum, Cetoscarus ocellatus, Cheilinus fasciatus, Cheilinus trilobatus, Cheilinus undulatus, Chlorurus bleekeri, Chlorurus frontalis, Chlorurus japanensis, Chlorurus microrhinos, Chlorurus sordidus, Coris aygula, Epibulus insidiator, Gnathodentex aureolineatus, Hemigymnus fasciatus, Hemigymnus melapterus, Hipposcarus longiceps, Kyphosus cinerascens, Kyphosus vaigiensis, Leptoscarus vaigiensis, Lethrinus erythracanthus, Lethrinus erythropterus, Lethrinus harak, Lethrinus obsoletus, Lethrinus olivaceus, Lethrinus xanthochilus, Lutjanus argentimaculatus, Lutjanus bohar, Lutjanus fulvus, Lutjanus gibbus, Lutjanus kasmira, Lutjanus monostigma, Lutjanus semicinctus, Macolor macularis, Macolor niger, Monotaxis grandoculis, Mulloidichthys flavolineatus, Mulloidichthys vanicolensis, Naso lituratus, Naso unicornis, Plectorhinchus albovittatus, Plectropomus oligacanthus, Pseudobalistes flavimarginatus, Scarus altipinnis, Scarus dimidiatus, Scarus festivus, Scarus flavipectoralis, Scarus forsteni, Scarus frenatus, Scarus ghobban, Scarus globiceps, Scarus niger, Scarus oviceps, Scarus Psittacus, Scarus rivulatus, Scarus rubroviolaceus, Scarus schlegeli, Scarus sp., Scarus spinus, Scolopsis sp., Siganus argenteus, Siganus doliatus, Siganus puellus, Siganus punctatissimus, Siganus punctatus, Siganus randalli, Siganus spinus, Siganus vulpinus, Variola louti*
2	*Acanthurus lineatus, Acanthurus nigricans, Acanthurus nigricauda, Acanthurus nigrofuscus, Calotomus carolinus, Cephalopholis argus, Cephalopholis urodeta, Ctenochaetus striatus, Epinephelus fuscoguttatus, Epinephelus howlandi, Epinephelus maculatus, Epinephelus merra, Epinephelus polyphekadion, Epinephelus spilotoceps, Gracila albomarginata, Myripristis murdjan, Myripristis sp., Parupeneus barberinoides, Parupeneus barberinus, Parupeneus cyclostomus, Parupeneus multifasciatus, Parupeneus trifasciatus, Plectorhinchus lineatus, Plectorhinchus picus, Plectropomus areolatus, Plectropomus laevis, Sargocentron spiniferum, Sargocentron tiere, Triaenodon obesus*
3	*Acanthurus mata, Caranx papuensis, Naso annulatus, Naso brevirostris, Naso caesius, Naso hexacanthus, Naso thynnoides*
4	*Aethaloperca rogaa, Aphareus furca, Aprion virescens, Caranx melampygus, Carcharhinus albimarginatus, Carcharhinus amblyrhynchos, Carcharhinus melanopterus, Plectropomus leopardus, Sphyraena barracuda*
5	*Alectis ciliaris, Caranx ignobilis, Caranx sexfasciatus, Elagatis bipinnulata, Grammatorcynus bilineatus, Scomberoides lysan, Seriola lalandi*
6	*Gymnothorax javanicus*
7	*Myripristis adusta, Myripristis berndti, Myripristis kuntee*



Appendix S7. PCoA of food fish community trait space, with species labels (some excluded for readability). Explains approx. 17.27 % of the variation.



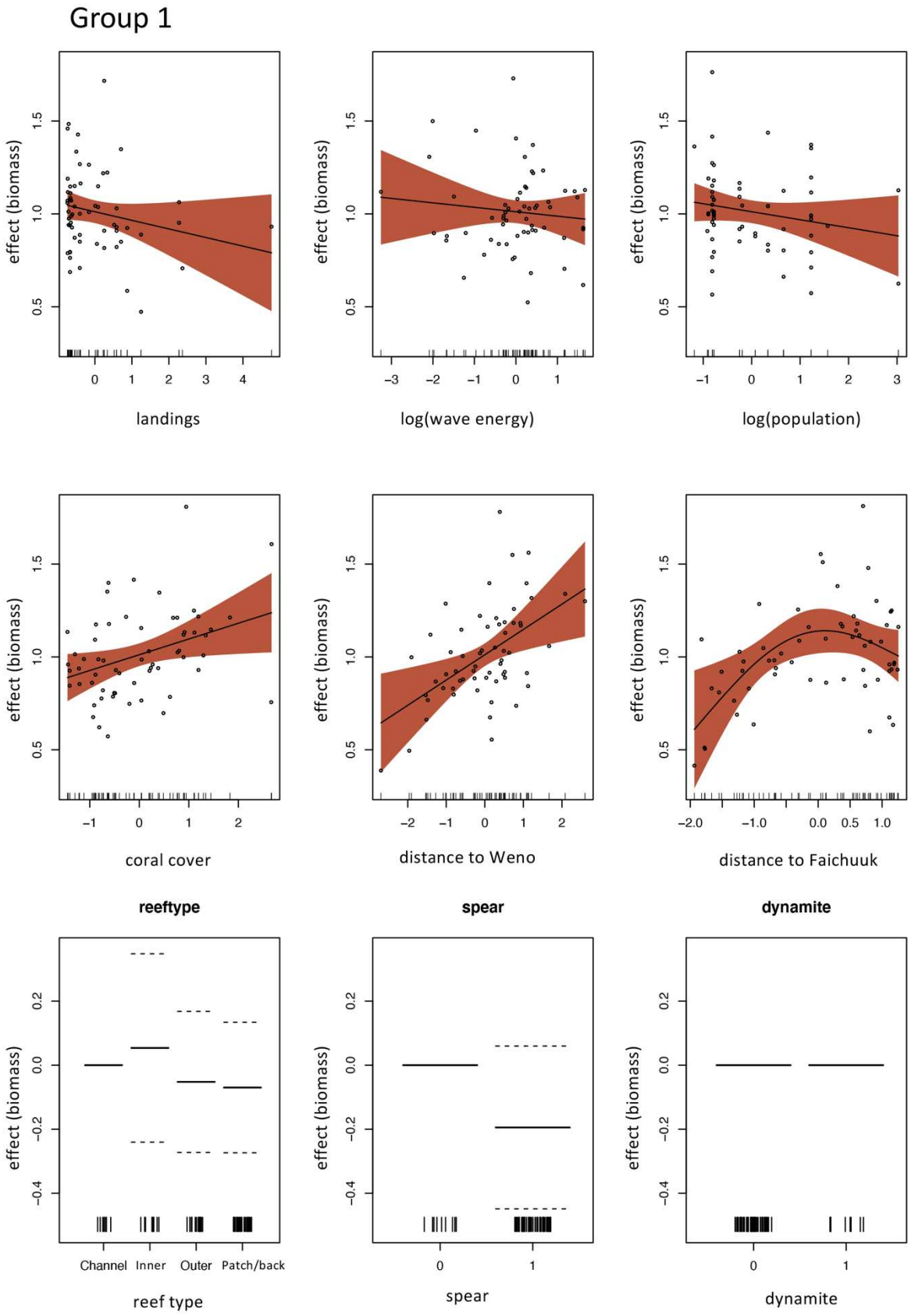
Appendix S8. 3rd and 4th axes of food fish community trait space (explains approx. 11.16% of variation).

Appendix S9. Mantel test results and PCoA variance for each possible combination of four out of five selected traits (Legendre et al., 2005).

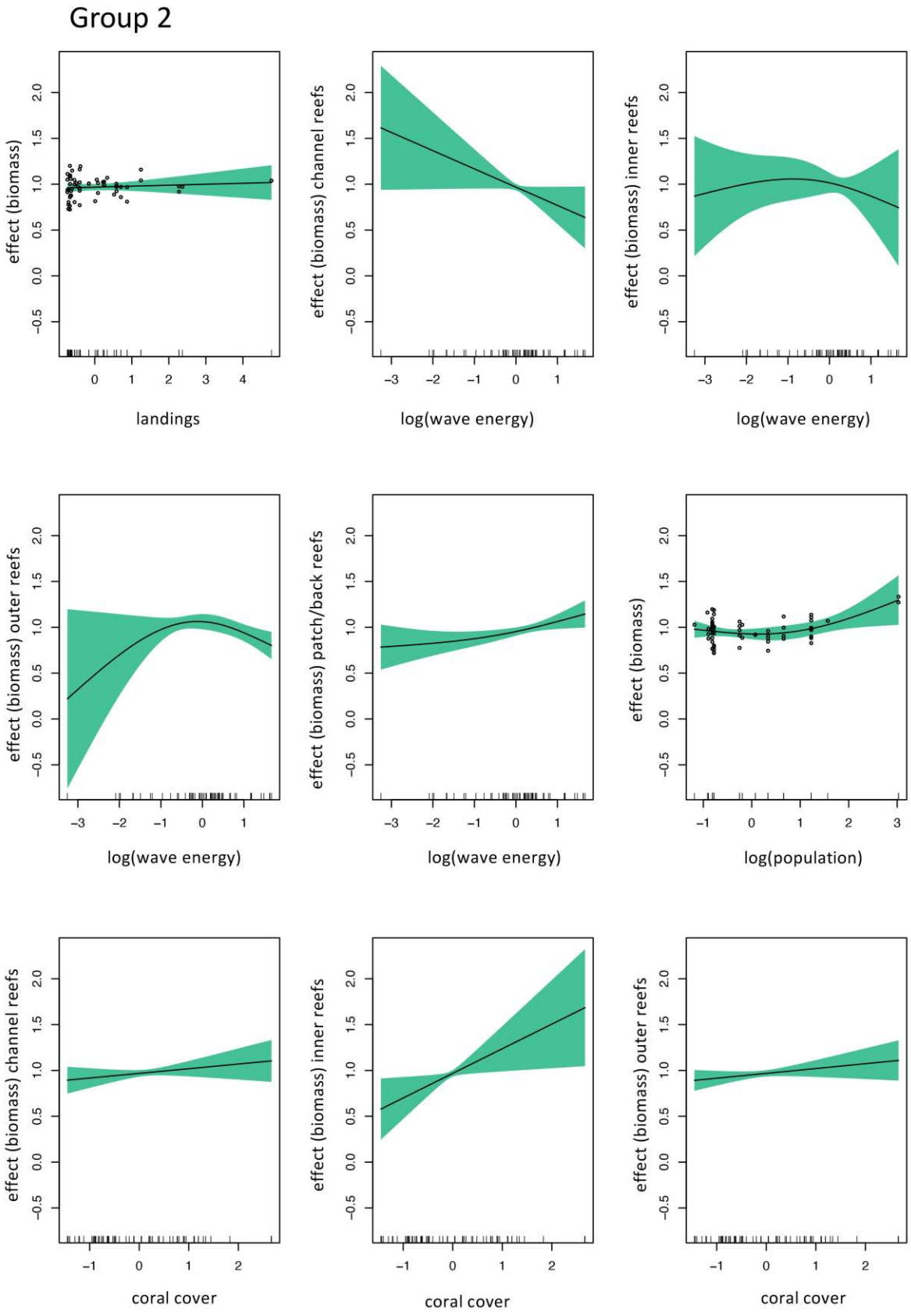
Traits	Mantel Statistic	Mantel significance	PCoA variance (4 axes)
All traits	-	-	29%
2 (- position)	0.843	0.001	25%
3 (- aggregation)	0.846	0.001	32%
4 (- trophic)	0.777	0.001	26%
5 (- PLD)	0.985	0.001	29%
6 (- max length)	0.687	0.001	50%

Appendix S10. Minimum adequate generalised additive model (GAM) structure for each trait group at each site (n=61). Each GAM was initially constructed with three knots (*k*) for each smooth term and further determined with REML smoothing parameter estimation method. Interaction terms between coral cover and reef type, and wave energy and reef type, were included if they improved fit (determined by Akaike Information Criterion and diagnostic plots) Wave energy and population were log-transformed.

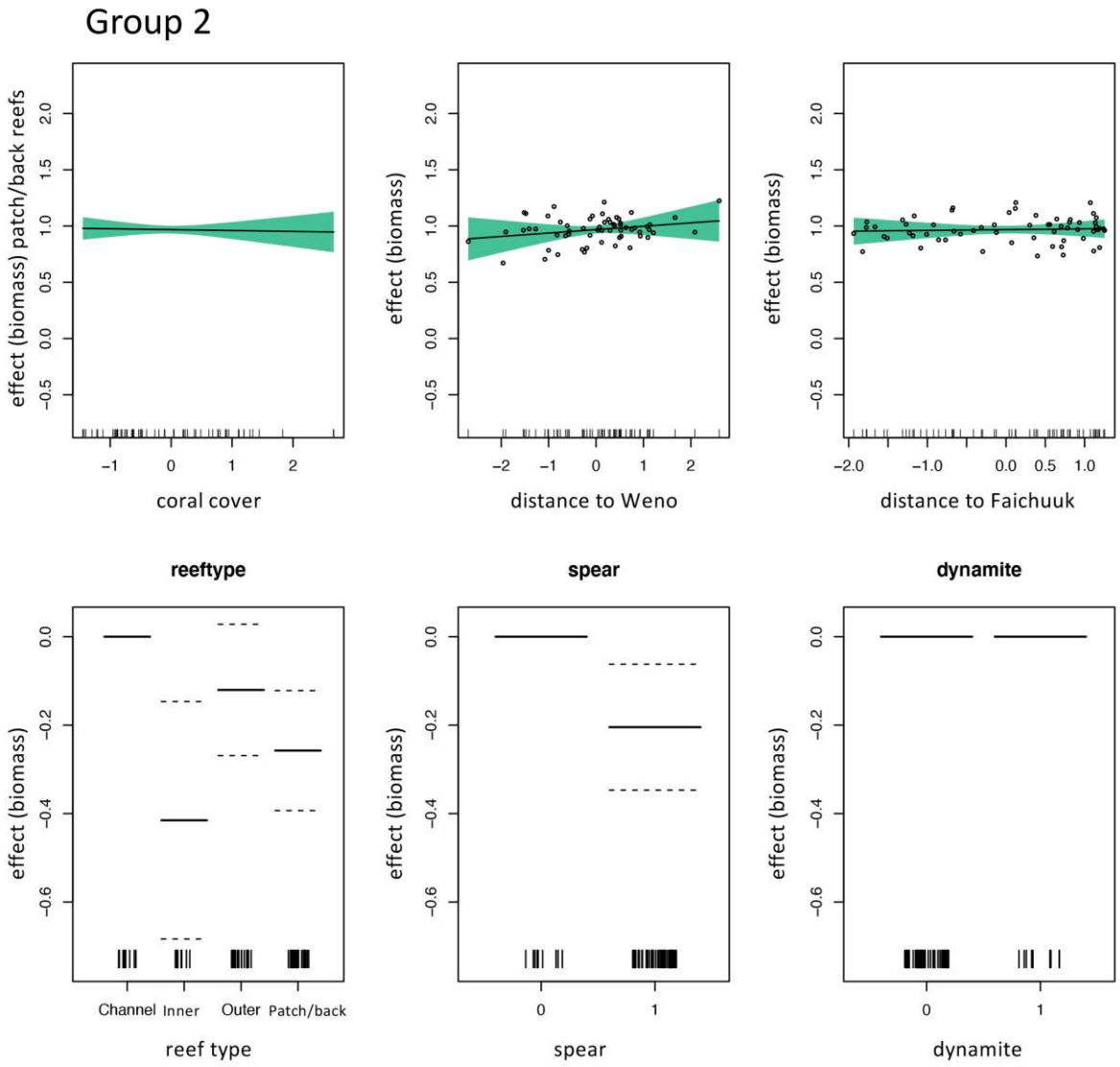
Group	Model Formula
1	sqrt(mean biomass) ~ s(landings, k = 3) + s(logWave, k = 3) + s(logPop, k = 3) + s(cover, k = 3) + s(market, k = 3) + s(market, k = 3) + s(market2, k = 3) + reeftype + spear + dynamite
2	sqrt(mean biomass) ~ s(landings, k = 3) + s(logWave, by = reeftype, k = 3) + s(logPop, k = 3) + s(cover, by = reeftype, k = 3) + s(market, k = 3) + s(market, k = 3) + s(market2, k = 3) + reeftype + spear + dynamite
3	sqrt(mean biomass) ~ s(landings, k = 3) + s(logWave, by = reeftype, k = 3) + s(logPop, k = 3) + s(cover, k = 3) + s(market, k = 3) + s(market, k = 3) + s(market2, k = 3) + reeftype + spear + dynamite
4	sqrt(mean biomass) ~ s(landings, k = 3) + s(logWave, k = 3) + s(logPop, k = 3) + s(cover, k = 3) + s(market, k = 3) + s(market, k = 3) + s(market2, k = 3) + reeftype + spear + dynamite
5	sqrt(mean biomass) ~ s(landings, k = 3) + s(logWave, by = reeftype, k = 3) + s(logPop, k = 3) + s(cover, k = 3) + s(market, k = 3) + s(market, k = 3) + s(market2, k = 3) + reeftype + spear + dynamite



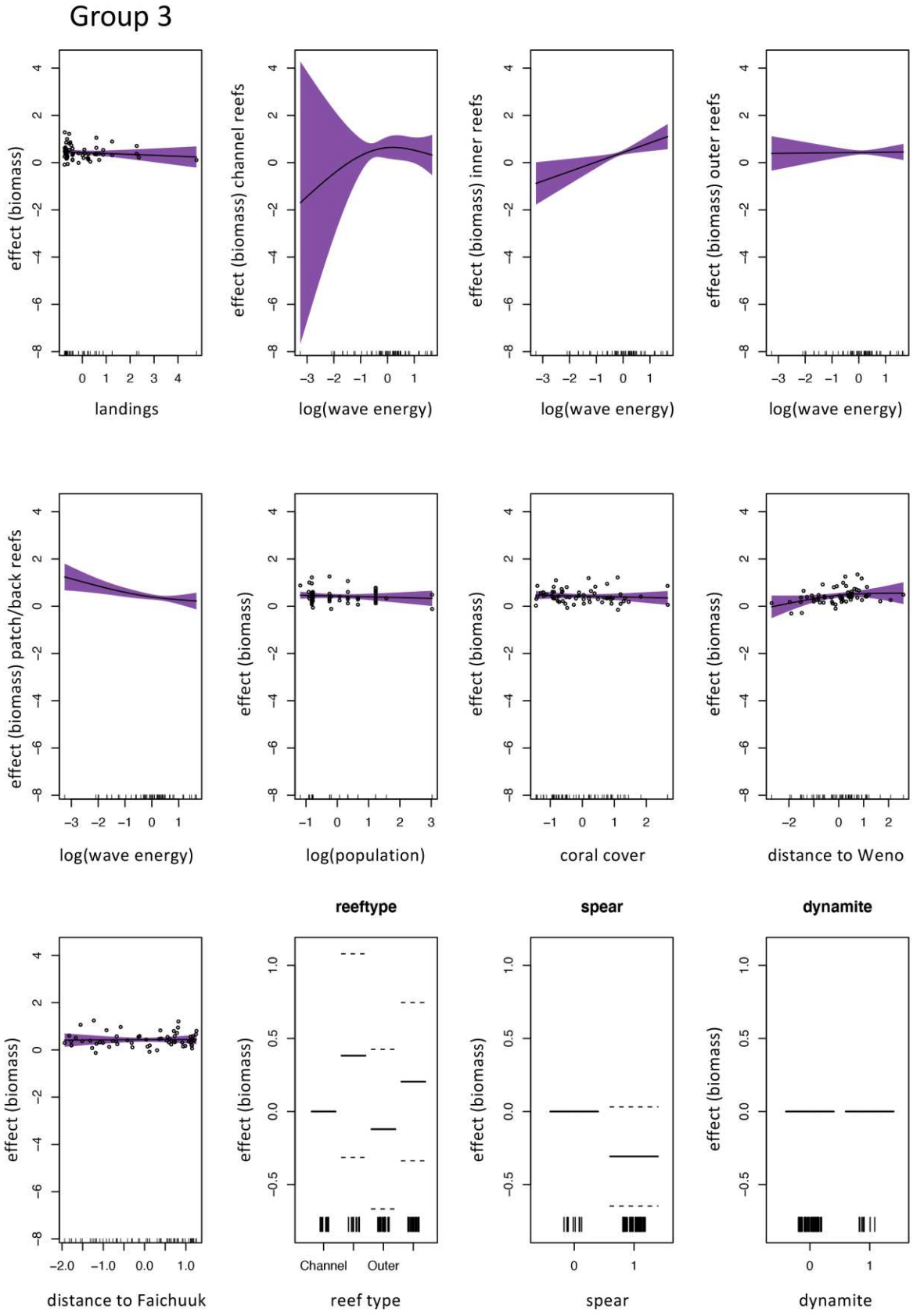
Appendix S11. Partial effects plots for all terms of GAM for trait group one: Smaller, reef-associated and mainly solitary species.



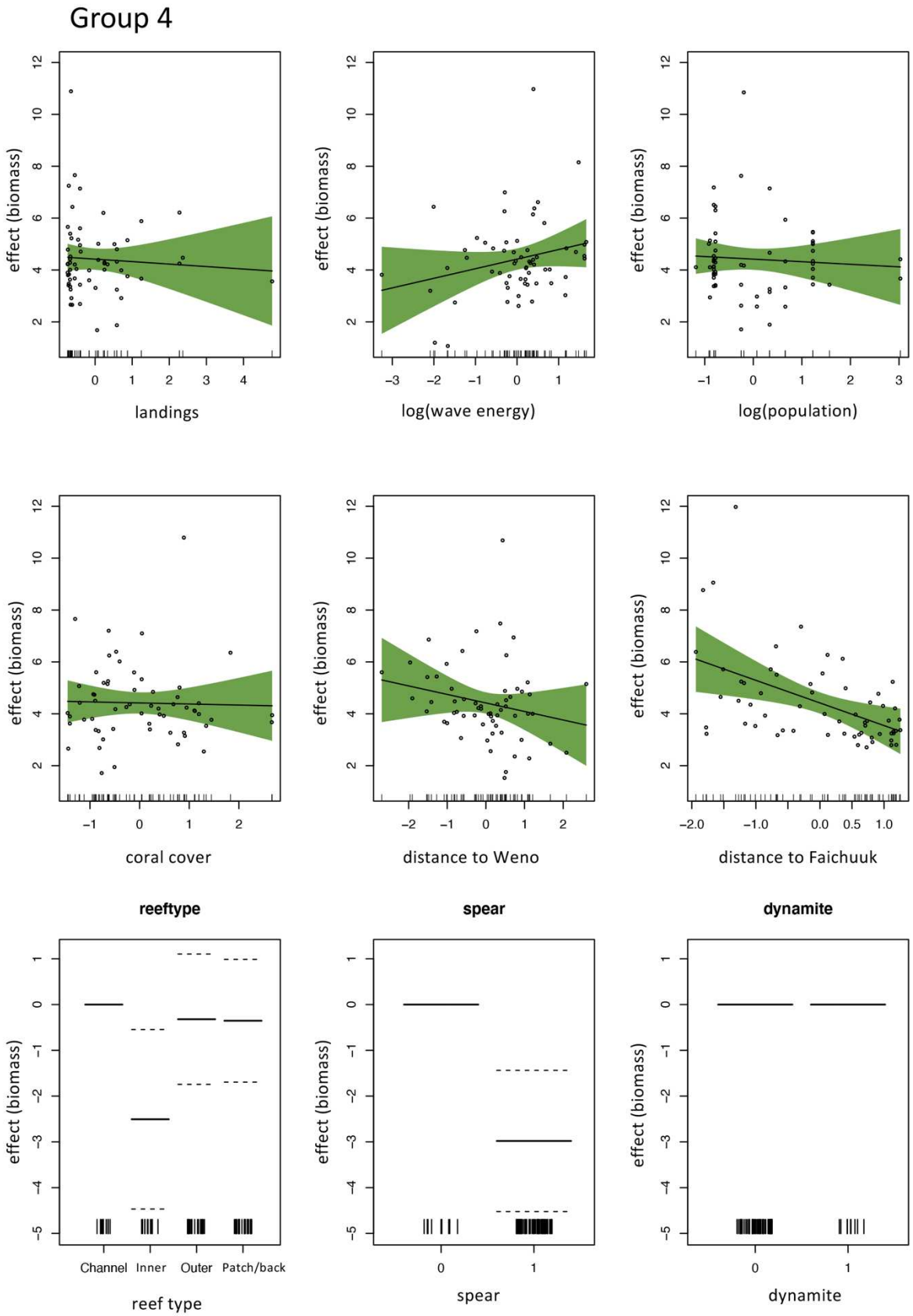
Appendix S12. Partial effects plots (1 of 2) for all terms of GAM for trait group two: smaller, solitary benthic predators.



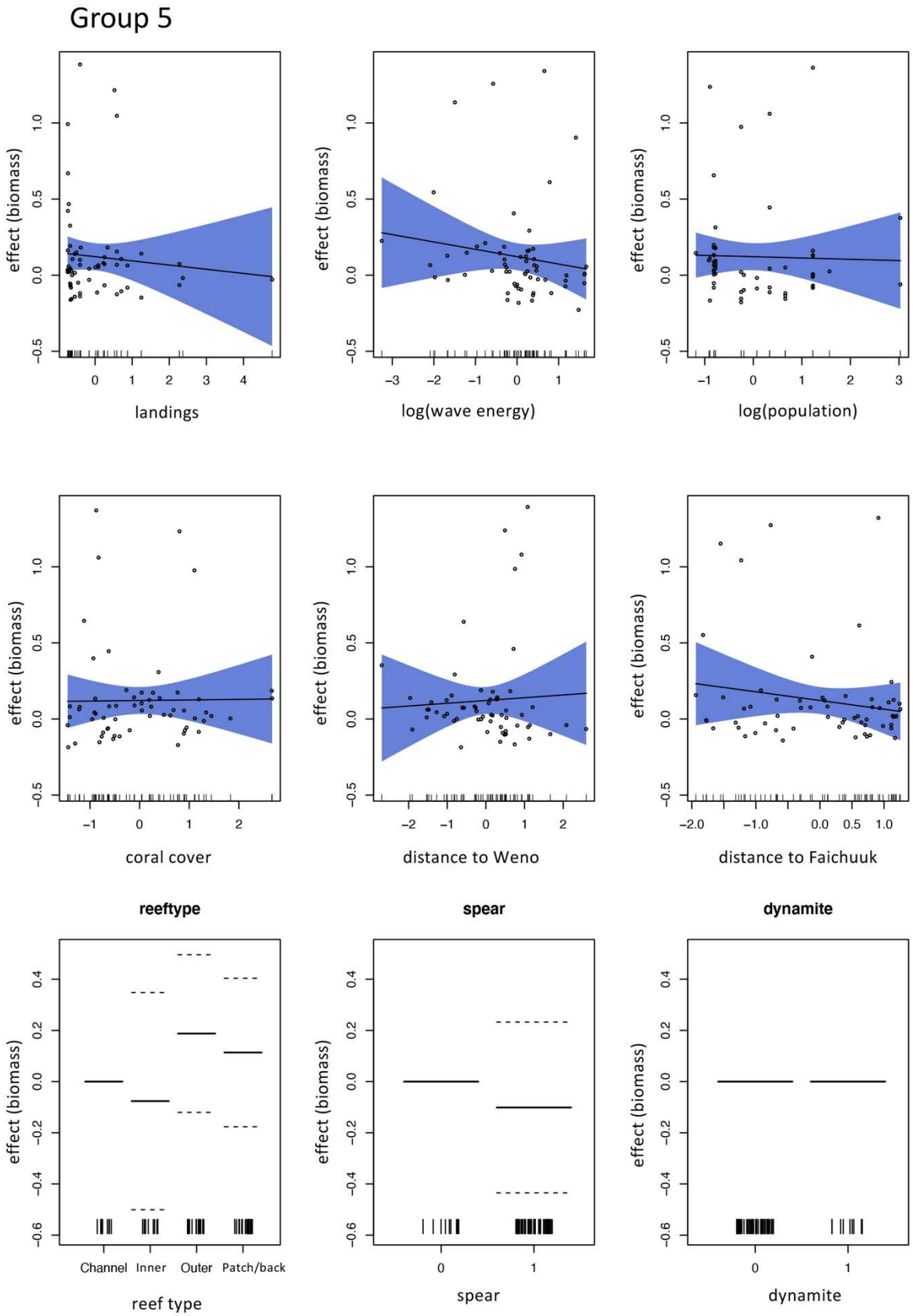
Appendix S13. Partial effects plots (2 of 2) for all terms of GAM for trait group two: smaller, solitary benthic predators.



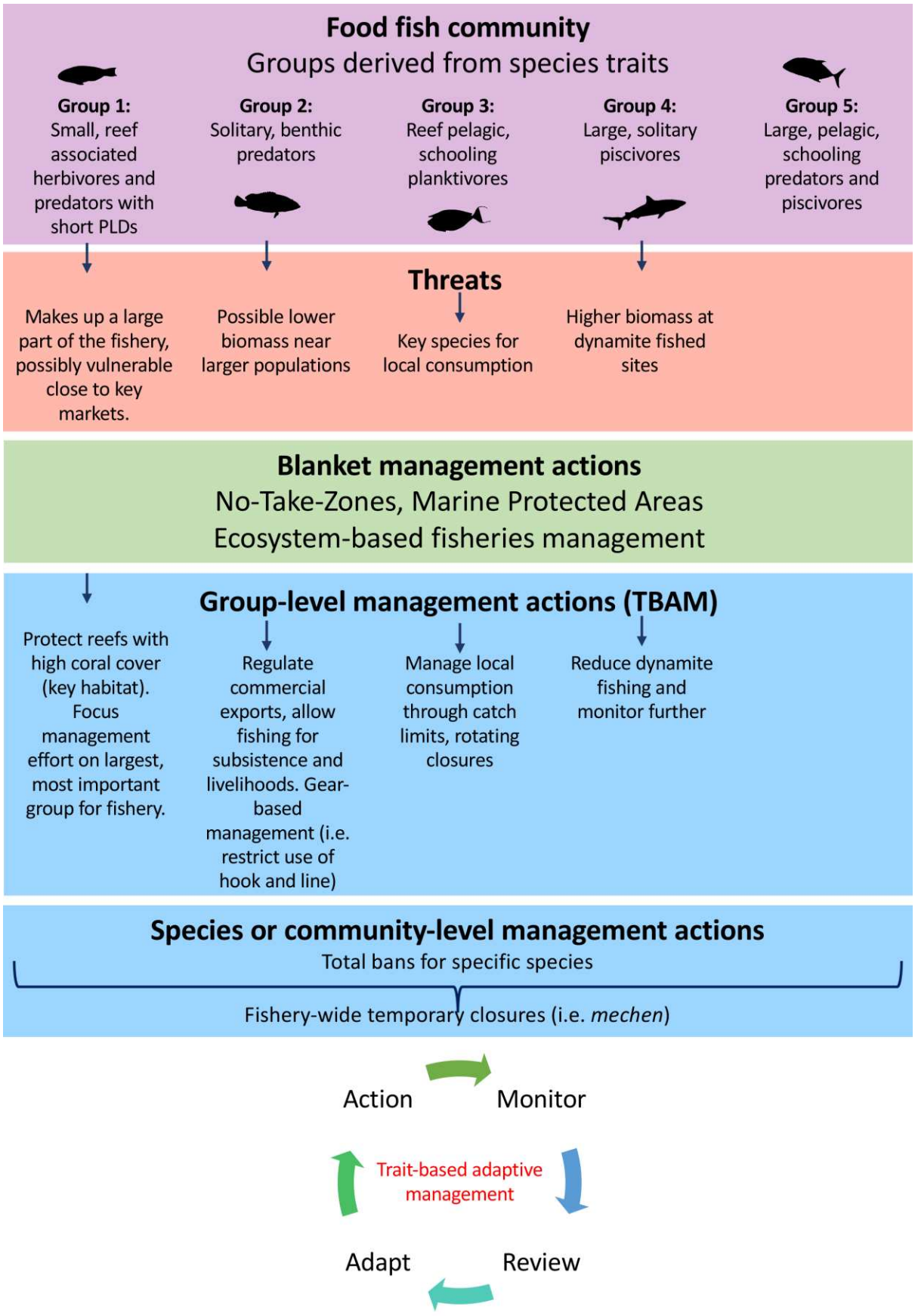
Appendix S14. Partial effects plots for all terms of GAM for trait group three: reef pelagic, schooling/grouping planktivores.



Appendix S15. Partial effects plots for all terms of GAM for trait group four: large, solitary upper benthic predators.



Appendix S16. Partial effects plots for all terms of GAM for trait group five. Group five: large, pelagic schooling/grouping predators and piscivores.


Food fish community
Groups derived from species traits
Group 1: Small, reef associated herbivores and predators with short PLDs
Group 2: Solitary, benthic predators
Group 3: Reef pelagic, schooling planktivores
Group 4: Large, solitary piscivores
Group 5: Large, pelagic, schooling predators and piscivores
Threats
Makes up a large part of the fishery, possibly vulnerable close to key markets.
Possible lower biomass near larger populations
Key species for local consumption
Higher biomass at dynamite fished sites
Blanket management actions
No-Take-Zones, Marine Protected Areas
Ecosystem-based fisheries management
Group-level management actions (TBAM)
Protect reefs with high coral cover (key habitat). Focus management effort on largest, most important group for fishery.
Regulate commercial exports, allow fishing for subsistence and livelihoods. Gear-based management (i.e. restrict use of hook and line)
Manage local consumption through catch limits, rotating closures
Reduce dynamite fishing and monitor further
Species or community-level management actions
Total bans for specific species
Fishery-wide temporary closures (i.e. mechen)
Action
Monitor
Trait-based adaptive management
Adapt
Review

Appendix S17. Schematic of trait based adaptive management for coral reef fisheries populated by the Chuuk food fish trait groups. Actions are broad suggestions based on the outcome of this study to demonstrate how TBAM could work in practice, rather than prescriptive recommendations.

Supplementary References

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