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A Synthesis of Diets and Trophic Overlap of Marine Species in the California Current

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A Synthesis of Diets and Trophic Overlap of Marine Species in the California Current

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Table of Contents

List of Figures

List of Tables

Executive Summary

A key step toward ecosystem-based management is to better understand how interactions within food webs affect species of commercial and conservation importance. Here we provide comprehensive diet information and food web analysis for major taxa within the California Current ecosystem, including fish, marine mammals, birds, and invertebrates.

We synthesized 75 published diet studies from this ecosystem and calculated representative diets for each species or aggregated functional group. We assessed diet relatedness using hierarchical cluster analysis and calculated diet overlaps based on percent similarity index (PSI). Both analyses were performed on functional group data and also separately for each vertebrate species.

Cluster analysis identified distinct feeding guilds and revealed both intuitive and novel diet similarities between several species and functional groups. One intuitive example is that functional groups preying on euphausiids, a key forage species in the California Current, show a high amount of overlap. A novel example is the significant diet overlap of shallow small rockfish and baleen whales (e.g., grey whales [*Eschrichtius robustus*]), both of which consume large amounts of benthic invertebrates.

Functional groups were highly significant in explaining the PSI differences between species, which suggests that key ecological interactions will be preserved in ecosystem models that use these functional groups. A visual representation of the complete food web and calculation of food web statistics suggest that there are strong similarities between the food webs of the California Current and the Benguela Current, a similar upwelling-driven eastern boundary current off the southwest coast of Africa.

Acknowledgments

This work was supported by grants to support ecosystem models and management from the Gordon and Betty Moore Foundation and the David and Lucille Packard Foundation. Nick Tolimieri assisted with the MANOVA plots, Cameron Ainsworth pointed us toward the hierarchical clustering algorithms in R, Jameal Samhouri suggested the use of FoodWeb3D, and Eliza Heery provided assistance with R. Data and feedback were supplied by more individuals than can be listed here, but key contributors included John Field, Richard Brodeur, Todd Miller, and Patrick Ressler. Brad Hanson and Mike Ford improved our diet sources for marine mammals. We are deeply indebted to more than 75 authors listed in Appendix A, who performed the diet studies summarized here.

Introduction

Beginning in 1999, a series of high-level commissions on marine policy have called for implementation of ecosystem-based management (EBM) of our oceans (NOAA 1999, Pew Oceans Commission 2003, U.S. Commission on Ocean Policy 2004). EBM attempts to consider the entire ecosystem, to maintain multiple ecosystem services as well as system resilience, and to focus on cumulative impacts of multiple sectors rather than focusing on a single species or sector (McLeod et al. 2005). As McLeod et al. (2005) stated,

Specifically, ecosystem-based management:

- emphasizes the protection of ecosystem structure, functioning and key processes;
- is place-based in focusing on a specific ecosystem and the range of activities affecting it;
- explicitly accounts for the interconnectedness within systems, recognizing the importance of interactions between many target species or key services and other nontarget species;
- acknowledges interconnectedness among systems, such as between air, land, and sea; and
- integrates ecological, social, economic, and institutional perspectives, recognizing their strong interdependences.

A key step toward addressing this third goal of EBM is to better understand how trophic interactions within food webs affect species of commercial and conservation importance (Pauly et al. 2002). In this paper, we provide comprehensive diet information and food web analysis for major taxa within the California Current ecosystem, including fish, marine mammals, birds, and invertebrates. We quantify trophic interactions for marine species by summarizing peer-reviewed literature and technical reports related to diet studies. Our work builds on Field (2004), who constructed an Ecopath with Ecosim food web model for the California Current. Field's food habits data and references served as the initial sources for our analysis, which we then supplemented with additional recent and historical publications. Other key literature reviews and field studies that we have incorporated include Buckley et al. (1999), Brodeur and Pearcy (1984),Wakefield (1984), Sydeman et al. (1997), Pauly et al. (1998), Hunt et al. (2000), and Miller and Brodeur (2007), among others. We also included food habits information from trawl surveys such as Dark and Wilkins (1994) and Weinberg et al. (2002). The complete list of diet sources is described in the Methods section and Appendix A.

Diet information such as the summaries presented here can be used to parameterize multispecies ecosystem models for use in quantitative projections, or to provide simple qualitative advice regarding trophic effects within the marine food web. In the context of ecosystem models, diets form the matrix of interspecies interactions. In these models, diets are

either fixed proportions, or more frequently vary in response to predator and prey abundance following a functional response (e.g., Atlantis, Ecosim, Walters et al. 2000, Christensen and Walters 2004, Fulton 2004, Fulton et al. 2007). For instance, the diets estimated in this study have been incorporated into two Atlantis ecosystem models of the U.S. West Coast and California Current (Kaplan and Levin 2009, Horne et al. in prep.). In the context of U.S. fishery management plans, decision makers may soon need to identify the predators and prey of species of commercial or conservation concern. Such requirements for strategic advice can be addressed graphically (as we have done in this report) or diets can be converted to food webs to qualitatively identify interactions within these food webs (Dambacher et al. 2002). The diet information provided in our synthesis can serve both these quantitative and qualitative roles.

Ecosystem models and EBM policies often aggregate species into functional groups or feeding guilds on the basis of diet, habitat, life history parameters, or fishery targeting. This is a necessary simplification for reasons related to field identification of species or specificity of catch or landings data, for computational reasons, and for ease of interpretation. However, ecological interactions such as intragroup competition and predation are lost in the formation of functional groups. Furthermore, functional groups are often formed based on expert opinion, as a compromise between the characteristics listed above. The ecosystem modeling literature suggests some guidelines for functional group formation, such as not aggregating species with drastically different turnover times or other rates, and not aggregating predators and prey (O'Neill and Rust 1979, Cale and Odell 1980, Gardner et al. 1982, Fulton et al. 2003). However, rarely have ecosystem modelers compared functional groups formed using these rules of thumb to those formed from statistical analyses of diet data, such as hierarchical clustering algorithms.

The goals of this study are to summarize diet information for key marine species of the U.S. West Coast at both the functional group and species levels, to identify key forage species in the California Current and diet overlaps between predators, to compare the functional groups from an Atlantis ecosystem model of the California Current (Brand et al. 2007, Kaplan and Levin 2009, Horne et al. in prep.) to functional groups based on diet similarity, and to compare this food web to other published marine food webs.

Methods

Data

We summarized the diets of marine species of the California Current ecosystem, which spans the entire U.S. West Coast. We compiled 75 sources, with 52 fish species comprising 22 functional groups (Appendix A). We also compiled diets from marine mammal, seabird, and invertebrate functional groups (Appendix A). Fish diets were from peer-reviewed journals and technical reports from 1957 to 2008, but primarily from the 1970s to present. The data span the oceanographic and ecological regime shift in the northern California Current in the late 1970s (Hare and Mantua 2000). Diet data for marine mammals relied heavily on a marine mammal diet review (Pauly 1998) and a review for seabird diets (Hunt 2000). We used diet data for invertebrates primarily from Field (2004) and a limited number of other sources. When diet data for a particular species were not available within the California Current, we included diets from other areas (e.g., Bering Sea) and noted these sources.

Our analysis focused on functional groups defined for the Atlantis ecosystem model of the California Current (Brand et al. 2007, Kaplan and Levin 2009). Most of these functional groups typically include several species. However, several functional groups are comprised of a single commercially important fish species, as these species are of particular interest to those working within the California Current.

For fish functional groups that were composed of multiple predator species, we weighted the diets by the relative biomass of the species within the functional group, based on NOAA Northwest Fisheries Science Center trawl survey data from 1998 to 2003 (Turk et al. 2001, Builder Ramsey et al. 2002, Keller et al. 2005, 2006a, 2006b, 2007). Prior to aggregating predator species into functional groups, we summarized all diet information for each predator species, differentiating between adult and juvenile predators and including percent by mass or volume diet data. When more than one data source was available for a species, we weighted each source by its sample size. Within studies, categories labeled as "unidentified" (e.g., unidentified flatfish or crustacea) were split among corresponding groups in the diet according to their existing relative weights. Specifically for "unidentified rockfish" as a prey item, we determined prey functional groups by considering the spatial overlap of predators and potential prey, as determined from trawl survey data (Turk et al. 2001, Builder Ramsey et al. 2002, Keller et al. 2005, 2006a, 2006b, 2007).

Diet data and population biomass estimates were available for most marine mammal, seabird, and invertebrate functional groups. In the absence of biomass estimates (most commonly for invertebrate groups), we inferred the final diet proportion based on related available literature (Appendix A). We adapted the majority of invertebrate diets from Field (2004).

Where possible, we differentiated between diets of adult predators and juvenile predators. For several functional groups, only one or a few species had published juvenile data, which we then used to calculate the juvenile diet data using the same method described above. In the absence of juvenile data, we assumed diets of juveniles were the same as that for adults (unless otherwise noted).

Table 1 summarizes the vertebrate species in each functional group and their relative proportion based on biomass. The species that comprise each functional group are ordered from largest to smallest proportion within the group, as stated in the first sentence for each group in Appendix A. Invertebrate functional groups are summarized in Table 2 and Appendix A.

Data Analysis

Functional Groups

To compare diet similarities between functional groups, we created a dendrogram using an agglomerative hierarchical cluster analysis. We first formed a complete diet matrix containing predator functional groups as rows and prey functional groups as columns. A Euclidian distance matrix was created in the statistical program R (MASS package, R version 2.9.1, University of Auckland, New Zealand) from the diet data. The data were clustered using the complete (MAX) method of linkage to create a dendrogram. We used the dendrogram in conjunction with the raw diet data to establish feeding guilds and to more effectively display functional group diet data.

We calculated percent similarity index (PSI) to assess diet overlap between functional groups. Complete diets of fish feeding guilds were arranged in a matrix similar to that described above for the cluster analysis. We used the PSI methods as described by Miller and Brodeur (2007), adapted from Schoener (1974), and implemented in the statistical software R. Diet overlaps were deemed significant if their index value was greater than 60 (Wallace and Ramsay 1983).

$$PSI_{i,j} = \left[1 - .5\sum_{k=1}^{n}\left|p_{ik} - p_{jk}\right|\right] \times 100$$

where p is the proportion of diet of predator i or j that is comprised of prey species k (Miller and Brodeur 2007).

Species Data

Our fish functional groups were defined prior to this work (Brand et al. 2007), based on a compromise between qualitative diet information, fishery targeting, habitat use, and management concerns. Here we used species-level quantitative fish diet information to assess how these original functional groups compare to feeding guilds suggested by hierarchical clustering and the PSI. Our methods for species data analysis were hierarchical cluster analysis and PSI, similar to the approach for functional groups. We calculated average PSI values and proportion of significant diet overlaps for species pairs within versus between functional groups. We analyzed

the significance of these values by performing a multivariate analysis of variance (MANOVA) in Primer (Primer, Version 6.1.11 with Permanova+, Version 1.0.1, Plymouth Marine Laboratory, Plymouth, United Kingdom).

Food Web

We constructed a visual representation of the complete California Current food web using the software Foodweb3d (Ver. 1.01, 2002, Pacific Ecoinformatics and Computational Ecology Laboratory, Berkeley, California). We used the diet data at the functional group level. Constructing a three-dimensional food web at the species level would require further resolution of all predators and prey to species-level taxonomic resolution.

For the food web analysis, any juvenile prey items were aggregated with their adult counterpart. This ensured that there were no species duplicated within the food web. Additionally, many published food webs lack any distinction between life stages of the included species (Opitz 1996, Yodzis 1998, Link 2002).

Summary statistics that we used to describe food web characteristics (Pimm 1980) include:

%B (basal species)—the percent of species (functional groups) that have no prey linkages in the food web (These groups can be autotrophs or groups that lack diet data.),

%T (top species)—the percent of species with no known predator, and

%I (intermediate species)—the percent of species that are neither basal nor top species.

We also describe the food web with metrics from Dunne et al. (2004), including:

L/S—links per species,

$C = L/S^2$—connectance,

%O (omnivorous)—the percent of species that are omnivorous (have trophic linkages to multiple trophic levels), and

%C (cannibalistic)—the percent of species that are cannibalistic.

We compared this study's food web to others compiled by Dunne et al. (2004).

Results

Diet Summary

Diet sources for each species or functional group are included in Appendix A. Complete diet summaries of functional groups are listed in Appendix B and complete diets of fish species are listed in Appendix C.

Cluster Analysis: Functional Group Level

Results from the hierarchical cluster analysis are shown in Figure 1. Based on this dendrogram, we subjectively formed 10 feeding guilds (boxes in Figure 1) that we used to structure the discussion below.

Feeding guilds generally contain species with similar diets (Figure 2 through Figure 9). Benthic detritivores and meiobenthos make up feeding guild A, primarily preying on detritus (Figure 2). Guild B contains groups feeding on large zooplankton (e.g., euphausiids, Figure 2). Guild C contains piscivorous groups targeting small planktivorous fishes (Figure 3). Guild D includes invertebrate consumer groups that prey on phytoplankton and small zooplankton groups (Figure 3). Transient killer whales (*Orcinus orca*) do not share diets with any groups and are excluded from all guilds (Figure 3). Guild E functional groups feed on benthic invertebrate taxa in high proportions, particularly deposit feeders such as polychaetes, amphipods, and other small crustaceans (Figure 4). Guild F preys primarily on various benthic invertebrate taxa such as herbivorous grazers (urchins) and megazoobenthos (crabs) (Figure 5). Guild G feeds on a variety of zooplankton groups including large zooplankton (euphausiids), mesozooplankton (copepods), and gelatinous zooplankton (jellyfish) (Figure 6). Other components of this guild's diets vary considerably by species, from phytoplankton to fish. Guild H contains largely high trophic level carnivorous functional groups (Figure 7). This group can be subdivided into groups specializing in benthic versus pelagic prey, although overlaps exist. Large demersal predators (lingcod [*Ophiodon elongatus*]), pelagic sharks, diving seabirds, and large flatfish all consume large amounts of pelagic prey such as small planktivores and miscellaneous nearshore fishes. The remaining groups including skates and rays, deep small rockfish, and deep miscellaneous fishes target benthic prey such as deposit feeders (amphipods and small crustacea), deep miscellaneous fishes, and shrimp (Figure 7). Guild I is composed of high trophic level functional groups that prey heavily on cephalopods (squid) (Figure 8). Guild J contains two invertebrate functional groups which rely heavily upon detritus in their diet (Figure 9).

PSI: Functional Group Level

PSIs for functional groups revealed few diet overlaps higher than 60% (Table 3). Of these significant diet overlaps, a large proportion occurred in guild B, which feed primarily on zooplankton (Table 3, Figure 2). These groups include Pacific hake (*Merluccius productus*),

canary rockfish (*Sebastes pinniger*), shallow large rockfish, small planktivores, cephalopods, and large planktivores. Functional groups preying on small planktivorous fish also had significant diet overlaps, including Chinook salmon (*Oncorhynchus tshawytscha*), albacore tuna (*Thunnus alalunga*), migrating seabirds, and surface seabirds. Further significant diet overlaps occurred for English sole (*Parophrys vetulus*), small flatfish, small cetaceans, and toothed whales, but are not surprising given the similar dietary habits of each group. We calculated a high percent similarity for baleen whales and shallow small rockfish such as rosethorn (*Sebastes helvomaculatus*) and greenstriped (*S. Elongatus*) rockfish. These species are in feeding guild E and prey heavily on benthic deposit feeders (e.g., primarily small crustacea and polychaetes) and large zooplankton (euphausiids).

Food Web Structure Analysis

Food web metrics indicate that the California Current is highly connected, has a high proportion of cannibalistic and basal species, and has a low proportion of omnivorous species (i.e., those that prey on multiple trophic levels) when compared to other food webs (Table 4, Figure 10). The number of functional groups included in our food web is also comparable to those reported in Dunne et al. (2004), despite the aggregation of our species into functional groups. The Benguela Current food web is comparable to the California Current food web in that it is an eastern boundary current with strong upwelling and high abundances of clupeids and hake (*Merluccius* spp.). Yodzis' (1998) Benguela food web is highly comparable to ours across most metrics (connectivity, links/species, and percent intermediate and top predators). However, relative to the Benguela Current (located off the southwest coast of Africa), the California Current has a lower proportion of omnivorous species and a higher percentage of basal groups and cannibalistic groups. These characteristics of the California Current are also apparent when comparing it to the three other reef and shelf food webs (Table 4) (Opitz 1996, Link 2002).

It is likely that the California Current food web's increased proportion of basal species is due to sampling methods. The number of basal species is highly sensitive to the completeness of the food web. Our food web, like many others used for ecosystem modeling, is biased toward fish species, while basal and low trophic level species are aggregated into larger functional groups, decreasing the number of basal groups represented in the food web. The northeast U.S. shelf (Link 2002) food web has fewer species per functional group than our representation of the California Current. The taxonomic groups included by Link (2002) are very similar, however.

We were unable to accurately enumerate total species that contributed to the food web because our literature sources frequently only identified prey to functional group. However, we estimate approximately 200 (±50) vertebrate and invertebrate species in total were included in this food web.

Analyses for Fish at the Species Level

Cluster analysis of species-level data for fish yielded eight feeding guilds similar to those described above for functional groups (Figure 11). A large number of species clustered in guild A, all feeding heavily on large zooplankton (Figure 12). Pacific viperfish diets were dissimilar from any other species and were excluded from feeding guilds. Guild B contains species that feed primarily on small planktivorous fish (Figure 13). Guild C contains two species of lampfish

feeding largely on mesozooplankton (e.g., copepods) (Figure 13). Guild D includes four species of flatfish feeding on small benthic prey, such as benthic carnivores (polychaetes) and deposit feeders (small crustaceans). Guild E species, ranging from skates to flatfish, fed on a variety of benthic fauna including small flatfish and shrimp (Figure 14). Guild F species largely feed on cephalopods (squid) and to a lesser degree on high trophic level fishes (Figure 15). Guild G species feed on a variety of large zooplankton (euphausiids), gelatinous zooplankton (jellyfish), deposit feeders (amphipods), and benthic herbivorous grazers (snails, urchins, etc.). Guild H contains species feeding on various fish (e.g., Pacific hake and small planktivores) and benthic invertebrates including deposit feeders (amphipods) and megazoobenthos (crabs) (Figure 16).

The cluster analysis for fish at the species level (Figure 17) indicated that most species had very similar diets to other species within their functional group. For example, the small flatfish group, made up of Dover sole (*Microstomus pacificus*), rex sole (*Glyptocephalus zachirus*), Pacific sanddab (*Citharichthys sordidus*) and deepsea sole (*Embassichthys bathybius*) all cluster within species guild D. Similarly, the three species within the skate functional group all cluster into guild E. The species-level dendrogram reveals other similarities that might be expected based on our preconceptions about functional groups, such as clustering of sardines and anchovies, arrowtooth flounder (*Atheresthes stomias*) and Pacific halibut (*Hippoglossus stenolepis*), widow (*Sebastes entomelas*) and yellowtail rockfish (*S. flavidus*), and sixgill (*Hexanchus griseus*) and sleeper sharks (*Somniosus pacificus*).

A few species do not cluster close to others within their functional group. The deep vertical migratory group, consisting of Pacific viperfish (*Chauliodus macouni*), blue lanternfish (*Tarletonbeania crenularis*), California headlightfish (*Diaphus theta*), garnet lampfish (*Stenobrachius nannochir*), and northern lampfish (*S. leucopsarus*), is only loosely related according to the species-level cluster analysis. Pacific viperfish (Figure 11 and Figure 12) diets are dissimilar from those of other species within this functional group, which generally feed on large and small zooplankton. Pacific viperfish feed almost exclusively on other deep vertically migrating fish (e.g., Myctophids) and were not assigned to a feeding guild for this reason. Blue lanternfish and California headlightfish cluster in group A, though their diets are less related. The remaining two species, garnet lampfish and northern lampfish, both cluster together in species guild C.

PSIs between fish species support the appropriateness of the majority of our functional groups for explaining diet variation between species (Table 5). On average, PSI was higher between species within a single functional group than between species in different groups (37.2 to 19.6, respectively). In addition, significant diet overlaps (>60%) were three times more likely within a functional group (21% and 7%, respectively). We found our functional groups to be highly significant in explaining the PSI between species (MANOVA, $F_{13} = 2.6138$, $p = 0.001$). A MANOVA plot of the species-level fish diets (Figure 17) identifies seven major axes of prey species, including large zooplankton, benthic invertebrates, Pacific hake and small pelagic fish; these are similar to the prey that define the species-level feeding guilds identified in the dendrogram (Figure 11).

Discussion

The diet summaries presented in Figure 2 through Figure 9, Figure 12 through Figure 16, and Appendix B and Appendix C present a synoptic view of marine species diets in the California Current. We have attempted to compile a comprehensive list of more than 75 sources of diet information (Appendix A). The diet summaries provide a convenient representative diet per predator species or functional group, averaging across disparate studies. For instance, our estimate that 40% of yellowtail rockfish diets are large zooplankton (euphausiids) is the weighted average of four studies, including but down-weighting a study of only 22 fish by Pereyra et al. (1969) that attributed only 13% of the diet to large zooplankton. In other cases our diet summaries for a predator stem from a single study (e.g., English sole) or several studies reporting similar diet composition (e.g., all four diets studies for canary rockfish indicate heavy predation on euphausiids and other large zooplankton). In these cases our summaries do not add any novel interpretation but may provide an easy reference for future applications.

Key prey functional groups were identified through both the functional group-level and species-level analyses. Many predator functional groups preyed heavily on the following, ranked by order of importance: large zooplankton (primarily euphausiids), deposit feeders (amphipods and other crustaceans), small planktivores (Pacific herring [*Clupea pallasii*], northern anchovy [*Engraulis mordax*], Pacific sardine [*Sardinops sagax*]), and phytoplankton. Large zooplankton such as euphausiids were particularly important, and were consumed by large planktivores, cephalopods, small planktivores, shallow large rockfish, canary rockfish, Pacific hake, deep vertical migrators, small demersal sharks, and midwater rockfish. The species-level analysis of fish predators yielded similar prey groups, with shrimp replacing phytoplankton as the fourth most utilized prey resource.

The PSI analysis identified both intuitive and novel overlaps in diet composition. We generally calculated high overlap when comparing species within functional groups and functional groups within guilds. One intuitive interaction is among Chinook salmon, albacore tuna, migrating seabirds, surface seabirds, and diving seabirds, all of which compete for small planktivorous fish prey. Similarly, we calculated high PSI for functional groups that fed primarily on euphausiids, cephalopods, or deposit feeders such as amphipods and snails. A diet overlap that may be somewhat unexpected was between baleen whales and shallow small rockfish. Gray whales (*Eschrichtius robustus*), which compose the majority of the baleen whale functional group biomass, scour the bottom to prey on deposit feeders. In addition, both baleen whales and shallow small rockfish prey heavily on euphausiids and other large zooplankton.

The species-level cluster analysis, PSIs, and MANOVA support the aggregation of fish species within the California Current into the functional groups considered here and originally defined for the Atlantis ecosystem model of Brand et al. (2007). Examples where our analysis of diets suggested a substantially different aggregation than our original functional groups were primarily cases where life history characteristics or fishery targeting rather than diets had driven the original functional group aggregation (e.g., combining the chondrichthyans spotted ratfish

[*Hydrolagus colliei*] and Pacific dogfish [*Squalus acanthias*] or aggregating Pacific sanddabs with other flatfish such as rex, deepsea, and Dover soles). For a few species (such as Pacific viperfish), new diet information from our literature search suggests specific improvements for future functional group aggregation.

As noted above, the California Current food web is particularly dependent on euphausiids as a key forage resource. This may imply substantial impacts of climate change on this food web. Current projections of CO_2 emissions and atmospheric modeling suggest declines in pH of ocean water of 0.14–0.35 by 2100 (IPCC 2007) that could lead to decreased shell calcification rates and increased mortality for arthropods such as euphausiids. However, Fabry et al. (2008) suggest that the effect of acidification on euphausiids is unknown, though Yamada and Ikeda (1999) found increased mortality with prolonged exposure to very low pH (<7.6). Other calcifying groups likely to decline under acidification include bivalves, sea urchins, brittle stars, and pteropods (Fabry et al. 2008), and predators of these would either switch to alternate prey or themselves decline in abundance or weight-at-age.

The diet summaries presented here are primarily derived from data from the 1970s to present. However, diets are likely to change with fluctuations in predator and prey abundance. For instance, northward range expansions in fish have been documented in the North Sea (Perry et al. 2005), and similar range expansions of subtropical species may occur in the California Current as water temperatures rise. For instance, Humboldt squid (*Dosidicus gigas*) once common off Baja California, Mexico, migrated as far north as British Columbia during warm El Niño periods and established themselves in those ranges thereafter (Field et al. 2007, Zeidberg and Robison 2007). This may drastically change the food web by introducing new competitive and predatory interactions. Field et al. (2007) suggest that Pacific hake, rockfish, and cephalopods are the three dominant prey items of Humboldt squid, and that the high productivity and consumption rates makes this predator's impacts particularly strong.

In conclusion, the diet summaries presented here can serve as the backbone of a range of analyses meant to support EBM and modeling. Stock assessment authors and managers setting allowable biological catches may consult the diet tables and figures, cluster diagrams of feeding guilds, or PSIs to identify impacts of harvest decisions in the food web context of the California Current. The diet data can be used at a range of levels, ranging from qualitative descriptions of predators and prey of a target species (e.g., Kaplan and Helser 2007) to quantitative modeling of tradeoffs in the food web for tactical management decisions (similar to Dorn et al. 2008) or strategic scoping of policy options (Kaplan and Levin 2009, Horne et al. in prep).

Figures 1–17 and Tables 1–5

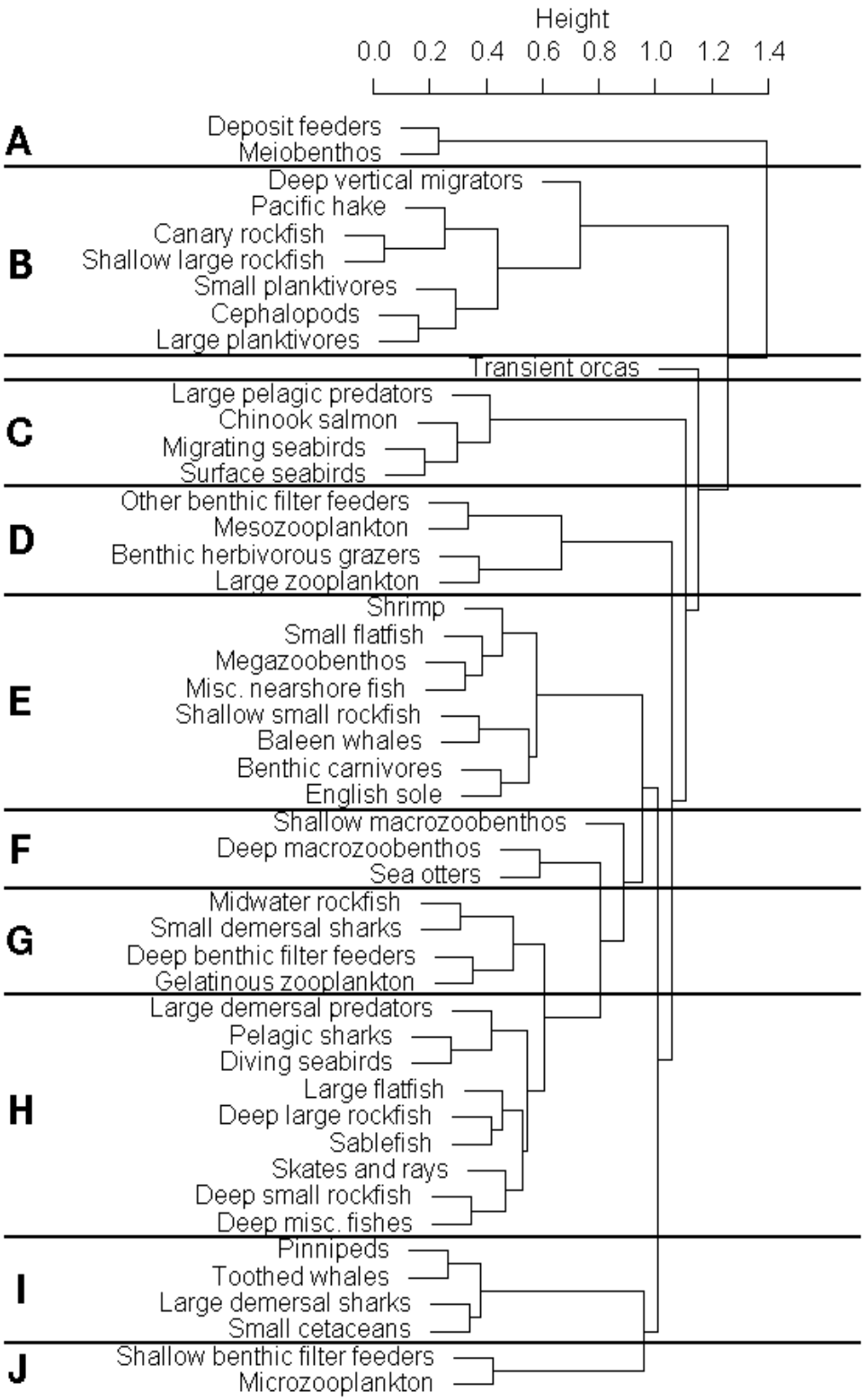

Figure 1. Dendrogram of California Current diets derived from the hierarchical cluster analysis. The Height scale is the Euclidian distance created by the distance matrix prior to clustering. Feeding guilds A through J, subjectively formed to simplify discussion of results, are delineated. For a synopsis of species included in vertebrate and invertebrate groups, see Table 1 and Table 2, respectively. For raw diet data, see Figure 2 through Figure 9 and Appendix B.

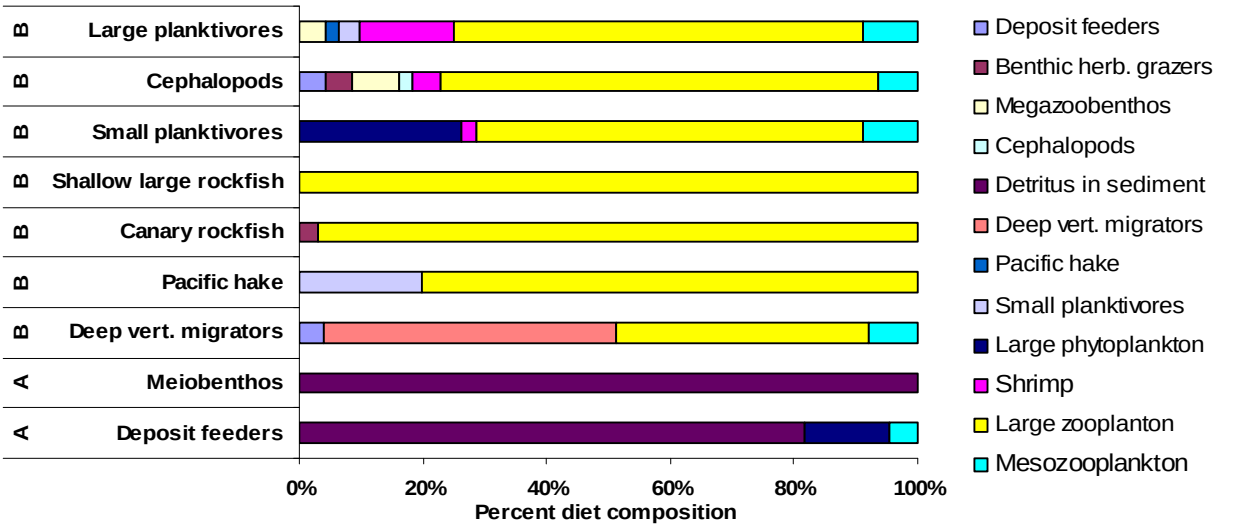

Figure 2. Percent diet composition of feeding guilds A and B (Figure 1). The feeding guilds were formed based on the functional group level hierarchical cluster analysis. The two groups in guild A feed almost exclusively on detritus. All groups in guild B prey heavily on large zooplankton. Prey taxa making up less than 2% of total diet proportion are excluded from this figure. For species names per vertebrate or invertebrate functional group, see Table 1 and Table 2, respectively.

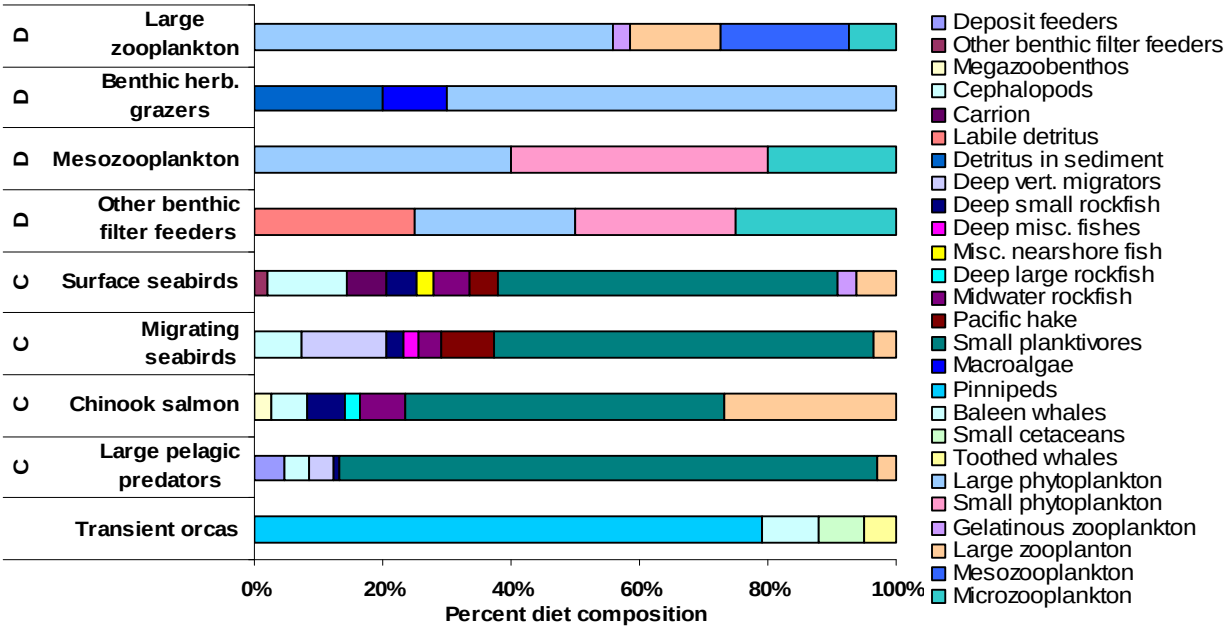

Figure 3. Percent diet composition of feeding guilds C and D (Figure 1) from the functional group level hierarchical cluster analysis. Functional groups in guild C prey on a mixture of small planktivores and zooplankton. Guild D groups feed on a mixture of phytoplankton and microzooplankton (dinoflagellates and ciliates). Transient orcas were not assigned to a feeding guild because their diet was dissimilar from all other functional groups. Prey taxa making up less than 2% of total diet proportion are excluded from this figure. For species names per vertebrate or invertebrate functional group, see Table 1 and Table 2, respectively.

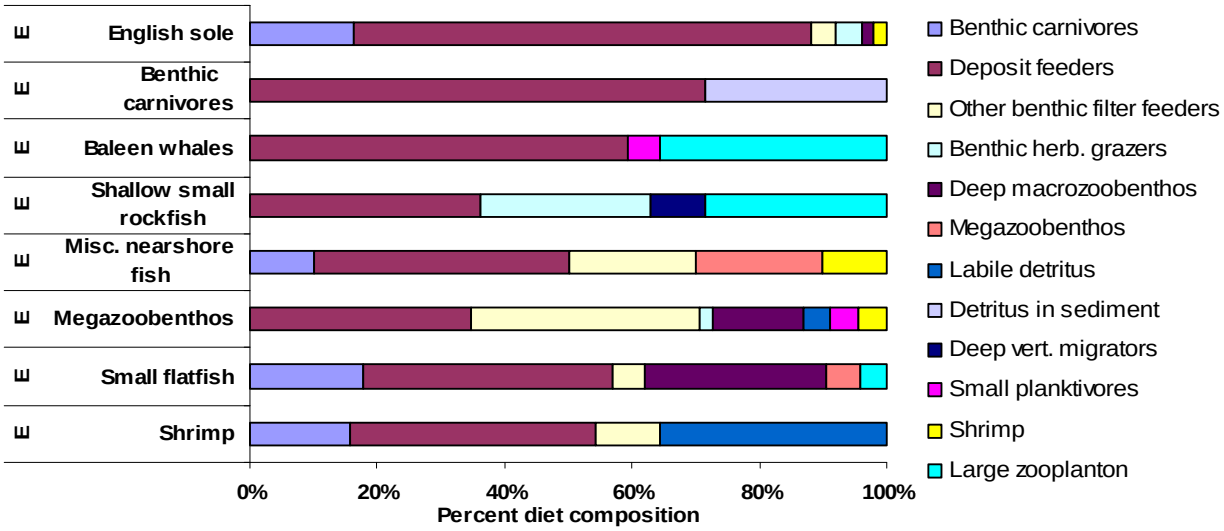

Figure 4. Percent diet composition of feeding guild E (Figure 1) from the functional group level hierarchical cluster analysis. All functional groups in this guild largely prey on benthic taxa including deposit feeders (amphipods, small crustacea) and other small benthic invertebrates. Prey taxa making up less than 2% of total diet proportion are excluded from this figure. For species names per vertebrate or invertebrate functional group, see Table 1 and Table 2, respectively.

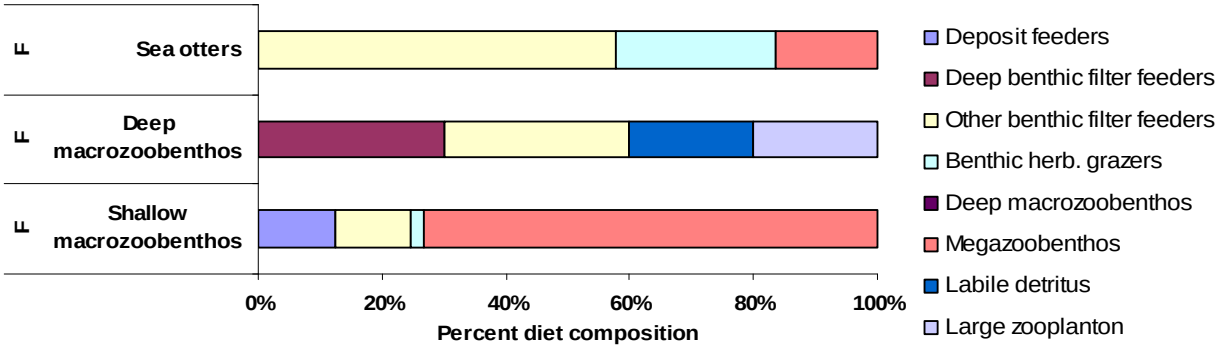

Figure 5. Percent diet composition of feeding guild F (Figure 1) from the functional group level hierarchical cluster analysis. Functional groups in this guild prey on a range of large benthic invertebrate taxa including other benthic filter feeders (bivalves) and megazoobenthos (crabs). Prey taxa making up less than 2% of total diet proportion are excluded from this figure. For species names per vertebrate or invertebrate functional group, see Table 1 and Table 2, respectively.

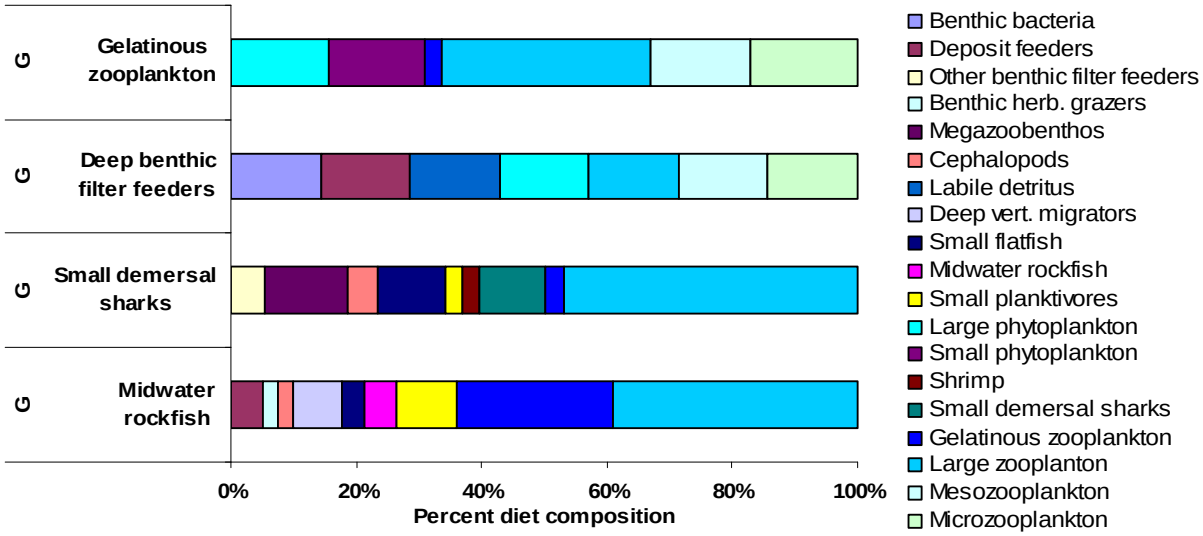

Figure 6. Percent diet composition of feeding guild G (Figure 1) from the functional group level hierarchical cluster analysis. Functional groups in this guild prey on a variety of zooplankton groups including large zooplankton (euphausiids), mesozooplankton (copepods), and gelatinous zooplankton (jellyfish). Prey taxa making up less than 2% of total diet proportion are excluded from this figure. For species names per vertebrate or invertebrate functional group, see Table 1 and Table 2, respectively.

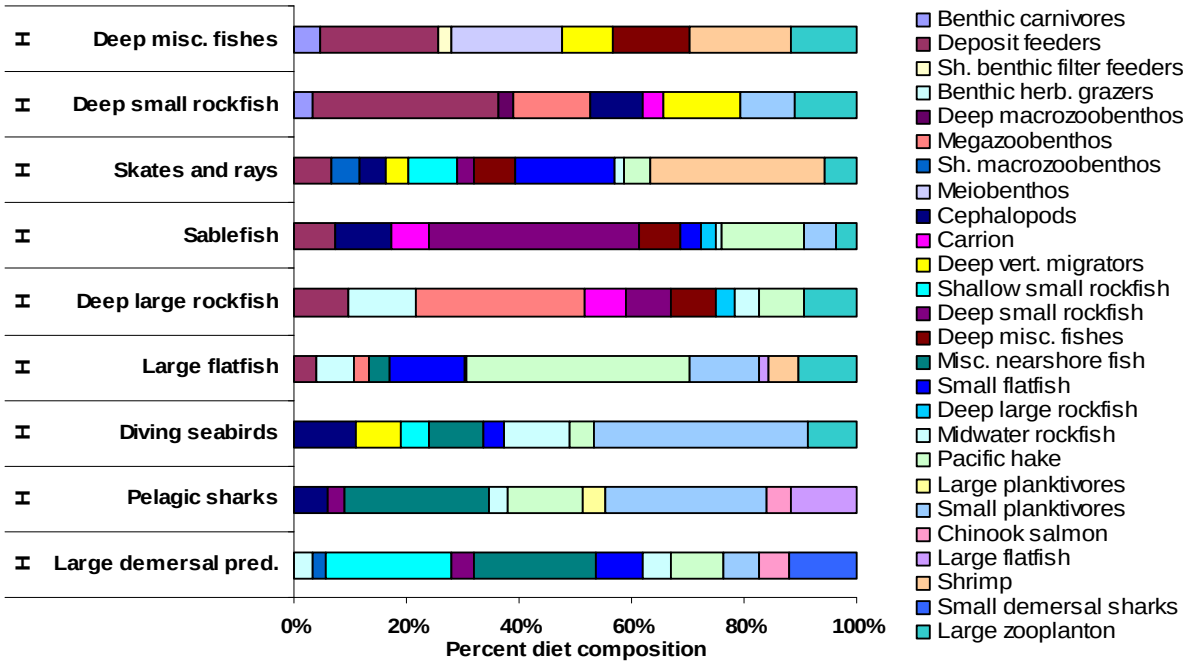

Figure 7. Percent diet composition of feeding guild H (Figure 1) from the functional group level hierarchical cluster analysis. Guild H contains high trophic level carnivorous functional groups. This group can be subdivided into groups specializing in benthic versus pelagic prey. Large demersal predators (lingcod), pelagic sharks, diving seabirds, and large flatfish primarily consume pelagic prey such as small planktivores and miscellaneous nearshore fish. The remaining groups, including skates and rays, deep small rockfish, and deep miscellaneous fishes, target benthic prey such as deposit feeders (amphipods and small crustacea), deep miscellaneous fishes, and shrimp. Prey taxa making up less than 2% of total diet proportion are excluded from this figure. For species names per vertebrate or invertebrate functional group, see Table 1 and Table 2, respectively.

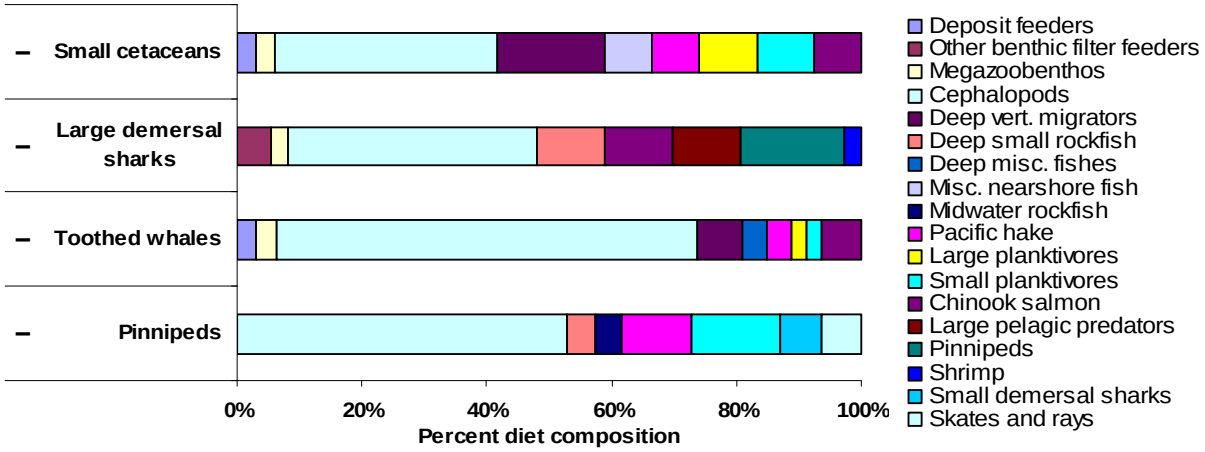

Figure 8. Percent diet composition of feeding guild I (Figure 1) from the functional group level hierarchical cluster analysis. Functional groups in this guild all prey on cephalopods to some degree. Prey taxa making up less than 2% of total diet proportion are excluded from this figure. For species names per vertebrate or invertebrate functional group, see Table 1 and Table 2, respectively.

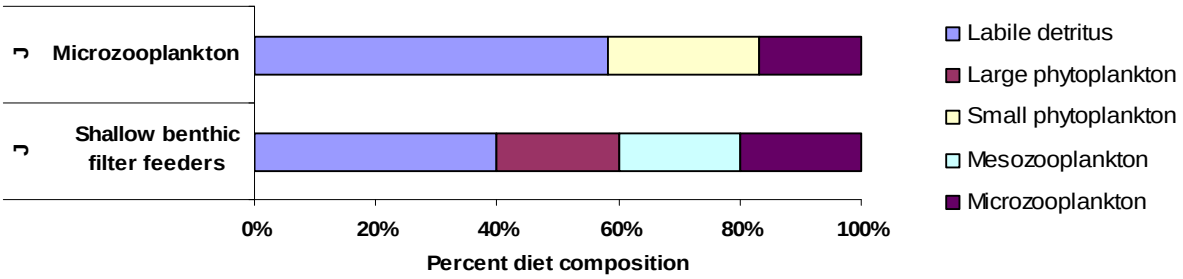

Figure 9. Percent diet composition of feeding guild J (Figure 1) from the functional group level hierarchical cluster analysis. Functional groups in this guild eat detritus and microzooplankton (dinoflagellates and ciliates). Prey taxa making up less than 2% of total diet proportion are excluded from this figure. For species names per vertebrate or invertebrate functional group, see Table 1 and Table 2, respectively.

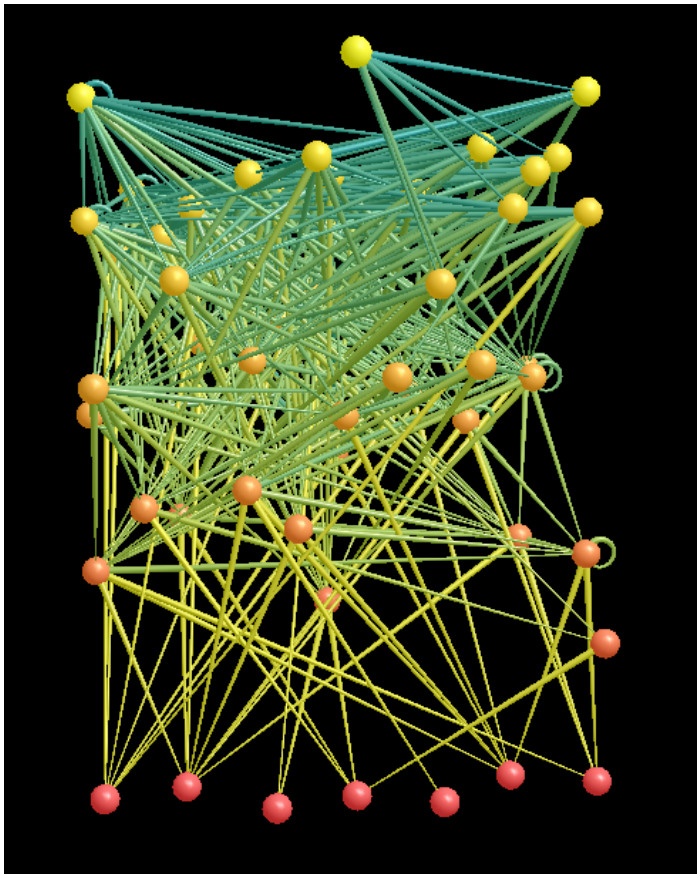

Figure 10. Visual representation of California Current food web structure. Each node represents a functional group, and height of the nodes represents trophic level. Diet linkages are indicated by lines. Basal species are indicated by red nodes and top species are indicated by yellow nodes. Intermediate species fall somewhere between red and yellow and are indicated by shades of orange. Predator linkages to basal species are indicated by yellow lines and predatory linkages to other intermediate or top species are indicated by green lines. Loops from a node to itself indicate cannibalism. (Image produced with FoodWeb3D, written by R. J. Williams, and provided by the Pacific Ecoinformatics and Computational Ecology Laboratory, Berkeley, California.)

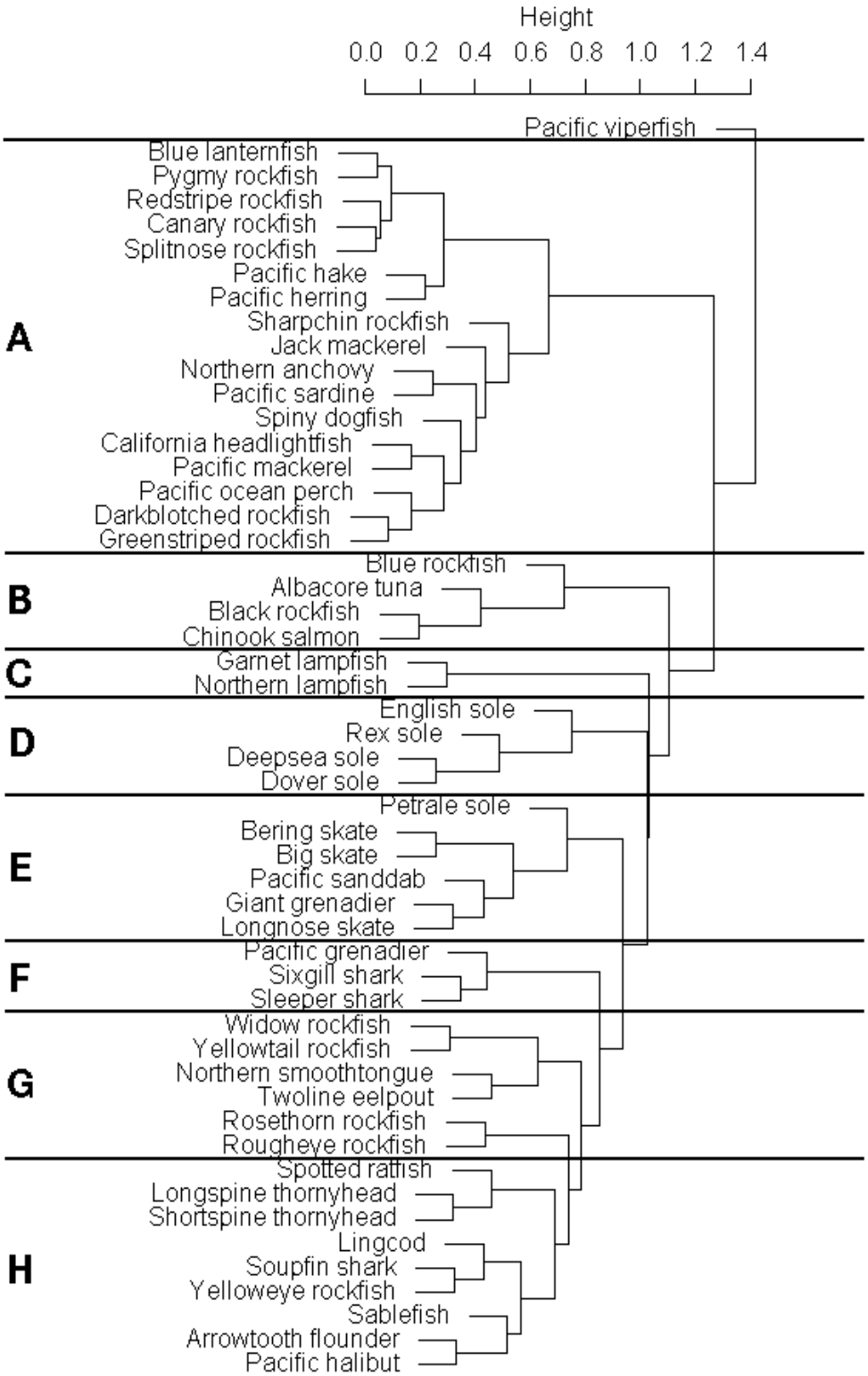

Figure 11. Dendrogram of California Current fish-only diets derived from the hierarchical cluster analysis. The Height scale is the Euclidian distance created by the distance matrix prior to clustering. Feeding guilds A through H, subjectively formed to simplify discussion of results, are delineated. For a synopsis of species included in fish functional groups, see Table 1. For raw diet data, see Figure 12 through Figure 16.

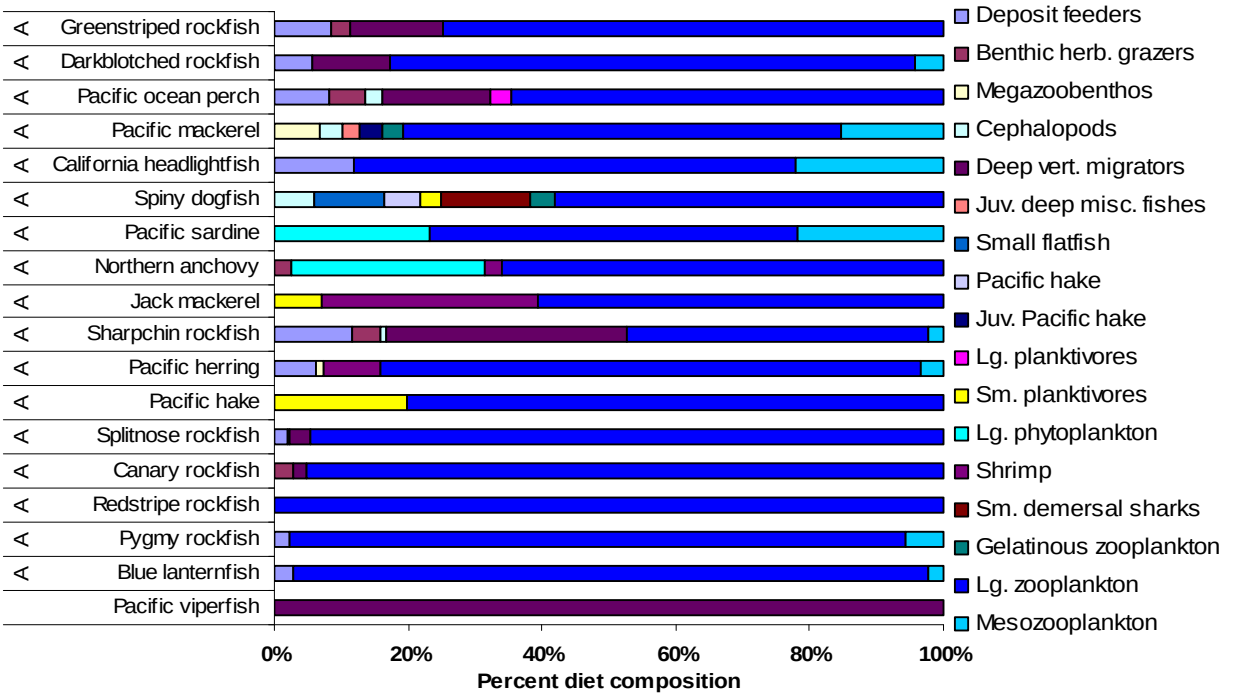

Figure 12. Percent diet composition of feeding guild A (Figure 11) from the species-level hierarchical cluster analysis. All species contain substantial contributions of zooplankton in their diet. Pacific viperfish were not assigned to a feeding guild because their diet was dissimilar from all other functional groups. Prey taxa making up less than 2% of total diet proportion are excluded from this figure. For predator species names and invertebrate prey functional group taxa, see Table 1 and Table 2, respectively.

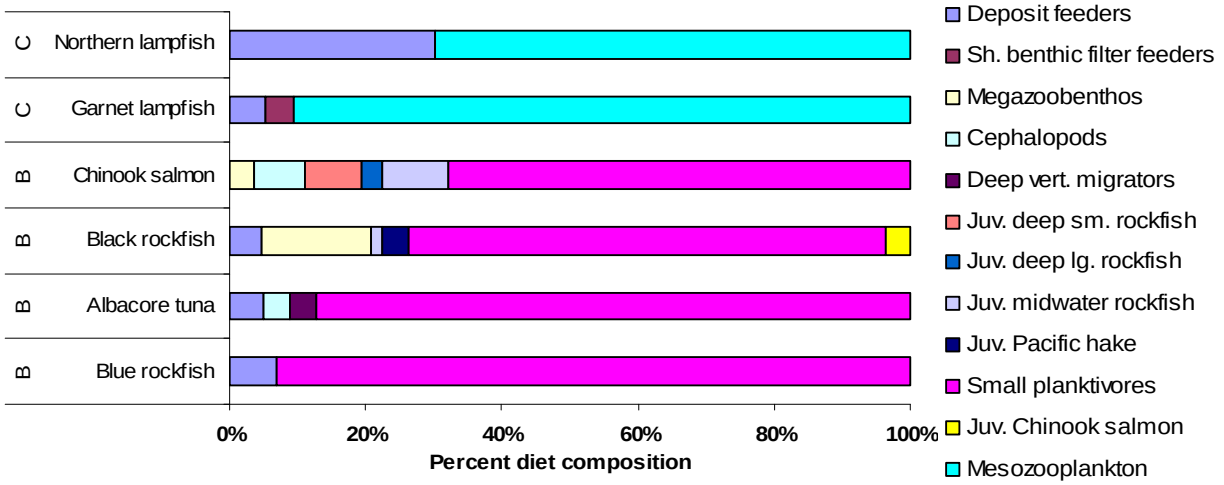

Figure 13. Percent diet composition of feeding guilds B and C (Figure 11) from the species-level hierarchical cluster analysis. Species in guild B feed predominately on small planktivorous fish. Feeding guild C species target mesozooplankton (copepods). Prey taxa making up less than 2% of total diet proportion are excluded from this figure. For predator species names and prey functional group taxa, see Table 1 and Table 2, respectively.

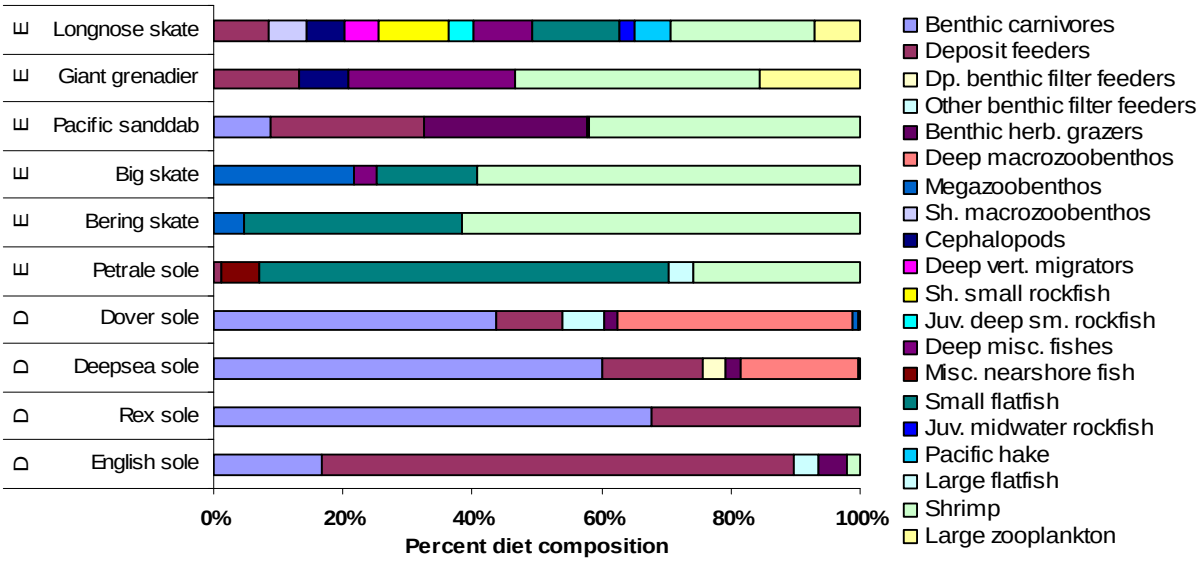

Figure 14. Percent diet composition of feeding guild D and E (Figure 11) from the species-level hierarchical cluster analysis (Figure 9). Guild D contains four species of flatfish feeding on small benthic prey such as benthic carnivores (polychaetes) and deposit feeders (small crustacean). Guild E primarily feeds on shrimp and small flatfish. Prey taxa making up less than 2% of total diet proportion are excluded from this figure. For predator species names and prey functional group taxa, see Table 1 and Table 2, respectively.

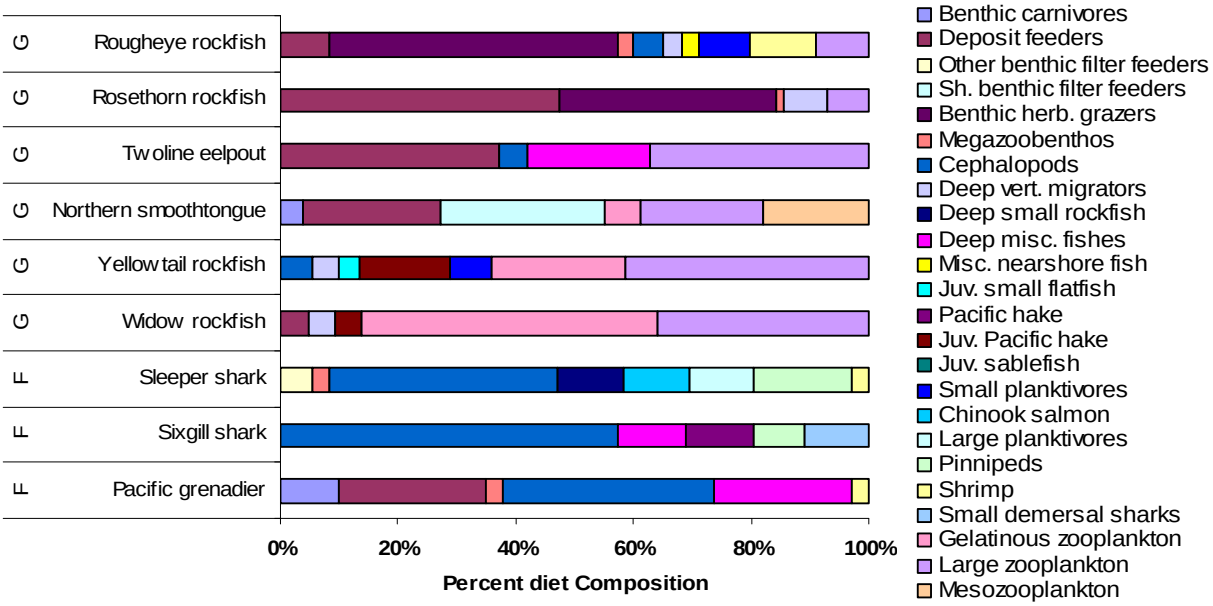

Figure 15. Percent diet composition of feeding guilds F and G (Figure 11) from the species-level hierarchical cluster analysis. Species in guild F largely feed on cephalopods (squid) and to a lesser degree high trophic level fishes. Guild G species feed on a variety of large zooplankton (euphausiids), gelatinous zooplankton (jellyfish), deposit feeders (amphipods), and benthic herbivorous grazers (snails, urchins, etc.). Prey taxa making up less than 2% of total diet proportion are excluded from this figure. For predator species names and prey functional group taxa, see Table 1 and Table 2, respectively.

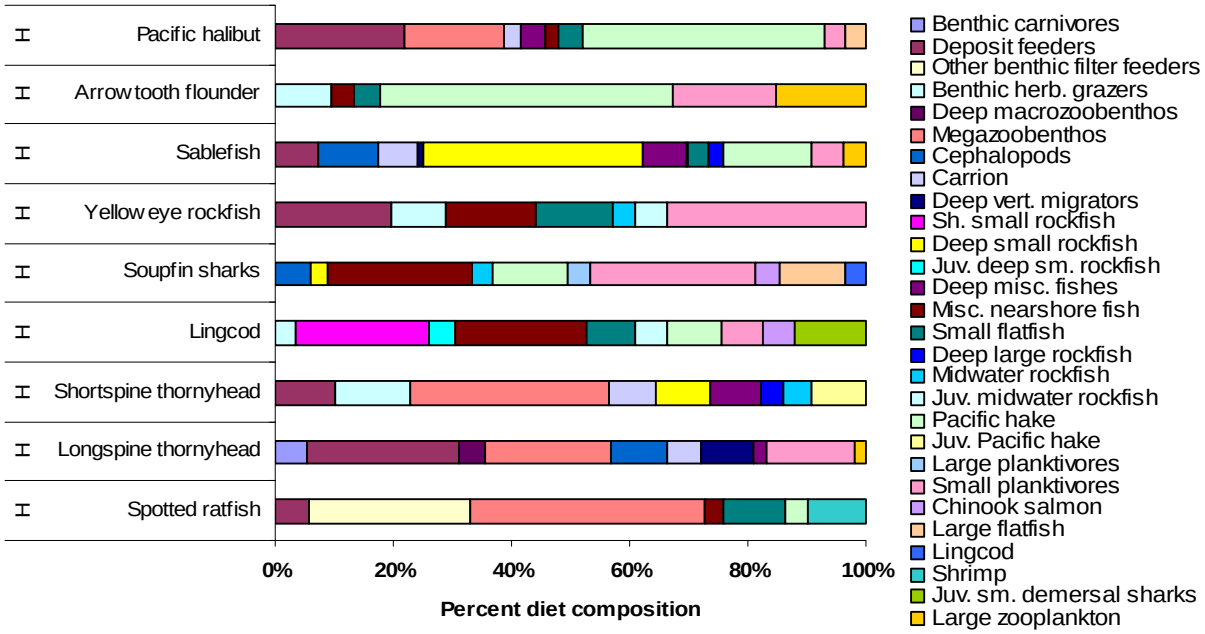

Figure 16. Percent diet composition of feeding guild H (Figure 11) from the species-level hierarchical cluster analysis. Species within this guild feed on various fish (e.g., Pacific hake and small planktivores) and benthic invertebrates including deposit feeders (amphipods) and megazoobenthos (crabs). Prey taxa making up less than 2% of total diet proportion are excluded from this figure. For predator species names and prey functional group taxa, see Table 1 and Table 2, respectively.

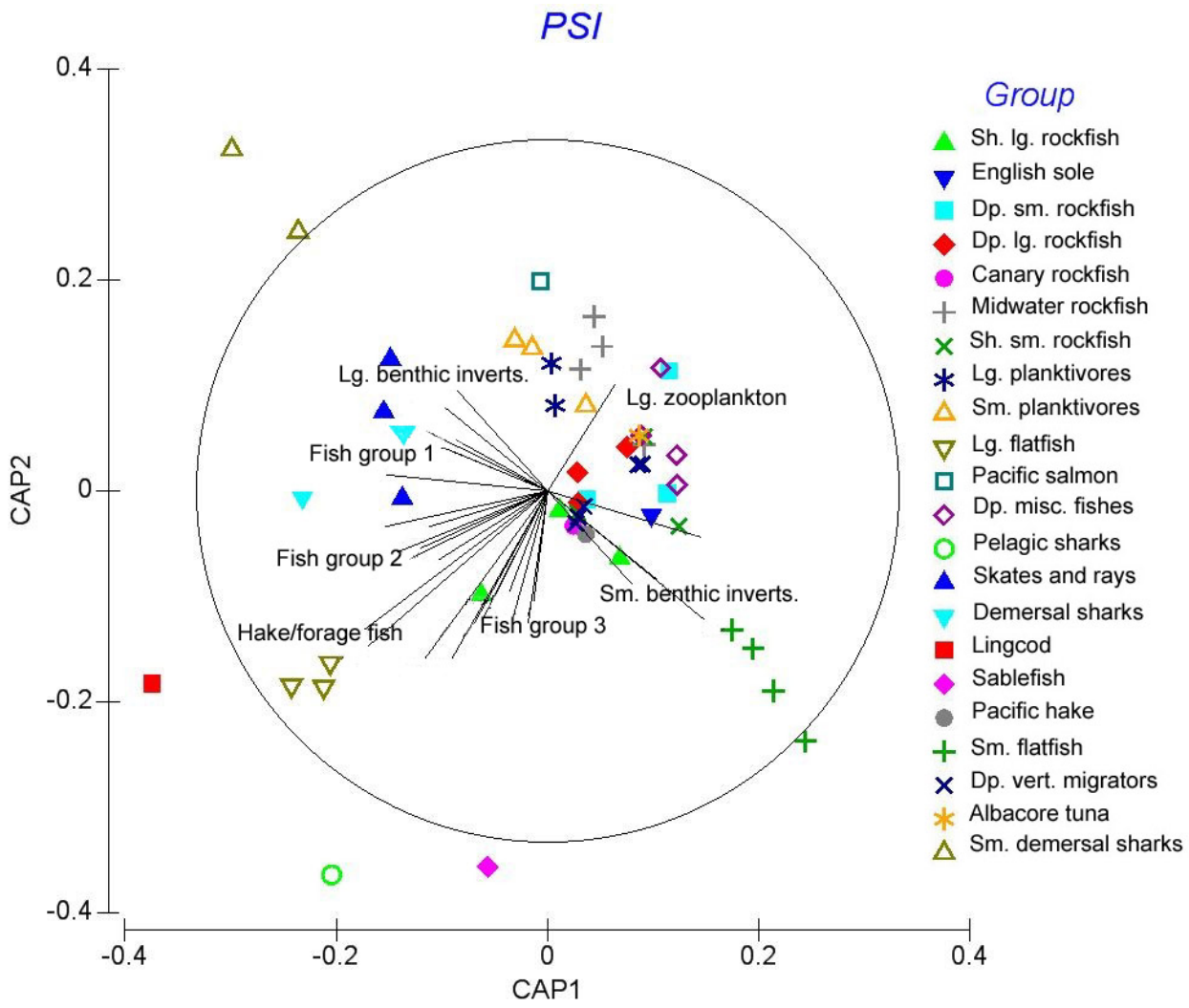

Figure 17. MANOVA plot of the PSI of species-level data. CAP1 and CAP2 are axes that represent diet composition from the canonical analysis of principal coordinates. Each symbol on the graph represents a predator species and the legend indicates functional groups for those species. Black axes radiating from the center represent key prey items that differentiate predator feeding habits. Fish prey group 1 includes juvenile rockfish species, shallow large rockfish, and small demersal sharks. Fish prey group 2 includes small flatfish, sablefish, and Chinook salmon. Fish prey group 3 includes midwater rockfish, juvenile sablefish, deep small rockfish, and large flatfish.

Table 1. Vertebrate species included in the functional group analysis and their respective proportional biomass within the functional group. Relative abundances for all fish groups except miscellaneous nearshore fish (e.g., sculpin, croakers) are taken from the NWFSC trawl survey data, 1998–2003. See Appendix A for seabird and marine mammal relative abundances. Functional groups and codes are from Brand et al. (2007), though group compositions may change slightly. NA = not available.

Code	Group		Common name	Scientific name	Proportion
SHR	Shallow large rockfish	Adult	Redstripe rockfish	*Sebastes proriger*	0.95
		Adult	Yelloweye rockfish	*S. ruberrimus*	0.05
		Adult	Blue rockfish	*S. mystinus*	<.01
		Juv.	Copper rockfish	*S. caurinus*	0.50
		Juv.	Blue rockfish	*S. mystinus*	0.50
FDP	English sole	Adult	English sole	*Parophrys vetulus*	1.00
		Juv.	English sole	*P. vetulus*	NA
FDC	Deep small rockfish	Adult	Longspine thornyhead	*Sebastolobus altivelis*	0.63
		Adult	Sharpchin rockfish	*Sebastes zacentrus*	0.20
		Adult	Splitnose rockfish	*S. diploproa*	0.17
		Juv.	Splitnose rockfish	*S. diploproa*	NA
FDO	Deep large rockfish	Adult	Shortspine thornyhead	*Sebastolobus alascanus*	0.75
		Adult	Darkblotched rockfish	*Sebastes crameri*	0.24
		Adult	Rougheye rockfish	*S. aleutianus*	0.01
		Juv.	Darkblotched rockfish	*S. crameri*	1.00
FPO	Canary rockfish	Adult	Canary rockfish	*S. pinniger*	1.00
		Juv.	Canary rockfish	*S. pinniger*	1.00
FDS	Midwater rockfish	Adult	Widow rockfish	*S. entomelas*	0.43
		Adult	Pacific ocean perch	*S. alutus*	0.34
		Adult	Yellowtail rockfish	*S. flavidus*	0.23
		Adult	Black rockfish	*S. melanops*	<0.01
		Juv.	Chilipepper rockfish	*S. goodei*	0.64
		Juv.	Yellowtail rockfish	*S. flavidus*	0.22
		Juv.	Widow rockfish	*S. entomelas*	0.12
		Juv.	Bocaccio	*S. paucispinis*	0.03
FDB	Shallow small rockfish	Adult	Rosethorn rockfish	*S. helvomaculatus*	0.71
		Adult	Greenstriped rockfish	*S. elongatus*	0.24
		Adult	Pygmy rockfish	*S. wilsoni*	0.06
		Juv.	Shortbelly rockfish	*S. jordani*	1.00
FDE	Misc. nearshore fish	Juv.	White croaker	*Genyonemus lineatus*	NA
		Juv.	Sculpin	Cottidae	NA
		Juv.	Midshipman	*Porichthys notatus*	NA
FPL	Large planktivores	Adult	Pacific mackerel	*Scomber japonicus*	0.59
		Adult	Jack mackerel	*Trachurus symetricus*	0.41
		Juv.	Jack mackerel	*T. symetricus*	NA
FPS	Small planktivores	Adult	Northern anchovy	*Engraulis mordax*	0.59
		Adult	Pacific sardine	*Sardinops sagax*	0.39
		Adult	Pacific herring	*Clupea pallasii*	0.02

Table 1 continued. Vertebrate species included in the functional group analysis and their respective proportional biomass within the functional group. Relative abundances for all fish groups except miscellaneous nearshore fish (e.g., sculpin, croakers) are taken from the NWFSC trawl survey data, 1998–2003. See Appendix A for seabird and marine mammal relative abundances. Functional groups and codes are from Brand et al. (2007), though group compositions may change slightly. NA = not available.

Code	Group		Common name	Scientific name	Proportion
FPS	Small planktivores (continued)	Juv.	Pacific herring	*C. pallasii*	NA
FVD	Large flatfish	Adult	Arrowtooth flounder	*Atheresthes stomias*	0.71
		Adult	Pacific halibut	*Hippoglossus stenolepis*	0.15
		Adult	Petrale sole	*Eopsetta jordani*	0.14
		Juv.	Arrowtooth flounder	*Atheresthes stomias*	0.83
		Juv.	Pacific halibut	*Hippoglossus stenolepis*	0.17
FVB	Chinook salmon	Adult	Chinook salmon	*Oncorhynchus tshawytscha*	1.00
		Juv.	Chinook salmon	*O. tshawytscha*	1.00
FDD	Deep misc. fishes	Adult	Pacific grenadier	*Coryphaenoides acrolepis*	0.49
		Adult	Giant grenadier	*Albatrossia pectoralis*	0.38
			Misc. fishes		0.13
		Adult	California smoothtongue	*Bathylagus stilbius*	
		Adult	Twoline eelpout	*Bothrocara brunneum*	
		Juv.	Pacific grenadier	*Coryphaenoides acrolepis*	0.57
		Juv.	Giant grenadier	*Albatrossia pectoralis*	0.43
SHP	Pelagic sharks	Adult	Soupfin shark	*Galeorhinus galeus*	1.00
		Juv.	Soupfin shark	*G. galeus*	NA
SSK	Skates and rays	Adult	Longnose skate	*Raja rhina*	0.80
		Adult	Bering skate	*Bathyraja interrupta*	0.16
		Adult	Big skate	*Raja binoculata*	0.04
		Juv.	Big skate	*R. binoculata*	NA
SHD	Large demersal sharks	Adult	Sleeper shark	*Somniosus pacificus*	0.97
		Adult	Sixgill shark	*Hexanchus griseus*	0.03
		Juv.	Sixgill shark	*H. griseus*	NA
FVS	Large demersal predators	Adult	Lingcod	*Ophiodon elongatus*	1.00
		Juv.	Lingcod	*O. elongatus*	1.00
FMN	Sablefish	Adult	Sablefish	*Anoplopoma fimbria*	1.00
		Juv.	Sablefish	*A. fimbria*	1.00
FMM	Pacific hake	Adult	Pacific hake	*Merluccius productus*	1.00
		Juv.	Pacific hake	*M. productus*	1.00
FDF	Small flatfish	Adult	Dover sole	*Microstomus pacificus*	0.76
		Adult	Rex sole	*Glyptocephalus zachirus*	0.14
		Adult	Pacific sanddab	*Citharichthys sordidus*	0.08
		Adult	Deepsea sole	*Embassichthys bathybius*	0.02
		Juv.	Deepsea sole	*E. bathybius*	NA

Table 1 continued. Vertebrate species included in the functional group analysis and their respective proportional biomass within the functional group. Relative abundances for all fish groups except miscellaneous nearshore fish (e.g., sculpin, croakers) are taken from the NWFSC trawl survey data, 1998–2003. See Appendix A for seabird and marine mammal relative abundances. Functional groups and codes are from Brand et al. (2007), though group compositions may change slightly. NA = not available.

Code	Group		Common name	Scientific name	Proportion
FBP	Deep vertical migrators		Misc. myctophids		0.38
		Adult	Blue lanternfish	*Tarletonbeania crenularis*	
		Adult	California headlightfish	*Diaphus theta*	
		Adult	Pacific viperfish	*Chauliodus macouni*	0.26
		Adult	Northern lampfish	*Stenobrachius leucopsarus*	0.18
		Adult	Garnet lanternfish	*S. nannochir*	0.18
FBP	Deep vertical migrators	Juv.	Pacific viperfish	*Chauliodus macouni*	0.26
FVT	Large pelagic predators	Adult	Albacore tuna	*Thunnus alalunga*	1.00
		Juv.	Albacore tuna	*T. alalunga*	NA
SHB	Small demersal sharks	Adult	Spiny dogfish	*Squalus acanthias*	0.81
		Adult	Spotted ratfish	*Hydrolagus colliei*	0.19
		Juv.	Spiny dogfish	*Squalus acanthias*	1.00
FVO	Migrating seabirds	Adult	Black-footed albatross	*Phoebastria nigripes*	0.06
		Adult	and Laysan albatross	*P. immutabilis*	
		Adult	Black-legged kittiwake	*Rissa tridactyla*	0.02
		Adult	Northern fulmar	*Fulmarus glacialis*	0.03
		Adult	Sooty shearwater	*Puffinus griseus*	0.90
		Juv.	Sooty shearwater	*P. griseus*	NA
SP	Diving seabirds	Adult	Cormorants, shags	Phalacrocoracidae	0.16
		Adult	Pigeon guillemot	*Cepphus columba*	0.00
		Adult	Rhinoceros auklet	*Cerorhinca monocerata*	0.19
		Adult	Cassin's auklet	*Ptychoramphus aleuticus*	0.01
		Adult	Common murre	*Uria aalge*	0.59
		Adult	Ancient murrelet and	*Synthliboramphus antiquus*	0.01
		Adult	Marbled murrelet	*Brachyramphus marmoratus*	
		Adult	Tufted puffin	*Fratercula cirrhata*	0.03
		Juv.	Tufted puffin	*F. cirrhata*	NA
SB	Surface seabirds	Adult	Western gull	*Larus occidentalis*	0.94
		Adult	Storm petrel	Hydrobatidae	0.06
		Juv.	Storm petrel	Hydrobatidae	NA
WHB	Baleen whales	Adult	Gray whale	*Eschrichtius robustus*	0.62
		Adult	Humpback whale	*Megaptera novaeangliae*	0.05
		Adult	Blue whale	*Balaenopter musculus*	0.15
		Adult	Fin whale	*B. physalus*	0.18
		Juv.	Fin whale	*B. physalus*	NA

Table 1 continued. Vertebrate species included in the functional group analysis and their respective proportional biomass within the functional group. Relative abundances for all fish groups except miscellaneous nearshore fish (e.g., sculpin, croakers) are taken from the NWFSC trawl survey data, 1998–2003. See Appendix A for seabird and marine mammal relative abundances. Functional groups and codes are from Brand et al. (2007) though group compositions may change slightly. NA = not available.

Code	Group		Common name	Scientific name	Proportion
WHT	Toothed whales	Adult	Resident orcas	*Orcinus orca*	0.03
		Adult	Baird's beaked whale	*Berardius bairdii*	0.07
		Adult	Cuvier's beaked whale	*Ziphius cavirostris*	0.17
		Adult	Mesoplodon beaked whales	*Mesoplodon spp.*	0.05
		Adult	Short-finned pilot whale	*Globicephala macrorhynchus*	0.00
		Adult	Sperm whale	*Physeter macrocephalus*	0.68
WHT	Toothed whales	Juv.	Sperm whale	*P. macrocephalus*	NA
REP	Transient orcas	Adult	Transient orca	*Orcinus orca*	1.00
		Juv.	Transient orca	*O. orca*	NA
WHS	Small cetaceans	Adult	Dall's porpoise	*Phocoenoides dalli*	0.20
		Adult	Harbor porpoise	*Phocoena phocoena*	0.07
		Adult	Short-beaked common dolphin	*Delphinus delphis*	0.31
		Adult	Bottlenose dolphin	*Tursiops truncatus*	0.03
		Adult	Striped dolphin	*Stenella coeruleoalba*	0.05
		Adult	Risso's dolphin	*Grampus griseus*	0.12
		Adult	N. right whale dolphin	*Lissodelphis borealis*	0.07
		Adult	Pacific white-sided dolphin	*Lagenorhynchus obliquidens*	0.15
		Juv.	Pacific white-sided dolphin	*L. obliquidens*	NA
PIN	Pinnipeds	Adult	California sea lion	*Zalophus californianus*	0.27
		Adult	Steller sea lion	*Eumetopias jubatus*	0.02
		Adult	Harbor seal	*Phoca vitulina*	0.15
		Adult	N. elephant seal	*Mirounga angustirostris*	0.32
		Adult	N. fur seal	*Callorhinus ursinus*	0.25
		Juv.	N. elephant seal	*Mirounga angustirostris*	0.38
		Juv.	California sea lion	*Zalophus californianus*	0.31
		Juv.	N. fur seal	*Callorhinus ursinus*	0.29
		Juv.	Steller sea lion	*Eumetopias jubatus*	0.02
WDG	Sea otters	Adult	Sea otter	*Enhydra lutris*	1.00
		Juv.	Sea otter	*E. lutris*	NA

Table 2. Invertebrate taxa included in each functional group. Functional groups and codes are from Brand et al. (2007).

Code	Group	Species
BB	Benthic bacteria	Not identified
BC	Benthic carnivores	Polychaetes, nematodes, burrowing crustacea, peanut worms (Sipuncula), flatworms
BD	Deposit feeders	Amphipods, isopods, small crustacea, snails, ghost shrimp (Thalassinidea), sea cucumbers (Holothuroidea), worms, sea mouse (polychaete worm), sea slugs, barnacles, solenogaster (Aplacophora), hermit crabs
BFD	Deep benthic filter feeders	Anemones, deep corals, lampshells, reticulate sea anemone (*Actinauge verrilli*), rough purple sea anemone (*Paractinostola faeculenta*), swimming sea anemone (*Stomphia coccinea*), gigantic sea anemone (*Metridium farcimen*), corals, sponges
BFF	Other benthic filter feeders	Geoduck (*Panopea abrupta*), barnacles, razor clam (*Siliqua patula*), littleneck clam (*Venerupis philippinarum*), Manila clam (*Ruditapes philippinarum*), miscellaneous bivalves, Vancouver scallop (*Delectopecten vancouverensis*), glass scallop (*Cyclopecten davidsoni*), green sea urchin (*Strongylocentrotus droebachiensis*), red sea urchin (*Strongylocentrotus franciscanus)*
BFS	Shallow benthic filter feeders	Barnacles, seafans, soft corals, gorgonian corals, black corals, green colonial tunicate (*Didenmum molle*), sea pens, sea whips, sea potatoes, vase sponge (*Leucandra heathi*), mussels, scallops
BG	Benthic herbivorous grazers	Snails, abalone (*Haliotis* spp.), nudibranchs, sand dollars, naked solarelle (*Solariella nuda*), dorid nudibranchs, limpets, heart sea urchin (echinoderm), spot prawns, pandalid shrimps
CEP	Cephalopods	Market squid (*Loligo opalescens*), *Japetella* spp., armhook squids (*Gonatus* spp.), *Chiroteuthis* spp., *Abraliopsis* spp., robust clubhook squid (*Moroteuthis robusta*), rhomboid squid (*Thysanoteuthis rhombus*), sandpaper squid (*Cranchia scabra*), vampire squid (*Vampyroteuthis infernalis*)
DC	Carrion	—
DL	Labile detritus	—
BMD	Deep macrozoobenthos	Sea stars, moonsnail (Naticidae), whelks, leather sea star (*Dermasterias imbricata*), bat star (*Asterina miniata*), sunflower sea star (*Pycnopodia helianthoides*), common mud star (*Ctenodiscus crispatus*), crinoids, brittlestars, basketstar (*Gorgonocephalus eucnemis*)
DR	Refractory detritus	—
MA	Macroalgae	Kelp
BO	Meiobenthos	Flagellates, ciliates, nematodes

Table 2 continued. Invertebrate taxa included in each functional group. Functional groups and codes are from Brand et al. (2007).

Code	Group	Species
BML	Megazoobenthos	Dungeness crab (*Cancer magister*), tanner crab (*Chionoecetes bairdi*), spiny lobster (*Panulirus interruptus*), pinchbug crabs, red rock crab (*Cancer productus*), graceful rock crab (*Cancer gracilis*), spider crabs, grooved tanner crab (*Chionoecetes tanneri*), bairdi, scarlet king crab (*Lithodes couesi*), California king crab (*Paralithodes californiensis*)
PL	Large phytoplankton	Diatoms
PS	Small phytoplankton	Microphytoplankton
PWN	Shrimp	Crangon and mysid shrimps
BMS	Shallow macrozoobenthos	Giant Pacific octopus (*Enteroctopus dofleini*), north Pacific bigeye octopus (*Octopus californicus*), yellowring octopus (*Japetella heathi*), smoothskin octopus (*Benthoctopus leioderma*), flapjack devilfish (*Opisthosteuthis californiana*)
ZG	Gelatinous zooplankton	Salps, jellyfish, ctenophores, comb jellies
ZL	Large zooplankton	Euphausiids, chaetognaths, pelagic shrimps, pelagic polychaetes, pasiphaeids
ZM	Mesozooplankton	Copepods, cladocera
ZS	Microzooplankton	Ciliates, dinoflagellates, nanoflagellates, gymnodinoids, protozoa

Table 3. PSI of California Current functional groups. Significant diet overlaps (>60%) are shaded in gray.

Group	Benthic detritivores	Meiobenthos	Deep vertical migrators	Pacific hake	Canary rockfish	Shallow large rockfish	Small planktivores	Cephalopods	Large planktivores	Transient orca	Albacore tuna	Chinook salmon	Migrating seabirds	Surface seabirds	Other benthic filter feeders	Mesozooplankton	Benthic herb. grazers	Large zooplankton	Shrimp	Small flatfish	Megazoobenthos	Misc. nearshore fish	Shallow small rockfish	Baleen whales	Benthic carnivores	English sole	Shallow macrozoobenthos	Deep macrozoobenthos	Sea otter
Benthic detritivores	X																												
Meiobenthos	**82**	X																											
Deep vertical migrators	5	0	X																										
Pacific hake	0	0	41	X																									
Canary rockfish	0	0	43	**80**	X																								
Sh. large rockfish	0	0	42	**81**	**95**	X																							
Small planktivores	18	0	49	**63**	**63**	**62**	X																						
Cephalopods	5	0	51	**72**	**73**	**72**	**72**	X																					
Large planktivores	5	0	49	**64**	**61**	**63**	**71**	**78**	X																				
Transient orca	0	0	0	0	0	0	0	0	0	X																			
Albacore tuna	0	0	11	23	6	6	3	11	10	0	X																		
Chinook salmon	0	0	26	46	27	28	26	32	36	0	58	X																	
Migrating seabirds	0	0	16	24	6	5	4	7	13	0	**70**	**66**	X																
Surface seabirds	0	0	6	26	7	9	6	9	16	0	**60**	**73**	**74**	X															
Other benthic filter feeders	14	0	0	0	0	0	25	0	0	0	0	0	0	0	X														
Mesozooplankton	14	0	0	0	0	0	26	0	0	0	0	0	0	0	**70**	X													
Benthic herb. grazers	34	20	0	0	0	0	26	0	0	0	0	0	0	0	25	40	X												
Large zooplankton	18	0	23	14	14	15	49	21	24	0	4	14	3	9	32	47	56	X											
Shrimp	0	0	4	0	0	1	1	6	1	0	5	0	0	3	25	0	0	1	X										
Small flatfish	0	0	8	6	6	5	6	16	9	0	9	7	4	6	0	0	0	5	59	X									
Megazoobenthos	0	0	4	6	2	4	4	12	9	0	9	5	5	8	4	0	0	1	49	55	X								
Misc. nearshore fish	0	0	4	0	0	1	3	17	14	0	5	3	0	2	0	0	0	1	59	58	58	X							

Table 3 continued vertically. PSI of California Current functional groups. Significant diet overlaps (>60%) are shaded in gray.

Group	Benthic detritivores	Meiobenthos	Deep vertical migrators	Pacific hake	Canary rockfish	Shallow large rockfish	Small planktivores	Cephalopods	Large planktivores	Transient orca	Albacore tuna	Chinook salmon	Migrating seabirds	Surface seabirds	Other benthic filter feeders	Mesozooplankton	Benthic herb. grazers	Large zooplankton	Shrimp	Small flatfish	Megazoobenthos	Misc. nearshore fish	Shallow small rockfish	Baleen whales	Benthic carnivores	English sole	Shallow macrozoobenthos	Deep macrozoobenthos	Sea otter
Sh. small rockfish	1	0	41	29	32	29	31	39	32	0	13	29	13	8	0	0	0	17	35	42	36	36	X						
Baleen whales	0	0	40	41	36	38	36	41	39	0	14	32	9	12	0	0	0	15	38	42	38	40	**63**	X					
Benthic carnivores	20	20	4	0	0	1	0	4	0	0	5	0	0	0	0	0	20	1	38	38	34	40	34	50	X				
English sole	0	0	4	1	3	1	4	13	5	0	5	2	0	2	0	0	0	1	58	**63**	43	58	40	59	50	X			
Shallow macrozoo-benthos	0	0	4	1	2	1	2	14	4	0	6	3	0	2	0	0	0	1	23	24	27	44	16	13	13	21	X		
Deep macrozoo-benthos	0	0	20	20	20	20	20	20	20	0	3	20	3	8	20	0	0	14	30	9	34	20	20	20	0	4	12	X	
Sea otter	0	0	0	1	3	0	2	12	4	0	1	3	0	2	0	0	0	0	10	12	37	36	27	0	0	10	31	30	X
Midwater rockfish	0	0	48	48	41	41	38	47	47	0	25	45	29	29	0	0	0	17	6	11	13	5	43	46	5	8	7	20	2
Small demersal sharks	0	0	42	47	43	47	46	58	**60**	0	13	37	16	24	0	0	0	17	7	16	13	21	31	40	1	9	18	25	17
Deep benthic filter feeders	18	0	26	14	14	15	38	24	23	0	8	14	3	6	43	29	14	50	29	18	18	14	30	29	14	15	13	29	0
Gelatinous zooplankton	18	0	41	33	33	33	57	39	43	0	3	26	3	9	48	48	15	55	0	4	0	0	29	33	0	0	0	20	0
Large demersal predators	0	0	1	9	4	5	2	8	11	0	12	21	25	28	0	0	0	1	1	3	8	0	5	7	0	4	3	1	3
Pelagic sharks	0	0	0	20	1	3	0	3	10	0	32	39	47	46	0	0	0	0	1	0	6	0	1	5	0	0	0	0	0
Diving seabirds	0	0	16	29	11	12	9	12	19	0	48	59	**64**	**66**	0	0	0	8	1	4	6	0	17	14	0	0	0	8	0
Large flatfish	0	0	14	24	14	14	14	28	27	0	22	26	27	27	0	0	0	11	5	13	17	12	23	20	4	12	9	10	9
Deep large rockfish	1	0	15	11	13	11	13	28	22	0	13	25	23	28	0	0	0	10	11	21	15	31	33	19	9	18	40	9	28
Sablefish	0	0	9	10	6	7	5	13	17	0	20	25	32	36	0	0	0	5	9	13	15	8	15	16	7	9	8	4	2
Skates and rays	0	0	13	8	9	8	9	19	31	0	18	19	25	21	0	0	0	6	7	14	14	18	19	13	6	11	9	5	3
Deep small rockfish	0	0	27	21	14	14	13	28	23	0	26	30	36	30	0	0	0	12	35	48	41	47	53	47	30	40	27	10	14
Deep misc. fishes	2	0	26	12	14	13	16	24	31	0	12	13	14	7	0	0	0	14	25	32	26	36	43	32	39	29	15	11	2

Table 3 continued vertically. PSI of California Current functional groups. Significant diet overlaps (>60%) are shaded in gray.

Group	Benthic detritivores	Meiobenthos	Deep vert. migrators	Pacific hake	Canary rockfish	Shallow large rockfish	Small planktivores	Cephalopods	Large planktivores	Transient orca	Albacore tuna	Chinook salmon	Migrating seabirds	Surface seabirds	Other benthic filter feeders	Mesozooplankton	Benthic herb. grazers	Large zooplankton	Shrimp	Small flatfish	Megazoobenthos	Misc. nearshore fish	Shallow small rockfish	Baleen whales	Benthic carnivores	English sole	Shallow macrozoobenthos	Deep macrozoobenthos	Sea otter
Pinnipeds	0	0	0	14	1	2	0	3	9	0	20	30	37	41	0	0	0	0	0	0	5	0	1	5	0	0	0	0	0
Toothed whales	0	0	10	3	2	3	0	9	11	0	15	11	23	18	0	0	0	1	3	7	6	6	12	6	3	5	6	0	3
Large demersal sharks	0	0	0	1	0	0	3	8	8	16	5	14	11	19	0	0	0	0	6	8	8	11	2	0	0	8	8	5	8
Small cetaceans	0	0	19	9	3	3	0	9	10	0	20	17	36	27	0	0	0	1	3	6	7	6	13	9	3	5	6	0	3
Shallow benthic filter feeders	18	0	8	0	0	0	29	6	8	0	0	0	0	0	**65**	40	20	47	35	0	4	0	1	0	0	0	0	20	0
Microzooplankton	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**67**	42	0	7	35	0	4	0	0	0	0	0	0	20	0

Table 3 continued horizontally. PSI of California Current functional groups. Significant diet overlaps (>60%) are shaded in gray. Group column list on this page repeats last 19 items from same list of previous two pages of this table.

Group	Midwater rockfish	Small demersal sharks	Deep benthic filter feeders	Gelatinous zooplankton	Large demersal predators	Pelagic sharks	Diving seabirds	Large flatfish	Deep large rockfish	Sablefish	Skates and rays	Deep small rockfish	Deep misc. fishes	Pinnipeds	Toothed whales	Large demersal sharks	Small cetaceans	Shallow benthic filter feeders	Microzooplankton
Midwater rockfish	X																		
Small demersal sharks	52	X																	
Deep benthic filter feeders	19	15	X																
Gelatinous zooplankton	36	36	57	X															
Large demersal predators	24	30	1	1	X														
Pelagic sharks	21	15	0	0	51	X													
Diving seabirds	37	25	8	8	37	51	X												
Large flatfish	33	36	14	10	33	32	34	X											
Deep large rockfish	27	31	19	9	23	16	21	36	X										
Sablefish	27	24	10	4	31	30	30	36	47	X									
Skates and rays	26	32	12	5	33	17	30	38	36	39	X								
Deep small rockfish	38	33	25	11	14	17	35	32	43	35	27	X							
Deep misc. fishes	25	17	27	13	2	0	17	23	31	21	42	48	X						
Pinnipeds	19	19	0	0	35	41	34	25	19	34	15	20	0	X					
Toothed whales	18	15	3	0	14	18	26	16	16	24	21	27	16	58	X				
Large demersal sharks	3	16	0	0	12	13	12	8	13	22	13	14	4	46	49	X			
Small cetaceans	24	16	3	0	28	36	39	27	15	26	18	36	13	50	**61**	44	X		
Shallow benthic filter feeders	0	0	57	49	0	0	0	0	1	0	0	0	2	0	0	0	0	X	
Microzooplankton	0	0	29	32	0	0	0	0	0	0	0	0	0	0	0	0	0	57	X

Table 4. Comparison of our California Current food web to other marine food webs from Dunne et al. (2004), using common food web structure properties including: taxa (the number of species), s (the number of lumped trophic species), c (connectance [C=L/S2]), links per species (L/S), percent top species (%T), percent intermediate species (%I), percent basal species (%B), percent cannibalistic species (%Can), and percent omnivorous species (%Omn).

Food web	Taxa	S	C	L/S	%T	%I	%B	%Can	%Omn	Source
California Current	*	49	0.23	11.3	4	83	14	39	37	This study
Other marine food webs										
Benguela Current	29	29	0.24	7.0	0	93	7	24	76	Yodzis 1998
Caribbean reef small	50	50	0.22	11.1	0	94	6	42	86	Opitz 1996
Northeast U.S. shelf	81	79	0.22	17.8	4	94	3	32	78	Link 2002
Caribbean reef large	249	245	0.05	13.8	0	98	2	4	87	Opitz 1996

*The number of species which contributed to this study is unknown due to the aggregation of prey into functional groups; however, we estimate the total to be approximately 200 (±50) species.

Table 5. PSI for all fish species diets. The borders outline comparisons of species within functional groups. Significant diet overlaps (>60%) are shaded in gray. Table is continued vertically on next page, then horizontally on third page to encompass all function groups and species.

Group	Species	Redstripe rockfish	Yelloweye rockfish	Blue rockfish	English sole	Longspine thornyhead	Sharpchin rockfish	Splitnose rockfish	Shortspine thornyhead	Darkblotched rockfish	Rougheye rockfish	Canary rockfish	Widow rockfish	Pacific ocean perch	Yellowtail rockfish	Black rockfish	Rosethorn rockfish	Greenstriped rockfish	Pygmy rockfish	Pacific mackerel	Jack mackerel	Northern anchovy	Pacific sardine	Pacific herring	Arrowtooth flounder	Pacific halibut	Petrale sole
Sh. large rockfish	Redstripe rockfish	X																									
	Yelloweye rockfish	1	X																								
	Blue rockfish	6	37	X																							
English sole	English sole	1	23	4	X																						
Deep small rockfish	Longspine thornyhead	2	35	19	34	X																					
	Sharpchin rockfish	45	16	10	16	24	X																				
	Splitnose rockfish	**95**	2	8	2	7	50	X																			
Deep large rockfish	Shortspine thornyhead	1	24	4	18	44	14	3	X																		
	Darkblotched rockfish	**79**	6	9	6	15	**64**	**84**	6	X																	
	Rougheye rockfish	9	29	19	17	32	25	14	26	18	X																
Canary rockfish	Canary rockfish	**95**	3	8	3	5	50	**97**	4	**80**	14	X															
Midwater rockfish	Widow rockfish	35	7	9	6	14	45	40	11	43	19	37	X														
	Pacific ocean perch	**65**	14	10	12	22	**74**	**70**	15	**82**	28	**69**	44	X													
	Yellowtail rockfish	41	10	15	2	20	48	44	12	45	26	44	**68**	49	X												
	Black rockfish	16	39	50	5	20	19	18	9	19	24	16	23	19	27	X											
Sh. small rockfish	Rosethorn rockfish	7	29	10	52	35	32	12	23	21	55	12	17	28	15	11	X										
	Greenstriped rockfish	**73**	12	10	13	22	**71**	**78**	13	**90**	26	**77**	44	**90**	48	20	26	X									
	Pygmy rockfish	**92**	2	8	3	4	49	**94**	2	**85**	11	**92**	37	**67**	41	18	11	**75**	X								
Large planktivores	Pacific mackerel	**63**	2	7	2	6	49	**63**	5	**67**	13	**63**	43	**66**	51	27	10	**66**	**69**	X							
	Jack mackerel	57	9	13	3	10	46	57	4	57	28	58	37	58	51	28	8	58	57	**60**	X						
Small planktivores	Northern anchovy	**66**	2	7	5	4	48	**65**	4	**66**	14	**68**	34	**67**	42	19	10	**69**	**66**	**64**	**61**	X					
	Pacific sardine	55	0	6	2	3	47	54	1	58	10	54	34	54	40	17	8	56	**60**	**69**	56	**79**	X				
	Pacific herring	**81**	7	9	8	10	53	**82**	8	**87**	24	**81**	40	**71**	42	25	14	**80**	**86**	**68**	**67**	**69**	59	X			
Large flatfish	Arrowtooth flounder	15	33	24	7	23	20	16	15	15	34	18	18	23	25	33	17	20	15	17	24	18	15	17	X		
	Halibut	1	30	7	24	49	15	3	35	7	21	3	8	13	7	9	24	13	3	3	6	2	1	8	55	X	
	Petrale sole	1	21	2	4	3	2	1	4	1	16	0	2	2	1	6	2	3	1	2	27	3	1	10	12	12	X

Table 5 continued vertically. PSI for all fish species diets. Significant diet overlaps (>60%) are shaded in gray.

Group	Species	Redstripe rockfish	Yelloweye rockfish	Blue rockfish	English sole	Longspine thornyhead	Sharpchin rockfish	Splitnose rockfish	Shortspine thornyhead	Darkblotched rockfish	Rougheye rockfish	Canary rockfish	Widow rockfish	Pacific ocean perch	Yellowtail rockfish	Black rockfish	Rosethorn rockfish	Greenstriped rockfish	Pygmy rockfish	Pacific mackerel	Jack mackerel	Northern anchovy	Pacific sardine	Pacific herring	Arrowtooth flounder	Pacific halibut	Petrale sole
Chinook salmon	Chinook salmon	27	40	41	0	21	27	27	1	26	23	27	29	29	40	**69**	8	28	26	33	36	26	26	28	32	6	1
Deep misc. fishes	Pacific grenadier	2	20	4	39	45	15	4	24	8	20	2	9	13	7	8	28	13	5	7	5	5	4	11	7	29	5
	Giant grenadier	16	16	10	17	27	30	18	22	21	35	17	21	28	22	22	22	27	18	20	46	20	17	30	21	20	28
	Northern smoothtongue	21	20	9	28	31	36	23	10	30	18	21	33	29	28	19	33	30	29	39	21	22	39	30	16	21	2
	Twoline eelpout	38	20	9	37	32	50	39	19	43	22	37	40	48	42	19	44	47	39	41	37	37	37	43	17	25	2
Pelagic sharks	Soupfin shark	1	46	26	0	23	1	0	8	0	17	0	2	6	12	27	0	1	0	3	7	0	0	1	35	26	11
Skates and rays	Longnose skate	7	27	10	12	25	22	12	22	17	37	10	18	24	20	17	22	23	9	12	31	11	8	21	24	27	37
	Bering skate	1	13	0	4	6	0	0	7	0	14	0	0	0	0	4	1	1	0	1	30	3	1	8	6	9	59
	Big skate	1	13	0	4	23	0	0	27	0	14	0	0	0	0	4	1	1	0	1	30	3	1	8	7	24	41
Dp. demersal sharks	Sleeper shark	0	1	0	8	14	1	0	14	0	10	0	1	2	5	3	2	3	0	4	3	3	1	3	4	6	3
	Sixgill shark	1	1	0	1	12	1	0	9	0	6	0	1	3	5	0	0	2	0	3	0	0	0	0	14	17	1
Lingcod	Lingcod	1	39	8	3	11	5	1	5	1	15	4	4	6	11	10	5	5	1	4	10	3	1	2	28	23	15
Sablefish	Sablefish	4	18	12	9	38	14	7	36	10	24	6	12	14	17	13	14	15	6	9	10	5	4	11	31	39	6
Pacific hake	Pacific hake	**79**	21	26	1	17	46	**79**	3	**79**	19	**80**	36	**66**	49	36	8	**74**	**79**	**63**	**65**	**66**	54	**79**	32	5	1
Small flatfish	Dover sole	1	12	4	34	23	13	3	13	6	12	3	7	11	3	4	13	12	3	1	1	3	0	7	4	13	2
	Rex sole	1	19	3	49	29	12	2	10	6	9	0	6	8	0	3	32	8	2	1	0	0	0	6	1	20	1
	Pacific sanddab	1	28	4	39	31	16	2	24	6	45	3	6	14	2	7	49	12	3	2	31	6	2	15	12	23	27
	Deepsea sole	1	18	4	36	28	14	2	13	6	11	2	6	11	2	4	18	11	2	1	1	3	1	7	4	18	2
Deep vert. migrators	Blue lanternfish	**95**	3	9	3	5	50	**97**	3	**84**	12	**95**	37	**67**	41	19	11	**76**	**97**	**65**	57	**66**	57	**85**	15	3	1
	California headlightfish	**67**	12	9	12	13	58	**68**	10	**76**	17	**66**	39	**73**	41	19	20	**75**	**74**	**78**	57	**66**	**76**	**76**	15	12	1
	Pacific viperfish	1	0	0	0	8	36	3	0	12	3	2	4	16	5	0	7	14	0	0	0	0	0	0	1	1	0
	Northern lampfish	29	19	9	22	23	42	30	10	38	17	28	33	36	28	19	30	37	36	43	28	29	50	37	15	20	1
	Garnet lanternfish	20	4	9	6	9	26	21	5	28	13	19	25	23	20	19	12	24	27	35	20	20	41	27	15	5	1
Albacore tuna	Albacore tuna	3	39	41	5	29	12	8	9	11	24	5	13	15	18	57	12	13	5	7	10	3	3	9	23	12	2
Sm. demersal sharks	Spiny dogfish	53	15	9	3	18	47	53	8	53	21	53	40	55	53	22	10	56	53	**60**	59	54	54	55	29	20	12
	Spotted ratfish	1	19	3	13	28	6	2	41	6	21	0	5	6	0	8	7	7	2	1	10	3	1	14	15	33	25

Table 5 continued horizontally. PSI for all fish species diets. The borders outline comparisons of species within functional groups. Significant diet overlaps (>60%) are shaded in gray. Group column list on this page is repeated from previous page and this page has 26 additional columns to the right.

Group	Species	Chinook salmon	Pacific grenadier	Giant grenadier	Northern smoothtongue	Twoline eelpout	Soupfin shark	Longnose skate	Bering skate	Big skate	Sleeper shark	Sixgill shark	Lg. demersal pred.	Sablefish	Pacific hake	Dover sole	Rex sole	Pacific sanddab	Deepsea sole	Blue lanternfish	California headlightfish	Pacific viperfish	Northern lampfish	Garnet lanternfish	Albacore tuna	Spiny dogfish	Spotted ratfish
Chinook salmon	Chinook salmon	X																									
Deep misc. fishes	Pacific grenadier	7	X																								
	Giant grenadier	21	48	X																							
	Northern smoothtongue	21	30	29	X																						
	Twoline eelpout	31	52	54	44	X																					
Pelagic sharks	Soupfin shark	31	6	5	0	5	X																				
Skates and rays	Longnose skate	20	27	52	15	28	14	X																			
	Bering skate	0	5	37	0	0	1	34	X																		
	Big skate	0	9	41	0	4	2	38	**79**	X																	
Dp. demersal sharks	Sleeper shark	5	40	10	0	5	13	9	6	6	X																
	Sixgill sharks	6	47	19	0	16	17	20	0	4	48	X															
Lg. demersal pred.	Lingcod	21	3	5	1	3	43	38	8	8	7	11	X														
Sablefish	Sablefish	14	26	25	12	22	29	37	4	8	21	28	24	X													
Pacific hake	Pacific hake	46	2	17	21	37	20	9	0	0	0	0	9	10	X												
Small flatfish	Dover sole	1	21	13	16	11	0	10	1	1	6	1	3	10	2	X											
	Rex sole	0	34	13	27	32	0	8	0	0	1	1	0	7	0	55	X										
	Pacific sanddab	1	35	52	28	24	0	31	42	42	3	0	4	9	2	21	32	X									
	Deepsea sole	0	26	16	21	15	0	10	1	1	1	0	3	9	1	**74**	**74**	27	X								
Deep vert. migrators	Blue lanternfish	26	5	18	26	40	0	10	0	0	0	0	1	6	**78**	3	3	3	3	X							
	California headlightfish	26	14	27	50	49	0	15	0	0	0	0	1	10	**66**	10	12	12	12	**72**	X						
	Pacific viperfish	0	0	0	0	0	0	5	0	0	0	0	0	1	0	0	0	0	0	0	0	X					
	Northern lampfish	26	24	28	**60**	50	0	15	0	0	0	0	1	10	28	10	22	22	15	33	**62**	0	X				
	Garnet lanternfish	19	8	19	46	23	0	11	0	0	0	0	1	8	20	7	6	6	7	25	46	0	**74**	X			
Albacore tuna	Albacore tuna	56	11	11	8	11	32	16	1	1	5	4	10	20	23	6	5	5	5	6	8	4	8	7	X		
Sm. demersal sharks	Spiny dogfish	37	11	22	24	42	15	30	16	17	9	21	20	23	56	2	0	2	1	53	53	0	28	20	11	X	
	Spotted ratfish	0	12	16	6	7	8	31	25	43	11	5	15	15	1	13	7	15	6	3	6	0	6	4	6	21	X

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Appendix A: Sources for Diets

Below are summaries of the publications that contributed to each species' diet and subsequently each functional group's diet. Two or three letter abbreviations for each functional group are listed for consistency with Brand et al. (2007). The species that comprise each functional group are listed in the first sentence of each summary, with the species ordered from most to least abundant by biomass.

Fish

Shallow Large Rockfish (SHR)

Adult shallow large rockfish diets consist of data from redstripe (*Sebastes proriger*), yelloweye (*S. ruberrimus*), and blue rockfishes (*S. mystinus*). Redstripe stomachs came from Shaw (1999) as mentioned in Field (2004). Steiner (1979) sampled an unknown number of yelloweye rockfish stomachs off the Oregon coast and York (2005) sampled 9 stomachs, also off the Oregon coast. Steiner also surveyed 51 blue rockfish off the Oregon coast. Juvenile large shallow rockfish diets consisted of copper (*S. caurinus*) and blue rockfish data. Singer (1982) analyzed 38 juvenile copper rockfish stomachs and 23 juvenile blue rockfish stomachs, all from central California.

English Sole (FDP)

Wakefield (1984) collected 49 English sole (*Parophrys vetulus*) stomachs off Newport, Oregon. There was no distinction between juvenile and adult diets in this study; therefore, adult diets were used for juvenile diets as well.

Deep Small Rockfish (FDC)

Longspine thornyhead (*Sebastolobus altivelis*), sharpchin rockfish (*Sebastes zacentrus*), and splitnose rockfish (*S. diploproa*) comprise this group. York (2005) collected 36 sharpchin stomachs from Oregon and Shaw (1999) collected 8 stomachs from this species. Brodeur and Pearcy (1984) analyzed 62 splitnose stomachs, and longspine thornyhead data were taken from Laidig (unpublished data) as described in the Field (2004) and Buckley et al. (1999) samples of 281 longspine thornyhead stomachs. No juvenile data were available for this group. Juvenile diet data were adapted from adult data by reducing fish prey items to juveniles of the associated species. Small-bodied fish prey such as small planktivores and benthopelagics were left unchanged.

Deep Large Rockfish (FDO)

Deep large rockfish diets are based on shortspine thornyhead (*Sebastolobus alascanus*), darkblotched (*Sebastes crameri*), and rougheye rockfish (*S. aleutianus*). Buckley (1999) collected 473 shortspine thornyhead stomachs and Brodeur and Pearcy (1984) collected 30 darkblotched stomachs. Yang and Nelson (2000) analyzed 238 rougheye stomach samples from Alaska sampled in 1991 and 1993. Juvenile data came from 18 darkblotched rockfish diets collected by Miller and Brodeur (2007).

Canary Rockfish (FPO)

Adult canary rockfish (*S. pinniger*) diets come from 561 stomach samples. Brodeur and Pearcy (1984) collected 368 stomachs from Oregon and Washington, Lee (2002) collected 104 stomachs off Oregon and Washington, and York (2005) analyzed 29 stomachs from Oregon. An additional 60 stomachs were analyzed by the NOAA-AFSC food habits database from the West Coast trawl survey. Juvenile data were adapted from Lea et al. (1999), which contained only frequency of occurrence data.

Midwater Rockfish (FDS)

Adult midwater rockfish diets consist of widow rockfish (*S. entomelas*), Pacific ocean perch (*S. alutus*), and yellowtail rockfish (*S. flavidus*). Yellowtail rockfish made up the greatest number of stomachs. Pereyra et al. (1969) collected 22 stomachs off Vancouver Island, Brodeur and Pearcy (1984) collected 264 off Oregon and Washington, and Lee (2002) collected 167 off Oregon. Additional unpublished data (526 stomachs) were summarized by Field (2004). Unpublished diet data (186 stomachs) for Pacific ocean perch were also summarized by Field (2004). Brodeur and Pearcy (1984) collected 73 stomachs off Washington and Oregon. Widow rockfish stomachs were analyzed from Oregon and northern California by Adams (1987) and Lee (2002). Ressler et al. (unpublished) analyzed 41 stomachs from Oregon in 2003. Field (2004) also summarized an unpublished analysis of 18 widow rockfish stomachs. Studies of adult bocaccio rockfish (*Sebastes paucispinis*) diet were not available, so this species was not included in species-level analysis. However, due to the overfished status of this species and its conservation importance, we have separated bocaccio from this functional group in ongoing work (Horne et al. in prep.).

Juvenile midwater rockfish diets come from chilipepper rockfish (*S. goodei*), yellowtail rockfish, widow rockfish, and bocaccio. Reilly et al. (1992) analyzed 195 juvenile widow stomachs, 97 yellowtail, 145 chilipepper, and 128 bocaccio from central California. Miller and Brodeur (2007) examined an additional 26 yellowtail and 41 juvenile widow rockfish.

Shallow Small Rockfish (FDB)

Rosethorn (*S. helvomaculatus*), greenstriped (*S. elongatus*), and pygmy rockfish (*S. wilsoni*) are the species in this functional group for which diet information is available. Shortbelly (*S. jordani*) and stripetail (*S. saxicola*) rockfish accounted for 70% of the biomass for this group (NMFS trawl survey, Keller et al. 2007); unfortunately, no adult diet information is available for either species. York (2005) analyzed stomachs from each species from Oregon,

with 60 rosethorn, 51 greenstriped, and 49 pygmy stomachs sampled. Juvenile diets came from 1,027 shortbelly rockfish from central California (Chess et al. 1988, Reilly et al. 1992).

Large Planktivores (FPL)

Pacific mackerel (*Scomber japonicus*) and jack mackerel (*Trachurus symetricus*) are the only 2 species to compose this group. Brodeur et al. (1987) sampled 290 Pacific mackerel and 132 jack mackerel diets from 1982 to 1984. Miller and Brodeur (2007) analyzed an additional 316 jack mackerel and 24 Pacific mackerel diets. There was no distinction between adult and juvenile diets in either of these studies. There exists a large degree of variability in prey items between sample years for these 2 species.

Small Planktivores (FPS)

Northern anchovy (*Engraulis mordax*), Pacific sardine (*Sardinops sagax*), and Pacific herring (*Clupea pallasii*) constitute the three species in this group. Anchovy and herring diets were summarized by Brodeur et al. (1987) from samples collected in 1981 to 1984. Northern anchovy data from 1981 consisted of 15 nonempty stomachs. Pacific herring diets consisted of 94 samples collected from 1981 to 1984. Emmett et al. (2005) examined 184 Pacific sardine stomachs from 1999 to 2002. Miller and Brodeur (2007) analyzed stomach samples from each of the three species off the Oregon coast in 2000 and 2002 (anchovy n = 132, sardine n = 268, herring n = 286). No juvenile data exist for these three species.

Large Flatfish (FVD)

Arrowtooth flounder (*Atheresthes stomias*), Pacific halibut (*Hippoglossus stenolepis*), and petrale sole (*Eopsetta jordani*) make up the large flatfish group. Large piscivorous flatfish diets have been well sampled. Arrowtooth flounder diet studies have largely been concentrated in the Gulf of Alaska. Buckley (1999) collected 178 adult stomachs, Yang (1994) collected 337, Gotshall (1969) collected 253, and Yang and Nelson (2000) analyzed nearly 3,000. Yang and others (Yang 1994, Yang and Nelson 2000) also analyzed 1,657 adult Pacific halibut diets from the Gulf of Alaska. Petrale sole diet data were less abundant, with Wakefield (1984) being the only source of percent by weight data. Juvenile piscivorous flatfish diets rely again on Yang (1994), who analyzed diets from 201 juvenile arrowtooth flounder and 91 juvenile Pacific halibut from the Gulf of Alaska.

Chinook Salmon (FVB)

Chinook salmon (*Oncorhynchus tshawytscha*) is the sole species of this group. Brodeur et al. (1987) collected 86 adult Chinook salmon stomachs off Washington and Oregon from 1979 to 1984. Other sources of adult Chinook salmon diets included Silliman (1941), who analyzed 818 stomachs from 1,939 salmon off Washington, and Merkel (1957), who collected 1,004 from near San Francisco. For juveniles, Brodeur and Pearcy (1990) collected 795 stomachs off Oregon and Washington, Landingham et al. (1998) collected 38 from British Columbia waters, and Schabetsberger (2003) collected 249 from the Columbia River plume.

Deep Miscellaneous Fish (FDD)

Diets for deep demersal fish are based on Pacific grenadiers (*Coryphaenoides acrolepis*), giant grenadiers (*Albatrossia pectoralis*), and two deepwater miscellaneous fishes (California smoothtongue [*Bathylagus stilbius*] and twoline eelpout [*Bothrocara brunneum*]). For adult diets, Buckley et al. (1999) collected 29 giant grenadier and 33 Pacific grenadier stomachs from the 1992 trawl survey, and Pearcy and Ambler (1974) described two additional Pacific grenadier stomachs. Deepwater miscellaneous diets came from 385 California smoothtongue off Santa Barbara, California (Cailliet and Ebeling 1990), and 228 twoline eelpout stomachs off central California (Monterey Bay) and the Columbia River plume (Ferry 1997). Juvenile diet data were available for 483 Pacific grenadiers and 304 giant grenadiers from the 1997 NMFS slope survey from Pt. Conception to the U.S.-Canadian border (Drazen et al. 2001).

Pelagic Sharks (SHP)

Soupfin sharks (*Galeorhinus galeus*) are the primary members of this functional group and diets were available only for adults. Brodeur et al. (1987) collected 12 soupfin shark stomachs off Oregon and Washington from 1981 to 1984, Bonham (1949) analyzed 50 off Washington, and Ripley (1946) examined 170 off California.

Skates and Rays (SSK)

Longnose (*Raja rhina*), Bering (*Bathyraja interrupta*), and big skates (*R. binoculata*) represent this group's diet data; no juvenile data are available. Longnose skate diets were available for central California from Robinson et al. (2007), who analyzed 563 stomachs. Wakefield (1984) analyzed an additional 4 samples from Newport, Oregon. A single Bering skate and 98 big skate stomachs were also available from Wakefield (1984), caught off Newport. No juvenile data were available for of this group.

Large Demersal Sharks (SHD)

Sleeper sharks (*Somniosus pacificus*) make up the majority of this group's diet data, with a small contribution from sixgill sharks (*Hexanchus griseus*). All shark diets were adapted from a review of shark diets worldwide by Cortes (1999), although adult and juvenile diets were not differentiated.

Large Demersal Predators (FVS)

Lingcod (*Ophiodon elongatus*) is the sole species making up this group. Lingcod diets were not widely available through the California Current. Wakefield (1984) collected 4 adult stomachs off Newport, Oregon. A larger sample size was available from Beaudreau and Essington (in press), who collected 160 adults and 400 juveniles from the San Juan Islands, Washington.

Sablefish (FMN)

Sablefish (*Anoplopoma fimbria*) diets have been well examined coast-wide. Buckley et al. (1999) reported on diets from 601 adult sablefish, from Washington to Pt. Conception in the

mid-1990s. Laidig and Adams (1997) also reported 1,868 stomachs collected from Oregon to central California, and Cailliet et al. (1988) analyzed 249 from central California as well. Brodeur et al. (1987) reported on 138 juvenile stomachs from Oregon and Washington and Cailliet et al. (1988) examined 65 juveniles from central California.

Pacific Hake (FMM)

Pacific hake (*Merluccius productus*) is the sole species to represent gadids in the California Current because they make up the vast majority of gadid biomass (Keller et al. 2007). Both adult and juvenile diets were available from multiple studies coast-wide. In Washington and Oregon, Brodeur et al. (1987) collected 156 adult stomachs, Livingston and Alton (1982) examined 164 adult stomachs, and Livingston (1983) analyzed 1,499 adult stomachs. Gotshall (1969) collected 450 stomachs from the California-Oregon border south to Pt. Conception and Rexstad and Pikitch (1986) analyzed 347 stomachs from the West Coast. Additionally, 1,201 stomachs were available from the NMFS trawl survey, with approximately twice as many samples north of Cape Blanco than south (Buckley et al. 1999), and 253 samples from more recent surveys (Ressler et al. 2007). Diets of 40 juvenile Pacific hake were available from Oregon and Washington (Livingston and Alton 1982) and 364 were analyzed from the trawl survey coast-wide (Buckley et al. 1999).

Small Flatfish (FDF)

Dover sole (*Microstomus pacificus*), rex sole (*Glyptocephalus zachirus*), Pacific sanddab (*Citharichthys sordidus*), and deepsea sole (*Embassichthys bathybius*) make up this group. Juvenile data were unavailable for all 4 species. Dover sole diets were available coast-wide; 770 stomachs were analyzed from the NMFS trawl survey (Buckley et al. 1999). The remainder of samples were from Oregon: 326 from Pearcy and Hancock (1978), 265 from Gabriel and Pearcy (1981), 243 from Gabriel (1978), and 24 from Wakefield (1984). Pearcy and Hancock (1978) analyzed 614 rex sole and 723 Pacific sanddab diets. Eight additional samples off Oregon were examined by Wakefield (1984). Deepsea sole stomachs were analyzed by Buckley et al. (1999), with 131 samples coast-wide.

Deep Vertical Migrators (FBP)

Myctophids (blue lanternfish [*Tarletonbeania crenularis*] and California headlightfish [*Diaphus theta*]), Pacific viperfish (*Chauliodus macouni*), and northern lampfish (*Stenobrachius leucopsarus*) compose this group. Tyler (1970) analyzed 326 samples from two species of lampfish. Balanov (1994) analyzed 7 adult Pacific viperfish stomachs from the Bering Sea. Northern lampfish stomachs were available from central California (n = 494, Cailliet and Ebeling 1990) and Oregon (n = 440, Tyler 1970). An unknown number of garnet lampfish (*Stenobrachius nannochir*) stomachs were analyzed by Beamish (1999). Juvenile data came from 7 Pacific viperfish from Balanov (1994).

Large Pelagic Predators (FVT)

Albacore tuna (*Thunnus alalunga*) is the sole contributor to this group. All available albacore diets were from relatively small individuals, which are immature according to published literature (90 cm, Collette and Nauen 1983). Despite the lack of large adults, the data were used

for both adults and juveniles. The majority of data were collected from the 1950s and 1960s in central and southern California by Iverson (1971, n = 905 collected from 1968 to 1969) and McHugh (1952, n = 107). In the early 1980s Bernard et al. (1985) examined 94 stomachs from the same region.

Small Demersal Sharks (SHB)

This group is composed of spiny dogfish (*Squalus acanthias*) and spotted ratfish (*Hydrolagus colliei*). This group was dominated by dogfish biomass (Keller et al. 2007), which in turn makes up the majority of predators sampled. For adults, 185 dogfish (Bonham 1954) from Washington and 28 ratfish from Oregon (Wakefield 1984) made up the diet. Juvenile data were only available for dogfish. Brodeur et al. (1987) examined 113 stomachs from Washington and Oregon. Since this was the only data source for juveniles from within the California Current, we also included 3,396 juvenile stomachs from off Vancouver Island (Tanasichuck et al. 1991).

Miscellaneous Nearshore Fish (FDE)

This group contains croakers (Sciaenidae), wrymouths (Cryptacanthodidae), and sculpins (Cottidae). Quantitative studies were lacking for this group and subsequently the group was excluded from the analysis as a predator, though it is included as a prey diet item.

Seabirds

Migrating Seabirds (FVO)

The migratory bird group consists primarily of sooty shearwaters (*Puffinus griseus*), but also includes black-footed albatross (*Phoebastria nigripes*), Laysan albatross (*P. immutabilis*), Northern fulmar (*Fulmarus glacialis*), and black-legged kittiwakes (*Rissa tridactyla*). There were no data differentiating adult and juvenile diets. Hunt et al. (2000) conducted a review of bird and mammal diets in the subarctic North Pacific, and subdivided the study area into regions, one of which approximates the area of the California Current. Also, Wiens and Scott (1975) estimated energetic fluxes to sooty shearwaters in Oregon. Because neither data source had a sample size associated with it, estimates from the two sources were averaged to determine the final diet for this group.

Diving Seabirds (SP)

Diving seabird diets are largely informed by two studies: a review of bird and mammal diets in the subarctic North Pacific by Hunt et al. (2000) and a broad survey of bird diets in central California by Sydeman et al. (1997). For cormorants (*Phalacrocorax* spp.), pigeon guillemots (*Cepphus columba*), Cassin's auklets (*Ptychoramphus aleuticus*), and rhinoceros auklets (*Cerorhinca monocerata*), the review and the empirical study were given equal weights. Ancient murrelet (*Synthliboramphus antiquus*), marbled murrelet (*Brachyramphus marmoratus*), and tufted puffin (*Fratercula cirrhata*) diets were only available from Hunt et al. (2000). Common murres (*Uria aalge*) make up the largest proportion of biomass for this group, with multiple empirical diet studies existing. Sydeman et al. (1997) described 1,985 chick-feeding

events and Ainley et al. (1996) observed 554 feeding bouts, both in central California. Because these two empirical studies existed and had such large sample sizes, we did not include the Hunt et al. (2000) review data for common murre.

Surface Seabirds (SB)

This seabird group is dominated by gulls and empirical diet data were collected from chick feeding at western gull (*Larus occidentalis*) colonies in California (n = 449, Hunt and Butler 1980). Storm petrels (Hydrobatidae) play a relatively small role in this group, but some diet data were available for them from a review (Hunt et al. 2000).

Marine Mammals

Baleen Whales (WHB)

Gray (*Eschrichtius robustus*), blue (*Balaenoptera musculus*), fin (*B. physalus*), and humpback (*Megaptera novaeangliae*) whales make up the baleen whale group. Baleen whale diets were adapted from a marine mammal diet review by Pauly et al. (1998), who provided diet data for all four species. Clapham et al. (1997) analyzed stomach contents from fin (n = 1,355) and humpback whales (n = 141) caught from 1919 to 1926. Croll et al. (1998) also analyzed an unknown number of blue whale fecal samples. Individual species biomass estimates were calculated from California Current abundance estimates from Barlow and Fourney (2007). Gray whale biomass estimates were obtained from Angliss and Outlaw (2008).

Toothed Whales (WHT)

Large toothed whale diets consist of contributions from sperm whales (*Physeter macrocephalus*), pilot whales (*Globicephala macrorhynchus*), Baird's beaked whales (*Berardius bairdii*), Cuvier's beaked whales (*Ziphius cavirostris*), mesoplodon beaked whales (*Mesoplodon* spp.), and resident killer whales (*Orcinus orca*). Data for resident killer whales came from Ford and Ellis (2006), who observed 529 feeding events from 1974 to 2005 along the coast of British Columbia, and Ford et al. (1996), who recorded 135 confirmed fish kills. All remaining species data came from a review of marine mammal diets (Pauly et al. 1998). Species biomass estimates were adapted from California Current abundance estimates from Barlow and Fourney (2007).

Transient Orcas (REP)

Transient killer whale data came from three sources. The majority of data for this group contained only predation observation events. From these predation events, we derived a diet proportion by accounting for killer whale feeding behavior and biomass of prey items. Jefferson et al. (1991) reviewed historic literature predation events on marine mammals, amounting to 764 different predation observations. Ford et al. (1998) observed 130 predation events on marine mammals and seabirds. Pauly et al. (1998) also reviewed literature to derive a proportion diet estimate.

Small Cetaceans (WHS)

Small cetaceans include eight species: short-beaked common dolphin (*Delphinus delphis*), Dall's porpoise (*Phocoenoides dalli*), Pacific white-sided dolphin (*Lagenorhynchus obliquidens*), Risso's dolphin (*Grampus griseus*), harbor porpoise (*Phocoena phocoena*), northern right whale dolphin (*Lissodelphis borealis*), striped dolphin (*Stenella coeruleoalba*), and bottlenose dolphin (*Tursiops truncatus*). All diet data were obtained from the 1998 review by Pauly et al.

Sea Otters (WDG)

Sea otter (*Enhydra lutris*) diets come from the southern regions of the California Current. The method of data collection for sea otter diets is visual identification of prey items that animals retrieve on each dive. As such, sample size is the number of successful dives observed and diet is represented by percent frequency of prey types. Van Blaricom et al. (1988) observed 1,025 successful dives from central California and the Channel Islands. Twenty years prior, Hall and Schaller observed 455 dives (1964), McLean (1962) observed 5,882 dives, and Ebert (1968) observed 243 dives in central California. Adults and juveniles diets were not differentiated in any of the studies; however, since juveniles are thought to learn feeding preferences directly from their mothers (Estes et al. 2003), it can be reasonably assumed that adults and juveniles have similar diets.

Pinnipeds (PIN)

California sea lion (*Zalophus californianus*), Steller sea lion (*Eumetopias jubatus*), northern fur seal (*Callorhinus ursinus*), harbor seal (*Phoca vitulina*), and northern elephant seal (*Mirounga angustirostris)* comprise this group. Adult California sea lion diets were sampled from 3 beached individuals in California (Fiscus and Baines 1966). Adult northern fur seals were sampled from the California coast from 1958 to 1966 (n = 2,566, Antonelis and Fiscus 1980). Perez and Biggs (1986) also described the diets of 3,798 individuals from Washington to California. Fiscus and Baines (1966) examined 6 northern fur seals from California and 3 Stellar sea lions, 2 from California and 1 from Oregon. Clemens and Wilby (1933) sampled 25 juvenile fur seals off Vancouver Island, Sinclair (1994) looked at 20 juvenile elephant seals from the Channel Islands, and Fiscus and Baines (1966) examined 1 juvenile Steller and 3 juvenile California sea lions from California.

Invertebrates

No empirical diet data are available for most invertebrate groups. Most invertebrate diets came from Field (2004), adapted to differences in functional group members, where necessary. A list of invertebrate groups and their contributing species is in Table 2.

Benthic Carnivores (BC)

This group is composed of polychaetes, burrowing crustacea, peanut worms, and flatworms. Diets were adapted from Field (2004).

Deposit Feeders (BD)

Benthic detritivores consist of primarily of small crustacea such as amphipods and isopods. Diets came from Field (2004).

Deep Benthic Filter Feeders (BFD)

This group spans a broad taxonomic range but consisted primarily of anemones, deep sea corals, and sponges. Diet data for anemones came from Kruger and Griffiths (1998), who analyzed the diet of single temperate species for a year. Sponge diets came from Ribes et al. (1999b).

Other Benthic Filter Feeders (BFF)

Bivalves and barnacles make up the majority of this group. Field (2004) constituted the only source for this group.

Shallow Benthic Filter Feeders (BFS)

Soft corals, gorgonians, tunicates, and sea pens are some of the taxa present in this group. Diets came from Ribes et al. (1999a) and Field (2004).

Benthic Herbivorous Grazers (BG)

The benthic herbivorous grazer group consists of primarily gastropods and urchins, but also includes herbivorous decapod shrimps. Data from Field (2004) were used for this group's diets.

Deep Macrozoobenthos (BMD)

Sea stars, brittle stars, and carnivorous gastropods comprise this group. Data from Field (2004) was adapted for this group's diet.

Meiobenthos (BO)

Flagellates, cilliates, and nematodes make up this group. Data were not available for their diet, so it was assumed they eat primarily detritus.

Megazoobenthos (BML)

Cancer (genus) and tanner (*Chionoecetes bairdi*) crabs and lobsters are the primary components of this group. Large crab diets are based on Field (2004). We assumed that tanner and Dungeness crabs (*Cancer magister*) contribute the majority of biomass for this group, and we weighted Field's (2004) species diets by their relative biomass to obtain a diet for this functional group.

Shallow Macrozoobenthos (BMS)

The only species for which diet data are available is giant octopus (*Enteroctopus dofleini*). Vincent et al. (1998) examined 193 octopus dens in the Gulf of Alaska.

Cephalopods (CEP)

Only one source is available to inform squid diets. Karpov and Cailliet (1995) examined 277 squid stomachs from Monterey Bay.

Shrimp (PWN)

Crangon and mysid shrimp comprise this group. Diets were derived from Field (2004).

Gelatinous Zooplankton (ZG)

Salps, jellyfish, ctenophores, and comb jellies all contribute to this group. Diets were adapted from Field (2004).

Microzooplankton (ZS)

Ciliates, dinoflagellates, nanoflagellates, etc., make up this group. Diets were solely based on Field (2004).

Mesozooplankton (ZM)

Copepods and cladocera comprise this group. Diets were adapted from Field (2004).

Large Zooplankton (ZL)

Euphausiids, chaetognaths, pelagic shrimp, pelagic polychaetes, etc., make up this group. Diets were adapted from Field (2004) to account for multiple taxa.

Appendix B: Tables of Functional Group Diets

Here diet composition is summarized in Tables B-1 through B-10 from the literature review by percent weight for members of the 10 feeding guilds in Figure 1. Functional groups are from Brand et al. (2007) and the species that comprise them are listed in Table 1 and Table 2. Vertebrate predator diets can vary between the juvenile and adult stages. Similarly, vertebrate prey may be either juveniles or adults. A Microsoft Excel file of the data is online at http://www.nwfsc.noaa.gov/publications/displayinclude.cfm?incfile=technicalmemorandum2009.inc.

Table B-1. Diet composition by percent weight for members of feeding guild A in Figure 1.

Prey	Deposit feeders	Meiobenthos
Labile detritus in sediment	0.8182	—
Large phytoplankton	0.1364	—
Mesozooplankton	0.0455	—
Sedimentary detritus	—	1.0000

Table B-2. Diet composition by percent weight for members of feeding guild B in Figure 1.

	Canary rockfish		Cephalopods	Deep vertical migrators		Large planktivores		Pacific hake		Shallow large rockfish		Small planktivores	
Prey	**Adult**	**Juv.**		**Adult**	**Juv.**	**Adult**	**Juv.**	**Adult**	**Juv.**	**Adult**	**Juv.**	**Adult**	**Juv.**
Benthic carnivores	—	—	0.0077	0.0005	0.0005	—	—	—	—	—	0.0393	—	—
Benthic herb. grazers	0.0285	—	0.0420	—	—	0.0031	0.0031	0.0107	—	0.0044	—	0.0143	0.0143
Cephalopods	—	—	0.0207	—	—	0.0182	0.0182	0.0009	0.0001	0.0003	—	0.0002	0.0002
Deep misc. fish	—	—	—	—	—	—	—	0.0004	—	—	—	—	—
Deep small rockfish	—	—	—	—	—	—	—	0.0001	—	—	—	—	—
Deep vertical migrators	0.0199	—		0.0106	0.0106	—	—	0.0007	—	—	—	—	—
Deposit feeders	—	0.2640	0.0406	0.0948	0.0948	0.0044	0.0044	0.0020	0.0057	0.0094	0.2466	0.0017	0.0017
Gelatinous zooplankton	0.0004	—	—	—	—	0.0164	0.0164	—	—	0.0006	0.1316	—	—
Juv. deep misc. fish	—	—	—	—	—	0.0167	0.0167	—	—	—	—	—	—
Juv. canary rockfish	—	0.0069	0.0001	—	—	—	—	—	—	—	—	—	—
Juv. deep large rockfish	—	0.0244	0.0002	—	—	0.0027	0.0027	0.0001	—	—	—	—	—
Juv. deep small rockfish	—	0.0666	0.0006	—	—	0.0030	0.0030	—	—	—	—	—	—
Juv. Pacific hake	0.0010	—	—	—	—	0.0200	0.0200	0.0059	0.0401	—	—	—	—
Juv. large demersal pred.	—	—	—	—	—	0.0062	0.0062	—	—	—	—	—	—
Juv. large flatfish	—	—	—	—	—	—	—	0.0002	—	—	—	—	—
Juv. midwater rockfish	—	0.0804	0.0007	—	—	0.0030	0.0030	0.0001	—	0.0025	—	—	—
Juv. misc. nearshore fish	—	—	—	—	—	—	—	—	—	0.0071	—	—	—
Juv. sh. large rockfish	—	0.0122	0.0001	—	—	0.0006	0.0006	—	—	0.0004	—	—	—
Juv. sh. small rockfish	—	0.0095	0.0001	—	—	0.0111	0.0111	—	—	0.0003	—	—	—
Juv. small flatfish	—	—	—	—	—	0.0070	0.0070	—	—	0.0062	—	—	—
Large phytoplankton	—	—	—	—	—	—	—	—	—	—	0.1402	0.2575	0.2575
Large zooplankton	0.9461	0.3120	0.6938	0.6670	0.6670	0.5983	0.5983	0.7827	0.8029	0.9500	—	0.6129	0.6129
Megazoobenthos	0.0001	—	0.0765	—	—	0.0373	0.0373	0.0004	—	—	0.1198	0.0024	0.0024
Mesozooplankton	—	—	0.0612	0.2260	0.2260	0.0789	0.0789	—	0.1419	—	0.2369	0.0876	0.0876
Midwater rockfish	—	—	—	—	—	—	—	—	—	0.0019	—	—	—
Misc. nearshore fish	—	—	—	—	—	0.0030	0.0030	0.0003	—	—	—	—	—
Other benthic filter feed.	—	—	—	—	—	—	—	—	—	—	0.0028	—	—
Sh. benthic filter feeders	—	—	—	0.0010	0.0010	—	—	—	—	—	—	—	—
Shallow large rockfish	—	—	—	—	—	—	—	—	—	0.0003	—	—	—
Shallow macrozoobenth.	—	—	—	—	—	—	—	—	0.0004	—	—	—	—
Shallow small rockfish	—		—	—	—	—	—	0.0005	—	0.0002	—	—	—
Shrimp	—	0.2240	0.0422	—	—	0.1395	0.1395	0.0006	0.0015	—	0.0828	0.0233	0.0233
Small flatfish	—	—	0.0017	—	—	—	—	0.0015	—	—	—	—	—
Small planktivores	0.0040	—	0.0098	—	—	0.0305	0.0305	0.1929	—	0.0164	—	0.0002	0.0002

Table B-3. Diet composition by percent weight for members of feeding guild C in Figure 1.

Prey	Large pelagic predators		Migrating seabirds		Chinook salmon		Surface seabirds	
	Adult	Juv.	Adult	Juv.	Adult	Juv.	Adult	Juv.
Benthic herbivorous grazers	—	—	—	—	0.0003	0.0040	—	—
Carrion	—	—	—	—	—	—	0.0608	0.0608
Cephalopods	0.0363	0.0363	0.0720	0.0720	0.0534	0.0142	0.1193	0.1193
Deep misc. fish	—	—	0.0227	0.0227	—	0.0045	—	—
Deep small rockfish	0.0078	0.0078	—	—	—	—	—	—
Deep vertical migrators	0.0366	0.0366	0.1293	0.1293	0.0025	0.0030	—	—
Deposit feeders	0.0465	0.0465	—	—	0.0002	0.0469	—	—
English sole	—	—	—	—	—	0.0043	—	—
Gelatinous zooplankton	0.0003	0.0003	—	—	0.0002	—	0.0264	0.0264
Juv. canary rockfish	—	—	0.0028	0.0028	—	—	—	—
Juv. deep large rockfish	0.0029	0.0029	0.0099	0.0099	0.0214	0.0145	0.0163	0.0163
Juv. deep small rockfish	—	—	0.0271	0.0271	0.0584	0.0397	0.0444	0.0444
Juv. Pacific hake	—	—	0.0813	0.0813	—	—	0.0439	0.0439
Juv. large flatfish	0.0002	0.0002	—	—	—	0.0011	—	—
Juv. midwater rockfish	—	—	0.0327	0.0327	0.0704	0.0479	0.0536	0.0536
Juv. misc. nearshore fish	—	—	—	—	—	—	0.0268	0.0268
Juv. shallow large rockfish	—	—	0.0050	0.0050	0.0107	0.0073	0.0082	0.0082
Juv. shallow small rockfish	—	—	0.0039	0.0039	0.0083	0.0091	0.0063	0.0063
Juv. small flatfish	0.0002	0.0002	—	—	—	0.0118	—	—
Large planktivores	0.0078	0.0078	—	—	—	—	—	—
Large zooplankton	0.0298	0.0298	0.0347	0.0347	0.2603	0.0859	0.0610	0.0610
Megazoobenthos	0.0083	0.0083	—	—	0.0262	0.0651	—	—
Mesozooplankton	—	—	—	—	—	0.0039	—	—
Midwater rockfish	0.0094	0.0094	—	—	—	—	—	—
Misc. nearshore fish	0.0016	0.0016	—	—	0.0002	0.0558	—	—
Other benthic filter feeders	—	—	—	—	—	—	0.0200	0.0200
Pacific hake	0.0012	0.0012	—	—	0.0020	0.0064	—	—
Shallow benthic filter feeders	—	—	—	—	—	0.0004	—	—
Shallow macrozoobenthos	0.0014	0.0014	—	—	0.0001	—	—	—
Shrimp	—	—	—	—	0.0001	0.0328	—	—
Small flatfish	—	—	—	—	0.0006	0.0607	—	—
Small planktivores	0.8097	0.8097	0.5786	0.5786	0.4840	0.4773	0.5130	0.5130

Table B-4. Diet composition by percent weight for members of feeding guild D in Figure 1.

Prey	Benthic herbivorous grazers	Large zooplankton	Meso-zooplankton	Other benthic filter feeders
Deposit feeders	—	0.0070	—	—
Labile detritus in sediment	0.2000	—	—	—
Gelatinous zooplankton	—	0.0245	—	—
Labile detritus	—	—	—	0.2500
Large phytoplankton	0.7000	0.5557	0.4000	0.2500
Large zooplankton	—	0.1400	—	—
Macroalgae	0.1000	—	—	—
Mesozooplankton	—	0.2011	—	—
Microzooplankton	—	0.0717	0.2000	0.2500
Small phytoplankton	—	—	0.4000	0.2500

Table B-5. Diet composition by percent weight for members of feeding guild E in Figure 1.

Prey	Baleen whales		Benthic carnivores	English sole		Megazoobenthos
	Adult	Juv.		Adult	Juv.	
Benthic carnivores	—	—	—	0.1600	0.1600	—
Benthic herbivorous grazers	—	—	—	0.0426	0.0426	—
Carrion	—	—	—	—	—	0.0125
Cephalopods	0.0049	0.0049	—	—	—	0.0005
Deep benthic filter feeders	—	—	—	—	—	—
Deep macrozoobenthos	—	—	—	0.0169	0.0169	0.1595
Deep vertical migrators	0.0049	0.0049	—	—	—	—
Deposit feeders	0.5863	0.5863	0.5000	0.7020	0.7020	0.2613
Labile detritus in sediment	—	—	0.2000	—	—	—
Gelatinous zooplankton	—	—	—	—	—	—
Juv. deep large rockfish	—	—	—	—	—	0.0001
Juv. deep misc. fish	—	—	—	—	—	0.0018
Juv. deep small rockfish	—	—	—	—	—	0.0002
Juv. large demersal predators	—	—	—	—	—	0.0002
Juv. midwater fish	—	—	—	—	—	—
Juv. midwater rockfish	—	—	—	—	—	0.0002
Juv. misc. nearshore fish	—	—	—	—	—	0.0017
Juv. sablefish	—	—	—	—	—	0.0002
Juv. shallow large rockfish	—	—	—	—	—	—
Juv. shallow small rockfish	—	—	—	—	—	—
Juv. small demersal sharks	—	—	—	—	—	0.0017
Juv. small flatfish	—	—	—	—	—	0.0050
Labile detritus	—	—	—	—	—	0.0451
Large zooplankton	0.3539	0.3539	—	—	—	—
Megazoobenthos	—	—	—	0.0199	0.0199	—
Meiobenthos	—	—	0.3000	—	—	—
Mesozooplankton	—	—	—	0.0029	0.0029	—
Other benthic filter feeders	—	—	—	0.0356	0.0356	0.3991
Shallow benthic filter feeders	—	—	—	—	—	—
Shrimp	—	—	—	0.0201	0.0201	0.0502
Small flatfish	—	—	—	—	—	0.0105
Small planktivores	0.0501	0.0501	—	—	—	0.0502

Table B-5 continued horizontally. Diet composition by percent weight for members of feeding guild E in Figure 1.

Prey (Column list is repeated from previous page.)	**Misc. nearshore fish**		**Shallow small rockfish**			**Small flatfish**	
	Adult	**Juv.**	**Adult**	**Juv.**	**Shrimp**	**Adult**	**Juv.**
Benthic carnivores	0.1000	0.1000	—	0.0027	0.1550	0.1713	0.1713
Benthic herbivorous grazers	—	—	0.2570	—	—	0.0170	0.0170
Carrion	—	—	—	—	0.0050	—	—
Cephalopods	—	—	0.0042	—	—	0.0021	0.0021
Deep benthic filter feeders	—	—	—	—	—	0.0011	0.0011
Deep macrozoobenthos	—	—	—	—	—	0.2759	0.2759
Deep vertical migrators	—	—	0.0816	—	—	0.0005	0.0005
Deposit feeders	0.4000	0.4000	0.3449	0.0179	0.3800	0.3776	0.3776
Labile detritus in sediment	—	—	—	—	—	—	—
Gelatinous zooplankton	—	—	0.0074	0.0364	—	0.0006	0.0006
Juv. deep large rockfish	—	—	0.0007	—	—	—	—
Juv. deep misc. fish	—	—	—	—	—	—	—
Juv. deep small rockfish	—	—	0.0019	—	—	—	—
Juv. large demersal predators	—	—	—	—	—	—	—
Juv. midwater fish	—	—	—	—	—	—	—
Juv. midwater rockfish	—	—	0.0023	—	—	—	—
Juv. misc. nearshore fish	—	—	—	—	—	0.0002	0.0002
Juv. sablefish	—	—	—	—	—	—	—
Juv. shallow large rockfish	—	—	0.0003	—	—	—	—
Juv. shallow small rockfish	—	—	0.0003	—	—	—	—
Juv. small demersal sharks	—	—	—	—	—	—	—
Juv. small flatfish	—	—	—	—	0.0050	0.0004	0.0004
Labile detritus	—	—	—	—	0.3500	—	—
Large zooplankton	—	—	0.2716	0.5892	—	0.0393	0.0393
Megazoobenthos	0.2000	0.2000	0.0122	0.0003	—	0.0512	0.0512
Meiobenthos	—	—	—	—	—	—	—
Mesozooplankton	—	—	0.0143	0.3535	—	0.0016	0.0016
Other benthic filter feeders	0.2000	0.2000	—	—	0.1000	0.0501	0.0501
Shallow benthic filter feeders	—	—	—	—	—	0.0076	0.0076
Shrimp	0.1000	0.1000	0.0013	—	0.0050	0.0035	0.0035
Small flatfish	—	—	—	—	—	—	—
Small planktivores	—	—	—	—	—	—	—

Table B-6. Diet composition by percent weight for members of feeding guild F in Figure 1.

Prey	Deep macrozoobenthos	Sea otters		Shallow macrozoobenthos
		Adult	Juv.	
Benthic herbivorous grazers	—	0.2596	0.2596	0.0238
Deep benthic filter feeders	0.3000	—	—	—
Deep macrozoobenthos	—	0.0008	0.0008	—
Deposit feeders	—	—	—	0.1260
Labile detritus	0.2000	—	—	—
Large zooplankton	0.2000	—	—	—
Megazoobenthos	—	0.1631	0.1631	0.7305
Other benthic filter feeders	0.3000	0.5760	0.5760	0.1187
Shallow macrozoobenthos	—	0.0005	0.0005	0.0010

Table B-7. Diet composition by percent weight for members of feeding guild G in Figure 1.

Prey	Deep benthic filter feeders	Gelatinous zooplankton	Midwater rockfish		Small demersal sharks	
			Adult	Juv.	Adult	Juv.
Benthic bacteria	0.1429	—	—	—	—	—
Benthic carnivores	—	—	0.0054	—	0.0016	—
Benthic herbivorous grazers	—	—	0.0236	—	—	—
Cephalopods	—	—	0.0233	—	0.0435	0.0001
Deep misc. fish	—	—	—	—	0.0024	—
Deep vertical migrators	—	—	0.0763	—	—	—
Deposit feeders	0.1429	—	0.0505	0.0016	0.0120	—
Gelatinous zooplankton	—	0.0268	0.2433	0.0016	0.0268	0.0027
Juv. canary rockfish	—	—	—	—	0.0005	—
Juv. deep large rockfish	—	—	0.0164	—	0.0017	—
Juv. deep small rockfish	—	—	0.0080	—	0.0047	—
Juv. English sole	—	—	—	—	—	0.0054
Juv. large flatfish	—	—	—	—	—	0.0018
Juv. midwater rockfish	—	—	0.0502	—	0.0057	—
Juv. Pacific hake	—	—	0.0182	—	0.0452	0.2099
Juv. sablefish	—	—	0.0012	—	—	—
Juv. shallow large rockfish	—	—	0.0008	—	0.0009	—
Juv. shallow small rockfish	—	—	0.0015	—	0.0007	—
Juv. small flatfish	—	—	0.0340	—	0.0997	0.0003
Labile detritus	0.1429	—	—	—	—	—
Large phytoplankton	0.1429	0.1547	—	—	—	—
Large planktivores	—	—	0.0117	—	—	—
Large zooplankton	0.1429	0.3323	0.3799	0.3855	0.4282	0.5904
Megazoobenthos	—	—	—	0.0017	0.1199	—
Mesozooplankton	0.1429	0.1607	—	0.6035	—	—
Microzooplankton	0.1429	0.1708	—	—	—	—
Misc. nearshore fish	—	—	—	—	0.0095	—
Other benthic filter feeders	—	—			0.0503	—
Shallow macrozoobenthos	—	—	0.0001	—	—	—
Shrimp	—	—	—	—	0.0258	—
Small demersal sharks	—	—	—	—	0.0964	—
Small phytoplankton	—	0.1547	—	—	—	—
Small planktivores	—	—	0.0929	—	0.0245	0.1894

Table B-8. Diet composition by percent weight for members of feeding guild H in Figure 1.

Prey	Deep large rockfish		Deep misc. fish		Deep small rockfish	
	Adult	Juv.	Adult	Juv.	Adult	Juv.
Benthic carnivores	0.0021	—	0.0447	0.0315	0.0316	0.0316
Benthic herbivorous grazers	0.1114	—	0.0088	0.0009	0.0150	0.0150
Canary rockfish	—	—	—	—	—	—
Carrion	0.0677	—	—	0.0975	0.0336	0.0336
Cephalopods	0.0058	—	—	0.3412	0.0880	0.0880
Chinook salmon	—	—	—	—	—	—
Deep benthic filter feeders	—	—	—	—	—	—
Deep large rockfish	—	—	—	—	0.0114	—
Deep macrozoobenthos	0.0001	—	0.0031	0.0053	0.0259	0.0259
Deep misc. fish	0.0735	—	0.1310	0.0173	0.0141	—
Deep small rockfish	—	—	—	—	0.0118	—
Deep vertical migrators	0.0137	—	0.0870	0.0773	0.1251	0.1251
Deposit feeders	0.0919	0.1798	0.2007	0.1847	0.3041	0.3041
Gelatinous zooplankton	—	0.2871	0.0048	0.0004	0.0025	0.0025
Juv. canary rockfish	—	—	—	—	—	—
Juv. deep large rockfish	0.0309	—	—	—	—	0.0114
Juv. deep misc. fish	—	—	—	—	—	0.0141
Juv. deep small rockfish	0.0771	—	—	—	—	0.0118
Juv. large flatfish	0.0020	—	—	—	—	—
Juv. midwater rockfish	0.0405	—	—	—	—	0.0008
Juv. Pacific hake	0.0773	—	—	0.0657	0.0043	0.0043
Juv. sablefish	—	—	—	—	—	—
Juv. shallow large rockfish	—	—	—	—	—	—
Juv. shallow small rockfish	0.0048	—	—	—	—	0.0001
Juv. small demersal sharks	—	—	—	—	—	—
Juv. small flatfish	0.0033	—	—	—	—	—
Large demersal predators	—	—	—	—	—	—
Large demersal sharks	—	—	—	—	—	—
Large flatfish	—	—	—	—	—	—
Large pelagic predators	—	—	—	—	—	—
Large planktivores	—	—	—	—	—	—
Large zooplankton	0.0867	0.1780	0.1112	0.0457	0.1030	0.1030
Macroalgae	—	—	—	—	—	—
Megazoobenthos	0.2830	—	0.0121	0.0371	0.1243	0.1243
Meiobenthos	—	—	0.1863	0.0002	—	—
Mesozooplankton	0.0077	0.1083	0.0167	0.0139	0.0045	0.0045
Midwater fish	—	—	—	—	—	—
Midwater rockfish	—	—	—	—	0.0008	—
Migrating seabirds	—	—	—	—	—	—
Misc. nearshore fish	—	—	—	—	—	—
Other benthic filter feeders	—	—	—	0.0014	—	—
Pacific hake	—	—	—	—	—	—
Pelagic sharks	—	—	—	—	—	—
Sablefish	—	—	—	—	—	—
Shallow benthic filter feeders	0.0006	—	0.0226	—	0.0079	0.0079
Shallow large rockfish	—	—	—	—	—	—
Shallow macrozoobenthos	0.0006	—	0.0003	0.0005	—	—
Shallow small rockfish	—	—	—	—	0.0001	—
Shrimp	0.0164	0.2467	0.1707	0.0794	0.0050	0.0050
Skates and rays	—	—	—	—	—	—
Small demersal sharks	—	—	—	—	—	—
Small flatfish	—	—	—	—	—	—
Small planktivores	0.0029	—	—	—	0.0870	0.0870

Table B-8 continued horizontally. Diet composition by percent weight for members of feeding guild H in Figure 1.

Prey (Column list is repeated from previous page.)	**Diving seabirds**		**Large flatfish**		**Large demersal predators**	
	Adult	**Juv.**	**Adult**	**Juv.**	**Adult**	**Juv.**
Benthic carnivores	—	—	0.0026	—	—	—
Benthic herbivorous grazers	—	—	0.0635	—	0.0326	0.0571
Canary rockfish	—	—	—	—	—	—
Carrion	—	—	0.0075	—	—	—
Cephalopods	0.1016	0.1016	0.0119	0.0063	0.0195	0.0058
Chinook salmon	0.0091	0.0091	0.0033	0.0022	0.0492	—
Deep benthic filter feeders	—	—	0.0003	—	—	—
Deep large rockfish	—	—	0.0008	—	—	—
Deep macrozoobenthos	—	—	—	0.0347	—	—
Deep misc. fish	0.0084	0.0084	0.0140	0.0090	—	0.0012
Deep small rockfish	—	—	0.0022	—	—	—
Deep vertical migrators	0.0755	0.0755	0.0057	0.0270	0.0011	0.0062
Deposit feeders	—	—	0.0370	0.1277	0.0022	0.0169
Gelatinous zooplankton	—	—	—	—	—	—
Juv. canary rockfish	0.0095	0.0095	—	—	0.0042	0.0080
Juv. deep large rockfish	—	—	—	—	0.0148	0.0283
Juv. deep misc. fish	—	—	—	—	—	—
Juv. deep small rockfish	—	—	—	—	0.0404	0.0773
Juv. large flatfish	—	—	—	—	—	—
Juv. midwater rockfish	0.1117	0.1117	—	—	0.0487	0.0934
Juv. Pacific hake	—	—	—	—	—	—
Juv. sablefish	—	—	—	—	—	—
Juv. shallow large rockfish	0.0170	0.0170	—	—	0.0074	0.0142
Juv. shallow small rockfish	0.0173	0.0173	—	—	0.0058	0.0110
Juv. small demersal sharks	—	—	—	—	0.1118	—
Juv. small flatfish	—	—	—	—	—	—
Large demersal predators	—	—	—	—	—	—
Large demersal sharks	—	—	—	—	—	—
Large flatfish	—	—	0.0175	—	—	—
Large pelagic predators	—	—	—	—	—	—
Large planktivores	—	—	0.0045	—	—	—
Large zooplankton	0.0823	0.0823	0.0984	0.0956	0.0076	0.0022
Macroalgae	—	—	—	—	—	—
Megazoobenthos	—	—	0.0267	—	—	—
Meiobenthos	—	—	—	—	—	—
Mesozooplankton	—	—	—	—	—	—
Midwater fish	—	—	—	—	—	—
Midwater rockfish	—	—	0.0027	—	—	—
Migrating seabirds	—	—	—	—	—	—
Misc. nearshore fish	0.0910	0.0910	0.0347	0.0259	0.2024	0.2135
Other benthic filter feeders	—	—	—	—	—	—
Pacific hake	0.0395	0.0395	0.3752	0.0612	0.0861	0.0612
Pelagic sharks	—	—	—	—	—	—
Sablefish	—	—	0.0003	—	—	—
Shallow benthic filter feeders	—	—	0.0005	—	—	—
Shallow large rockfish	—	—	—	—	—	—
Shallow macrozoobenthos	—	—	0.0015	—	0.0217	0.0174
Shallow small rockfish	0.0466	0.0466	—	—	0.2067	0.0773
Shrimp	0.0019	0.0019	0.0489	—	—	—
Skates and rays	—	—	0.0005	—	—	—
Small demersal sharks	—	—	—	—	—	—
Small flatfish	0.0337	0.0337	0.1240	0.0203	0.0763	0.0130
Small planktivores	0.3549	0.3549	0.1158	0.5901	0.0615	0.2960

Table B-8 continued horizontally. Diet composition by percent weight for members of feeding guild H in Figure 1.

Prey (Column list is repeated from previous page.)	**Pelagic sharks**		**Sablefish**		**Skates and rays**	
	Adult	**Juv.**	**Adult**	**Juv.**	**Adult**	**Juv.**
Benthic carnivores	—	—	0.0032	—	—	—
Benthic herbivorous grazers	—	—	0.0077	0.0325	0.0112	0.0112
Canary rockfish	0.0027	0.0027	—	—	—	—
Carrion	—	—	0.0602	—	—	—
Cephalopods	0.0545	0.0545	0.0894	0.0293	0.0444	0.0444
Chinook salmon	0.0384	0.0384	0.0016	—	—	—
Deep benthic filter feeders	—	—	0.0006	—	—	—
Deep large rockfish	0.0096	0.0096	0.0236	—	—	—
Deep macrozoobenthos	—	—	0.0006	—	—	—
Deep misc. fish	—	—	0.0664	0.0470	0.0704	0.0704
Deep small rockfish	0.0262	0.0262	0.3350	—	—	—
Deep vertical migrators	—	—	0.0109	—	0.0391	0.0391
Deposit feeders	—	—	0.0668	0.1183	0.0639	0.0639
Gelatinous zooplankton	0.0003	0.0003	0.0080	0.1308	—	—
Juv. canary rockfish	—	—	—	—	0.0035	0.0035
Juv. deep large rockfish	—	—	—	0.0051	0.0048	0.0048
Juv. deep misc. fish	—	—	—	—	—	—
Juv. deep small rockfish	—	—	—	0.0140	0.0276	0.0276
Juv. large flatfish	—	—	0.0016	—	—	—
Juv. midwater rockfish	—	—	—	0.0169	0.0173	0.0173
Juv. Pacific hake	—	—	—	—	—	—
Juv. sablefish	—	—	0.0094	—	—	—
Juv. shallow large rockfish	—	—	—	—	0.0042	0.0042
Juv. shallow small rockfish	—	—	—	—	0.0034	0.0034
Juv. small demersal sharks	—	—	—	—	0.0009	0.0009
Juv. small flatfish	—	—	—	—	—	—
Large demersal predators	0.0322	0.0322	—	0.0093	—	—
Large demersal sharks	0.0089	0.0089	—	—	—	—
Large flatfish	0.1019	0.1019	—	—	—	—
Large pelagic predators	0.0089	0.0089	—	—	—	—
Large planktivores	0.0359	0.0359	—	—	—	—
Large zooplankton	—	—	0.0339	0.2531	0.0534	0.0534
Macroalgae	—	—	0.0025	—	—	—
Megazoobenthos	—	—	0.0073	0.0473	0.0177	0.0177
Meiobenthos	—	—	—	—	—	—
Mesozooplankton	—	—	—	0.0006	—	—
Midwater fish	—	—	—	—	—	—
Midwater rockfish	0.0317	0.0317	0.0086	—	—	—
Migrating seabirds	0.0024	0.0024	—	—	—	—
Misc. nearshore fish	0.2246	0.2246	0.0008	0.0132	0.0032	0.0032
Other benthic filter feeders	—	—	0.0015	0.0001	—	—
Pacific hake	0.1156	0.1156	0.1338	—	0.0431	0.0431
Pelagic sharks	0.0088	0.0088	—	—	—	—
Sablefish	0.0049	0.0049	—	—	0.0002	0.0002
Shallow benthic filter feeders	—	—	0.0021	—	—	—
Shallow large rockfish	0.0048	0.0048	0.0012	—	—	—
Shallow macrozoobenthos	0.0043	0.0043	0.0089	0.0254	0.0456	0.0456
Shallow small rockfish	0.0037	0.0037	0.0186	—	0.0828	0.0828
Shrimp	—	—	0.0043	0.0002	0.2956	0.2956
Skates and rays	0.0121	0.0121	0.0020	—	—	—
Small demersal sharks	—	—	0.0079	—	—	—
Small flatfish	0.0120	0.0120	0.0321	0.0027	0.1659	0.1659
Small planktivores	0.2556	0.2556	0.0495	0.2542	0.0018	0.0018

Table B-9. Diet composition by percent weight for members of feeding guild I.

	Large demersal sharks		Pinnipeds		Small cetaceans		Toothed whales	
Prey	**Adult**	**Juv.**	**Adult**	**Juv.**	**Adult**	**Juv.**	**Adult**	**Juv.**
Cephalopods	0.3945	0.3945	0.4531	0.3719	0.3334	0.3334	0.6740	0.6740
Chinook salmon	0.1073	0.1073	0.0116	—	0.0710	0.0710	0.0639	0.0639
Deep large rockfish	—	—	0.0109	—	—	—	—	—
Deep small rockfish	0.1073	0.1073	0.0384	—	—	—	—	—
Deep vertical migrators	—	—	—	—	0.1580	0.1580	0.0724	0.0724
Deep. misc. fish	0.0037	0.0037	—	0.0616	—	—	0.0397	0.0397
Deposit feeders	—	—	—	0.0214	0.0276	0.0276	0.0316	0.0316
Gelatinous zooplankton	—	—	—	0.0060	—	—	—	—
Juv. Chinook salmon	—	—	—	0.0482	—	—	—	—
Juv. deep large rockfish	—	—	—	0.0012	—	—	—	—
Juv. deep small rockfish	—	—	—	0.0034	—	—	—	—
Juv. midwater rockfish	—	—	—	0.0041	—	—	—	—
Juv. Pacific hake	—	—	0.1035	0.0428	—	—	—	—
Juv. sablefish	—	—	—	0.0086	—	—	—	—
Juv. shallow large rockfish	—	—	—	0.0006	—	—	—	—
Juv. shallow small rockfish	—	—	—	0.0005	—	—	—	—
Juv. skates and rays	—	—	0.0550	0.0199	—	—	—	—
Juv. small demersal sharks	—	—	0.0550	0.0311	—	—	—	—
Juv. small flatfish	—	—	—	0.0212	—	—	—	—
Large flatfish	—	—	—	—	—	—	<0.00005	<0.00005
Large pelagic predators	0.1073	0.1073	—	—	—	—	—	—
Large planktivores	—	—	0.0018	—	0.0847	0.0847	0.0236	0.0236
Megazoobenthos	0.0271	0.0271	—	—	0.0276	0.0276	0.0316	0.0316
Midwater rockfish	—	—	0.0358	—	—	—	—	—
Misc. nearshore fish	—	—	—	0.0207	0.0710	0.0710	—	—
Other benthic filter feeders	0.0542	0.0542	—	—	—	—	—	—
Pacific hake	0.0037	0.0037	0.0967	—	0.0710	0.0710	0.0397	0.0397
Pinnipeds	0.1643	0.1643	—	—	—	—	—	—
Sablefish	—	—	0.0046	—	—	—	<0.00005	<0.00005
Shallow large rockfish	—	—	0.0054	—	—	—	<0.00005	<0.00005
Shallow macrozoobenthos	—	—	—	0.0172	—	—	—	—
Shallow small rockfish	—	—	0.0068	—	—	—	—	—
Shrimp	0.0271	0.0271	—	—	—	—	—	—
Small demersal sharks	0.0035	0.0035	—	—	—	—	—	—
Small planktivores	—	—	0.1214	0.3196	0.0847	0.0847	0.0236	0.0236

Table B-10. Diet composition by percent weight for members of feeding guild J in Figure 1.

Prey	**Shallow benthic filter feeders**	**Microzooplankton**
Labile detritus	0.4000	0.2500
Large phytoplankton	0.2000	0.3750
Mesozooplankton	0.2000	—
Microzooplankton	0.2000	—
Small phytoplankton	—	0.3750

Appendix C: Tables of Fish Species Diets

Here diet composition for fish species is summarized in Tables C-1 through C-52 from the literature review by percent weight. Each table lists prey by descending percent. A Microsoft Excel file of the data is online at http://www.nwfsc.noaa.gov/publications/displayinclude.cfm?incfile=technicalmemorandum2009.inc. The predator species appear in alphabetical order as follows:

Table C-1. Diet composition by weight for albacore tuna, a member of feeding guild B in Figure 11.

Prey	Percent
Small planktivores	0.8097
Deposit feeders	0.0465
Deep vertical migrators	0.0366
Cephalopods	0.0363
Large zooplankton	0.0298
Midwater rockfish	0.0094
Megazoobenthos	0.0083
Deep small rockfish	0.0078
Large planktivores	0.0078
Juv. deep large rockfish	0.0029
Miscellaneous nearshore fish	0.0016
Shallow macrozoobenthos	0.0014
Pacific hake	0.0012
Gelatinous zooplankton	0.0003
Juv. large flatfish	0.0002
Juv. small flatfish	0.0002

Table C-2. Diet composition by weight for arrowtooth flounder, a member of feeding guild H in Figure 11.

Prey	Percent
Pacific hake	0.4556
Small planktivores	0.1588
Large zooplankton	0.1402
Benthic herbivorous grazers	0.0881
Small flatfish	0.0411
Miscellaneous nearshore fish	0.0331
Shrimp	0.0155
Cephalopods	0.0134
Deep miscellaneous fishes	0.0109
Large flatfish	0.0106
Deposit feeders	0.0069
Deep vertical migrators	0.0064
Carrion	0.0050
Megazoobenthos	0.0044
Large planktivores	0.0037
Benthic carnivores	0.0035
Chinook salmon	0.0026
Shallow benthic filter feeders	0.0001
Gelatinous zooplankton	<0.00005
Mesozooplankton	<0.00005

Table C-3. Diet composition by weight for Bering skate, a member of feeding guild E in Figure 11.

Prey	Percent
Shrimp	0.6150
Small flatfish	0.3380
Megazoobenthos	0.0470

Table C-4. Diet composition by weight for big skate, a member of feeding guild E in Figure 11.

Prey	Percent
Shrimp	0.5879
Megazoobenthos	0.2165
Small flatfish	0.1542
Deep miscellaneous fishes	0.0356
Sablefish	0.0058
Benthic herbivorous grazers	<0.00005

Table C-5. Diet composition by weight for black rockfish, a member of feeding guild B in Figure 11.

Prey	Percent
Small planktivores	0.5076
Large zooplankton	0.1577
Juv. megazoobenthos	0.1158
Gelatinous zooplankton	0.0660
Deposit feeders	0.0346
Shrimp	0.0322
Juv. Pacific hake	0.0272
Juv. Chinook salmon	0.0261
Juv. midwater rockfish	0.0129
Small flatfish	0.0114
Juv. small flatfish	0.0042
Juv. shallow large rockfish	0.0020
Juv. shallow small rockfish	0.0015
Cephalopods	0.0010
Benthic herbivorous grazers	0.0003

Table C-6. Diet composition by weight for blue lanternfish, a member of feeding guild A in Figure 11.

Prey	Percent
Large zooplankton	0.9467
Deposit feeders	0.0296
Mesozooplankton	0.0237

Table C-7. Diet composition by weight for blue rockfish, a member of feeding guild B in Figure 11.

Prey	Percent
Gelatinous zooplankton	0.5502
Small planktivores	0.3517
Large zooplankton	0.0586
Deposit feeders	0.0265
Benthic herbivorous grazers	0.0130

Table C-8. Diet composition by weight for California headlightfish, a member of feeding guild A in Figure 11.

Prey	Percent
Large zooplankton	0.6618
Mesozooplankton	0.2206
Deposit feeders	0.1176

Table C-9. Diet composition by weight for canary rockfish, a member of feeding guild A in Figure 11.

Prey	Percent
Large zooplankton	0.9461
Benthic herbivorous grazers	0.0285
Deep vertical migrators	0.0199
Small planktivores	0.0040
Juv. Pacific hake	0.0010
Gelatinous zooplankton	0.0004
Megazoobenthos	0.0001

Table C-10. Diet composition by weight for Chinook salmon, a member of feeding guild B in Figure 11.

Prey	Percent
Small planktivores	0.4840
Large zooplankton	0.2603
Juv. midwater rockfish	0.0704
Juv. deep small rockfish	0.0584
Cephalopods	0.0534
Juv. megazoobenthos	0.0262
Juv. deep large rockfish	0.0214
Juv. shallow large rockfish	0.0107
Juv. shallow small rockfish	0.0083
Deep vertical migrators	0.0025
Pacific hake	0.0020
Miscellaneous nearshore fish	0.0008
Small flatfish	0.0006
Benthic herbivorous grazers	0.0003
Deposit feeders	0.0002
Gelatinous zooplankton	0.0002
Shallow macrozoobenthos	0.0001
Shrimp	0.0001

Table C-11. Diet composition by weight for darkblotched rockfish, a member of feeding guild A in Figure 11.

Prey	Percent
Large zooplankton	0.7845
Deep vertical migrators	0.1188
Deposit feeders	0.0552
Mesozooplankton	0.0414

Table C-12. Diet composition by weight for deepsea sole, a member of feeding guild D in Figure 11.

Prey	Percent
Benthic carnivores	0.5891
Deep macrozoobenthos	0.1790
Deposit feeders	0.1545
Deep benthic filter feeders	0.0343
Benthic herbivorous grazers	0.0229
Shallow benthic filter feeders	0.0131
Shrimp	0.0050
Megazoobenthos	0.0017
Other benthic filter feeders	0.0003

Table C-13. Diet composition by weight for Dover sole, a member of feeding guild D in Figure 11.

Prey	Percent
Benthic carnivores	0.4316
Deep macrozoobenthos	0.3597
Deposit feeders	0.0992
Other benthic filter feeders	0.0635
Benthic herbivorous grazers	0.0216
Shallow benthic filter feeders	0.0096
Megazoobenthos	0.0065
Large zooplankton	0.0040
Cephalopods	0.0027
Deep benthic filter feeders	0.0006
Gelatinous zooplankton	0.0006
Deep vertical migrators	0.0002
Mesozooplankton	0.0001
Macroalgae	<0.00005
Microzooplankton	<0.00005

Table C-14. Diet composition by weight for English sole, a member of feeding guild D in Figure 11.

Prey	Percent
Deposit feeders	0.7020
Benthic carnivores	0.1600
Benthic herbivorous grazers	0.0426
Other benthic filter feeders	0.0356
Shrimp	0.0201
Megazoobenthos	0.0199
Deep macrozoobenthos	0.0169
Mesozooplankton	0.0029

Table C-15. Diet composition by weight for garnet lampfish, a member of feeding guild C in Figure 11.

Prey	Percent
Mesozooplankton	0.7150
Large zooplankton	0.1934
Deposit feeders	0.0415
Shallow benthic filter feeders	0.0334
Benthic carnivores	0.0167

Table C-16. Diet composition by weight for giant grenadier, a member of feeding guild E in Figure 11.

Prey	Percent
Shrimp	0.3704
Deep miscellaneous fishes	0.2499
Large zooplankton	0.1523
Deposit feeders	0.1299
Cephalopods	0.0743
Benthic herbivorous grazers	0.0198
Deep macrozoobenthos	0.0032
Shallow macrozoobenthos	0.0003

Table C-17. Diet composition by weight for greenstriped rockfish, a member of feeding guild A in Figure 11.

Prey	Percent
Large zooplankton	0.7220
Deep vertical migrators	0.1349
Deposit feeders	0.0826
Benthic herbivorous grazers	0.0272
Cephalopods	0.0141
Megazoobenthos	0.0075
Mesozooplankton	0.0062
Shrimp	0.0056

Table C-18. Diet composition by weight for jack mackerel, a member of feeding guild A in Figure 11.

Prey	Percent
Large zooplankton	0.5674
Shrimp	0.2996
Small planktivores	0.0668
Juv. small flatfish	0.0130
Miscellaneous nearshore fish	0.0066
Benthic herbivorous grazers	0.0061
Juv. Pacific hake	0.0058
Juv. deep miscellaneous fish	0.0057
Juv. megazoobenthos	0.0055
Juv. midwater rockfish	0.0052
Juv. deep small rockfish	0.0051
Juv. deep large rockfish	0.0050
Juv. shallow small rockfish	0.0049
Deposit feeders	0.0016
Cephalopods	0.0010
Juv. shallow large rockfish	0.0003
Mesozooplankton	0.0003

Table C-19. Diet composition by weight for lingcod, a member of feeding guild H in Figure 11.

Prey	Percent
Shallow small rockfish	0.2067
Miscellaneous nearshore fish	0.2024
Juv. small demersal sharks	0.1118
Pacific hake	0.0861
Small flatfish	0.0763
Small planktivores	0.0615
Chinook salmon	0.0492
Juv. midwater rockfish	0.0487
Juv. deep small rockfish	0.0404
Benthic herbivorous grazers	0.0326
Shallow macrozoobenthos	0.0217
Cephalopods	0.0195
Juv. deep large rockfish	0.0148
Large zooplankton	0.0076
Juv. shallow large rockfish	0.0074
Juv. shallow small rockfish	0.0058
Juv. canary rockfish	0.0042
Deposit feeders	0.0022
Deep vertical migrators	0.0011

Table C-20. Diet composition by weight for longnose skate, a member of feeding guild E in Figure 11.

Prey	Percent
Shrimp	0.2126
Small flatfish	0.1293
Shallow small rockfish	0.1044
Deep miscellaneous fishes	0.0870
Deposit feeders	0.0803
Large zooplankton	0.0673
Shallow macrozoobenthos	0.0575
Cephalopods	0.0559
Pacific hake	0.0543
Deep vertical migrators	0.0493
Juv. deep small rockfish	0.0348
Juv. midwater rockfish	0.0218
Benthic herbivorous grazers	0.0141
Juv. deep large rockfish	0.0060
Juv. shallow large rockfish	0.0053
Juv. canary rockfish	0.0044
Juv. shallow small rockfish	0.0042
Miscellaneous nearshore fish	0.0040
Surfperch	0.0023
Small planktivores	0.0023
Megazoobenthos	0.0017
Small demersal sharks	0.0011

Table C-21. Diet composition by weight for longspine thornyhead, a member of feeding guild H in Figure 11.

Prey	Percent
Deposit feeders	0.2362
Megazoobenthos	0.1966
Small planktivores	0.1375
Cephalopods	0.0869
Deep vertical migrators	0.0812
Carrion	0.0531
Benthic carnivores	0.0499
Deep macrozoobenthos	0.0410
Deep miscellaneous fishes	0.0223
Deep small rockfish	0.0187
Deep large rockfish	0.0180
Large zooplankton	0.0167
Shallow benthic filter feeders	0.0124
Benthic herbivorous grazers	0.0114
Shrimp	0.0080
Pacific hake	0.0068
Gelatinous zooplankton	0.0015
Midwater rockfish	0.0012
Mesozooplankton	0.0002
Shallow small rockfish	0.0001

Table C-22. Diet composition by weight for northern anchovy, a member of feeding guild A in Figure 11.

Prey	Percent
Large zooplankton	0.6515
Large phytoplankton	0.2855
Shrimp	0.0277
Benthic herbivorous grazers	0.0241
Mesozooplankton	0.0070
Juv. megazoobenthos	0.0035
Deposit feeders	0.0004
Cephalopods	0.0003

Table C-23. Diet composition by weight for northern lampfish, a member of feeding guild C in Figure 11.

Prey	Percent
Large zooplankton	0.6401
Mesozooplankton	0.2509
Deposit feeders	0.1090

Table C-24. Diet composition by weight for northern smoothtongue, a member of feeding guild G in Figure 11.

Prey	Percent
Shallow benthic filter feeders	0.2779
Deposit feeders	0.2323
Large zooplankton	0.2073
Mesozooplankton	0.1788
Gelatinous zooplankton	0.0592
Benthic carnivores	0.0399
Benthic herbivorous grazers	0.0034
Cephalopods	0.0011

Table C-25. Diet composition by weight for Pacific grenadier, a member of feeding guild F in Figure 11.

Prey	Percent
Cephalopods	0.3490
Deposit feeders	0.2426
Deep miscellaneous fishes	0.2283
Benthic carnivores	0.0980
Megazoobenthos	0.0278
Shrimp	0.0267
Large zooplankton	0.0180
Mesozooplankton	0.0050
Deep macrozoobenthos	0.0040
Shallow macrozoobenthos	0.0005

Table C-26. Diet composition by weight for Pacific hake, a member of feeding guild A in Figure 11.

Prey	Percent
Large zooplankton	0.7827
Small planktivores	0.1929
Benthic herbivorous grazers	0.0107
Juv. Pacific hake	0.0059
Deposit feeders	0.0020
Small flatfish	0.0015
Cephalopods	0.0009
Deep vertical migrators	0.0007
Shrimp	0.0006
Shallow small rockfish	0.0005
Deep miscellaneous fishes	0.0004
Megazoobenthos	0.0004
Miscellaneous nearshore fish	0.0003
Juv. large flatfish	0.0002
Deep small rockfish	0.0001
Juv. deep large rockfish	0.0001
Juv. midwater rockfish	0.0001

Table C-27. Diet composition by weight for Pacific halibut, a member of feeding guild H in Figure 11.

Prey	Percent
Pacific hake	0.3763
Deposit feeders	0.2003
Megazoobenthos	0.1551
Deep miscellaneous fishes	0.0366
Small flatfish	0.0364
Small planktivores	0.0333
Large flatfish	0.0305
Carrion	0.0260
Miscellaneous nearshore fish	0.0208
Cephalopods	0.0128
Large planktivores	0.0125
Shallow macrozoobenthos	0.0098
Benthic herbivorous grazers	0.0096
Chinook salmon	0.0096
Shrimp	0.0085
Deep vertical migrators	0.0079
Large zooplankton	0.0039
Skates and rays	0.0035
Shallow benthic filter feeders	0.0031
Sablefish	0.0021
Benthic carnivores	0.0011
Deep macrozoobenthos	0.0002
Deep benthic filter feeders	0.0001

Table C-28. Diet composition by weight for Pacific herring, a member of feeding guild A in Figure 11.

Prey	Percent
Large zooplankton	0.8010
Shrimp	0.0833
Deposit feeders	0.0610
Mesozooplankton	0.0325
Juv. megazoobenthos	0.0130
Small planktivores	0.0089
Benthic herbivorous grazers	0.0003

Table C-29. Diet composition by weight for Pacific mackerel, a member of feeding guild A in Figure 11.

Prey	Percent
Large zooplankton	0.6242
Mesozooplankton	0.1448
Juv. megazoobenthos	0.0640
Cephalopods	0.0326
Juv. Pacific hake	0.0318
Gelatinous zooplankton	0.0301
Juv. deep miscellaneous fish	0.0258
Juv. shallow small rockfish	0.0164
Juv. large demersal predators	0.0115
Deposit feeders	0.0067
Shrimp	0.0055
Juv. small flatfish	0.0019
Juv. deep small rockfish	0.0012
Juv. midwater rockfish	0.0012
Juv. deep large rockfish	0.0009
Juv. shallow large rockfish	0.0008
Benthic herbivorous grazers	0.0006

Table C-30. Diet composition by weight for Pacific ocean perch, a member of feeding guild A in Figure 11.

Prey	Percent
Large zooplankton	0.6452
Deep vertical migrators	0.1605
Deposit feeders	0.0822
Benthic herbivorous grazers	0.0549
Large planktivores	0.0324
Cephalopods	0.0248

Table C-31. Diet composition by weight for Pacific sanddab, a member of feeding guild E in Figure 11.

Prey	Percent
Shrimp	0.4166
Benthic herbivorous grazers	0.2514
Deposit feeders	0.2374
Benthic carnivores	0.0866
Large zooplankton	0.0028
Small flatfish	0.0018
Gelatinous zooplankton	0.0012
Mesozooplankton	0.0010
Miscellaneous nearshore fish	0.0006
Cephalopods	0.0004
Pacific hake	0.0002

Table C-32. Diet composition by weight for Pacific sardine, a member of feeding guild A in Figure 11.

Prey	Percent
Large zooplankton	0.5429
Large phytoplankton	0.2279
Mesozooplankton	0.2157
Shrimp	0.0131
Deposit feeders	0.0005

Table C-33. Diet composition by weight for Pacific viperfish, not a member of a feeding guild.

Prey	Percent
Deep vertical migrators	0.9989
Mesozooplankton	0.0011

Table C-34. Diet composition by weight for petrale sole, a member of feeding guild E in Figure 11.

Prey	Percent
Small flatfish	0.6212
Shrimp	0.2546
Miscellaneous nearshore fish	0.0585
Large flatfish	0.0378
Deposit feeders	0.0122
Deep miscellaneous fishes	0.0056
Benthic herbivorous grazers	0.0041
Cephalopods	0.0041
Deep benthic filter feeders	0.0020

Table C-35. Diet composition by weight for pygmy rockfish, a member of feeding guild A in Figure 11.

Prey	Percent
Large zooplankton	0.9193
Mesozooplankton	0.0568
Deposit feeders	0.0226
Cephalopods	0.0009
Benthic herbivorous grazers	0.0004

Table C-36. Diet composition by weight for redstripe rockfish, a member of feeding guild A in Figure 11.

Prey	Percent
Large zooplankton	1.0000

Table C-37. Diet composition by weight for rex sole, a member of feeding guild D in Figure 11.

Prey	Percent
Benthic carnivores	0.6667
Deposit feeders	0.3189
Other benthic filter feeders	0.0144

Table C-38. Diet composition by weight for rosethorn rockfish, a member of feeding guild G in Figure 11.

Prey	Percent
Deposit feeders	0.4592
Benthic herbivorous grazers	0.3549
Deep vertical migrators	0.0706
Large zooplankton	0.0675
Megazoobenthos	0.0149
Mesozooplankton	0.0135
Gelatinous zooplankton	0.0105
Juv. midwater rockfish	0.0032
Juv. deep small rockfish	0.0027
Cephalopods	0.0011
Juv. deep large rockfish	0.0010
Juv. shallow large rockfish	0.0005
Juv. shallow small rockfish	0.0004

Table C-39. Diet composition by weight for rougheye rockfish, a member of feeding guild G in Figure 11.

Prey	Percent
Benthic herbivorous grazers	0.4875
Shrimp	0.1129
Large zooplankton	0.0875
Small planktivores	0.0869
Deposit feeders	0.0810
Cephalopods	0.0494
Deep vertical migrators	0.0340
Megazoobenthos	0.0262
Miscellaneous nearshore fish	0.0261
Pacific hake	0.0036
Benthic carnivores	0.0032
Other benthic filter feeders	0.0012
Small flatfish	0.0004

Table C-40. Diet composition by weight for sablefish, a member of feeding guild H in Figure 11.

Prey	Percent
Deep small rockfish	0.3350
Pacific hake	0.1338
Cephalopods	0.0894
Deposit feeders	0.0668
Deep miscellaneous fishes	0.0664
Carrion	0.0602
Small planktivores	0.0495
Large zooplankton	0.0339
Small flatfish	0.0321
Deep large rockfish	0.0236
Shallow small rockfish	0.0186
Deep vertical migrators	0.0109
Juv. sablefish	0.0094
Shallow macrozoobenthos	0.0089
Midwater rockfish	0.0086
Gelatinous zooplankton	0.0080
Small demersal sharks	0.0079
Benthic herbivorous grazers	0.0077
Megazoobenthos	0.0073
Shrimp	0.0043
Benthic carnivores	0.0032
Macroalgae	0.0025
Shallow benthic filter feeders	0.0021
Skates and rays	0.0020
Chinook salmon	0.0016
Juv. large flatfish	0.0016
Other benthic filter feeders	0.0015
Shallow large rockfish	0.0012
Miscellaneous nearshore fish	0.0008
Deep benthic filter feeders	0.0006
Deep macrozoobenthos	0.0006

Table C-41. Diet composition by weight for sharpchin rockfish, a member of feeding guild A in Figure 11.

Prey	Percent
Large zooplankton	0.4462
Deep vertical migrators	0.3571
Deposit feeders	0.1164
Benthic herbivorous grazers	0.0399
Mesozooplankton	0.0221
Cephalopods	0.0103
Gelatinous zooplankton	0.0080

Table C-42. Diet composition by weight for shortspine thornyhead, a member of feeding guild A in Figure 11.

Prey	Percent
Megazoobenthos	0.3196
Benthic herbivorous grazers	0.1206
Deposit feeders	0.0955
Juv. Pacific hake	0.0872
Deep small rockfish	0.0871
Deep miscellaneous fishes	0.0830
Carrion	0.0764
Midwater rockfish	0.0457
Deep large rockfish	0.0349
Shrimp	0.0185
Cephalopods	0.0066
Shallow small rockfish	0.0054
Canary rockfish	0.0039
Juv. small flatfish	0.0037
Small planktivores	0.0032
Benthic carnivores	0.0024
Juv. large flatfish	0.0023
Deep vertical migrators	0.0017
Large zooplankton	0.0009
Shallow benthic filter feeders	0.0007
Shallow macrozoobenthos	0.0007
Deep macrozoobenthos	0.0001

Table C-43. Diet composition by weight for sixgill shark, a member of feeding guild F in Figure 11.

Prey	Percent
Cephalopods	0.5689
Deep miscellaneous fishes	0.1143
Pacific hake	0.1143
Small demersal sharks	0.1068
Pinnipeds	0.0888
Other benthic filter feeders	0.0030

Table C-44. Diet composition by weight for sleeper shark, a member of feeding guild H in Figure 11.

Prey	Percent
Cephalopods	0.3890
Pinnipeds	0.1670
Chinook salmon	0.1110
Deep small rockfish	0.1110
Large pelagic predators	0.1110
Other benthic filter feeders	0.0560
Megazoobenthos	0.0280
Shrimp	0.0280

Table C-45. Diet composition by weight for soupfin shark, a member of feeding guild H in Figure 11.

Prey	Percent
Small planktivores	0.2556
Miscellaneous nearshore fish	0.2246
Pacific hake	0.1156
Large flatfish	0.1019
Cephalopods	0.0545
Chinook salmon	0.0384
Large planktivores	0.0359
Large demersal predators	0.0322
Midwater rockfish	0.0317
Deep small rockfish	0.0262
Skates and rays	0.0121
Small flatfish	0.0120
Deep large rockfish	0.0096
Large demersal sharks	0.0089
Large pelagic predators	0.0089
Pelagic sharks	0.0088
Sablefish	0.0049
Shallow large rockfish	0.0048
Shallow macrozoobenthos	0.0043
Shallow small rockfish	0.0037
Canary rockfish	0.0027
Migrating seabirds	0.0024
Gelatinous zooplankton	0.0003

Table C-46. Diet composition by weight for spiny dogfish, a member of feeding guild A in Figure 11.

Prey	Percent
Large zooplankton	0.5265
Small demersal sharks	0.1209
Small flatfish	0.0968
Megazoobenthos	0.0569
Cephalopods	0.0535
Pacific hake	0.0465
Gelatinous zooplankton	0.0330
Small planktivores	0.0308
Shrimp	0.0096
Miscellaneous nearshore fish	0.0039
Juv. shallow small rockfish	0.0030
Juv. canary rockfish	0.0030
Juv. deep large rockfish	0.0030
Juv. deep small rockfish	0.0030
Juv. midwater rockfish	0.0030
Juv. shallow large rockfish	0.0030

Table C-47. Diet composition by weight for splitnose rockfish, a member of feeding guild A in Figure 11.

Prey	Percent
Large zooplankton	0.9462
Deep vertical migrators	0.0310
Deposit feeders	0.0207
Cephalopods	0.0021

Table C-48. Diet composition by weight for spotted ratfish, a member of feeding guild H in Figure 11.

Prey	Percent
Megazoobenthos	0.3945
Other benthic filter feeders	0.2696
Small flatfish	0.1051
Shrimp	0.0965
Deposit feeders	0.0558
Pacific hake	0.0379
Miscellaneous nearshore fish	0.0296
Deep miscellaneous fishes	0.0111

Table C-49. Diet composition by weight for twoline eelpout, a member of feeding guild G in Figure 11.

Prey	Percent
Deposit feeders	0.3704
Large zooplankton	0.3704
Deep miscellaneous fishes	0.2111
Cephalopods	0.0482

Table C-50. Diet composition by weight for widow rockfish, a member of feeding guild G in Figure 11.

Prey	Percent
Gelatinous zooplankton	0.4829
Large zooplankton	0.3419
Deposit feeders	0.0460
Deep vertical migrators	0.0422
Juv. Pacific hake	0.0422
Benthic carnivores	0.0126
Cephalopods	0.0095
Small planktivores	0.0074
Juv. sablefish	0.0029
Juv. shallow small rockfish	0.0018
Juv. deep large rockfish	0.0018
Juv. deep small rockfish	0.0018
Juv. midwater rockfish	0.0018
Juv. shallow large rockfish	0.0018
Benthic herbivorous grazers	0.0017
Juv. small flatfish	0.0013
Shallow macrozoobenthos	0.0003
Deep miscellaneous fishes	<0.00005
Small flatfish	<0.00005

Table C-51. Diet composition by weight for yelloweye rockfish, a member of feeding guild H in Figure 11.

Prey	Percent
Small planktivores	0.3273
Deposit feeders	0.1913
Miscellaneous nearshore fish	0.1450
Small flatfish	0.1267
Benthic herbivorous grazers	0.0900
Juv. midwater rockfish	0.0508
Midwater rockfish	0.0382
Juv. shallow large rockfish	0.0077
Cephalopods	0.0066
Juv. shallow small rockfish	0.0060
Shallow large rockfish	0.0058
Shallow small rockfish	0.0045
Large zooplankton	0.0001

Table C-52. Diet composition by weight for yellowtail rockfish, a member of feeding guild G in Figure 11.

Prey	Percent
Large zooplankton	0.4013
Gelatinous zooplankton	0.2208
Juv. Pacific hake	0.1498
Small planktivores	0.0699
Cephalopods	0.0523
Deep vertical migrators	0.0459
Juv. small flatfish	0.0324
Benthic herbivorous grazers	0.0132
Deposit feeders	0.0046
Juv. midwater rockfish	0.0041
Juv. deep small rockfish	0.0034
Juv. deep large rockfish	0.0012
Juv. shallow large rockfish	0.0006
Juv. shallow small rockfish	0.0005

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