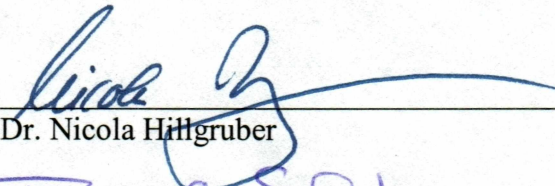


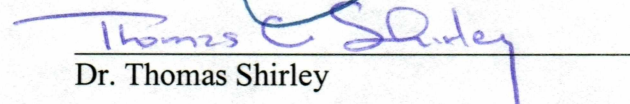
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IN SOUTHEASTERN ALASKA

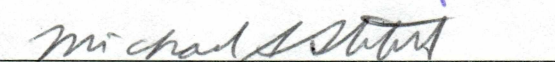
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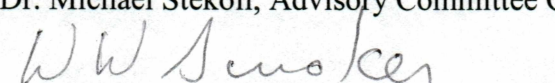
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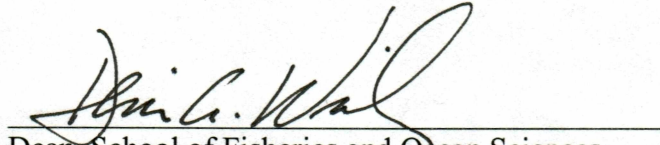

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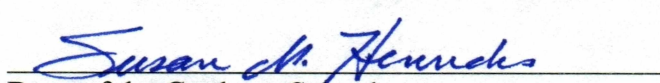

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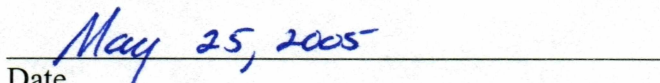

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Dean of the Graduate School

Date


May 25, 2005

KELP BEDS AS FISH AND INVERTEBRATE HABITAT
IN SOUTHEASTERN ALASKA

A
THESIS

Presented to the Faculty
of the University of Alaska Fairbanks

in Partial Fulfillment of the Requirements
for the Degree of

MASTER OF SCIENCE

By

Elizabeth L. Calvert, B.S.

Fairbanks, Alaska

August 2005

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Abstract

Throughout the temperate marine regime, the shallow subtidal is dominated by rocky reefs and algal assemblages. The ecological significance of high-latitude, cold-water kelp systems is poorly understood particularly for Alaska. Two large-scale experiments conducted near Juneau, Alaska were designed to study fish and invertebrate assemblages in regard to (1) canopy forming *Nereocystis luetkeana* (1500 m² manipulations) and (2) sub-canopy forming *Laminaria bongardiana* (600 m²). Fish and invertebrates were quantified using Standard Monitoring Units for the Recruitment of Fish (SMURFs), light traps, and visual surveys. The canopy kelp experiment revealed significantly greater abundance ($\bar{X}=0.57$ fish/SMURF; $\bar{X}=0.28$ fish/SMURF) and biomass ($\bar{X}=0.95$ g/SMURF; $\bar{X}=0.23$ g/SMURF) of benthic fishes at *Nereocystis* sites versus sites without canopy kelp. In contrast, a direct negative effect of *Nereocystis* was observed for schooling fish; significantly more fish were observed at sites without canopy kelp as compared to *Nereocystis* sites ($\bar{X}=27.3$ fish/15 m³; $\bar{X}=4.2$ fish/15 m³). Fish assemblages were independent of *L. bongardiana*, yet invertebrates were twice as abundant at sub-canopy sites. *Nereocystis* has direct and indirect effects on fish distributions through behavioral and habitat modifications. Overall, canopy kelps with associated sub-canopy kelps promote more abundant and rich fish assemblages in southeastern Alaska, while invertebrate assemblages are greater in sub-canopy areas.

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General Introduction

Over 40% of marine fish stocks are heavily to fully exploited, while 25% are classified as overexploited, depleted, or recovering (NRC 1999). Fisheries biologists work to manage and sustain commercially important stocks and habitat areas while researchers conduct studies to determine stock fluctuations and the outcome of natural or anthropogenic perturbations. Human damage to habitats (i.e., degradation, fragmentation) alters community function, habitat heterogeneity, and ecosystem biodiversity. Anthropogenic effects that cause community change include: fishing pressure, discharge of sediments, pesticides, sewage, industrial pollutants, and high concentrations of nutrients (Murray et al. 1999). Biologists and researchers have recognized the increasing need for further protection of the world's oceans, and prevention of continued habitat degradation and loss of ecosystem diversity (Allison et al. 1998).

In response to declining fish populations worldwide, the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA) of 1996 mandated the description and identification of essential fish habitat (EFH). Essential fish habitat is defined as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity. For the purpose of interpreting the definition of essential fish habitat: 'waters' includes aquatic areas and their associated physical, chemical, and biological properties that are used by fish, and may include areas historically used by fish where appropriate; 'substrate' includes sediment, hard bottom, structures underlying the waters, and associated biological communities; 'necessary' means the habitat required to

support a sustainable fishery and a healthy ecosystem; and 'spawning, breeding, feeding, or growth to maturity' covers a species' full life cycle" (NOAA 1998).

While fishery management previously focused on target species, the MSFCMA encouraged a more encompassing view of managing fish stocks, taking into account habitat attributes as well as the waters and surrounding environment. This expansion led to the prevalence of ecosystem-based fisheries management over single species approaches as species exist within ecosystems and cannot be isolated from their communities (Tegner & Dayton 2000).

Ecosystem-based research must therefore take into account a variety of biotic and abiotic factors that may affect populations. For example, many influences on recruitment success are abiotic (i.e., wind, currents, temperature) and beyond the control of management efforts. However, biotic factors such as nursery habitat and spawning grounds can be protected and controlled through management efforts. Many habitats are characterized by their biogenic structure (i.e., coral reefs, mangrove systems, kelp beds), thus adding a layer of complexity to the underlying rocky substratum.

Beneficial recruitment habitat may increase year class strength and secure population success. Some marine experiments have emphasized the combined and interactive effects of both propagule supply and adequate nursery habitat in determining patterns of recruitment (Carr 1994). Differential recruitment success may be affected by processes such as predation and food supply, which will ultimately determine year class strength. Larval recruitment to different habitat types results in variability of survivorship (Carr 1989). Beneficial habitat types will increase survivorship by

decreasing mortality due to predation, food limitation, or density-dependent competition. Therefore, determining essential habitats for critical life stages of marine fishes and protecting these may be the best means to protect and sustain fish stocks. Research into the distributional patterns of species and habitat preferences will allow the identification of essential fish habitat prior to natural or anthropogenic changes. Generalizing to common habitat attributes (i.e., increased structure, complexity, or diversity) could lead to managed protection plans earlier than scientific experiments could be completed.

The role of habitat types throughout the life cycle of marine organisms can vary. Species may depend on different habitat types throughout their life cycle and stage-based research shows some stages may be more influential to a population's success than others (Crouse et al. 1987). For example, nursery areas are those habitats that support or enhance the survivorship of newly released larvae and early life stages in higher abundances than predicted by larval availability. By identifying and protecting these nursery areas, managers hope to protect early life stages of fish.

Habitat complexity and spatial heterogeneity may be important to recruitment success by providing protection from predation (Willis & Anderson 2003), cannibalism (Carr 1989, Carr 1991, Anderson 1994, Carr 1994), and environmental stressors. Habitat complexity lessens competition for resources by providing more interstitial spaces, and food sources for juvenile fish. Also, more species can utilize microhabitats, specific habitats, or ecotones within spatial refugia of habitat types (Nelson 2001, Stunz et al. 2002). Therefore, maintaining spatial heterogeneity will help protect biodiversity across ecosystems. Because habitats occur in close proximity, ecotones, or the edges between

two different habitats, offer a habitat type of their own. Ecotones located at the marsh edge within estuaries in Galveston Bay, Texas are essential habitat for the recruitment of red drum, *Sciaenops ocellatus* (Stunz et al. 2002). The seagrass meadows and marsh edge interface supported much higher densities of newly settled red drum recruits as compared to other areas of the estuary. This ecotone may function as a nursery area for newly recruited red drum fish. Habitat complexity, spatial heterogeneity, and ecotone function must be taken into account when determining the importance of habitat types.

Coral reef fishes (tropical and temperate) are distinguished as those fish that depend on the structure or resources provided by the reefs for the majority of their life cycle (Montgomery et al. 2001). The three dimensional habitat created by branching coral species creates a refuge from predators and increased protection from storm events while epiphytic microalgae provide a food source for larval fish. Studies reviewed by Beukers & Jones (1997) show that increased complexity of coral reef habitats leads to increased density and survivorship of recruiting species.

Kelp beds, another type of a structurally complex habitat, have been studied throughout temperate ecosystems. Temperate reefs are dominated by macroalgae and the rocky substratum (Bodkin 1986) and are extremely variable spatially and temporally (Carr 1991). Interannual variation in biogenic structure is due to annual growth and senescence phases of kelps as well as strong storm events, nutrient limitation and sunlight. For example, *Macrocystis pyrifera*, a perennial canopy kelp, may be dense one year and more sparse the next (Duggins 1981, Carr 1994) while *Nereocystis luetkeana*, an annual canopy kelp, has distinct growth and senescent phases. *Macrocystis* beds have

less seasonal variation than do *Nereocystis* beds, and *Macrocystis* contributes more structure to the understory composition than *Nereocystis* does (Shaffer 2000). Both the spatial and temporal variation in the abundance and distribution of macroalgae has an effect on reef fish recruitment (Bodkin 1986, Anderson et al. 1989, DeMartini & Roberts 1990, Carr 1994, Nelson 2001). Macroalgae provide habitat to a variety of temperate reef fishes in both northern and southern hemispheres. Off southern California, for example, rocky reefs and *Macrocystis* kelp beds harbor more than 100 species of fish (Ebeling et al. 1979, DeMartini & Roberts 1990). In general, the more complex the habitat within a kelp bed, the greater the recruitment of fishes will be (Carr 1989, DeMartini & Roberts 1990, Carr 1991).

The interaction among canopy and understory algal species or varying alga species within a kelp bed affects the species composition of recruits to temperate reef assemblages (Carr 1989, Levin 1994). Within-habitat heterogeneity can occur in a single species algal assemblage, as well, since different parts of the plant may provide different microhabitats. Kelp perch, *Brachyistius frenatus*, used microhabitats within *Macrocystis pyrifera* plants before migrating to the holdfasts near the reef bottom (Anderson 1994). In another study (Nelson 2001) young-of-the-year rockfish (*Sebastes spp.*) first occupied the canopy where it was thinnest and the light penetrated easily. As the fish grew, they progressed to the elbow, where stipes bend over at the water surface. This area was usually heavily shaded due to the density of stipes and blades. Next, a vertical shift in the fish distribution occurred to the stipe area, defined as 1-1.5 m below the surface, before the fish migrated to the holdfast region of the kelp bed. Several weeks following these

microhabitat shifts, fish made a final move to the rocky interstices of the reef bottom. These detailed observations on habitat use are necessary to describe the complex interactions that occur within kelp habitats. It is likely that canopy kelp systems worldwide will support intricate assemblages, yet little experimental research has been done in other kelp systems.

Alaska is a high-latitude region where kelp beds and rocky reefs are the dominant structural habitat types available for organisms in the shallow subtidal. Little is known about the role of these nearshore habitats on fish distributions, yet fisheries are the economic basis of many communities within southeastern Alaska. In Kachemak Bay, Alaska, fish distributions varied with variations in algal cover (Hamilton 2004). In Prince William Sound, Alaska, vegetation characteristics (abundance or type) may explain a significant amount of variation in fish distributions (Dean et al. 2000). Research on the role of kelp beds throughout Alaska is minimal when compared to the knowledge of canopy kelp beds along the coasts of California and Oregon and sub-canopy kelps throughout temperate regions of the world. Furthermore, no experimental work has been done on *Nereocystis* and it is the main canopy kelp throughout southeastern Alaska.

The goal of this study was to use large scale manipulation studies to understand the role of the canopy forming kelp *Nereocystis luetkeana* and the sub-canopy forming kelp *Laminaria bongardiana* as habitat for fish and invertebrates in southeastern Alaska. *Nereocystis* is the dominant canopy-forming kelp throughout the inside waters of southeastern Alaska and may provide integral habitat for stage-based needs (nursery

ground, spawning area) or for transient users (i.e., predator protection, shelter from storm events, feeding grounds). The canopy experiment, in which large (1500 m²) beds were manipulated to remove the overlying kelp, was conducted over 10 months, thus taking into account the seasonal variation that occurs in these systems. We then isolated the role of *L. bongardiana* through manipulations of 600 m² beds to further understand the role of these prevalent sub-canopy algae. This experiment was conducted over three months during the summer of 2004 and focused on fish and invertebrate assemblages associated with sub-canopy kelp systems.

Kelp Beds as Fish and Invertebrate Habitat in Southeastern Alaska¹

1.1 Abstract

Throughout the temperate marine regime, the shallow subtidal is dominated by rocky reefs and algal assemblages. The ecological significance of high-latitude, cold-water kelp systems is poorly understood particularly for Alaska. Two large-scale experiments conducted near Juneau, Alaska were designed to study fish and invertebrate assemblages in regard to (1) canopy forming *Nereocystis luetkeana* (1500 m² manipulations) and (2) sub-canopy forming *Laminaria bongardiana* (600 m²). Fish and invertebrates were quantified using Standard Monitoring Units for the Recruitment of Fish (SMURFs), light traps, and visual surveys. The canopy kelp experiment revealed significantly greater abundance ($\bar{X}=0.57$ fish/SMURF; $\bar{X}=0.28$ fish/SMURF) and biomass ($\bar{X}=0.95$ g/SMURF; $\bar{X}=0.23$ g/SMURF) of benthic fishes at *Nereocystis* sites versus sites without canopy kelp. In contrast, a direct negative effect of *Nereocystis* was observed for schooling fish; significantly more fish were observed at sites without canopy kelp as compared to *Nereocystis* sites ($\bar{X}=27.3$ fish/15 m³; $\bar{X}=4.2$ fish/15 m³). Fish assemblages were independent of *L. bongardiana*, yet invertebrates were twice as abundant at sub-canopy sites. *Nereocystis* has direct and indirect effects on fish distributions through behavioral and habitat modifications. Overall, canopy kelps with associated sub-canopy kelps promote more abundant and rich fish assemblages in southeastern Alaska, while invertebrate assemblages are greater in sub-canopy areas.

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1.2 Introduction

In 1996, the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA) was passed, which required the description and identification of essential fish habitat. While fishery management previously focused on single species, the MSFCMA encouraged a more encompassing view of managing fish stocks, taking into account habitat attributes. This expansion led to the prevalence of ecosystem-based fisheries management over single species approaches as species exist within ecosystems and cannot be isolated from their communities (Tegner & Dayton 2000).

Ecosystem-based research incorporates a variety of biotic and abiotic factors that may affect populations. Biotic factors, including recruitment habitat and spawning grounds, can be protected and controlled through management efforts. Identifying habitat attributes and key characteristics in species distributional patterns, is an important aspect of ecology. Increasing degradation as a result of human impacts and natural disturbances (Duggins 1981, Shears & Babcock 2003) makes it essential to understand how habitats function and how they recover. Recognizing what role different aspects of habitats may have on life history patterns and distributions of species will enable us to predict the outcome of habitat removal or alterations (Anderson 1994, Levin 1994, Levin & Hay 1996). Nearshore habitats are characterized by their biogenic architecture (coral reefs, kelp beds, sea grass beds) as well as their structural composition (rocky reefs, piers). These attributes also influence the faunal communities within them (Lough et al. 1989, Carr 1991, Anderson 1994, Norderhaug et al. 2002).

Increased habitat complexity leads to greater abundances and species richness due to increased niches and food supply, decreased mortality due to decreased predation and density-dependent competition, and decreased environmental stressors (Allen & Griffiths 1981, Carr 1989, Carr 1991, Anderson 1994, Carr 1994, Levin & Hay 1996, Willis & Anderson 2003, Arroyo et al. 2004). While the abundance of macroalgae may affect fish distributions at large spatial scales, variability in prey populations as well as species composition of algal patches may influence juvenile fish densities at smaller spatial scales (Levin 1994). High relief artificial structure supports similar abundances and diversity of fishes when compared to a complex canopy-forming kelp bed (Stephens et al. 1984), indicating that structure, biogenic or artificial, may be of utmost importance.

Canopy-forming kelps, such as *Macrocystis pyrifera* (hereafter *Macrocystis*), *Nereocystis luetkeana* (hereafter *Nereocystis*), and *Alaria fistulosa* create biogenic structure throughout the water column and produce complex habitats for many fish and invertebrate species. Structure provided by these kelps varies within and between years. *Nereocystis*, for example, forms dense structure at the surface during summer months but senesces during the fall and winter. *Macrocystis* beds play an important role in structuring fish communities (DeMartini & Roberts 1990, Carr 1991, Anderson 1994); in general, fish abundance and diversity increase in areas with greater *Macrocystis* abundance (Bodkin 1988, Carr 1989, Anderson 1994). Fish species composition was found to be similar between *Macrocystis* and *Nereocystis* kelp beds in Central California, though *Macrocystis* supported higher densities (Bodkin 1986). Invertebrate assemblages associated with canopy forming kelps represent a major portion of the food resource

available to kelp forest fishes (Coyer 1979). Canopy-associated invertebrates are smaller than the larger, benthic organisms and could therefore be a more important part of the food chain in canopy kelp systems (Allen & Griffiths 1981).

Sub-canopy kelps (Family Laminariaceae), which often form secondary structure within canopy kelp beds, also influence the associated faunal communities. The presence of sub-canopy kelps impacts the distribution, feeding, and mobility patterns of fish (Jones 1992, Levin 1994) and invertebrates (Marliave & Roth 1995, Cruz-Rivera & Hay 2000, Norderhaug et al. 2002, Christie et al. 2003, Norderhaug et al. 2003, Arroyo et al. 2004). These patterns are dependent on quantitative (abundance) and qualitative (chemical cues, species composition) attributes of the kelps (Levin & Hay 1996). Algal-associated invertebrates represent an important food source for newly recruited fishes through apex predators (Love et al. 1991, Steneck et al. 2002). Kelp beds are thought to enhance the productivity of organisms, including fishes, due to a detrital pathway that increases the abundance of invertebrate grazers which provide a food source to many fishes (DeMartini & Roberts 1990, Duggins & Eckman 1994).

Multiple effects such as shade (Clark et al. 2004), flow (Eckman et al. 2003), and habitat modification (Bertness et al. 1999) may drive the distributional patterns of organisms within these systems. The combination of sub-canopy kelps and understory algae associated with canopy-forming kelp forests forms densely vegetated areas that are used both as habitat and as a food source. Complexity in kelp morphologies affects the species composition of invertebrates as well as reef fish assemblages (Levin 1994). Both

direct and indirect effects of macroalgae may affect the distribution and abundance of reef fishes (Carr 1989).

In this paper, we address the ecological significance of kelp beds as habitat in southeastern Alaska. We investigated the importance of the canopy forming *Nereocystis* and the sub-canopy forming *Laminaria bongardiana* as habitat for both fish and invertebrate species near Juneau, Alaska. Specifically, we tested the hypotheses that (1) fish and invertebrate abundances will differ based on the presence of canopy-forming *Nereocystis* and that (2) fish and invertebrate abundances will differ based on the presence of the sub-canopy forming kelp *L. bongardiana*. Our data support the hypothesis that the presence of canopy-forming kelps affects the abundance of fishes for benthic species, but perhaps through an indirect habitat modification. Conversely, canopy kelps had a direct negative effect on the schooling behavior of pelagic fish. Sub-canopy beds of *L. bongardiana*, which create structure in the lower 1-2 m of the water column, provide added habitat for invertebrates while fish distributions were independent of *L. bongardiana* presence.

1.3 Materials and Methods

1.3.1 Study Area

All data collection and experiments were conducted between Saginaw Channel and Stephens Passage, 11 km west of Auke Bay, Alaska, in depths of 6 to 8 m (Fig 1.1). Two large-scale experiments were designed to study fish and invertebrate assemblages in regard to (1) canopy forming *Nereocystis luetkeana* (1500 m² manipulations) and (2) sub-canopy forming *Laminaria bongardiana* (600 m²). Canopy kelp manipulations were

performed in June 2003; all data collection occurred between July 2003 and March 2004. Sub-canopy kelp manipulations were performed in June 2004; all data collection occurred in July and August 2004.

1.3.2 Field Sampling

Large scale manipulations, in which the dominant algal type within study sites was removed by hand, may alter other sub-canopy or understory algae (Clark et al. 2004). Algal composition in these experiments was therefore quantified at each site using a random sampling design to describe the habitat type and document changes due to seasonality and manipulations. Monthly surveys were conducted during the canopy experiment and three surveys were performed between July and August 2004 during the sub-canopy experiment. For both experiments transects (20 m for canopy experiment and 15 m for sub-canopy experiment) were laid out haphazardly within study sites and 10-0.25 m² quadrats were randomly sampled per transect. All *Nereocystis* plants were counted in a 20 x 2 m (40 m²) band transect. Sub-canopy algae of the order Laminariales (*Cymathere triplicata*, *L. bongardiana*, *Costaria costata*, and *Agarum spp.*) were counted in the 0.25 m² quadrats (n = 30 quadrats per site). Laminariales less than 30 cm in height were categorized as juvenile Laminariales. Percent cover for understory algae (*Desmarestia spp.*, corallines, green and red algae) were estimated visually (Dethier et al. 1993).

Mooring lines were placed within each study site as attachment points for two independent sampling techniques, SMURFs and light traps. Mooring lines used in this study were adapted from a design used by Ammann (2004). Two replicate mooring lines

were placed at least 10 m apart and at least 5 m from the edge of the habitat to avoid potential ecotone interactions. All *Nereocystis* plants within 5 m of the mooring lines were removed to provide access to SMURFs with a BINCKE net (Benthic Ichthyofauna Net for Coral/Kelp Environments; Anderson & Carr 1998) and to prevent entanglement with the kelp. SMURFs and light traps were not deployed simultaneously, but for non-overlapping sampling periods. As a result of the anchoring method, surface units were maintained at 1 m below the surface and bottom units were 1 m above the substratum regardless of tidal height.

Standard Monitoring Units for the Recruitment of Fish (SMURFs) used in this study were adapted from a design used by Steele et al. (2002) and Ammann (2004). SMURFs are a passive collection method used to simulate habitat structure and provide refuge for juvenile fish. SMURFs were deployed within study sites for a 72 hour period per sampling interval. The outer mesh (2.54 cm grid) did not restrict movement of juvenile fish into or out of the SMURF, but did prevent entry of larger fish. SMURFs were sampled by scuba divers. To collect juvenile fish, each SMURF was enclosed in a BINCKE net, detached from the mooring line, and brought into the boat where it was removed from the net and placed in an 80 L plastic tub. After retrieval, SMURFs were agitated and rinsed with seawater to remove any fish. After this, SMURFs were returned to the laboratory until the next sampling period. All fish collected were euthanized with MS-222 followed by immersion in 80 % ethanol and brought to the laboratory for identification and morphometrics.

Light traps used in this study were adapted from a design used by Roegner et al. (2003). Each light trap was constructed using a 5-gallon white plastic carboy with four white plastic funnels (110 mm mouth narrowing to a 20 mm stem) through which organisms can enter. A PVC plug fitted with a 500 μ m mesh was inserted at the bottom of the trap and two [®]Princeton Tec LED underwater lights (the [®]Attitude) were attached to the inside of the light trap and remained lit for the duration of the 24 hour sampling. To collect the sample, each light trap was removed from the mooring line and brought to the boat. At the boat, the PVC plug at the bottom of the trap was removed allowing water to flow through the 500 μ m mesh. All retained organisms were euthanized in MS-222 followed by immersion in 80 % ethanol and brought to the laboratory for identification and morphometrics.

Visual surveys, using scuba, were conducted along three haphazardly-placed transects at two depth strata (surface and bottom). Transect dimensions were 1 x 1 x 20 m ($W \times H \times L = 20 \text{ m}^3$) for the canopy experiment and 1 x 1 x 15 m (15 m^3) for the sub-canopy experiment. All fish were enumerated along transects and identified to the best taxonomic resolution possible.

1.3.3 Canopy Kelp Experiment

A three-way orthogonal design was used to test the importance of *Nereocystis*: season, canopy, and depth. Seasonal variation of algal assemblages was documented through a temporal assessment of kelp densities and species abundance between July – September 2003 (summer) and November 2003 – March 2004 (winter). Sampling continued through winter to test for any residual effect of *Nereocystis* on species

densities. Two of four study sites were experimentally manipulated to remove the overlying canopy (no canopy) while the other two were left intact (canopy). Sampling occurred at the bottom and surface. This scheme distinguished between direct versus indirect effects of *Nereocystis* and between the levels of complexity at the surface and at the sub-canopy level. Sampling occurred approximately every two weeks (six times total) during summer and monthly (three times total) throughout the winter season. Algal surveys occurred once a month throughout the course of the experiment. Fish were quantified using three independent methods: SMURFs, light traps, and visual surveys; invertebrate abundances were determined using light traps while SMURFs were used to enumerate snail abundances. Other invertebrates were sampled by SMURFs, however light traps were a more efficient and reliable method for these taxa.

1.3.4 Sub-Canopy Kelp Experiment

To test the importance of sub-canopy kelps, an unreplicated randomized block design was used. Two study locations (1400 m²), dominated by *L. bongardiana*, were experimentally manipulated and half of the location (600 m²) was cleared of sub-canopy kelps and *Desmarestia spp.* (cleared) while the other half (600 m²) was not manipulated (sub-canopy). Understory (corralines, red, and green) algae were left intact at all sites. Sampling occurred within 1 m of the substratum at each site (bottom). Five replicate sampling intervals occurred over a short time scale (July and August 2004). Algal surveys were conducted three times throughout the experiment. Fish and invertebrates were quantified using SMURFs, light traps, and visual surveys as described above.

1.3.5 Laboratory Procedures

All organisms sampled by SMURFs and light traps were preserved in 80% ethanol and brought to the laboratory for identification and morphometrics. All fish were identified to species while all invertebrates were identified to order. Fish were weighed to the nearest 0.01 g. Total, fork, and standard lengths were measured to the nearest 0.01 cm.

1.3.6 Statistical Analyses

All statistical analyses were performed using JMP ([®] Statistical software Version 4.0.4). When needed, data were log or log (x+1) transformed to help meet the assumptions of normality and equal variances (Underwood 1997).

1.3.6.1 Canopy Kelp Experiment

A one-way ANOVA was performed within the summer season of the canopy kelp experiment to test whether canopy sites contained significantly more *Nereocystis*. During the winter season no *Nereocystis* were present in either treatment, therefore, no statistical analyses were done on these data. The mean number of sub-canopy kelps and the percent cover of understory algae per site were calculated per treatment as a descriptor of the habitat available to fish and invertebrates during the experiment.

The mean abundance and biomass of fish sampled by SMURFs and the abundance of fish by light traps was calculated for each sampling date. Data from each sampling device were pooled within season, assuming each trial was independent of the others. Three-way ANOVAs (season, canopy, depth) were performed to test the effects of *Nereocystis* and water depth on fish abundance and biomass over a temporal scale.

All fish observed during visual surveys were seen at the bottom stratum of study sites, therefore surface data were removed from the data set. The mean number of fish per transect was calculated for each sampling date. Data were pooled within season followed by a two-way ANOVA (season, canopy) on bottom transect data. Paired t-tests on the mean difference in fish abundance as well as the mean difference in presence/absence data were performed. Due to low fish abundances during the winter, these data were removed from the analysis and a one-way ANOVA was performed on summer fish abundances.

The mean number for each predominant invertebrate taxon (shrimps, amphipods, copepods, cumaceans, and krill) sampled by light traps was calculated per site for each sampling date. Data were pooled within season and a three-way MANOVA was performed to examine the correlated response of the major invertebrate taxa. Following the MANOVA, univariate three-way ANOVAs were performed to determine differences within and between taxa. The mean number of snails sampled by SMURFs was calculated for each sampling date. Data were pooled within season followed by a three-way ANOVA (season, canopy, depth).

1.3.6.2 Sub-Canopy Kelp Experiment

The mean number of sub-canopy kelps and the percent cover of understory algae per site were calculated per treatment as a descriptor of the habitat available to fish and invertebrates during the experiment.

The mean abundance and biomass of fish sampled by SMURFs and the mean abundance observed on visual surveys were calculated for each sampling date. Data were

pooled across the experiment, the mean difference was calculated, and paired t-tests were performed. Only one fish was sampled by the light traps during this experiment, therefore no statistical analyses were performed on these data.

The mean difference in the abundance of predominant invertebrate taxa (shrimps, amphipods, copepods, and cumaceans) sampled by light traps and snails sampled by SMURFs were calculated. Data were pooled by sampling device across the experiment and paired t-tests were performed.

1.4 Results

1.4.1 Canopy Kelp Experiment

1.4.1.1 Community Structure

During the summer season, canopy sites contained significantly more *Nereocystis* than no canopy sites ($\bar{X}=1.97 \text{ m}^{-2}$, $\text{SE}=4.7$ and $\bar{X}=0 \text{ m}^{-2}$, $\text{SE}=0$, respectively. One-way ANOVA: $F_{(1,10)}=17.88$, $p=0.0017$; Fig 1.2). During the winter season, no *Nereocystis* was present at any of the study sites.

Sub-canopy kelp and understory algal composition were similar between treatments throughout the course of the experiment (Figs 1.3 and 1.4, respectively). Kelps were more than twice as dense during summer ($\bar{X}=17.8 \text{ m}^{-2}$, $\text{SE}=1.4$) as compared to winter ($\bar{X}=8.3 \text{ m}^{-2}$, $\text{SE}=0.9$) season. Coralline algae comprised a majority of the percent cover of understory algae throughout the course of the experiment. In summer, *Cymathere triplicata* was the most abundant sub-canopy kelp at canopy and no canopy sites ($\bar{X}=9.2 \text{ m}^{-2}$, $\text{SE}=1.1$ and $\bar{X}=10.8 \text{ m}^{-2}$, $\text{SE}=3.4$, respectively) while the understory had abundant cover of *Desmarestia* spp. During winter, juvenile Laminariales comprised

the majority of sub-canopy kelps. However, these were highly variable and too small to identify to species. Red algae were abundant in both treatments during winter.

1.4.1.2 Fish Abundances

Significantly more fish were collected in SMURFs during the summer (51 fish total) than in winter (9 fish total; Fig 1.5, Appendix 1.1). Greater abundance and biomass of fish were supported by canopy sites throughout the experiment. Also, fish abundance and biomass were significantly greater at the bottom of all sites regardless of season (Fig 1.5, Appendix 1.1 for abundance; Fig 1.6, Appendix 1.2 for biomass). The biomass of fish was similar between seasons (Fig 1.6, Appendix 1.2). A total of 60 fish belonging to 6 families and 12 species were collected with SMURFs during the canopy kelp experiment (Table 1.1). The majority (98%) of these were benthic fishes, predominantly of the families Pholidae, Cyclopteridae, and Hemitriptidae.

Very few fish were sampled by light traps, therefore no significant effects were detected on log (x+1) transformed abundance (Appendix 1.3) or biomass (Appendix 1.4) data.

All fish observed during visual surveys were found at the bottom of study sites. Fish densities in the summer season were significantly greater than winter fish densities ($\bar{X}=21.95$, $SE=7.11$ and $\bar{X}=0.21$, $SE=0.11$, respectively; Fig 1.7). Significantly more fish were present at no canopy sites (paired t-test, $t_{0.05(2), 13}=-2.8467$, $p=0.0137$). However, fish were independent of canopy cover when the data were converted to presence/absence of fish per site per sampling period (paired t-test, $t_{0.05(2), 13}=0.5631$, $p=0.5830$). During summer significantly more fish were seen at no canopy sites (one-

way ANOVA: $F_{(1,18)}=5.7304$, $p=0.0278$; Fig 1.7); the majority of these fish were schools of pelagic gadids. During the winter season, fish distributions were independent of *Nereocystis* abundance.

1.4.1.3 Invertebrate Abundances

The relative composition of invertebrate taxa varied significantly throughout the course of the experiment (MANOVA; Appendix 1.5). While individual abundances of taxa changed over the course of the experiment, significant interactions by taxa were detected for season, depth, and a season by depth interaction. However, invertebrate taxa were independent of canopy cover. A significant interaction was caused by more abundant shrimp at the bottom stratum during the summer than at other treatments. During summer, the invertebrate assemblage was made up of a greater proportion of shrimps and cumaceans whereas the winter assemblage was dominated by krill and amphipods (Appendix 1.6). No effect of canopy was detected, therefore samples were pooled between treatments (Fig 1.8).

Significantly more snails, predominantly *Lacuna vincta*, were present in SMURFs during the summer as compared to the winter (Fig 1.9). Also, snails were significantly more abundant at the bottom of study sites (Fig 1.9). An interaction between season and canopy was detected with significantly higher snail abundance at canopy sites during the summer (Fig 1.9, Appendix 1.7).

1.4.2 Sub-Canopy Kelp Experiment

1.4.2.1 Community Structure

All sub-canopy kelps and *Desmarestia* spp. were successfully removed from half of the study sites (cleared) while leaving the other sites intact (sub-canopy; Fig 1.10). *L. bongardiana* dominated the composition ($\bar{X}=18.3$ plants m^{-2} , $SE=0.2$) of sub-canopy kelps. Understory (coralline, red, and green) algae were left intact at all sites and the composition was similar between treatments throughout the course of the experiment (Fig 1.11).

1.4.2.2 Fish Abundances

Very few fish were caught in SMURFs throughout the sub-canopy kelp experiment. SMURFs sampled predominantly benthic fishes (Table 1.2). No effect of sub-canopy kelps was detected on either the abundance (paired t-test, $t_{0.05(2), 9}=-0.3180$, $p=0.7577$) or biomass (paired t-test, $t_{0.05(2), 9}=-1.3532$, $p=0.2090$) of fish.

Very few fish were observed during visual surveys conducted during the summer 2004. These fish were comprised of 48% gunnells (Pholidae) and 44% greenlings (Hexagrammidae). Fish distributions were independent of *L. bongardiana* abundance (paired t-test, $t_{0.05(2), 9}=-1.3351$, $p=0.2146$).

1.4.2.3 Invertebrate Abundances

Significantly greater abundances of combined invertebrates (amphipods, copepods, cumaceans, and shrimps) were found at sub-canopy sites (paired t-test: $t_{0.05(2), 9}=3.2273$, $p=0.0104$; Fig 1.12) as compared to cleared sites. While invertebrate

abundances were greater at sub-canopy sites, the percent composition between treatments was nearly identical (Fig 1.13).

Significantly more snails, predominantly *Lacuna vincta*, were present at sub-canopy sites ($\bar{X}=38.6$, $SE=5.78$) than cleared sites ($\bar{X}=10.0$, $SE=1.37$); (paired t-test: $t_{0.05(2),9}=4.6780$, $p=0.0012$).

1.5 Discussion

Three independent sampling methods were used to measure the abundance, biomass, and diversity of organisms present within our study sites: SMURFs, light traps, and visual surveys. SMURFs are designed to mimic and provide habitat to fishes. Light traps, which emit light within a few meters of the trap, are designed to attract positively photo-tactic organisms. Due to the potential for attracting organisms from outside the treatment areas, relatively short soak times (72 hours for SMURFs and 24 hours for light traps) were used (Findlay and Allen 2002, Steele et al 2002, and Ammann 2004).

SMURFs have been placed away from reefs to avoid resident predators (Ammann 2004). We placed SMURFs inside of kelp beds to quantify those fish using the available habitat. In order to access the SMURFs with the BINKE nets and prevent entanglement with the kelps, 5 m halos were cleared around the base of the mooring lines. These halos created breaks in the surface canopy that were comparable to the natural patchiness of *Nereocystis* beds. In this experiment, SMURFs added structure to sites cleared of their dominant habitat. Organisms in the manipulated sites had the added complexity of SMURFs or light traps for refuge whereas organisms in the structured (canopy or sub-canopy) sites had a choice between biogenic or artificial refuge. We might expect to see

higher catch rates from our manipulated sites because those organisms lacked biogenic refuge. However, our results showed either no effect of kelp or significantly greater abundances of fish and invertebrates at canopy and sub-canopy sites. Therefore we feel our estimates are conservative.

Light traps placed at the bottom of study sites or throughout the winter season might be expected to sample more effectively because of ambient low light conditions. Greater invertebrate abundances were found in *Macrocystis* beds during the winter season and greater abundance and biomass of invertebrate assemblages at the bottom of beds than associated with the canopy (Coyer 1979). While light penetration differed between seasons and depths, ambient conditions were relative per sampling interval. Invertebrate abundances by taxa varied by season, however some taxa were more abundant in the summer and others in the winter. Although ambient light differs drastically at high latitudes between seasons, we feel seasonal differences in invertebrate taxa are more likely due to life history characteristics. Our results confirm those of Coyer (1979) in which invertebrates strongly preferred the bottom of study areas. This difference was highly significant; therefore we feel it is not due to light artifacts between depths.

The sampling methods proved discrete in their capabilities and catch rates based on functional groupings. SMURFs, commonly used to measure recruitment by young-of-the-year fishes, effectively estimated the relative abundance of older juveniles within the study sites. Over 98% of the fish caught in SMURFs were from benthic families (predominantly Pholidae, Cyclopteridae, and Hemitriptidae). Species composition of

fishes sampled differs dramatically from those sampled by Findlay and Allen (2002), Steele et al (2002), or Amman (2004). Both Findlay and Allen (2002) and Steele et al (2002) used similar water column collectors to analyze settlement patterns of the kelp bass, *Paralabrax clathratus*. Ammann (2004) evaluated SMURFs for the recruitment of temperate reef fishes and found the genus *Sebastes* to be the dominant group in SMURF catches. Light traps were efficient for collecting invertebrates, but also sampled additional fish families (Zaproridae and Agonidae). Over 90% of all fish seen during visual surveys were schools of juvenile Pacific cod, *Gadus macrocephalus*, and walleye pollock, *Theragra chalcogramma*. Due to the small size of many fishes, however, species identifications were not always possible and these fish were grouped as Gadidae. Light traps confirmed the presence of both Pacific cod and walleye pollock within the study sites. Water column collectors (i.e., SMURFs) sampled 9 times more fish than light traps and 5 times more fish than rock-filled benthic collectors (Steele et al 2002). Our results support the effectiveness of SMURFs as fish collectors, but we recommend the use of multiple, discrete sampling methods in order to estimate the relative abundance of various taxonomic groups.

Experimental manipulations are the best method to isolate the role of habitat attributes and determine their importance. The scale of manipulation is dependent upon the question and goal of the experiment. Small scale manipulation experiments have been conducted measuring less than 10 m² (Jones 1992, Levin and Hay 1996) and large scale manipulations measuring between 100 m² and 500 m² (Bodkin 1988, Carr 1989, Carr 1991, Carr 1994, Nelson 2001). The experimental manipulations performed in our

experiments are among the largest that have been conducted (1500 m² and 600 m²) and allowed us to examine ecosystem wide effects of habitat characteristics. Although authors have documented strong correlative and causative patterns of fish abundance in relation to kelp abundance (Dean et al. 2000, Hamilton 2004), few have looked at the role of *Nereocystis* (Shaffer 2000) and no previous research has been conducted at high latitudes to directly test the importance of canopy kelps as fish habitat.

The distributional patterns of marine fish populations are commonly determined by benthic architecture and habitat attributes. Thus, increased structural complexity should lead to increased abundance and species richness (Allen and Griffiths 1981, Bodkin 1988, Carr 1989, Anderson 1994, Levin and Hay 1996, Willis and Anderson 2003, Arroyo et al 2004). Consequently, we would expect increased fish abundances in highly complex habitats created at the surface by canopy forming *Nereocystis* and at the bottom by sub-canopy forming Laminariales.

1.5.1 Canopy Kelp Experiment

In southeastern Alaska, *Nereocystis* forms dense canopy structure throughout the summer season from mid June to mid September. During this time, we hypothesized an increase in abundance of fish utilizing the additional structural habitat at the canopy. Greater fish abundance and species richness were found with SMURFs at canopy sites throughout the duration of the experiment. However, collected fish were predominantly members of benthic families and were sampled typically at the bottom of study sites. If these benthic fishes merely preferred the bottom, we would expect to see similar abundances between our canopy and no canopy treatments. However, a positive indirect

effect of canopy structure may occur that increases the abundance and species richness of fishes at the bottom of canopy kelp systems. The canopy of *Macrocystis* acts as transient habitat preferred by newly recruited kelp perch (Anderson 1994) and kelp rockfish (Nelson 2001) before finally settling at the bottom or to the holdfasts. While during this experiment no fish were ever sampled in higher abundances at the surface, we cannot rule out their potential use as brief, transient, preferred habitat that might have occurred between sampling periods or prior to the initiation of sampling. The overall importance of canopy kelp sites throughout the course of this experiment may be due to a historical, or lag effect of *Nereocystis* beds or due to potentially small home ranges of the benthic fishes sampled.

No fish were observed in visual surveys at the surface of our study sites. Conversely, large schools of Gadidae were seen at the bottom of no canopy sites during the summer season of 2003. The structure of *Nereocystis* throughout the water column may disrupt or negatively impact the schooling behavior of these gadids, causing schools to break up. Unequal variances due to large schools of fish at no canopy sites were observed as compared to individual or small groups of fishes at canopy sites. Large schools of gadids have a biological impact on the ecosystem during the summer season. However, fish are equally likely to be encountered in both canopy and no canopy sites. Therefore, a fish encountered at a no canopy site is more likely to be part of a school of fish.

While abundances of taxonomic groups of invertebrates varied with season and depth, they were consistently greater in the bottom stratum of all study sites with no

discernable effect of *Nereocystis*. Whether invertebrates preferred the benthic substratum, or whether there was an effect of sub-canopy structure affecting their location was difficult to discern because of the experimental design. In turn, invertebrates are a potential food source for fishes and may be attracting fish to kelp beds. Snails, predominantly *Lacuna vincta*, were found in higher abundances at the bottom of study sites as well as canopy sites during the summer. Snails are mesograzers and are at the base of the detrital pathway that provides food through trophic levels to apex predators within these systems (Duggins et al. 2001). Primary production within kelp beds is an important food source for mesograzers. However, kelp may not be readily available. Bacterial communities on kelp surfaces facilitate the degradation and transfer of this primary production to higher trophic levels (Norderhaug et al 2003). Our results confirm the presence of mesograzers, in turn making primary production available to invertebrates and fishes within kelp systems.

Many field studies are limited to the summer to maximize logistical support, data collection, and good weather conditions. Here, we sampled throughout both summer and winter seasons to elucidate the seasonal role of these ecosystems and the biological differences of the habitat types. Fish abundances, as sampled with SMURFs, light traps, and visual surveys, dropped off dramatically from summer to winter. The large schools of Pacific cod and walleye pollock observed during summer visual surveys were absent from winter surveys, possibly because of their migration to deeper waters during winter. Very little is known about the life histories of benthic, cryptic fishes, therefore we can only hypothesize as to their decline in the winter. Some evidence points to the

importance of sculpins in the diet of Steller sea lions (J. Womble, NOAA Auke Bay Laboratory, pers comm). Sea lions return to the inside waters of southeastern Alaska during winter for breeding and were present at our study sites in high numbers during winter. The decline in fish abundances we observed from summer to winter could be due to attrition, as well as lowered activity levels or migration. Water conditions in the shallow subtidal throughout southeastern Alaska during winter are cold and more turbulent than summer conditions. Also, large changes in water salinity accompany changes in fresh water runoff from nearby glaciers. Thus, fish may migrate to deeper waters during winter to avoid harsher conditions in the shallow subtidal where most of the macroalgal cover has senesced. While fish abundance was greater during the summer, fish biomass was not significantly different between seasons. This suggests that fewer, larger fish were sampled during the winter season than the summer. Juvenile fish require stored fats for survival through the winter, during which time their food is limited. Therefore, fish biomass would increase due to stored fats used for survival through the winter.

1.5.2 Sub-Canopy Kelp Experiment

During the sub-canopy experiment, very few fish were sampled during visual surveys or with SMURFs as compared to catch rates from the summer 2003 of the canopy kelp experiment. Consequently, no trends could be detected. We conclude that sub-canopy kelps appeared to have no effect on the distribution of fishes at this spatial scale and for the species sampled. However, if fish distributions do not depend on the

presence of sub-canopy kelps, the increased abundance and biomass of fish sampled at the bottom of canopy sites emphasize the importance of indirect effects of *Nereocystis*.

A strong positive relationship existed between sub-canopy kelp cover and abundance of invertebrates. Invertebrate assemblages appeared to prefer sub-canopy kelps, not merely benthic substratum, as sub-canopy kelps act as a food source and habitat niche for invertebrates. Snails were also more abundant in sub-canopy sites, emphasizing the importance of the detrital pathway and mesograzer transfer of primary production.

1.5.3 General Conclusions

Our results do not directly agree with the pattern of increased species abundance in areas of increased structure as has been reported previously (Allen and Griffiths 1981, Bodkin 1988, Carr 1989, Anderson 1994, Levin and Hay 1996, Willis and Anderson 2003, Arroyo et al 2004). Our results support the importance of discrete depth sampling and of benthic habitats for fish and invertebrate populations in southeastern Alaska. Others have found that water column depth also affects fish distributions (Carr 1991, Findlay and Allen 2002, Steele et al 2002). The predominant fishes sampled within the canopy kelp systems did not utilize the increased available habitat provided by *Nereocystis*. However, an indirect effect of the canopy or habitat modification may cause fish to prefer the bottom of these systems. Results from the sub-canopy kelp experiment showed no effect of sub-canopy kelps on fish distributions. However, sub-canopy kelps were important in structuring invertebrate assemblages which are a food source to fishes.

Results from both experiments indicated that *Nereocystis* had direct and indirect effects on fish distributions through behavioral and habitat modifications. Overall, canopy kelp systems with associated sub-canopy kelps promoted the most abundant and diverse fish assemblages in southeastern Alaska, while invertebrate assemblages were greatest in sub-canopy areas. While these mixed systems provided the most structural complexity, experimental designs should consider the potential for indirect interaction and habitat modifications. Direct and indirect effects (Siddon and Witman 2004) of habitats must be incorporated into experimental designs to more fully understand the role of the habitat (DeMartini and Roberts 1990).

1.6 Acknowledgements

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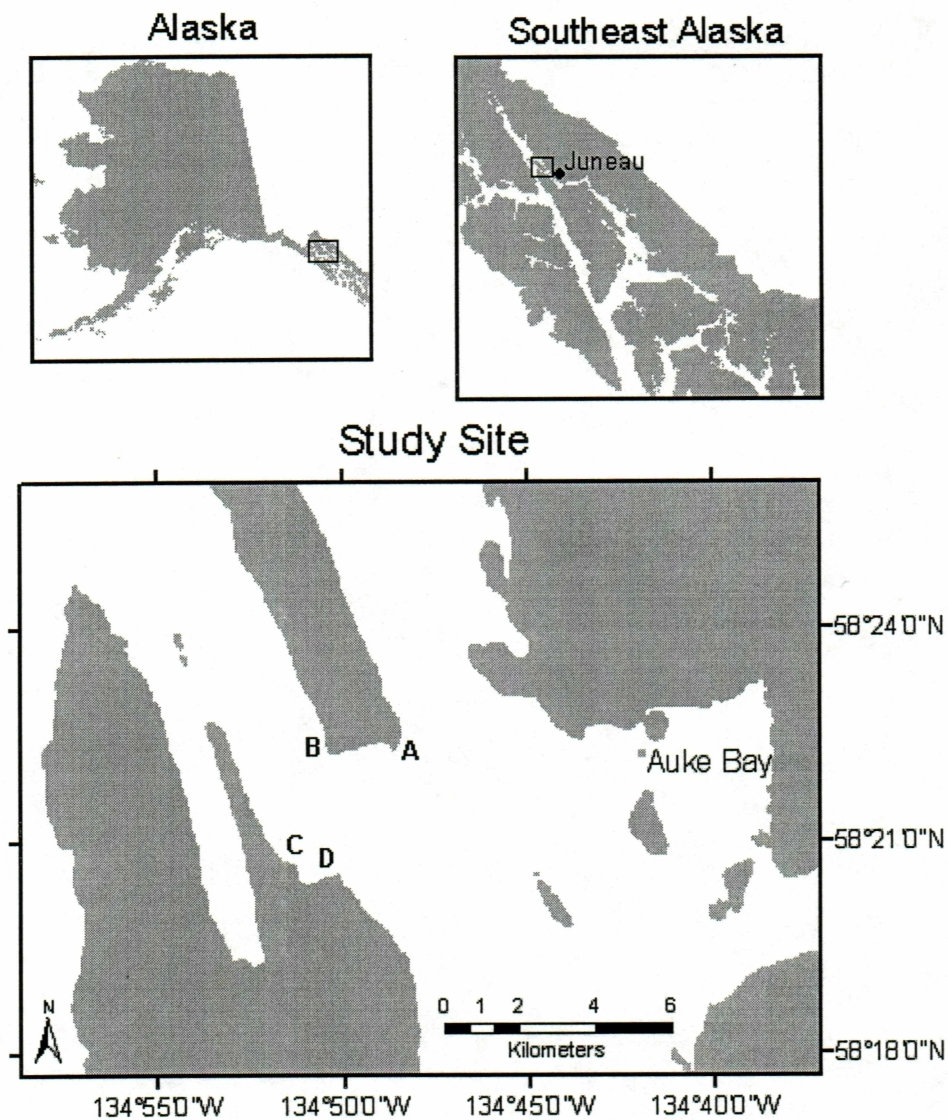


Fig 1.1 Map of the study area. Sites A and C represent canopy sites, B and D represent no canopy sites during the canopy kelp experiment. Sites B and C were used during the sub-canopy kelp experiment and treatments of sub-canopy and cleared were sub-divided within these areas. The study area is located approximately 25 km WNW of Juneau, Alaska. Map courtesy of Edwin Knuth, University of Alaska Southeast, Juneau, AK

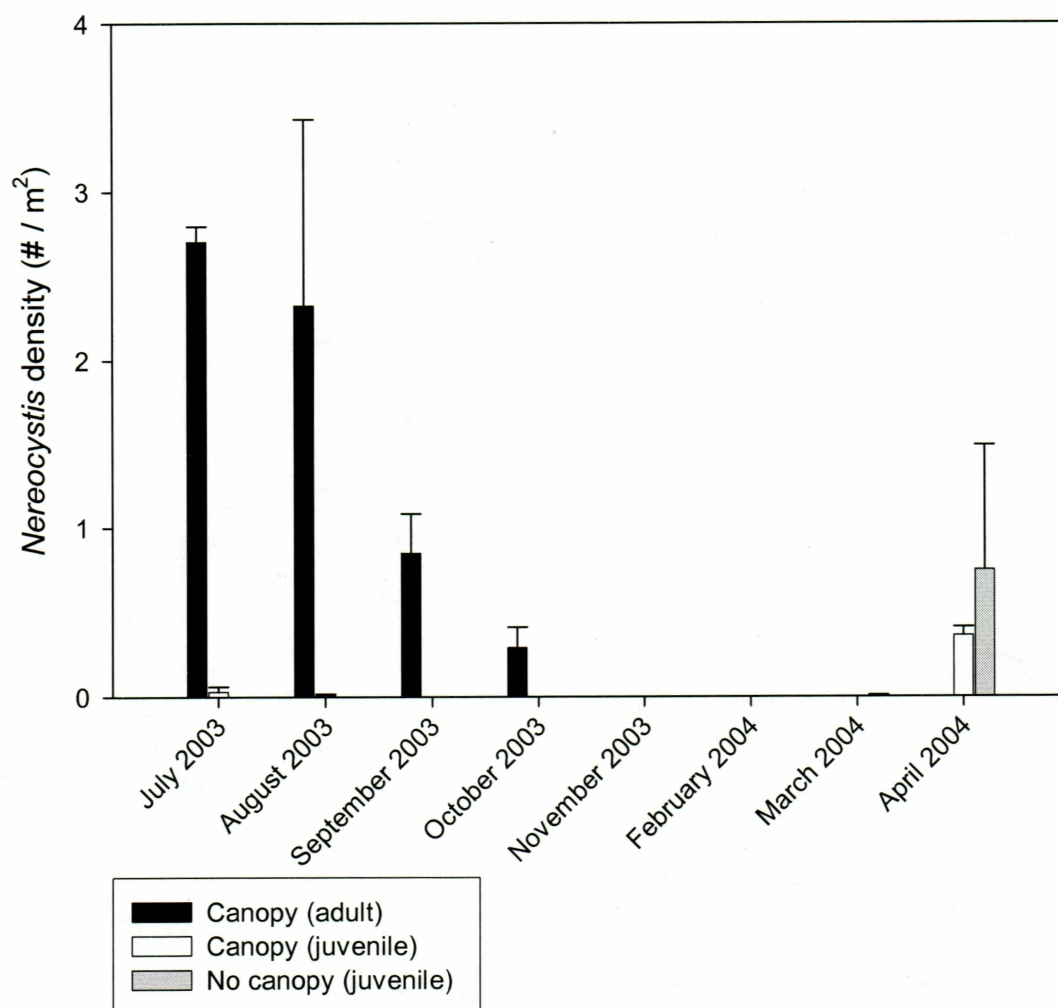


Fig. 1.2 Monthly *Nereocystis luetkeana* densities (+1 standard error) at canopy and no canopy sites during the canopy kelp experiment. Density of adult *Nereocystis* was 0 plants m^{-2} at no canopy sites due to manipulations and remained 0 plants m^{-2} throughout the course of the experiment

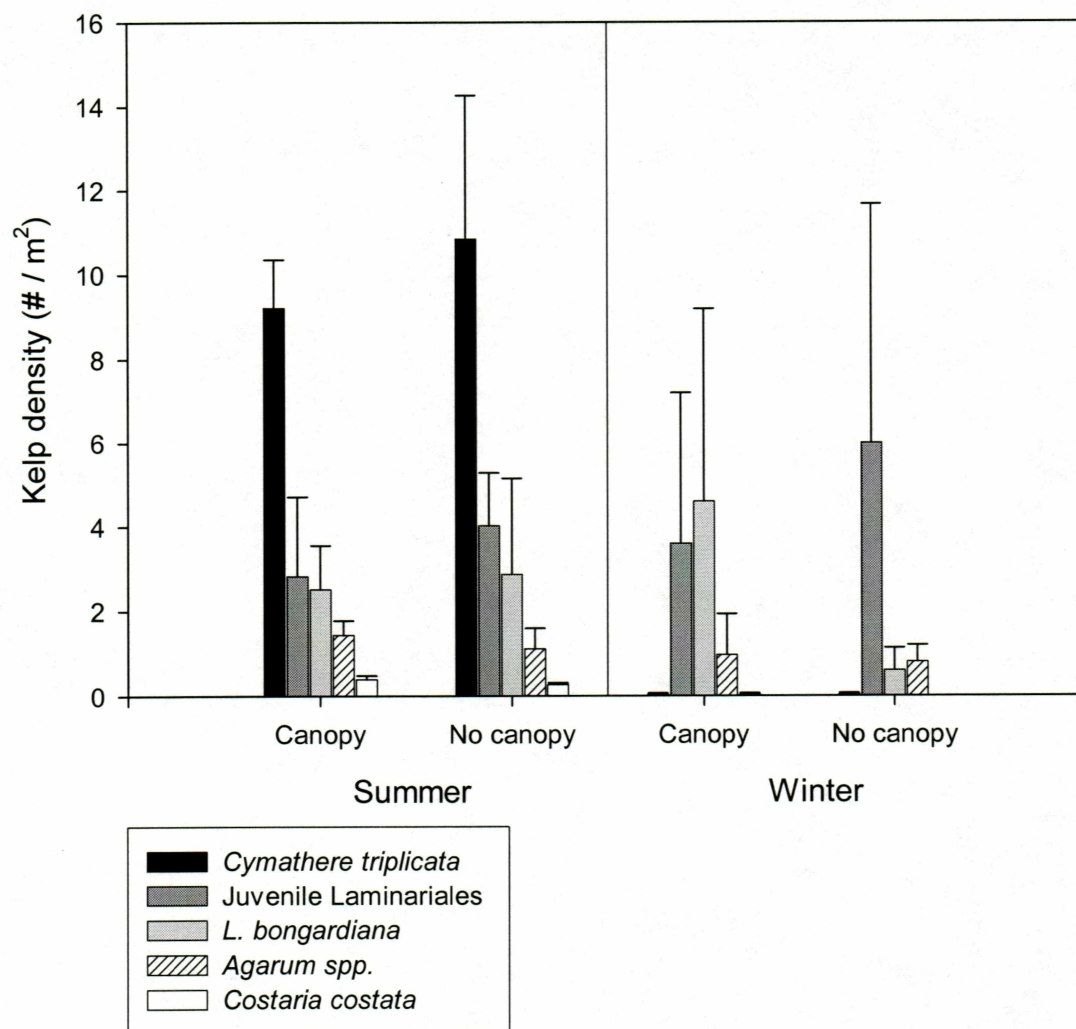


Fig. 1.3 Sub-canopy kelp densities (+1 SE) during the canopy kelp experiment

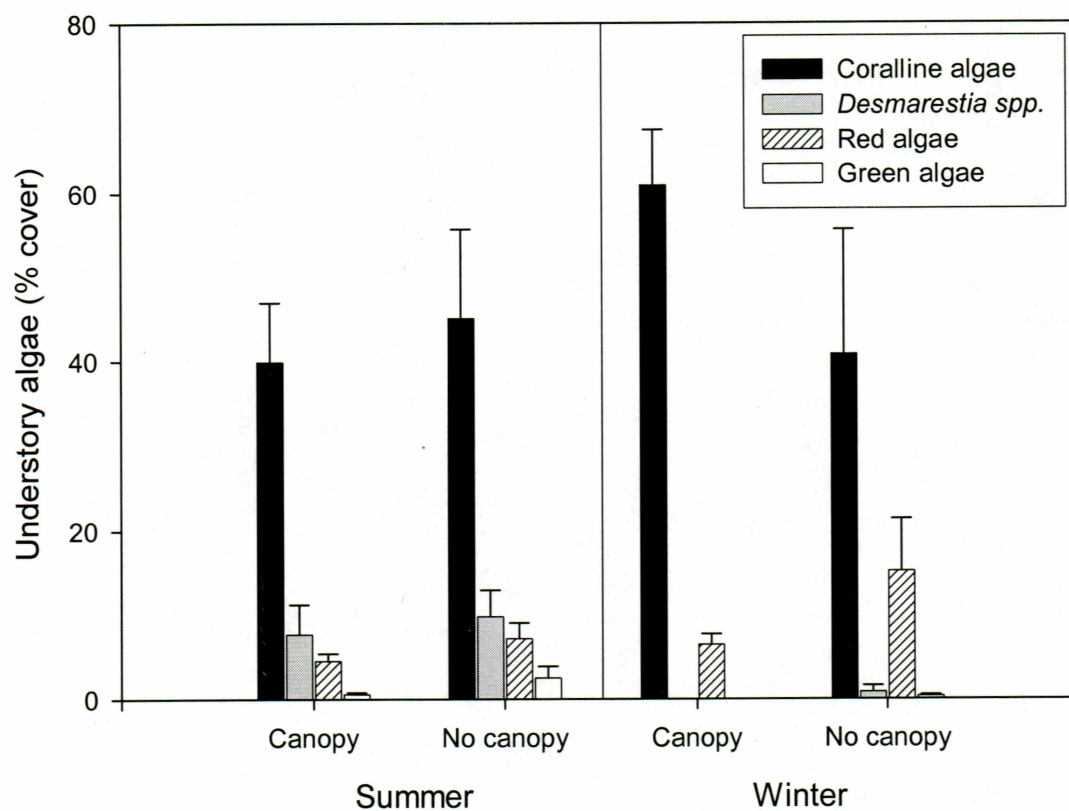


Fig. 1.4 Understory algae percent cover (+1 SE) during the canopy kelp experiment

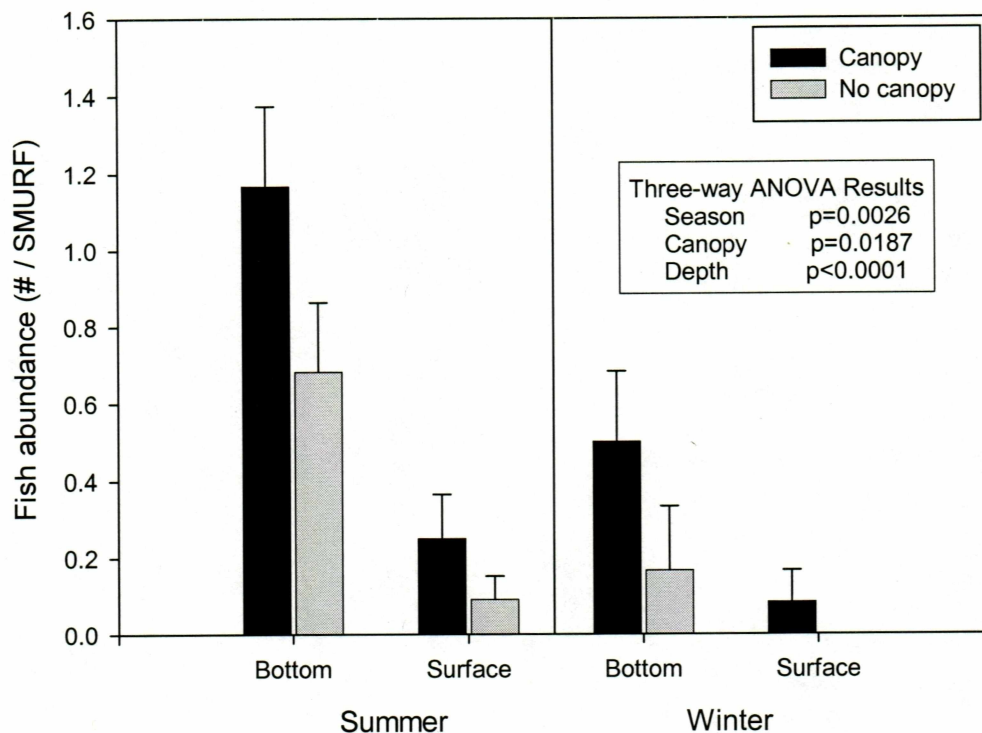


Fig. 1.5 Mean abundance (± 1 SE) of fish sampled using SMURFs during the canopy kelp experiment in summer to winter. Mean values are calculated based on $\log(x+1)$ transformed data. Main effects results show significantly greater abundances of fish during the summer season, at canopy sites, and at the bottom strata. No significant interactions were detected (see Appendix 1.1 for additional ANOVA statistics)

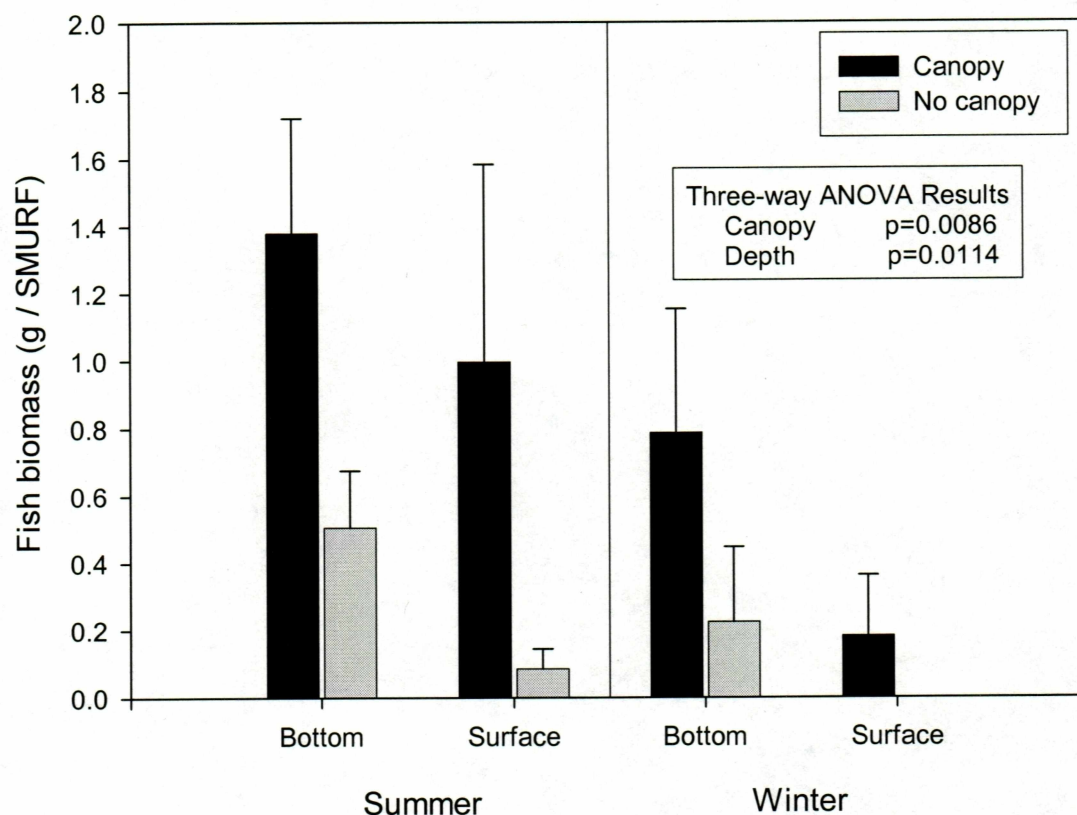


Fig. 1.6 Mean biomass (g) (+1 SE) of fish sampled using SMURFs during the canopy kelp experiment in summer to winter. Mean values are calculated based on $\log(x+1)$ transformed data. Main effects results show significantly greater biomass of fish at canopy sites and at the bottom strata. No significant interactions were detected (see Appendix 1.2 for additional ANOVA statistics)

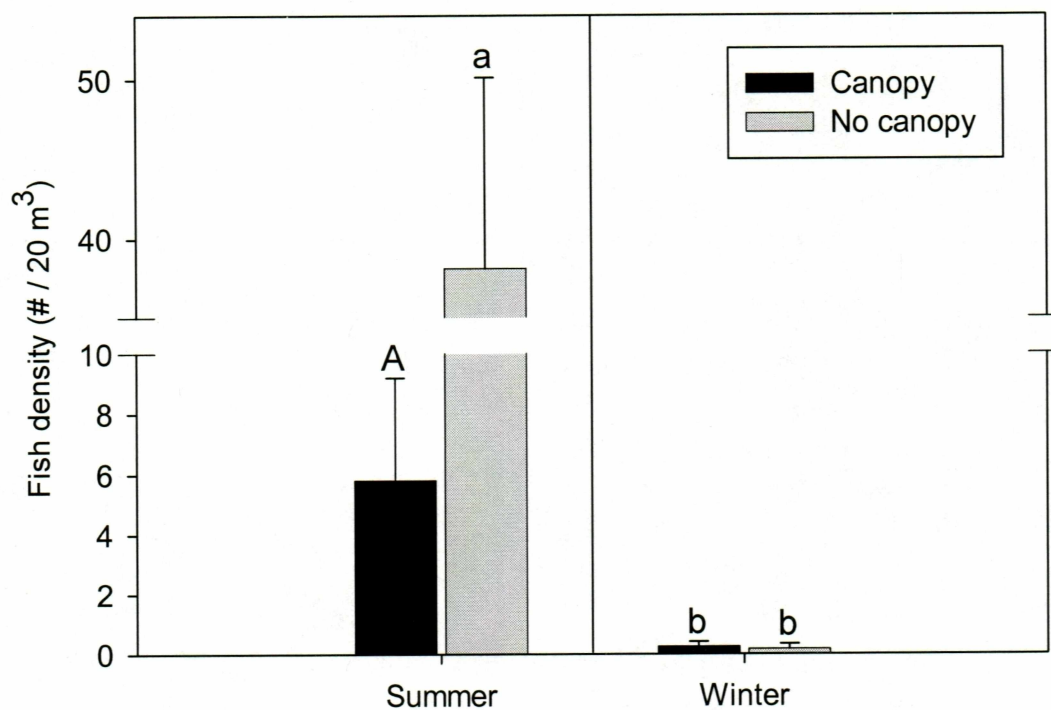


Fig. 1.7 Fish densities at canopy and no canopy sites. Data are from visual surveys and are the mean (+1 SE) per transect during the canopy kelp experiment. Different letters indicate significant differences between seasons ($p < 0.05$). Mean values are calculated based on $\log(x+1)$ transformed data. Case sensitive letters indicate significant canopy differences within season ($p < 0.05$). Mean values are calculated based on $\log(x)$ transformed data

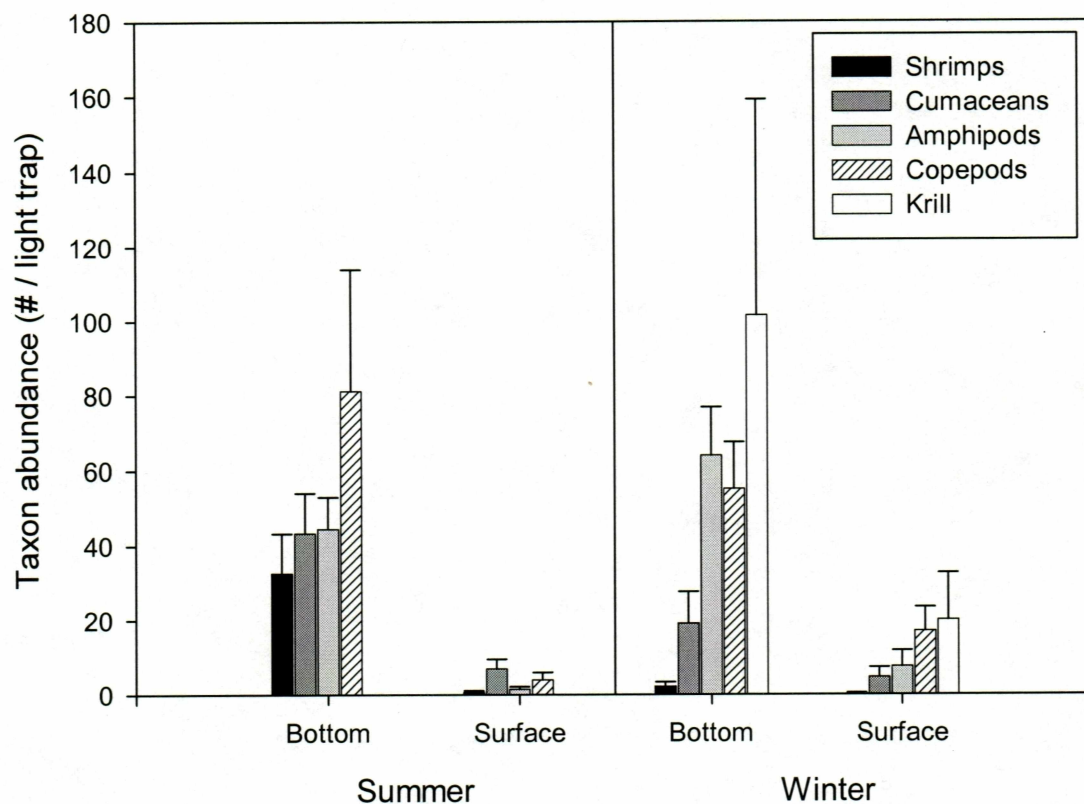


Fig. 1.8 Mean invertebrate taxon abundances by season and depth during the canopy kelp experiment using light trap data. Mean densities ($+1$ SE) are plotted. Mean values are calculated based on $\log(x+1)$ transformed data. No differences were detected between canopy and no canopy treatments, therefore data were pooled

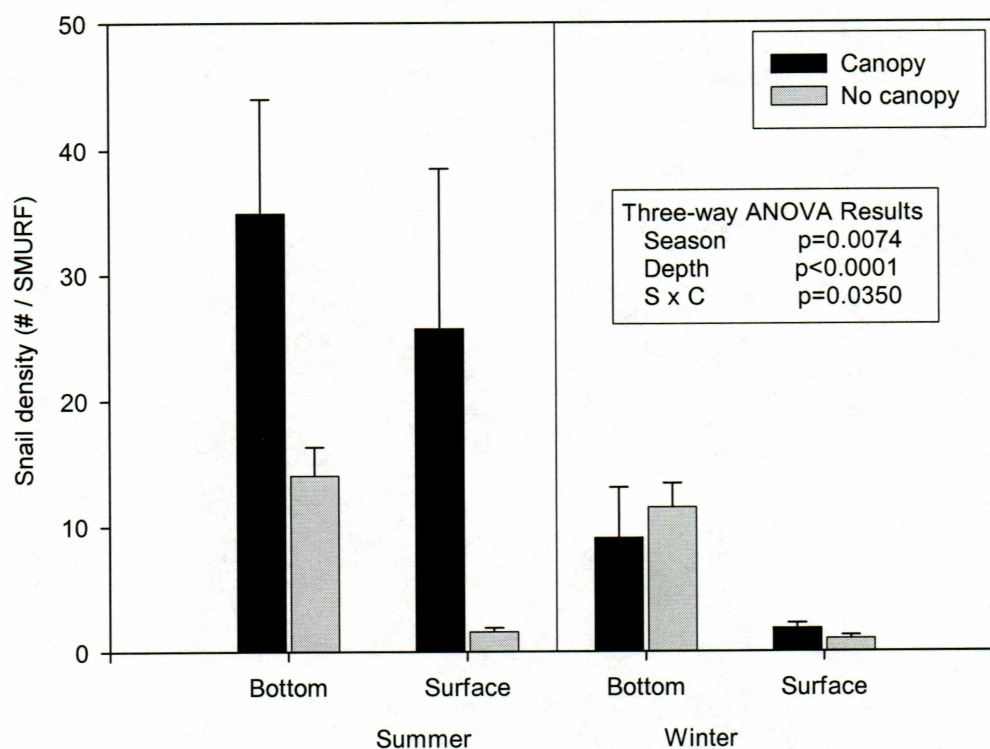


Fig. 1.9 Mean snail density (+1 SE) during the canopy kelp experiment using SMURF data. Mean values are calculated based on $\log(x+1)$ transformed data. Main effects results show significantly greater abundances of snails during the summer season and at the bottom strata. A significant season by canopy interaction (S x C) was caused by a higher abundance of snails at canopy sites during the summer season (see Appendix 1.7 for additional ANOVA statistics)

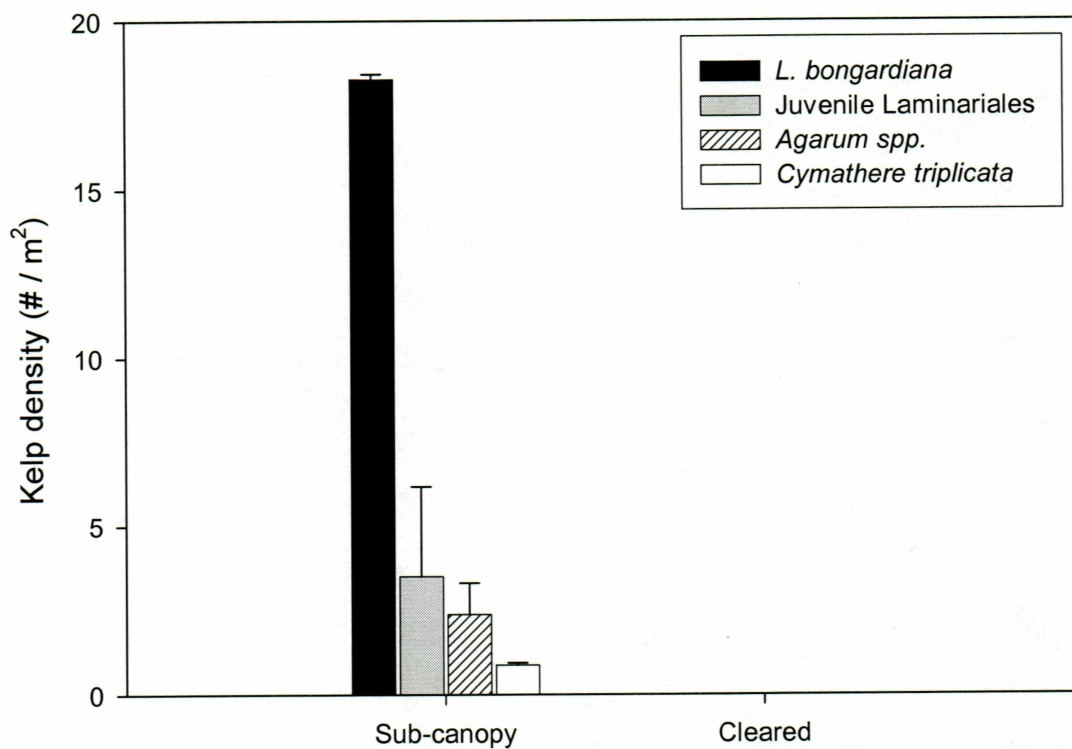


Fig. 1.10 Mean sub-canopy kelp densities (+1 SE) during the sub-canopy kelp experiment. No kelp plants were present at cleared sites due to manipulations and remained absent throughout the course of the experiment

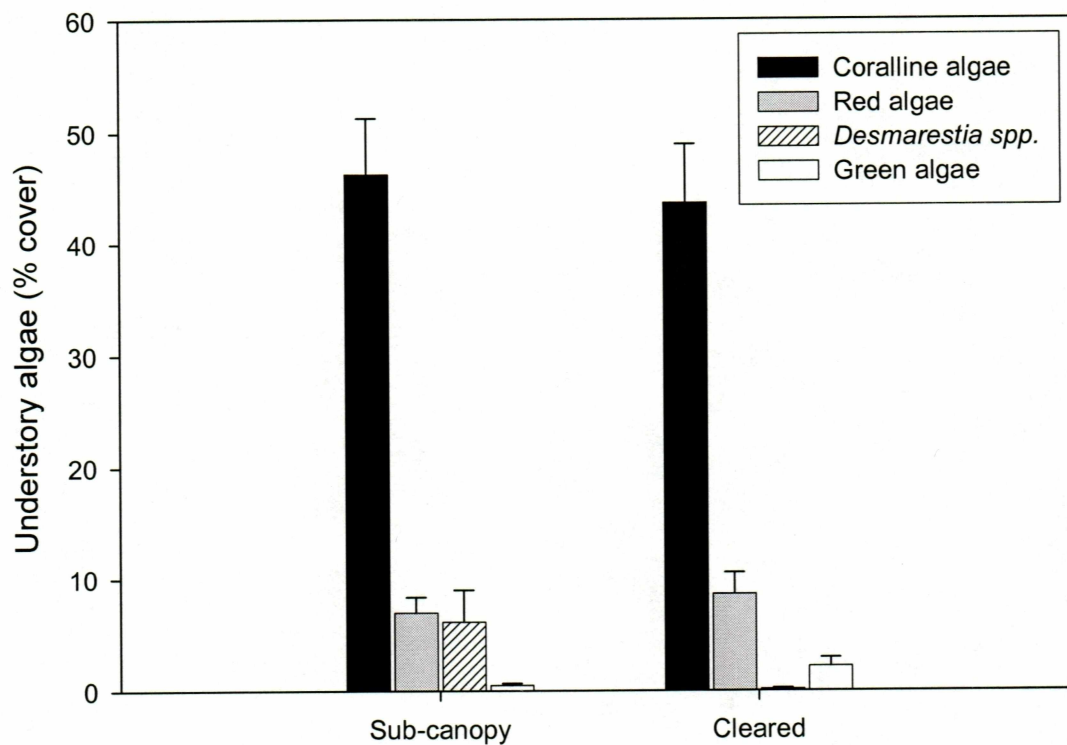


Fig. 1.11 Mean understory algae percent cover (+1 SE) during the sub-canopy kelp experiment. *Desmarestia* spp. were removed from cleared treatments

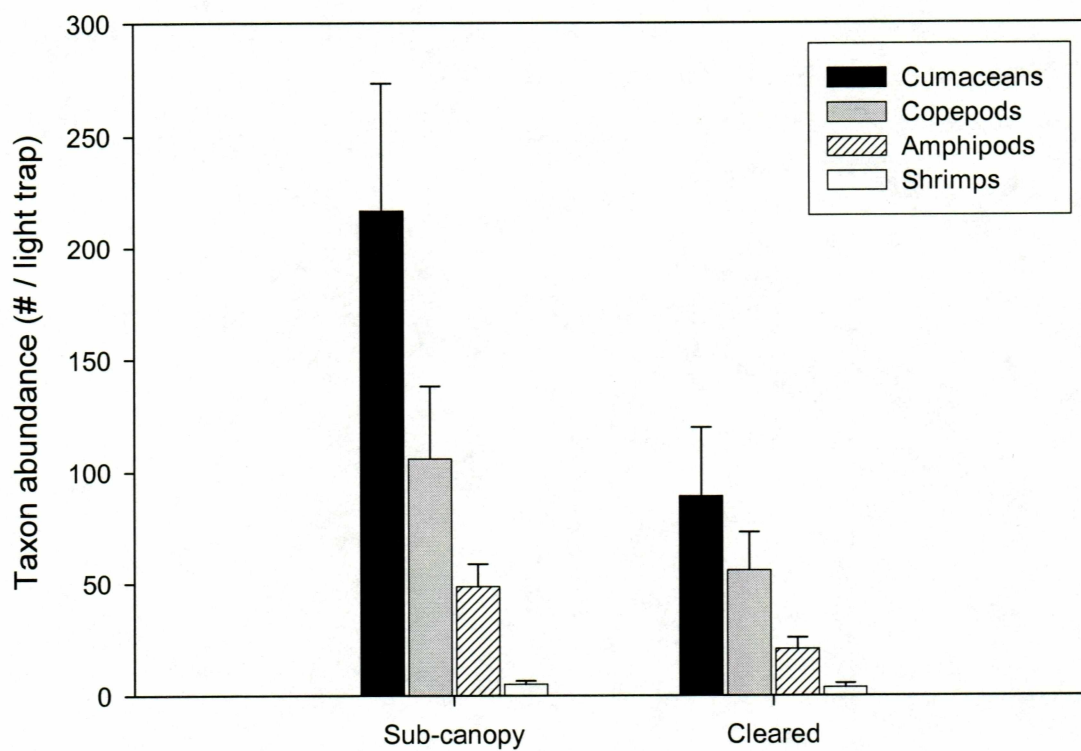


Fig. 1.12 Mean invertebrate taxon abundances (+1 SE) during the sub-canopy kelp experiment using light trap data

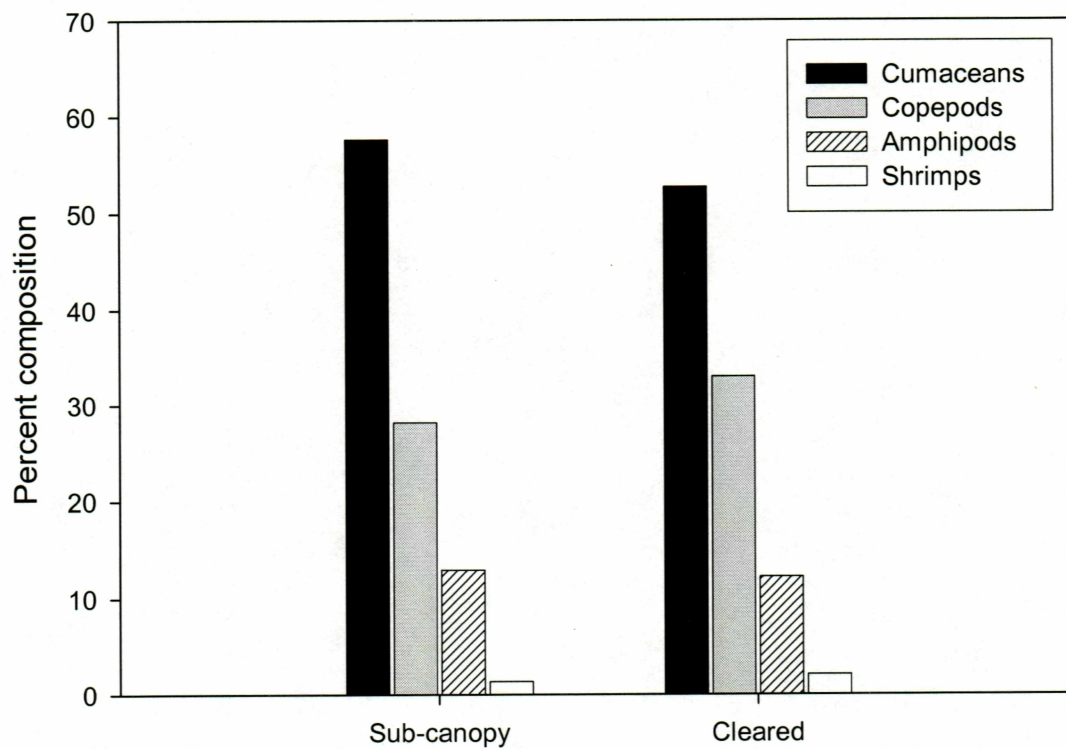


Fig. 1.13 Percent composition of invertebrate taxa during the sub-canopy kelp experiment using light trap data

Table 1.1 Species of fish sampled by SMURFs during the canopy kelp experiment

Family, common name, <i>species name</i>	TOTAL	Summer canopy	Summer no canopy	Winter canopy	Winter no canopy
Pholidae					
Penpoint gunnel (<i>Apodichthys flavidus</i>)	7	2	5	0	0
Crescent gunnel (<i>Pholis laeta</i>)	15	12	2	1	0
Cyclopteridae					
Smooth lumpsucker (<i>Aptocyclus ventricosus</i>)	9	5	4	0	0
Pacific spiny lumpsucker (<i>Eumicrotremus orbis</i>)	5	3	1	1	0
Hemitripterae					
Crested sculpin (<i>Blepsias bilobus</i>)	1	1	0	0	0
Silverspotted sculpin (<i>Blepsias cirrhosus</i>)	8	3	3	1	1
Sailfin sculpin (<i>Nautichthys oculofasciatus</i>)	3	3	0	0	0
Cottidae					
Manacled sculpin (<i>Synchirus gilli</i>)	7	0	2	4	1
Spatulate sculpin (<i>Icelus spatula</i>)	1	1	0	0	0
Liparidae					
Ribbon snailfish (<i>Liparis cyclopus</i>)	2	2	0	0	0
Spotted snailfish (<i>Liparis callyodon</i>)	1	1	0	0	0
Zaproridae					
Prowfish (<i>Zaprora silenus</i>)	1	1	0	0	0
TOTALS	60	34	17	7	2

Table 1.2 Species of fish sampled by SMURFs during the sub-canopy kelp experiment

Family, common name, <i>species name</i>	TOTAL	Sub-canopy	Cleared
Pholidae			
Penpoint gunnel (<i>Apodichthys flavidus</i>)	5	2	3
Crescent gunnel (<i>Pholis laeta</i>)	3	2	1
Cottidae			
Manacled sculpin (<i>Synchirus gilli</i>)	3	1	2
Hemitripterae			
Silverspotted sculpin (<i>Blepsias cirrhosus</i>)	3	1	2
Scorpaenidae			
Quillback rockfish (<i>Sebastes maliger</i>)	3	1	2
Cyclopteridae			
Smooth lumpsucker (<i>Aptocyclus ventricosus</i>)	1	1	0
Liparidae			
Spotted snailfish (<i>Liparis callyodon</i>)	1	0	1
TOTALS	19	8	11

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Source	df	MS	F	p
Season	1	0.7754	9.8581	0.0026
Canopy	1	0.4586	5.8307	0.0187
S x C	1	0.0021	0.0263	0.8717
Depth	1	1.7610	22.3876	<0.0001
S x D	1	0.2550	3.2413	0.0767
C x D	1	0.1063	1.3508	0.2496
S x C x D	1	0.0014	0.0179	0.8941
Error	62	0.0787		

Appendix 1.1 Three-way ANOVA results for mean fish abundance per SMURF per treatment during the canopy kelp experiment

Source	df	MS	F	p
Season	1	0.6571	3.4543	0.0678
Canopy	1	1.4006	7.3627	0.0086
S x C	1	0.0662	0.3478	0.5575
Depth	1	1.2934	6.7992	0.0114
S x D	1	0.0181	0.0949	0.7591
C x D	1	0.0845	0.4440	0.5077
S x C x D	1	0.0221	0.1162	0.7344
Error	62	0.1902		

Appendix 1.2 Three-way ANOVA results for mean fish biomass (g) per SMURF per treatment during the canopy kelp experiment

Source	df	MS	F	p
Season	1	0.1691	2.6897	0.1061
Canopy	1	0.0930	1.4797	0.2284
S x C	1	0.0034	0.0543	0.8165
Depth	1	0.1311	2.0856	0.1537
S x D	1	0.0000	0.0000	0.9958
C x D	1	0.0343	0.5451	0.4631
S x C x D	1	0.0318	0.5058	0.4796
Error	62	0.0629		

Appendix 1.3 Three-way ANOVA results for fish abundance sampled by light traps during the canopy kelp experiment

Source	df	MS	F	p
Season	1	0.1012	0.7926	0.3768
Canopy	1	0.3106	2.4313	0.1240
S x C	1	0.0165	0.1295	0.7202
Depth	1	0.1861	1.4569	0.2320
S x D	1	0.0648	0.5070	0.4791
C x D	1	0.1206	0.9442	0.3350
S x C x D	1	0.1147	0.8975	0.3471
Error	62	0.1277		

Appendix 1.4 Three-way ANOVA results for fish biomass (g) sampled by light traps during the canopy kelp experiment

Source	Value	df	F	p
Wilks' lambda	0.1925	28,214.15	4.43	<0.0001
Pillai's trace	1.1604	28,248	3.62	<0.0001
Taxa	3.4701	4,59	51.1843	<0.0001
Season	1.0871	4,59	16.0341	<0.0001
Canopy	0.1008	4,59	1.4862	0.2179
S x C	0.0631	4,59	0.9302	0.4527
Depth	0.9045	4,59	13.3413	<0.0001
S x D	0.1995	4,59	2.9433	0.0276
C x D	0.0180	4,59	0.2657	0.8988
S x C x D	0.0575	4,59	0.8480	0.5006

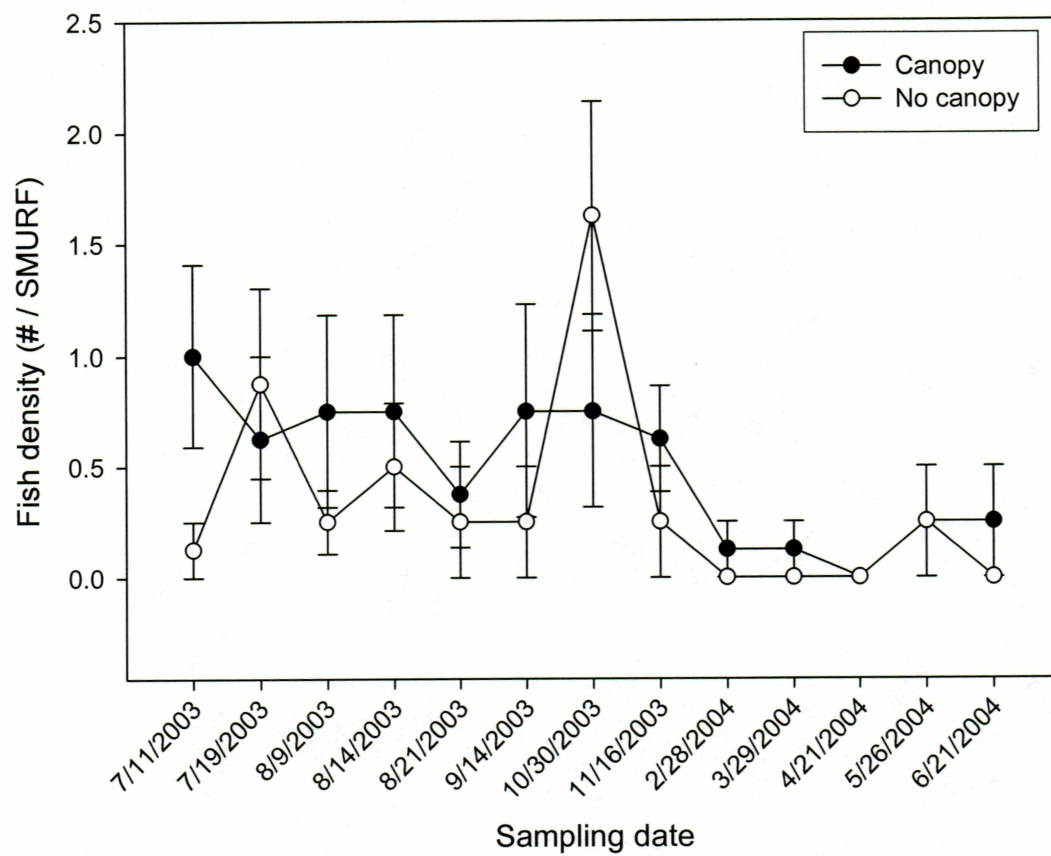
Appendix 1.5 MANOVA results for the predominant invertebrate taxa sampled in light traps throughout the canopy kelp experiment

Taxa	Source	df	MS	F	p
Shrimp	Season	1	14.2461	15.6509	0.0002 (S)
	Canopy	1	0.2290	0.2516	0.6177
	S x C	1	0.3903	0.4288	0.5150
	Depth	1	32.7631	35.9937	<0.0001 (B)
	S x D	1	11.5394	12.6772	0.0007
	C x D	1	0.0326	0.0359	0.8504
	S x C x D	1	0.1455	0.1599	0.6907
	Error	62	0.9102		
Cumaceans	Season	1	7.0928	4.4049	0.0399 (S)
	Canopy	1	0.3873	0.2405	0.6256
	S x C	1	1.4831	0.9211	0.3409
	Depth	1	50.9302	31.6296	<0.0001 (B)
	S x D	1	1.9525	1.2126	0.2751
	C x D	1	1.2586	0.7817	0.3800
	S x C x D	1	0.7531	0.4677	0.4966
	Error	62	1.6102		
Amphipods	Season	1	7.1443	8.1379	0.0059 (W)
	Canopy	1	2.1406	2.4383	0.1235
	S x C	1	0.0282	0.0321	0.8584
	Depth	1	114.0280	129.8860	<0.0001 (B)
	S x D	1	0.2478	0.2823	0.5971
	C x D	1	0.1745	0.1987	0.6573
	S x C x D	1	1.0315	1.1750	0.2826
	Error	62	0.8779		
Copepods	Season	1	5.7417	3.5739	0.0634
	Canopy	1	6.0787	3.7837	0.0563
	S x C	1	0.7969	0.4960	0.4839
	Depth	1	60.8375	37.8681	<0.0001 (B)
	S x D	1	2.6731	1.6639	0.2019
	C x D	1	2.0421	1.2711	0.2639
	S x C x D	1	0.1112	0.0692	0.7934
	Error	62	1.6066		
Krill	Season	1	27.6642	15.2195	0.0002 (W)
	Canopy	1	3.6123	1.9873	0.1636
	S x C	1	3.6123	1.9873	0.1636
	Depth	1	1.1451	0.6300	0.4304
	S x D	1	1.1451	0.6300	0.4304
	C x D	1	0.0002	0.0001	0.9915
	S x C x D	1	0.0002	0.0001	0.9915
	Error	62	1.8177		

Appendix 1.6 Three-way ANOVA results for each invertebrate taxon sampled by light traps during the canopy kelp experiment. Data were log (x+1) transformed. Significant differences are in bold text. Parentheses indicate which treatment was greater (S=summer, W=winter, B=bottom)

Source	df	MS	F	p
Season	1	6.5926	7.6720	0.0074
Canopy	1	2.7247	3.1708	0.0799
S x C	1	3.9945	4.6485	0.0350
Depth	1	32.0835	37.3364	<0.0001
S x D	1	0.0133	0.0155	0.9013
C x D	1	2.0015	2.3292	0.1321
S x C x D	1	0.0892	0.1038	0.7484
Error	62	0.8593		

Appendix 1.7 Three-way ANOVA results for the mean abundance of snails sampled by SMURFs during the canopy kelp experiment



Appendix 1.8 Mean fish densities (\pm SE) sampled with SMURFs by sampling date throughout the canopy kelp experiment

Sample Reference Number	Site	Canopy	Mooring	Location	Deployed	Retrieved	Total Fish
1	SW Shelter	Cleared	North	Bottom	7/9/2003	7/11/2003	1
2	SE Shelter	Present	North	Bottom	7/9/2003	7/11/2003	2
3	SE Shelter	Present	South	Bottom	7/9/2003	7/11/2003	2
4	N. Symonds	Present	East	Surface	7/9/2003	7/11/2003	2
5	N. Symonds	Present	East	Bottom	7/9/2003	7/11/2003	1
6	N. Symonds	Present	West	Bottom	7/9/2003	7/11/2003	1
7	N. Symonds	Present	East	Surface	7/16/2003	7/19/2003	2
8	N. Symonds	Present	West	Bottom	7/16/2003	7/19/2003	3
9	SW Shelter	Cleared	North	Bottom	7/16/2003	7/19/2003	1
10	SW Shelter	Cleared	South	Bottom	7/16/2003	7/19/2003	1
11	S. Symonds	Cleared	East	Bottom	7/16/2003	7/19/2003	1
12	S. Symonds	Cleared	West	Surface	7/16/2003	7/19/2003	1
13	S. Symonds	Cleared	West	Bottom	7/16/2003	7/19/2003	3
14	SE Shelter	Present	North	Bottom	8/6/2003	8/9/2003	4
15	N. Symonds	Present	East	Bottom	8/6/2003	8/9/2003	1
16	N. Symonds	Present	West	Surface	8/6/2003	8/9/2003	1
17	S. Symonds	Cleared	East	Surface	8/6/2003	8/9/2003	1
18	S. Symonds	Cleared	East	Bottom	8/6/2003	8/9/2003	1
19	SE Shelter	Present	North	Bottom	8/11/2003	8/14/2003	1
20	SW Shelter	Cleared	North	Bottom	8/11/2003	8/14/2003	1
21	SW Shelter	Cleared	South	Bottom	8/11/2003	8/14/2003	1
22	N. Symonds	Present	East	Bottom	8/11/2003	8/14/2003	3
23	N. Symonds	Present	West	Surface	8/11/2003	8/14/2003	1
24	N. Symonds	Present	West	Bottom	8/11/2003	8/14/2003	1
25	S. Symonds	Cleared	East	Bottom	8/11/2003	8/14/2003	1
26	S. Symonds	Cleared	West	Bottom	8/11/2003	8/14/2003	1
27	SE Shelter	Present	North	Bottom	8/18/2003	8/21/2003	1
28	N. Symonds	Present	West	Bottom	8/18/2003	8/21/2003	2
29	S. Symonds	Cleared	West	Bottom	8/18/2003	8/21/2003	2
30	SE Shelter	Present	North	Bottom	9/11/2003	9/14/2003	4
31	N. Symonds	Present	East	Bottom	9/11/2003	9/14/2003	1
32	N. Symonds	Present	West	Bottom	9/11/2003	9/14/2003	1
33	S. Symonds	Cleared	West	Bottom	9/11/2003	9/14/2003	1
34	SE Shelter	Present	South	Bottom	10/26/2003	10/30/2003	3
35	SW Shelter	Cleared	North	Bottom	10/26/2003	10/30/2003	2
36	SW Shelter	Cleared	South	Surface	10/26/2003	10/30/2003	1
37	SW Shelter	Cleared	South	Bottom	10/26/2003	10/30/2003	1
38	N. Symonds	Present	West	Bottom	10/26/2003	10/30/2003	3
39	S. Symonds	Cleared	East	Surface	10/26/2003	10/30/2003	3
40	S. Symonds	Cleared	East	Bottom	10/26/2003	10/30/2003	2

Appendix 1.9 Species identification and morphometrics for fish sampled by SMURFs during the canopy kelp experiment. Only samples that contained fish are listed; 188 samples taken total

Sample Reference Number	Site	Canopy	Mooring	Location	Deployed	Retrieved	Total Fish
41	S. Symonds	Cleared	West	Surface	10/26/2003	10/30/2003	3
42	S. Symonds	Cleared	West	Bottom	10/26/2003	10/30/2003	1
43	SE Shelter	Present	North	Bottom	11/13/2003	11/16/2003	2
44	N. Symonds	Present	East	Surface	11/13/2003	11/17/2003	1
45	N. Symonds	Present	East	Bottom	11/13/2003	11/17/2003	1
46	N. Symonds	Present	West	Bottom	11/13/2003	11/17/2003	1
47	S. Symonds	Cleared	East	Bottom	11/13/2003	11/17/2003	1
48	S. Symonds	Cleared	West	Bottom	11/13/2003	11/17/2003	1
49	N. Symonds	Present	West	Bottom	2/25/2004	2/28/2004	1
50	N. Symonds	Present	East	Bottom	3/25/2004	3/29/2004	1
51	S. Symonds	Present	West	Bottom	5/23/2004	5/26/2004	1
52	S. Symonds	Cleared	East	Bottom	5/23/2004	5/26/2004	1
53	S. Symonds	Present	East	Bottom	6/18/2004	6/21/2004	1

Appendix 1.9 Species identification and morphometrics for fish sampled by SMURFs during the canopy kelp experiment. Only samples that contained fish are listed; 188 samples taken total

Sample Reference Number	Total Fish	Fish 1	Weight (g)	SL (cm)	FL (cm)	TL (cm)	Fish 2	Weight (g)	SL (cm)	FL (cm)	TL (cm)
1	1	Penpoint Gunnel	0.3865	4.95	5.1	5.1					
2	2	Silverspotted Sculpin	1.9091	5.7	7.1	7.1	Silverspotted Sculpin	1.4894	5.4	6.5	6.5
3	2	Smooth Lumpsucker	0.0438	0.95	1.2	1.2	Ribbon Snailfish	0.0905	1.8	2.2	2.2
4	2	Crescent Gunnel	1.2	7.5	8	8	Crescent Gunnel	0.2	3.7	3.9	3.9
5	1	Sailfin Sculpin	0.1299	2	2.4	2.4					
6	1	Smooth Lumpsucker	0.075	1.1	1.4	1.4					
7	2	Crescent Gunnel	1.4647	8	8.5	8.5	Smooth Lumpsucker	0.0865	1.1	1.45	1.45
8	3	Crescent Gunnel	1.936	8.9	9.5	9.5	Crescent Gunnel	0.8851	7	7.4	7.4
9	1	Smooth Lumpsucker	0.0342	0.9	1.1	1.1					
10	1	Penpoint Gunnel	0.4355	5	5.4	5.4					
11	1	Penpoint Gunnel	0.7344	5.9	6.3	6.3					
12	1	Silverspotted Sculpin	1.2248	4.5	5.7	5.7					

Appendix 1.9 Species identification and morphometrics for fish sampled by SMURFs during the canopy kelp experiment. Only samples that contained fish are listed; 188 samples taken total

Sample Reference Number	Total Fish	Fish 1	Weight (g)	SL (cm)	FL (cm)	TL (cm)	Fish 2	Weight (g)	SL (cm)	FL (cm)	TL (cm)
13	3	Silverspotted Sculpin	1.5738	4.8	6.2	6.2	Smooth Lumpsucker	0.0862	1.15	1.5	1.5
14	4	Crescent Gunnel	2.6018	9.7	10.3	10.3	Silverspotted Sculpin	3.7974	7.2	8	8
15	1	Crescent Gunnel	3.6157	10.8	11.5	11.5					
16	1	Crested Sculpin	8.6304	7.2	9.6	9.6					
17	1	Penpoint Gunnel	0.6238	6.4	6.9	6.9					
18	1	Silverspotted Sculpin	1.5891	5.3	6.8	6.8					
19	1	Penpoint Gunnel	1.0267	6.8	7.2	7.2					
20	1	Crescent Gunnel	2.2787	8.9	9.6	9.6					
21	1	Penpoint Gunnel	1.1732	7.5	8	8					
22	3	Crescent Gunnel	1.6334	9.15	9.8	9.8	Crescent Gunnel	0.1484	3.8	4.1	4.1
23	1	Spotted Snailfish	12.3071	9.5	11	11					

Appendix 1.9 Species identification and morphometrics for fish sampled by SMURFs during the canopy kelp experiment. Only samples that contained fish are listed; 188 samples taken total

Sample Reference Number	Total Fish	Fish 1	Weight (g)	SL (cm)	FL (cm)	TL (cm)	Fish 2	Weight (g)	SL (cm)	FL (cm)	TL (cm)
24	1	Crescent Gunnel	2.3383	9.6	10.1	10.1					
25	1	Smooth Lumpsucker	0.0609	1.05	1.35	1.35					
26	1	Crescent Gunnel	1.5408	8.6	9.2	9.2					
27	1	Crescent Gunnel	1.745	8.6	9.3	9.3					
28	2	Penpoint Gunnel	1.0009	6.8	7.3	7.3	Sailfin Sculpin	0.6228	3.2	4.1	4.1
29	2	Manacled Sculpin	0.4812	3.9	4.6	4.6	P. Spiny Lumpsucker	0.0854	1.1	1.45	1.45
30	4	Smooth Lumpsucker	0.12	1.3	1.7	1.7	Smooth Lumpsucker	0.088	1.2	1.5	1.5
31	1	Crescent Gunnel	2.1826	9.3	9.9	9.9					
32	1	Sailfin Sculpin	0.7833	3.7	4.6	4.6					
33	1	Manacled Sculpin	0.626	4.3	4.9	4.9					
34	3	Manacled Sculpin	0.9801	4.7	5.4	5.4	Manacled Sculpin	0.7088	4.5	5.15	5.15
35	2	Manacled Sculpin	1.1319	5	5.8	5.8	P. Spiny Lumpsucker	0.2736	1.6	2	2
36	1	Manacled Sculpin	0.4369	3.9	4.5	4.5					

Appendix 1.9 Species identification and morphometrics for fish sampled by SMURFs during the canopy kelp experiment. Only samples that contained fish are listed; 188 samples taken total

Sample Reference Number	Total Fish	Fish 1	Weight (g)	SL (cm)	FL (cm)	TL (cm)	Fish 2	Weight (g)	SL (cm)	FL (cm)	TL (cm)
37	1	Manacled Sculpin	0.4427	3.9	4.6	4.6					
38	3	Manacled Sculpin	1.4944	5.4	6.1	6.1	Manacled Sculpin	0.4446	3.9	4.6	4.6
39	3	Silverspotted Sculpin	2.4847	5.2	6.5	6.5	Manacled Sculpin	0.8711	4.7	5.3	5.3
40	2	Sailfin Sculpin	1.5546	4.7	5.8	5.8	Manacled Sculpin	1.1626	5	5.7	5.7
41	3	Silverspotted Sculpin	3.3226	6.5	7.9	7.9	Manacled Sculpin	1.2239	5.1	6	6
42	1	Quilback Rockfish	2.0654	4.7	5.3	5.4					
43	2	Manacled Sculpin	1.142	7.1	7.8	7.8	P. Spiny Lumpsucker	0.749	2.4	3	3
44	1	Silverspotted Sculpin	2.1751	5.6	6.9	6.9					
45	1	Manacled Sculpin	1.2098	5.1	6	6					
46	1	Crescent Gunnel	3.6006	10.8	11.4	11.4					
47	1	Silverspotted Sculpin	2.2024	5.5	7	7.1					
48	1	Manacled Sculpin	0.4856	3.9	4.5	4.6					

Appendix 1.9 Species identification and morphometrics for fish sampled by SMURFs during the canopy kelp experiment. Only samples that contained fish are listed; 188 samples taken total

Sample Reference Number	Total Fish	Fish 1	Weight (g)	SL (cm)	FL (cm)	TL (cm)	Fish 2	Weight (g)	SL (cm)	FL (cm)	TL (cm)
49	1	Manacled Sculpin	0.9132	4.9	5.6	5.6					
50	1	Manacled Sculpin	1.8262	5.6	6.5	6.5					
51	1	P. Spiny Lumpsucker	0.0298	0.9	1.1	1.1					
52	1	Penpoint Gunnel				40					
53	1	Crescent Gunnel	1.3458	8.5	9.1	9.1					

Appendix 1.9 Species identification and morphometrics for fish sampled by SMURFs during the canopy kelp experiment. Only samples that contained fish are listed; 188 samples taken total

Sample Reference Number	Fish 3	Weight (g)	SL (cm)	FL (cm)	TL (cm)	Fish 4	Weight (g)	SL (cm)	FL (cm)	TL (cm)
1										
2										
3										
4										
5										
6										
7										
8	Prowfish	3.7463	6	7.3	7.3					
9										
10										
11										
12										

Appendix 1.9 Species identification and morphometrics for fish sampled by SMURFs during the canopy kelp experiment. Only samples that contained fish are listed; 188 samples taken total

Sample Reference Number	Fish 3	Weight (g)	SL (cm)	FL (cm)	TL (cm)	Fish 4	Weight (g)	SL (cm)	FL (cm)	TL (cm)
13	Smooth Lumpsucker	0.0304	0.95	1.2	1.2					
14	Spatulate Sculpin	0.2665	2.5	3.2	3.2	Ribbon Snailfish	0.4351	3.2	3.8	3.8
15										
16										
17										
18										
19										
20										
21										
22	P. Spiny Lumpsucker	0.1019	1.2	1.5	1.5					
23										

Appendix 1.9 Species identification and morphometrics for fish sampled by SMURFs during the canopy kelp experiment. Only samples that contained fish are listed; 188 samples taken total

Sample Reference Number	Fish 3	Weight (g)	SL (cm)	FL (cm)	TL (cm)	Fish 4	Weight (g)	SL (cm)	FL (cm)	TL (cm)
24										
25										
26										
27										
28										
29										
30	P. Spiny Lumpsucker	0.1422	1.3	1.6	1.6	P. Spiny Lumpsucker	0.1366	1.4	1.7	1.7
31										
32										
33										
34	Manacled Sculpin	0.3331	3.6	4.15	4.15					
35										
36										

Appendix 1.9 Species identification and morphometrics for fish sampled by SMURFs during the canopy kelp experiment. Only samples that contained fish are listed; 188 samples taken total

Sample Reference Number	Fish 3	Weight (g)	SL (cm)	FL (cm)	TL (cm)	Fish 4	Weight (g)	SL (cm)	FL (cm)	TL (cm)
37										
38	Manacled Sculpin	0.1973	2.9	3.3	3.3					
39	Manacled Sculpin	0.6718	4.3	5	5					
40										
41	Manacled Sculpin	0.4365	3.95	4.6	4.6					
42										
43										
44										
45										
46										
47										
48										

Appendix 1.9 Species identification and morphometrics for fish sampled by SMURFs during the canopy kelp experiment. Only samples that contained fish are listed; 188 samples taken total

Sample Reference Number	Site	Canopy	Mooring	Location	Deployed	Retrieved	Total Fish
1	SW Shelter	Cleared	North	Surface	7/8/2003	7/9/2003	2
2	SW Shelter	Cleared	South	Surface	7/8/2003	7/9/2003	1
3	N. Symonds	Present	East	Bottom	7/8/2003	7/9/2003	2
4	SW Shelter	Cleared	North	Bottom	7/15/2003	7/16/2003	1
5	N. Symonds	Present	West	Surface	7/15/2003	7/16/2003	1
6	S. Symonds	Cleared	East	Surface	7/15/2003	7/16/2003	1
7	S. Symonds	Cleared	East	Bottom	7/15/2003	7/16/2003	2
8	S. Symonds	Cleared	West	Surface	7/15/2003	7/16/2003	1
9	S. Symonds	Cleared	West	Bottom	7/15/2003	7/16/2003	2
10	SW Shelter	Cleared	South	Bottom	8/5/2003	8/6/2003	1
11	N. Symonds	Present	West	Surface	8/5/2003	8/6/2003	1
12	SE Shelter	Present	North	Bottom	8/17/2003	8/18/2003	1
13	N. Symonds	Present	West	Bottom	8/17/2003	8/18/2003	2
14	S. Symonds	Cleared	East	Bottom	8/17/2003	8/18/2003	1
15	S. Symonds	Cleared	East	Bottom	9/10/2003	9/11/2003	1
16	SE Shelter	Present	North	Bottom	10/17/2003	10/18/2003	1
17	SW Shelter	Cleared	North	Bottom	10/17/2003	10/18/2003	1
18	N. Symonds	Present	East	Bottom	10/17/2003	10/18/2003	2
19	N. Symonds	Present	West	Bottom	10/17/2003	10/18/2003	1
20	SW Shelter	Cleared	South	Bottom	2/24/2004	2/25/2004	1
21	SW Shelter	Cleared	North	Bottom	3/24/2004	3/25/2004	2
22	SW Shelter	Cleared	South	Bottom	4/17/2004	4/18/2004	1
23	N. Symonds	Present	West	Surface	4/17/2004	4/18/2004	1
24	N. Symonds	Present	West	Bottom	4/17/2004	4/18/2004	1
25	S. Symonds	Present	East	Bottom	5/22/2004	5/23/2004	2
26	S. Symonds	Cleared	East	Surface	5/22/2004	5/23/2004	1
27	S. Symonds	Present	East	Bottom	6/17/2004	6/18/2004	1
28	S. Symonds	Cleared	West	Surface	6/17/2004	6/18/2004	2
29	S. Symonds	Cleared	East	Bottom	6/17/2004	6/18/2004	1

Appendix 1.10 Species identification and morphometrics for fish sampled by light traps during the canopy kelp experiment. Only samples that contained fish are listed; 188 samples taken total

Sample Reference Number	Total Fish	Fish 1	Weight (g)	SL (cm)	FL (cm)	TL (cm)
1	2	Prowfish	2.3557	5.3	6.4	6.4
2	1	Prowfish	2.3457	5.7	6.9	6.9
3	2	Larvae 1	0.0061	1.4	1.5	1.5
4	1	P. cod	1.8372	5.8	6.2	6.3
5	1	Prowfish	2.5845	5.9	6.7	6.7
6	1	Prowfish	2.6489	5.2	6.4	6.4
7	2	Walleye pollock	0.2182	3.4	3.6	3.7
8	1	Sandlance	1.2252	7.2	7.5	7.7
9	2	Walleye pollock	0.6921	4.6	4.9	5
10	1	Larvae 1	0.0056	1.25	1.3	1.3
11	1	Manacled Sculpin	0.3834	3.2	4.2	4.2
12	1	Tubesnout	0.3762	7.5	7.8	7.9
13	2	P. cod	4.1931	8	8.6	8.7
14	1	P. cod	4.3334	7.9	8.6	8.65
15	1	Antlered Sculpin	0.5452	2.8	3.3	3.3
16	1	Walleye pollock	7.1823	9.5	10.2	10.4
17	1	Penpoint Gunnel	1.9113	8.5	8.95	8.95
18	2	Walleye pollock	6.4086	9.7	10.3	10.5
19	1	Tadpole Sculpin	0.4414	2.8	3.2	3.2
20	1	Penpoint Gunnel	2.3851	8.8	9.7	9.7
21	2	Tubesnout	3.5482	13.6	14.5	14.9
22	1	Crescent Gunnel	5.2336	13.5	14.8	14.8
23	1	Larvae 1	0.0018			0.6
24	1	Larvae 1	0.0002			0.8
25	2	Larvae 1	0.0077	1.25	1.3	1.3
26	1	Silverspotted Sculpin	0.1184	2.3	2.85	2.85
27	1	Larvae 1	0.0275	1.95	2.1	2.15
28	2	Larvae 1	0.0516	2.2	2.5	2.55
29	1	Larvae 1	0.0019	0.9	0.9	0.9

Appendix 1.10 Species identification and morphometrics for fish sampled by light traps during the canopy kelp experiment. Only samples that contained fish are listed; 188 samples taken total

Sample Reference Number	Total Fish	Fish 2	Weight (g)	SL (cm)	FL (cm)	TL (cm)
1	2	Prowfish	0.5524	3.7	4.4	4.4
2	1					
3	2	Larvae 2	0.0014	0.7	0.8	0.8
4	1					
5	1					
6	1					
7	2	Larvae 1	0.0115	1.7	1.8	1.8
8	1					
9	2	Crescent Gunnel	1.8934	8.8	9.3	9.3
10	1					
11	1					
12	1					
13	2	Crescent Gunnel	1.1083	7.4	7.9	7.9
14	1					
15	1					
16	1					
17	1					
18	2	Walleye pollock	4.8289	8.9	9.6	9.7
19	1					
20	1					
21	2	Tubesnout	1.7041	11	11.6	11.9
22	1					
23	1					
24	1					
25	2	Larvae 2	0.0001	0.6	0.6	0.6
26	1					
27	1					
28	2	Larvae 2	0.0812	2.55	2.8	2.9
29	1					

Appendix 1.10 Species identification and morphometrics for fish sampled by light traps during the canopy kelp experiment. Only samples that contained fish are listed; 188 samples taken total

Site	Depth	Canopy	Transect	Date	Total Fish	Pelagic Fish	Benthic Fish
SE Shelter	Bottom	Present	1	7/11/2003	1	0	1
SE Shelter	Bottom	Present	1	7/11/2003	0	0	0
SE Shelter	Bottom	Present	1	7/11/2003	0	0	0
SE Shelter	Surface	Present	2	7/11/2003	0	0	0
SE Shelter	Surface	Present	2	7/11/2003	0	0	0
SE Shelter	Surface	Present	2	7/11/2003	0	0	0
SW Shelter	Bottom	Cleared	3	7/11/2003	0	0	0
SW Shelter	Bottom	Cleared	3	7/11/2003	0	0	0
SW Shelter	Bottom	Cleared	3	7/11/2003	23	22	1
SW Shelter	Surface	Cleared	4	7/11/2003	0	0	0
SW Shelter	Surface	Cleared	4	7/11/2003	0	0	0
SW Shelter	Surface	Cleared	4	7/11/2003	0	0	0
N. Symonds	Bottom	Present	1	7/10/2003	0	0	0
N. Symonds	Bottom	Present	1	7/10/2003	4	4	0
N. Symonds	Bottom	Present	1	7/10/2003	9	8	1
N. Symonds	Surface	Present	2	7/10/2003	0	0	0
N. Symonds	Surface	Present	2	7/10/2003	0	0	0
N. Symonds	Surface	Present	2	7/10/2003	0	0	0
S. Symonds	Bottom	Cleared	3	7/10/2003	31	31	0
S. Symonds	Bottom	Cleared	3	7/10/2003	136	135	1
S. Symonds	Bottom	Cleared	3	7/10/2003	66	66	0
S. Symonds	Surface	Cleared	4	7/10/2003	0	0	0
S. Symonds	Surface	Cleared	4	7/10/2003	0	0	0
S. Symonds	Surface	Cleared	4	7/10/2003	0	0	0
SE Shelter	Bottom	Present	1	8/9/2003	0	0	0
SE Shelter	Bottom	Present	1	8/9/2003	1	0	1
SE Shelter	Bottom	Present	1	8/9/2003	2	2	0
SE Shelter	Surface	Present	2	8/9/2003	0	0	0
SE Shelter	Surface	Present	2	8/9/2003	0	0	0
SE Shelter	Surface	Present	2	8/9/2003	0	0	0
SW Shelter	Bottom	Cleared	3	8/9/2003	1	1	0
SW Shelter	Bottom	Cleared	3	8/9/2003	50	50	0
SW Shelter	Bottom	Cleared	3	8/9/2003	0	0	0
SW Shelter	Surface	Cleared	4	8/9/2003	0	0	0
SW Shelter	Surface	Cleared	4	8/9/2003	0	0	0
SW Shelter	Surface	Cleared	4	8/9/2003	0	0	0
N. Symonds	Bottom	Present	1	8/5/2003	0	0	0
N. Symonds	Bottom	Present	1	8/5/2003	1	1	0
N. Symonds	Bottom	Present	1	8/5/2003	10	10	0
N. Symonds	Surface	Present	2	8/5/2003	0	0	0
N. Symonds	Surface	Present	2	8/5/2003	0	0	0

Appendix 1.11 Number of fish observed on visual surveys
during the canopy kelp experiment

Site	Depth	Canopy	Transect	Date	Total	Pelagic	Benthic
N. Symonds	Surface	Present	2	8/5/2003	0	0	0
S. Symonds	Bottom	Cleared	3	8/7/2003	6	5	1
S. Symonds	Bottom	Cleared	3	8/7/2003	104	104	0
S. Symonds	Bottom	Cleared	3	8/7/2003	64	63	1
S. Symonds	Surface	Cleared	4	8/7/2003	0	0	0
S. Symonds	Surface	Cleared	4	8/7/2003	0	0	0
S. Symonds	Surface	Cleared	4	8/7/2003	0	0	0
SE Shelter	Bottom	Present	1	8/11/2003	1	1	0
SE Shelter	Bottom	Present	1	8/11/2003	1	0	1
SE Shelter	Bottom	Present	1	8/11/2003	2	0	2
SE Shelter	Surface	Present	2	8/11/2003	0	0	0
SE Shelter	Surface	Present	2	8/11/2003	0	0	0
SE Shelter	Surface	Present	2	8/11/2003	0	0	0
SW Shelter	Bottom	Cleared	3	8/11/2003	1	1	0
SW Shelter	Bottom	Cleared	3	8/11/2003	0	0	0
SW Shelter	Bottom	Cleared	3	8/11/2003	200	200	0
SW Shelter	Surface	Cleared	4	8/11/2003	0	0	0
SW Shelter	Surface	Cleared	4	8/11/2003	0	0	0
SW Shelter	Surface	Cleared	4	8/11/2003	0	0	0
N. Symonds	Bottom	Present	1	8/12/2003	22	22	0
N. Symonds	Bottom	Present	1	8/12/2003	22	22	0
N. Symonds	Bottom	Present	1	8/12/2003	63	61	2
N. Symonds	Surface	Present	2	8/12/2003	0	0	0
N. Symonds	Surface	Present	2	8/12/2003	0	0	0
N. Symonds	Surface	Present	2	8/12/2003	0	0	0
S. Symonds	Bottom	Cleared	3	8/12/2003	12	12	0
S. Symonds	Bottom	Cleared	3	8/12/2003	113	113	0
S. Symonds	Bottom	Cleared	3	8/12/2003	200	200	0
S. Symonds	Surface	Cleared	4	8/12/2003	0	0	0
S. Symonds	Surface	Cleared	4	8/12/2003	0	0	0
S. Symonds	Surface	Cleared	4	8/12/2003	0	0	0
SE Shelter	Bottom	Present	1	8/18/2003	1	1	0
SE Shelter	Bottom	Present	1	8/18/2003	0	0	0
SE Shelter	Bottom	Present	1	8/18/2003	0	0	0
SE Shelter	Surface	Present	2	8/18/2003	0	0	0
SE Shelter	Surface	Present	2	8/18/2003	0	0	0
SE Shelter	Surface	Present	2	8/18/2003	0	0	0
SW Shelter	Bottom	Cleared	3	8/17/2003	2	2	0
SW Shelter	Bottom	Cleared	3	8/17/2003	0	0	0
SW Shelter	Bottom	Cleared	3	8/17/2003	0	0	0
SW Shelter	Surface	Cleared	4	8/17/2003	0	0	0
SW Shelter	Surface	Cleared	4	8/17/2003	0	0	0

Appendix 1.11 Number of fish observed on visual surveys during the canopy kelp experiment

Site	Depth	Canopy	Transect	Date	Total	Pelagic	Benthic
SW Shelter	Surface	Cleared	4	8/17/2003	0	0	0
N. Symonds	Bottom	Present	1	8/17/2003	12	12	0
N. Symonds	Bottom	Present	1	8/17/2003	2	2	0
N. Symonds	Bottom	Present	1	8/17/2003	1	0	1
N. Symonds	Surface	Present	2	8/17/2003	0	0	0
N. Symonds	Surface	Present	2	8/17/2003	0	0	0
N. Symonds	Surface	Present	2	8/17/2003	0	0	0
S. Symonds	Bottom	Cleared	3	8/18/2003	5	4	1
S. Symonds	Bottom	Cleared	3	8/18/2003	21	20	1
S. Symonds	Bottom	Cleared	3	8/18/2003	90	90	0
S. Symonds	Surface	Cleared	4	8/18/2003	0	0	0
S. Symonds	Surface	Cleared	4	8/18/2003	0	0	0
S. Symonds	Surface	Cleared	4	8/18/2003	0	0	0
SE Shelter	Bottom	Present	1	9/11/2003	1	0	1
SE Shelter	Bottom	Present	1	9/11/2003	0	0	0
SE Shelter	Bottom	Present	1	9/11/2003	0	0	0
SE Shelter	Surface	Present	2	9/11/2003	0	0	0
SE Shelter	Surface	Present	2	9/11/2003	0	0	0
SE Shelter	Surface	Present	2	9/11/2003	0	0	0
SW Shelter	Bottom	Cleared	3	9/10/2003	1	1	0
SW Shelter	Bottom	Cleared	3	9/10/2003	0	0	0
SW Shelter	Bottom	Cleared	3	9/10/2003	0	0	0
SW Shelter	Surface	Cleared	4	9/10/2003	0	0	0
SW Shelter	Surface	Cleared	4	9/10/2003	0	0	0
SW Shelter	Surface	Cleared	4	9/10/2003	0	0	0
N. Symonds	Bottom	Present	1	9/10/2003	5	5	0
N. Symonds	Bottom	Present	1	9/10/2003	1	1	0
N. Symonds	Bottom	Present	1	9/10/2003	12	12	0
N. Symonds	Surface	Present	2	9/10/2003	0	0	0
N. Symonds	Surface	Present	2	9/10/2003	0	0	0
N. Symonds	Surface	Present	2	9/10/2003	0	0	0
S. Symonds	Bottom	Cleared	3	9/11/2003	15	14	1
S. Symonds	Bottom	Cleared	3	9/11/2003	0	0	0
S. Symonds	Bottom	Cleared	3	9/11/2003	2	2	0
S. Symonds	Surface	Cleared	4	9/11/2003	0	0	0
S. Symonds	Surface	Cleared	4	9/11/2003	0	0	0
S. Symonds	Surface	Cleared	4	9/11/2003	0	0	0
SE Shelter	Bottom	Present	1	10/17/2003	0	0	0
SE Shelter	Bottom	Present	1	10/17/2003	0	0	0
SE Shelter	Bottom	Present	1	10/17/2003	0	0	0
SE Shelter	Surface	Present	2	10/17/2003	0	0	0
SE Shelter	Surface	Present	2	10/17/2003	0	0	0

Appendix 1.11 Number of fish observed on visual surveys
during the canopy kelp experiment

Site	Depth	Canopy	Transect	Date	Total	Pelagic	Benthic
SE Shelter	Surface	Present	2	10/17/2003	0	0	0
SW Shelter	Bottom	Cleared	3	10/17/2003	0	0	0
SW Shelter	Bottom	Cleared	3	10/17/2003	0	0	0
SW Shelter	Bottom	Cleared	3	10/17/2003	1	1	0
SW Shelter	Surface	Cleared	4	10/17/2003	0	0	0
SW Shelter	Surface	Cleared	4	10/17/2003	0	0	0
SW Shelter	Surface	Cleared	4	10/17/2003	0	0	0
N. Symonds	Bottom	Present	1	10/17/2003	2	1	1
N. Symonds	Bottom	Present	1	10/17/2003	3	3	0
N. Symonds	Bottom	Present	1	10/17/2003	0	0	0
N. Symonds	Surface	Present	2	10/17/2003	0	0	0
N. Symonds	Surface	Present	2	10/17/2003	0	0	0
N. Symonds	Surface	Present	2	10/17/2003	0	0	0
S. Symonds	Bottom	Cleared	3	10/18/2003	0	0	0
S. Symonds	Bottom	Cleared	3	10/18/2003	1	1	0
S. Symonds	Bottom	Cleared	3	10/18/2003	1	0	1
S. Symonds	Surface	Cleared	4	10/18/2003	0	0	0
S. Symonds	Surface	Cleared	4	10/18/2003	0	0	0
S. Symonds	Surface	Cleared	4	10/18/2003	0	0	0
SE Shelter	Bottom	Present	1	2/25/2004	0	0	0
SE Shelter	Bottom	Present	1	2/25/2004	0	0	0
SE Shelter	Bottom	Present	1	2/25/2004	0	0	0
SE Shelter	Surface	Present	2	2/25/2004	0	0	0
SE Shelter	Surface	Present	2	2/25/2004	0	0	0
SE Shelter	Surface	Present	2	2/25/2004	0	0	0
SW Shelter	Bottom	Cleared	3	2/25/2004	0	0	0
SW Shelter	Bottom	Cleared	3	2/25/2004	0	0	0
SW Shelter	Bottom	Cleared	3	2/25/2004	0	0	0
SW Shelter	Surface	Cleared	4	2/25/2004	0	0	0
SW Shelter	Surface	Cleared	4	2/25/2004	0	0	0
SW Shelter	Surface	Cleared	4	2/25/2004	0	0	0
N. Symonds	Bottom	Present	1	2/24/2004	0	0	0
N. Symonds	Bottom	Present	1	2/24/2004	1	0	1
N. Symonds	Bottom	Present	1	2/24/2004	0	0	0
N. Symonds	Surface	Present	2	2/24/2004	0	0	0
N. Symonds	Surface	Present	2	2/24/2004	0	0	0
N. Symonds	Surface	Present	2	2/24/2004	0	0	0
S. Symonds	Bottom	Cleared	3	2/24/2004	0	0	0
S. Symonds	Bottom	Cleared	3	2/24/2004	0	0	0
S. Symonds	Bottom	Cleared	3	2/24/2004	0	0	0
S. Symonds	Surface	Cleared	4	2/24/2004	0	0	0
S. Symonds	Surface	Cleared	4	2/24/2004	0	0	0

Appendix 1.11 Number of fish observed on visual surveys
during the canopy kelp experiment

Site	Depth	Canopy	Transect	Date	Total	Pelagic	Benthic
S. Symonds	Surface	Cleared	4	2/24/2004	0	0	0
SE Shelter	Bottom	Present	1	3/24/2004	0	0	0
SE Shelter	Bottom	Present	1	3/24/2004	1	0	1
SE Shelter	Bottom	Present	1	3/24/2004	1	0	1
SE Shelter	Surface	Present	2	3/24/2004	0	0	0
SE Shelter	Surface	Present	2	3/24/2004	0	0	0
SE Shelter	Surface	Present	2	3/24/2004	0	0	0
SW Shelter	Bottom	Cleared	3	3/24/2004	0	0	0
SW Shelter	Bottom	Cleared	3	3/24/2004	0	0	0
SW Shelter	Bottom	Cleared	3	3/24/2004	0	0	0
SW Shelter	Surface	Cleared	4	3/24/2004	0	0	0
SW Shelter	Surface	Cleared	4	3/24/2004	0	0	0
SW Shelter	Surface	Cleared	4	3/24/2004	0	0	0
N. Symonds	Bottom	Present	1	3/24/2004	0	0	0
N. Symonds	Bottom	Present	1	3/24/2004	0	0	0
N. Symonds	Bottom	Present	1	3/24/2004	0	0	0
N. Symonds	Surface	Present	2	3/24/2004	0	0	0
N. Symonds	Surface	Present	2	3/24/2004	0	0	0
N. Symonds	Surface	Present	2	3/24/2004	0	0	0
S. Symonds	Bottom	Cleared	3	3/24/2004	2	0	2
S. Symonds	Bottom	Cleared	3	3/24/2004	0	0	0
S. Symonds	Bottom	Cleared	3	3/24/2004	0	0	0
S. Symonds	Surface	Cleared	4	3/24/2004	0	0	0
S. Symonds	Surface	Cleared	4	3/24/2004	0	0	0
S. Symonds	Surface	Cleared	4	3/24/2004	0	0	0
SE Shelter	Bottom	Present	1	4/17/2004	1	0	1
SE Shelter	Bottom	Present	1	4/17/2004	0	0	0
SE Shelter	Bottom	Present	1	4/17/2004	0	0	0
SE Shelter	Surface	Present	2	4/17/2004	0	0	0
SE Shelter	Surface	Present	2	4/17/2004	0	0	0
SE Shelter	Surface	Present	2	4/17/2004	0	0	0
SW Shelter	Bottom	Cleared	3	4/17/2004	0	0	0
SW Shelter	Bottom	Cleared	3	4/17/2004	0	0	0
SW Shelter	Bottom	Cleared	3	4/17/2004	0	0	0
SW Shelter	Surface	Cleared	4	4/17/2004	0	0	0
SW Shelter	Surface	Cleared	4	4/17/2004	0	0	0
SW Shelter	Surface	Cleared	4	4/17/2004	0	0	0
N. Symonds	Bottom	Present	1	4/18/2004	0	0	0
N. Symonds	Bottom	Present	1	4/18/2004	0	0	0
N. Symonds	Bottom	Present	1	4/18/2004	1	0	1
N. Symonds	Surface	Present	2	4/18/2004	0	0	0
N. Symonds	Surface	Present	2	4/18/2004	0	0	0

Appendix 1.11 Number of fish observed on visual surveys during the canopy kelp experiment

Site	Depth	Canopy	Transect	Date	Total	Pelagic	Benthic
N. Symonds	Surface	Present	2	4/18/2004	0	0	0
S. Symonds	Bottom	Cleared	3	4/18/2004	0	0	0
S. Symonds	Bottom	Cleared	3	4/18/2004	0	0	0
S. Symonds	Bottom	Cleared	3	4/18/2004	0	0	0
S. Symonds	Surface	Cleared	4	4/18/2004	0	0	0
S. Symonds	Surface	Cleared	4	4/18/2004	0	0	0
S. Symonds	Surface	Cleared	4	4/18/2004	0	0	0
S. Symonds	Bottom	Present	1	5/22/2004	0	0	0
S. Symonds	Bottom	Present	1	5/22/2004	0	0	0
S. Symonds	Bottom	Present	1	5/22/2004	0	0	0
S. Symonds	Surface	Present	2	5/22/2004	0	0	0
S. Symonds	Surface	Present	2	5/22/2004	0	0	0
S. Symonds	Surface	Present	2	5/22/2004	0	0	0
S. Symonds	Bottom	Cleared	3	5/22/2004	0	0	0
S. Symonds	Bottom	Cleared	3	5/22/2004	1	1	0
S. Symonds	Bottom	Cleared	3	5/22/2004	0	0	0
S. Symonds	Surface	Cleared	4	5/22/2004	0	0	0
S. Symonds	Surface	Cleared	4	5/22/2004	0	0	0
S. Symonds	Surface	Cleared	4	5/22/2004	0	0	0
S. Symonds	Bottom	Present	1	6/21/2004	0	0	0
S. Symonds	Bottom	Present	1	6/21/2004	0	0	0
S. Symonds	Bottom	Present	1	6/21/2004	0	0	0
S. Symonds	Surface	Present	2	6/21/2004	0	0	0
S. Symonds	Surface	Present	2	6/21/2004	0	0	0
S. Symonds	Surface	Present	2	6/21/2004	0	0	0
S. Symonds	Bottom	Cleared	3	6/21/2004	0	0	0
S. Symonds	Bottom	Cleared	3	6/21/2004	1	0	1
S. Symonds	Bottom	Cleared	3	6/21/2004	0	0	0
S. Symonds	Surface	Cleared	4	6/21/2004	0	0	0
S. Symonds	Surface	Cleared	4	6/21/2004	0	0	0
S. Symonds	Surface	Cleared	4	6/21/2004	0	0	0

Appendix 1.11 Number of fish observed on visual surveys
during the canopy kelp experiment

Sample Reference Number	Site	Canopy	Mooring	Location	Deployed	Retrieved
1	SE Shelter	Present	North	Surface	7/8/2003	7/9/2003
2	SE Shelter	Present	North	Bottom	7/8/2003	7/9/2003
3	SE Shelter	Present	South	Surface	7/8/2003	7/9/2003
4	SE Shelter	Present	South	Bottom	7/8/2003	7/9/2003
5	SW Shelter	Cleared	North	Surface	7/8/2003	7/9/2003
6	SW Shelter	Cleared	North	Bottom	7/8/2003	7/9/2003
7	SW Shelter	Cleared	South	Surface	7/8/2003	7/9/2003
8	SW Shelter	Cleared	South	Bottom	7/8/2003	7/9/2003
9	N. Symonds	Present	East	Surface	7/8/2003	7/9/2003
10	N. Symonds	Present	East	Bottom	7/8/2003	7/9/2003
11	N. Symonds	Present	West	Surface	7/8/2003	7/9/2003
12	N. Symonds	Present	West	Bottom	7/8/2003	7/9/2003
13	S. Symonds	Cleared	East	Surface	7/8/2003	7/9/2003
14	S. Symonds	Cleared	East	Bottom	7/8/2003	7/9/2003
15	S. Symonds	Cleared	West	Surface	7/8/2003	7/9/2003
16	S. Symonds	Cleared	West	Bottom	7/8/2003	7/9/2003
17	SE Shelter	Present	North	Surface	7/15/2003	7/16/2003
18	SE Shelter	Present	North	Bottom	7/15/2003	7/16/2003
19	SE Shelter	Present	South	Surface	7/15/2003	7/16/2003
20	SE Shelter	Present	South	Bottom	7/15/2003	7/16/2003
21	SW Shelter	Cleared	North	Surface	7/15/2003	7/16/2003
22	SW Shelter	Cleared	North	Bottom	7/15/2003	7/16/2003
23	SW Shelter	Cleared	South	Surface	7/15/2003	7/16/2003
24	SW Shelter	Cleared	South	Bottom	7/15/2003	7/16/2003
25	N. Symonds	Present	East	Surface	7/15/2003	7/16/2003
26	N. Symonds	Present	East	Bottom	7/15/2003	7/16/2003
27	N. Symonds	Present	West	Surface	7/15/2003	7/16/2003
28	N. Symonds	Present	West	Bottom	7/15/2003	7/16/2003
29	S. Symonds	Cleared	East	Surface	7/15/2003	7/16/2003
30	S. Symonds	Cleared	East	Bottom	7/15/2003	7/16/2003
31	S. Symonds	Cleared	West	Surface	7/15/2003	7/16/2003
32	S. Symonds	Cleared	West	Bottom	7/15/2003	7/16/2003
33	SE Shelter	Present	North	Surface	8/5/2003	8/6/2003
34	SE Shelter	Present	North	Bottom	8/5/2003	8/6/2003

Appendix 1.12 Invertebrate identifications for light trap samples during the canopy kelp experiment

Sample Reference Number	Site	Canopy	Mooring	Location	Deployed	Retrieved
35	SE Shelter	Present	South	Surface	8/5/2003	8/6/2003
36	SE Shelter	Present	South	Bottom	8/5/2003	8/6/2003
37	SW Shelter	Cleared	North	Surface	8/5/2003	8/6/2003
38	SW Shelter	Cleared	North	Bottom	8/5/2003	8/6/2003
39	SW Shelter	Cleared	South	Surface	8/5/2003	8/6/2003
40	SW Shelter	Cleared	South	Bottom	8/5/2003	8/6/2003
41	N. Symonds	Present	East	Surface	8/5/2003	8/6/2003
42	N. Symonds	Present	East	Bottom	8/5/2003	8/6/2003
43	N. Symonds	Present	West	Surface	8/5/2003	8/6/2003
44	N. Symonds	Present	West	Bottom	8/5/2003	8/6/2003
45	S. Symonds	Cleared	East	Surface	8/5/2003	8/6/2003
46	S. Symonds	Cleared	East	Bottom	8/5/2003	8/6/2003
47	S. Symonds	Cleared	West	Surface	8/5/2003	8/6/2003
48	S. Symonds	Cleared	West	Bottom	8/5/2003	8/6/2003
49	SE Shelter	Present	North	Surface	8/10/2003	8/11/2003
50	SE Shelter	Present	North	Bottom	8/10/2003	8/11/2003
51	SE Shelter	Present	South	Surface	8/10/2003	8/11/2003
52	SE Shelter	Present	South	Bottom	8/10/2003	8/11/2003
53	SW Shelter	Cleared	North	Surface	8/10/2003	8/11/2003
54	SW Shelter	Cleared	North	Bottom	8/10/2003	8/11/2003
55	SW Shelter	Cleared	South	Surface	8/10/2003	8/11/2003
56	SW Shelter	Cleared	South	Bottom	8/10/2003	8/11/2003
57	N. Symonds	Present	East	Surface	8/10/2003	8/11/2003
58	N. Symonds	Present	East	Bottom	8/10/2003	8/11/2003
59	N. Symonds	Present	West	Surface	8/10/2003	8/11/2003
60	N. Symonds	Present	West	Bottom	8/10/2003	8/11/2003
61	S. Symonds	Cleared	East	Surface	8/10/2003	8/11/2003
62	S. Symonds	Cleared	East	Bottom	8/10/2003	8/11/2003
63	S. Symonds	Cleared	West	Surface	8/10/2003	8/11/2003
64	S. Symonds	Cleared	West	Bottom	8/10/2003	8/11/2003
65	SE Shelter	Present	North	Surface	8/17/2003	8/18/2003
66	SE Shelter	Present	North	Bottom	8/17/2003	8/18/2003
67	SE Shelter	Present	South	Surface	8/17/2003	8/18/2003
68	SE Shelter	Present	South	Bottom	8/17/2003	8/18/2003

Appendix 1.12 Invertebrate identifications for light trap samples
during the canopy kelp experiment

Sample Reference Number	Site	Canopy	Mooring	Location	Deployed	Retrieved
69	SW Shelter	Cleared	North	Surface	8/17/2003	8/18/2003
70	SW Shelter	Cleared	North	Bottom	8/17/2003	8/18/2003
71	SW Shelter	Cleared	South	Surface	8/17/2003	8/18/2003
72	SW Shelter	Cleared	South	Bottom	8/17/2003	8/18/2003
73	N. Symonds	Present	East	Surface	8/17/2003	8/18/2003
74	N. Symonds	Present	East	Bottom	8/17/2003	8/18/2003
75	N. Symonds	Present	West	Surface	8/17/2003	8/18/2003
76	N. Symonds	Present	West	Bottom	8/17/2003	8/18/2003
77	S. Symonds	Cleared	East	Surface	8/17/2003	8/18/2003
78	S. Symonds	Cleared	East	Bottom	8/17/2003	8/18/2003
79	S. Symonds	Cleared	West	Surface	8/17/2003	8/18/2003
80	S. Symonds	Cleared	West	Bottom	8/17/2003	8/18/2003
81	SE Shelter	Present	North	Surface	9/10/2003	9/11/2003
82	SE Shelter	Present	North	Bottom	9/10/2003	9/11/2003
83	SE Shelter	Present	South	Surface	9/10/2003	9/11/2003
84	SE Shelter	Present	South	Bottom	9/10/2003	9/11/2003
85	SW Shelter	Cleared	North	Surface	9/10/2003	9/11/2003
86	SW Shelter	Cleared	North	Bottom	9/10/2003	9/11/2003
87	SW Shelter	Cleared	South	Surface	9/10/2003	9/11/2003
88	SW Shelter	Cleared	South	Bottom	9/10/2003	9/11/2003
89	N. Symonds	Present	East	Surface	9/10/2003	9/11/2003
90	N. Symonds	Present	East	Bottom	9/10/2003	9/11/2003
91	N. Symonds	Present	West	Surface	9/10/2003	9/11/2003
92	N. Symonds	Present	West	Bottom	9/10/2003	9/11/2003
93	S. Symonds	Cleared	East	Surface	9/10/2003	9/11/2003
94	S. Symonds	Cleared	East	Bottom	9/10/2003	9/11/2003
95	S. Symonds	Cleared	West	Surface	9/10/2003	9/11/2003
96	S. Symonds	Cleared	West	Bottom	9/10/2003	9/11/2003
97	SE Shelter	Present	North	Surface	10/17/2003	10/18/2003
98	SE Shelter	Present	North	Bottom	10/17/2003	10/18/2003
99	SE Shelter	Present	South	Surface	10/17/2003	10/18/2003
100	SE Shelter	Present	South	Bottom	10/17/2003	10/18/2003
101	SW Shelter	Cleared	North	Surface	10/17/2003	10/18/2003
102	SW Shelter	Cleared	North	Bottom	10/17/2003	10/18/2003

Appendix 1.12 Invertebrate identifications for light trap samples during the canopy kelp experiment

Sample Reference Number	Site	Canopy	Mooring	Location	Deployed	Retrieved
103	SW Shelter	Cleared	South	Surface	10/17/2003	10/18/2003
104	SW Shelter	Cleared	South	Bottom	10/17/2003	10/18/2003
105	N. Symonds	Present	East	Surface	10/17/2003	10/18/2003
106	N. Symonds	Present	East	Bottom	10/17/2003	10/18/2003
107	N. Symonds	Present	West	Surface	10/17/2003	10/18/2003
108	N. Symonds	Present	West	Bottom	10/17/2003	10/18/2003
109	S. Symonds	Cleared	East	Surface	10/17/2003	10/18/2003
110	S. Symonds	Cleared	East	Bottom	10/17/2003	10/18/2003
111	S. Symonds	Cleared	West	Surface	10/17/2003	10/18/2003
112	S. Symonds	Cleared	West	Bottom	10/17/2003	10/18/2003
113	SE Shelter	Present	North	Surface	11/16/2003	11/17/2003
114	SE Shelter	Present	North	Bottom	11/16/2003	11/17/2003
115	SE Shelter	Present	South	Surface	11/16/2003	11/17/2003
116	SE Shelter	Present	South	Bottom	11/16/2003	11/17/2003
117	SW Shelter	Cleared	North	Surface	11/16/2003	11/17/2003
118	SW Shelter	Cleared	North	Bottom	11/16/2003	11/17/2003
119	SW Shelter	Cleared	South	Surface	11/16/2003	11/17/2003
120	SW Shelter	Cleared	South	Bottom	11/16/2003	11/17/2003
121	N. Symonds	Present	East	Surface	11/12/2003	11/13/2003
122	N. Symonds	Present	East	Bottom	11/12/2003	11/13/2003
123	N. Symonds	Present	West	Surface	11/12/2003	11/13/2003
124	N. Symonds	Present	West	Bottom	11/12/2003	11/13/2003
125	S. Symonds	Cleared	East	Surface	11/12/2003	11/13/2003
126	S. Symonds	Cleared	East	Bottom	11/12/2003	11/13/2003
127	S. Symonds	Cleared	West	Surface	11/12/2003	11/13/2003
128	S. Symonds	Cleared	West	Bottom	11/12/2003	11/13/2003
129	SE Shelter	Present	North	Surface	2/24/2004	2/25/2004
130	SE Shelter	Present	North	Bottom	2/24/2004	2/25/2004
131	SE Shelter	Present	South	Surface	2/24/2004	2/25/2004
132	SE Shelter	Present	South	Bottom	2/24/2004	2/25/2004
133	SW Shelter	Cleared	North	Surface	2/24/2004	2/25/2004
134	SW Shelter	Cleared	North	Bottom	2/24/2004	2/25/2004
135	SW Shelter	Cleared	South	Surface	2/24/2004	2/25/2004
136	SW Shelter	Cleared	South	Bottom	2/24/2004	2/25/2004

Appendix 1.12 Invertebrate identifications for light trap samples during the canopy kelp experiment

Sample Reference Number	Site	Canopy	Mooring	Location	Deployed	Retrieved
137	N. Symonds	Present	East	Surface	2/24/2004	2/25/2004
138	N. Symonds	Present	East	Bottom	2/24/2004	2/25/2004
139	N. Symonds	Present	West	Surface	2/24/2004	2/25/2004
140	N. Symonds	Present	West	Bottom	2/24/2004	2/25/2004
141	S. Symonds	Cleared	East	Surface	2/24/2004	2/25/2004
142	S. Symonds	Cleared	East	Bottom	2/24/2004	2/25/2004
143	S. Symonds	Cleared	West	Surface	2/24/2004	2/25/2004
144	S. Symonds	Cleared	West	Bottom	2/24/2004	2/25/2004
145	SE Shelter	Present	North	Surface	3/24/2004	3/25/2004
146	SE Shelter	Present	North	Bottom	3/24/2004	3/25/2004
147	SE Shelter	Present	South	Surface	3/24/2004	3/25/2004
148	SE Shelter	Present	South	Bottom	3/24/2004	3/25/2004
149	SW Shelter	Cleared	North	Surface	3/24/2004	3/25/2004
150	SW Shelter	Cleared	North	Bottom	3/24/2004	3/25/2004
151	SW Shelter	Cleared	South	Surface	3/24/2004	3/25/2004
152	SW Shelter	Cleared	South	Bottom	3/24/2004	3/25/2004
153	N. Symonds	Present	East	Surface	3/24/2004	3/25/2004
154	N. Symonds	Present	East	Bottom	3/24/2004	3/25/2004
155	N. Symonds	Present	West	Surface	3/24/2004	3/25/2004
156	N. Symonds	Present	West	Bottom	3/24/2004	3/25/2004
157	S. Symonds	Cleared	East	Surface	3/24/2004	3/25/2004
158	S. Symonds	Cleared	East	Bottom	3/24/2004	3/25/2004
159	S. Symonds	Cleared	West	Surface	3/24/2004	3/25/2004
160	S. Symonds	Cleared	West	Bottom	3/24/2004	3/25/2004
161	SE Shelter	Present	North	Surface	4/17/2004	4/18/2004
162	SE Shelter	Present	North	Bottom	4/17/2004	4/18/2004
163	SE Shelter	Present	South	Surface	4/17/2004	4/18/2004
164	SE Shelter	Present	South	Bottom	4/17/2004	4/18/2004
165	SW Shelter	Cleared	North	Surface	4/17/2004	4/18/2004
166	SW Shelter	Cleared	North	Bottom	4/17/2004	4/18/2004
167	SW Shelter	Cleared	South	Surface	4/17/2004	4/18/2004
168	SW Shelter	Cleared	South	Bottom	4/17/2004	4/18/2004
169	N. Symonds	Present	East	Surface	4/17/2004	4/18/2004
170	N. Symonds	Present	East	Bottom	4/17/2004	4/18/2004

Appendix 1.12 Invertebrate identifications for light trap samples during the canopy kelp experiment

Sample Reference Number	Site	Canopy	Mooring	Location	Deployed	Retrieved
171	N. Symonds	Present	West	Surface	4/17/2004	4/18/2004
172	N. Symonds	Present	West	Bottom	4/17/2004	4/18/2004
173	S. Symonds	Cleared	East	Surface	4/17/2004	4/18/2004
174	S. Symonds	Cleared	East	Bottom	4/17/2004	4/18/2004
175	S. Symonds	Cleared	West	Surface	4/17/2004	4/18/2004
176	S. Symonds	Cleared	West	Bottom	4/17/2004	4/18/2004
177	S. Symonds	Present	East	Surface	5/22/2004	5/23/2004
178	S. Symonds	Present	East	Bottom	5/22/2004	5/23/2004
179	S. Symonds	Present	West	Surface	5/22/2004	5/23/2004
180	S. Symonds	Present	West	Bottom	5/22/2004	5/23/2004
181	S. Symonds	Cleared	East	Surface	5/22/2004	5/23/2004
182	S. Symonds	Cleared	East	Bottom	5/22/2004	5/23/2004
183	S. Symonds	Cleared	West	Surface	5/22/2004	5/23/2004
184	S. Symonds	Cleared	West	Bottom	5/22/2004	5/23/2004
185	S. Symonds	Present	West	Surface	6/17/2004	6/18/2004
186	S. Symonds	Present	West	Bottom	6/17/2004	6/18/2004
187	S. Symonds	Present	East	Surface	6/17/2004	6/18/2004
188	S. Symonds	Present	East	Bottom	6/17/2004	6/18/2004
189	S. Symonds	Cleared	West	Surface	6/17/2004	6/18/2004
190	S. Symonds	Cleared	West	Bottom	6/17/2004	6/18/2004
191	S. Symonds	Cleared	East	Surface	6/17/2004	6/18/2004
192	S. Symonds	Cleared	East	Bottom	6/17/2004	6/18/2004

Appendix 1.12 Invertebrate identifications for light trap samples
during the canopy kelp experiment

Sample Reference Number	Fish	Shrimp	Shrimp Biomass (g)	Cumaceans	Snails	Amphipods	Isopods	Copepods	Krill	Krill Biomass (g)	Mysids	Ostracod	Other
1	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	8	0.1	20	1	34	13	24	0	0	0	0	0
3	0	0	0	1	0	0	0	0	0	0	0	0	0
4	0	23	0.3	100	5	61	2	33	0	0	0	0	1
5	2	0	0	1	0	1	0	0	0	0	0	0	0
6	0	36	1.1	54	7	162	40	40	0	0	0	0	3
7	1	0	0	8	0	1	0	1	0	0	0	0	2
8	0	55	0.7	30	2	35	11	19	0	0	0	0	0
9	0	0	0	34	29	1	0	11	0	0	0	0	10
10	2	19	0.6	100	3	24	5	10	0	0	0	0	0
11	0	0	0	1	4	2	0	1	0	0	0	0	1
12	0	8	0.2	28	1	11	19	19	0	0	0	0	10
13	0	0	0	1	1	0	0	0	0	0	0	0	0
14	0	2	0.05	47	6	28	4	9	0	0	0	0	11
15	0	0	0	0	0	0	0	8	0	0	0	0	4
16	0	6	0.2	20	12	8	7	30	0	0	0	0	35
17													
18													
19													
20													
21	0	1	0.05	0	0	0	0	1	0	0	0	0	0
22	1	1	0.05	29	1	52	0	42	0	0	0	0	2
23	0	1	0.1	1	0	0	0	4	0	0	0	0	2
24	0	5	0.05	42	4	87	2	59	0	0	0	0	11
25	0	0	0	0	0	0	0	0	0	0	0	0	1
26	0	5	0.2	3	3	3	1	4	0	0	0	0	2
27	1	1	0.05	0	1	3	0	0	0	0	0	0	1
28	0	9	0.3	19	6	23	3	15	0	0	0	0	4
29	1	2	0.05	0	0	0	0	3	0	0	0	0	0
30	2	3	0.1	8	8	13	0	255	0	0	0	0	5
31	1	0	0	0	0	1	0	2	0	0	0	0	1
32	2	3	0.1	12	0	6	1	63	0	0	0	0	4
33	0	0	0	0	0	0	0	0	0	0	0	0	0
34	0	54	0.2	35	0	19	0	99	0	0	0	0	3
35	0	0	0	1	0	1	0	3	0	0	0	0	2
36	0	85	0.8	129	7	28	0	52	0	0	0	0	11
37	0	0	0	4	0	2	0	0	0	0	0	0	1
38	0	109	1.6	57	3	66	5	11	0	0	0	0	32

Appendix 1.12 Invertebrate identifications for light trap samples during the canopy kelp experiment

Sample Reference Number	Fish	Shrimp	Shrimp Biomass (g)	Cumaceans	Snails	Amphipods	Isopods	Copepods	Krill	Krill Biomass (g)	Mysids	Ostracod	Other
39	0	0	0	24	0	6	0	2	0	0	0	0	0
40	1	243	2.8	55	8	87	6	52	0	0	0	0	29
41	0	0	0	21	0	1	1	0	0	0	0	0	1
42	0	117	1.2	51	7	107	7	45	0	0	0	0	13
43	1	0	0	0	0	0	0	0	0	0	0	0	0
44	0	9	0.05	48	0	41	11	11	0	0	0	0	4
45	0	1	0.05	0	1	0	0	0	0	0	0	0	2
46	0	49	0.4	59	3	100	4	22	0	0	0	0	12
47	0	0	0	0	0	0	2	0	0	0	0	0	5
48	0	46	0.5	39	19	78	3	60	0	0	0	0	14
49	0	9	0.1	12	6	10	0	8	0	0	0	0	5
50	0	1	0.01	1	0	0	0	0	0	0	0	0	1
51	0	10	0.1	2	4	21	0	3	0	0	0	0	5
52	0	0	0	0	3	0	0	0	0	0	0	0	1
53	0	0	0	0	4	1	0	1	0	0	0	0	4
54	0	4	0.05	8	30	14	0	56	0	0	0	0	4
55	0	0	0	0	1	0	0	2	0	0	0	0	5
56	0	19	0.2	9	7	25	1	36	0	0	0	0	5
57	0	1	0.01	0	1	0	0	0	0	0	0	0	3
58	0	8	0.05	0	4	16	0	0	0	0	0	0	4
59	0	1	0.01	1	18	0	0	4	0	0	0	0	1
60	0	9	0.3	7	6	25	0	2	0	0	0	0	4
61	0	0	0	1	1	0	0	0	0	0	0	0	0
62	0	4	0.1	11	5	22	0	1	0	0	0	0	6
63	0	0	0	0	1	1	0	2	0	0	0	0	6
64	0	8	2.9	11	4	7	0	2	0	0	0	0	4
65	0	1	0.01	3	0	0	0	2	0	0	0	0	4
66	1	79	0.8	9	10	39	0	103	0	0	0	0	21
67	0	1	0.01	0	0	0	0	4	0	0	0	0	2
68	0	279	2.4	36	1	90	1	82	0	0	0	0	12
69	0	0	0	17	0	0	0	38	0	0	0	0	0
70	0	1	0.01	23	8	48	0	615	0	0	0	0	27
71	0	0	0	32	0	0	0	58	0	0	0	0	13
72	0	7	0.05	99	16	94	1	862	0	0	0	0	24
73	0	0	0	21	0	0	0	0	0	0	0	0	2
74	0	3	0.05	281	1	0	0	26	0	0	0	0	4
75	0	0	0	79	0	1	0	0	0	0	0	0	0
76	2	0	0	219	3	15	0	11	0	0	0	0	1

Appendix 1.12 Invertebrate identifications for light trap samples during the canopy kelp experiment

Sample Reference Number	Fish	Shrimp	Shrimp Biomass (g)	Cumaceans	Snails	Amphipods	Isopods	Copepods	Krill	Krill Biomass (g)	Mysids	Ostracod	Other
77	0	0	0	34	0	0	0	1	0	0	0	0	1
78	1	7	2.2	23	65	16	0	333	0	0	0	0	20
79	0	0	0	18	0	1	0	3	0	0	0	0	1
80	0	2	0.01	97	13	11	0	263	0	0	0	0	10
81	0	0	0	0	0	0	0	0	0	0	0	0	0
82	0	107	0.7	20	0	32	0	2	0	0	3	0	0
83	0	0	0	0	0	1	0	1	0	0	0	0	0
84	0	41	0.5	91	1	53	0	8	0	0	0	0	0
85	0	0	0	0	1	1	0	1	0	0	0	0	0
86	0	12	0.7	0	5	99	1	23	0	0	0	0	2
87	0	0	0	0	1	5	0	2	0	0	0	0	0
88	0	2	0.05	22	4	247	0	99	0	0	2	0	0
89	0	0	0	0	0	0	0	0	0	0	0	0	0
90	0	2	0.05	0	8	7	0	3	0	0	0	0	0
91	0	0	0	0	1	0	0	4	0	0	0	0	0
92	0	1	0.2	28	4	37	0	85	0	0	4	0	0
93	0	0	0	0	0	1	0	0	0	0	0	0	0
94	1	3	0.05	2	4	56	0	55	0	0	1	0	22
95	0	0	0	0	0	3	0	8	0	0	0	0	0
96	0	5	0.9	11	3	19	0	92	0	0	1	0	10
97	0	0	0	3	2	0	0	0	0	0	0	0	0
98	1	2	0.05	58	0	57	14	127	0	0	1	0	0
99	0	0	0	1	1	1	0	1	0	0	0	0	0
100	0	5	0.8	76	3	82	4	91	0	0	2	0	0
101	0	0	0	2	0	3	0	35	0	0	0	0	0
102	1	5	1.3	405	2	378	0	325	0	0	0	0	0
103	0	0	0	3	1	3	0	0	0	0	0	0	0
104	0	3	1.7	131	1	162	0	385	0	0	1	0	0
105	0	0	0	0	0	0	0	1	0	0	0	0	0
106	2	1	0.05	221	0	49	3	57	0	0	0	0	0
107	0	0	0	6	1	9	0	34	0	0	0	0	0
108	1	6	0.05	91	1	213	19	869	0	0	0	0	4
109	0	0	0	64	1	17	0	28	0	0	0	0	0
110	0	0	0	68	0	95	2	679	0	0	3	0	10
111	0	0	0	19	0	21	1	27	0	0	1	0	0
112	0	11	4.8	159	5	172	2	536	0	0	1	0	12
113	0	0	0	19	0	1	0	2	0	0	2	0	0
114	0	7	0.9	25	3	169	17	111	0	0	2	0	0

Appendix 1.12 Invertebrate identifications for light trap samples during the canopy kelp experiment

Sample Reference Number	Fish	Shrimp	Shrimp Biomass (g)	Cumaceans	Snails	Amphipods	Isopods	Copepods	Krill	Krill Biomass (g)	Mysids	Ostracod	Other
115	0	0	0	1	0	1	0	0	0	0	0	0	0
116	0	0	0	3	0	12	2	14	0	0	1	0	0
117	0	1	3.1	3	0	2	1	7	0	0	0	0	0
118	0	5	8.6	51	1	174	12	46	0	0	3	0	0
119	0	1	3.2	60	3	9	0	6	0	0	0	0	0
120	0	0	0	153	0	125	7	45	0	0	13	0	1
121	0	1	0.1	0	0	1	0	0	0	0	0	0	0
122	0	1	2.1	3	2	10	0	1	0	0	13	0	0
123	0	2	4.8	0	1	31	0	0	0	0	0	0	0
124	0	1	0.2	0	1	16	0	2	0	0	14	0	0
125	0	0	0	0	0	32	0	0	0	0	0	0	0
126	0	7	2.4	16	0	14	0	6	0	0	5	0	2
127	0	0	0	0	0	74	0	0	0	0	0	0	0
128	0	21	9.4	20	3	75	0	5	0	0	9	0	7
129	0	0	0	0	0	0	0	1	0	0	0	0	0
130	0	0	0	0	1	31	0	2	0	0	0	0	0
131	0	0	0	0	0	0	0	8	0	0	0	0	0
132	0	0	0	0	2	12	0	13	0	0	1	0	0
133	0	0	0	1	0	3	0	10	0	0	0	0	0
134	0	0	0	20	4	162	3	98	0	0	4	0	0
135	0	0	0	0	1	1	1	19	0	0	0	0	0
136	1	0	0	4	0	14	0	15	0	0	0	0	0
137	0	0	0	0	0	3	0	0	0	0	0	0	0
138	0	0	0	1	0	24	0	94	0	0	12	0	0
139	0	0	0	0	1	4	0	62	0	0	1	0	0
140	0	0	0	2	1	20	0	51	0	0	2	0	1
141	0	0	0	0	0	0	0	17	0	0	1	0	0
142	0	2	0.8	10	1	39	3	176	0	0	0	0	0
143	0	0	0	0	1	1	0	99	0	0	0	0	0
144	0	0	0	4	1	4	1	122	0	0	2	0	0
145	0	0	0	23	1	5	0	91	42	3.4	0	2	0
146	0	0	0	62	0	175	2	60	205	9.1	5	2	0
147	0	1	0.05	0	1	1	2	31	21	2.6	0	0	0
148	0	2	0.3	42	0	60	1	23	188	7.2	3	2	0
149	0	0	0	1	0	6	0	19	53	5.3	1	0	0
150	2	0	0	8	2	65	1	127	421	12.6	3	0	0
151	0	0	0	0	0	1	0	27	231	18.2	0	0	0
152	0	1	0.3	5	1	86	0	94	695	29.4	2	0	0

Appendix 1.12 Invertebrate identifications for light trap samples during the canopy kelp experiment

Sample Reference Number	Fish	Shrimp	Shrimp Biomass (g)	Cumaceans	Snails	Amphipods	Isopods	Copepods	Krill	Krill Biomass (g)	Mysids	Ostracod	Other
153	0	0	0	0	0	0	0	0	0	0	0	0	0
154	0	0	0	7	1	59	0	46	6	0.4	21	0	0
155	0	0	0	0	0	0	0	9	0	0	0	0	0
156	0	4	0.9	7	1	124	0	73	0	0	9	0	0
157	0	0	0	1	0	1	0	1	60	6.2	0	0	0
158	0	0	0	9	1	38	0	37	319	12.6	5	0	0
159	0	0	0	0	0	2	0	0	74	9.4	0	0	0
160	0	0	0	6	1	26	0	60	602	19.4	3	0	0
161	0	0	0	0	1	0	0	9	46	7.1	0	0	2
162	0	0	0	1		15	25	1148	47	3.6	1	0	3
163	0	0	0	0	0	0	0	11	31	3.8	0	0	0
164	0	0	0	3	0	6	0	392	7	0.3	0	0	3
165	0	0	0	0	0	0	38	30	2	0.7	0	0	0
166	0	0	0	18	0	14	4	76	8	0.5	0	0	3
167	0	0	0	0	0	0	0	79	6	1.2	1	0	0
168	1	0	0	6	2	114	10	221	0	0	4	0	1
169	0	0	0	0	1	0	0	7	0	0	1	5	0
170	0	0	0	2	0	14	0	10	0	0	11	0	0
171	1	0	0	0	0	0	0	80	0	0	2	3	4
172	1	0	0	77	0	70	3	35	0	0	52	3	1
173	0	0	0	0	0	1	0	13	0	0	0	1	2
174	0	0	0	4	0	8	7	15	0	0	3	1	2
175	0	0	0	0	0	0	0	46	0	0	1	0	2
176	0	0	0	21	0	12	89	65	0	0	25	1	1
177	0	0	0	1	0	0	0	0	0	0	0	0	0
178	2	0	0	258	2	117	29	166	0	0	32	0	1
179	0	0	0	2	0	2	1	6	0	0	0	0	0
180	0	0	0	282	0	217	10	197	0	0	12	5	0
181	1	0	0	5	0	0	0	10	0	0	0	0	4
182	0	0	0	109	1	93	3	133	0	0	37	0	0
183	0	0	0	3	0	3	0	11	0	0	0	0	2
184	0	0	0	35	0	53	0	62	0	0	4	0	0
185	0	0	0	0	0	5	0	13	0	0	0	0	2
186	0	0	0	79	0	31	5	814	0	0	7	0	1
187	0	0	0	0	0	0	0	3	0	0	0	0	0
188	1	0	0	42	2	8	2	374	0	0	28	0	3
189	2	0	0	0	0	1	0	2	0	0	0	0	5
190	0	0	0	36	2	32	0	1191	0	0	1	0	6
191	0	0	0	0	0	0	0	21	0	0	0	0	0
192	1	2	0.05	23	5	32	3	298	0	0	6	1	0

Appendix 1.12 Invertebrate identifications for light trap samples during the canopy kelp experiment

Site	Canopy	Mooring	Location	Deployed	Retrieved	Snails
SW Shelter	Cleared	North	Surface	7/9/2003	7/11/2003	4
SW Shelter	Cleared	North	Bottom	7/9/2003	7/11/2003	17
SW Shelter	Cleared	South	Surface	7/9/2003	7/11/2003	0
SW Shelter	Cleared	South	Bottom	7/9/2003	7/11/2003	3
SE Shelter	Present	North	Surface	7/9/2003	7/11/2003	1
SE Shelter	Present	North	Bottom	7/9/2003	7/11/2003	16
SE Shelter	Present	South	Surface	7/9/2003	7/11/2003	1
SE Shelter	Present	South	Bottom	7/9/2003	7/11/2003	22
S. Symonds	Cleared	East	Surface	7/9/2003	7/11/2003	1
S. Symonds	Cleared	East	Bottom	7/9/2003	7/11/2003	10
S. Symonds	Cleared	West	Surface	7/9/2003	7/11/2003	6
S. Symonds	Cleared	West	Bottom	7/9/2003	7/11/2003	10
N. Symonds	Present	East	Surface	7/9/2003	7/11/2003	92
N. Symonds	Present	East	Bottom	7/9/2003	7/11/2003	57
N. Symonds	Present	West	Surface	7/9/2003	7/11/2003	42
N. Symonds	Present	West	Bottom	7/9/2003	7/11/2003	34
N. Symonds	Present	East	Surface	7/16/2003	7/19/2003	181
N. Symonds	Present	East	Bottom	7/16/2003	7/19/2003	135
N. Symonds	Present	West	Surface	7/16/2003	7/19/2003	114
N. Symonds	Present	West	Bottom	7/16/2003	7/19/2003	75
SE Shelter	Present	North	Surface	7/16/2003	7/19/2003	0
SE Shelter	Present	North	Bottom	7/16/2003	7/19/2003	5
SE Shelter	Present	South	Surface	7/16/2003	7/19/2003	1
SE Shelter	Present	South	Bottom	7/16/2003	7/19/2003	3
SW Shelter	Cleared	North	Surface	7/16/2003	7/19/2003	0
SW Shelter	Cleared	North	Bottom	7/16/2003	7/19/2003	9
SW Shelter	Cleared	South	Surface	7/16/2003	7/19/2003	4
SW Shelter	Cleared	South	Bottom	7/16/2003	7/19/2003	5
S. Symonds	Cleared	East	Surface	7/16/2003	7/19/2003	1
S. Symonds	Cleared	East	Bottom	7/16/2003	7/19/2003	15
S. Symonds	Cleared	West	Surface	7/16/2003	7/19/2003	2
S. Symonds	Cleared	West	Bottom	7/16/2003	7/19/2003	14
SE Shelter	Present	North	Surface	8/6/2003	8/9/2003	2
SE Shelter	Present	North	Bottom	8/6/2003	8/9/2003	35
SE Shelter	Present	South	Surface	8/6/2003	8/9/2003	0
SE Shelter	Present	South	Bottom	8/6/2003	8/9/2003	24
SW Shelter	Cleared	North	Surface	8/6/2003	8/9/2003	2
SW Shelter	Cleared	North	Bottom	8/6/2003	8/9/2003	15
SW Shelter	Cleared	South	Surface	8/6/2003	8/9/2003	3
SW Shelter	Cleared	South	Bottom	8/6/2003	8/9/2003	28
N. Symonds	Present	East	Surface	8/6/2003	8/9/2003	81
N. Symonds	Present	East	Bottom	8/6/2003	8/9/2003	88

Appendix 1.13 Number of snails sampled by SMURFs
during the canopy kelp experiment

Site	Canopy	Mooring	Location	Deployed	Retrieved	Snails
N. Symonds	Present	West	Surface	8/6/2003	8/9/2003	23
N. Symonds	Present	West	Bottom	8/6/2003	8/9/2003	80
S. Symonds	Cleared	East	Surface	8/6/2003	8/9/2003	2
S. Symonds	Cleared	East	Bottom	8/6/2003	8/9/2003	24
S. Symonds	Cleared	West	Surface	8/6/2003	8/9/2003	1
S. Symonds	Cleared	West	Bottom	8/6/2003	8/9/2003	19
SE Shelter	Present	North	Surface	8/11/2003	8/14/2003	4
SE Shelter	Present	North	Bottom	8/11/2003	8/14/2003	8
SE Shelter	Present	South	Surface	8/11/2003	8/14/2003	1
SE Shelter	Present	South	Bottom	8/11/2003	8/14/2003	4
SW Shelter	Cleared	North	Surface	8/11/2003	8/14/2003	0
SW Shelter	Cleared	North	Bottom	8/11/2003	8/14/2003	18
SW Shelter	Cleared	South	Surface	8/11/2003	8/14/2003	2
SW Shelter	Cleared	South	Bottom	8/11/2003	8/14/2003	14
N. Symonds	Present	East	Surface	8/11/2003	8/14/2003	8
N. Symonds	Present	East	Bottom	8/11/2003	8/14/2003	29
N. Symonds	Present	West	Surface	8/11/2003	8/14/2003	7
N. Symonds	Present	West	Bottom	8/11/2003	8/14/2003	20
S. Symonds	Cleared	East	Surface	8/11/2003	8/14/2003	0
S. Symonds	Cleared	East	Bottom	8/11/2003	8/14/2003	28
S. Symonds	Cleared	West	Surface	8/11/2003	8/14/2003	0
S. Symonds	Cleared	West	Bottom	8/11/2003	8/14/2003	10
SE Shelter	Present	North	Surface	8/18/2003	8/21/2003	2
SE Shelter	Present	North	Bottom	8/18/2003	8/21/2003	12
SE Shelter	Present	South	Surface	8/18/2003	8/21/2003	1
SE Shelter	Present	South	Bottom	8/18/2003	8/21/2003	7
SW Shelter	Cleared	North	Surface	8/18/2003	8/21/2003	0
SW Shelter	Cleared	North	Bottom	8/18/2003	8/21/2003	14
SW Shelter	Cleared	South	Surface	8/18/2003	8/21/2003	0
SW Shelter	Cleared	South	Bottom	8/18/2003	8/21/2003	39
N. Symonds	Present	East	Surface	8/18/2003	8/21/2003	6
N. Symonds	Present	East	Bottom	8/18/2003	8/21/2003	55
N. Symonds	Present	West	Surface	8/18/2003	8/21/2003	6
N. Symonds	Present	West	Bottom	8/18/2003	8/21/2003	43
S. Symonds	Cleared	East	Surface	8/18/2003	8/21/2003	2
S. Symonds	Cleared	East	Bottom	8/18/2003	8/21/2003	10
S. Symonds	Cleared	West	Surface	8/18/2003	8/21/2003	3
S. Symonds	Cleared	West	Bottom	8/18/2003	8/21/2003	1
SE Shelter	Present	North	Surface	9/11/2003	9/14/2003	0
SE Shelter	Present	North	Bottom	9/11/2003	9/14/2003	18
SE Shelter	Present	South	Surface	9/11/2003	9/14/2003	0
SE Shelter	Present	South	Bottom	9/11/2003	9/14/2003	7

Appendix 1.13 Number of snails sampled by SMURFs during the canopy kelp experiment

Site	Canopy	Mooring	Location	Deployed	Retrieved	Snails
SW Shelter	Cleared	North	Surface	9/11/2003		
SW Shelter	Cleared	North	Bottom	9/11/2003		
SW Shelter	Cleared	South	Surface	9/11/2003		
SW Shelter	Cleared	South	Bottom	9/11/2003		
N. Symonds	Present	East	Surface	9/11/2003	9/14/2003	30
N. Symonds	Present	East	Bottom	9/11/2003	9/14/2003	42
N. Symonds	Present	West	Surface	9/11/2003	9/14/2003	14
N. Symonds	Present	West	Bottom	9/11/2003	9/14/2003	19
S. Symonds	Cleared	East	Surface	9/11/2003	9/14/2003	0
S. Symonds	Cleared	East	Bottom	9/11/2003	9/14/2003	2
S. Symonds	Cleared	West	Surface	9/11/2003	9/14/2003	1
S. Symonds	Cleared	West	Bottom	9/11/2003	9/14/2003	4
SE Shelter	Present	North	Surface	10/26/2003	10/30/2003	4
SE Shelter	Present	North	Bottom	10/26/2003	10/30/2003	12
SE Shelter	Present	South	Surface	10/26/2003	10/30/2003	4
SE Shelter	Present	South	Bottom	10/26/2003	10/30/2003	33
SW Shelter	Cleared	North	Surface	10/26/2003	10/30/2003	4
SW Shelter	Cleared	North	Bottom	10/26/2003	10/30/2003	71
SW Shelter	Cleared	South	Surface	10/26/2003	10/30/2003	3
SW Shelter	Cleared	South	Bottom	10/26/2003	10/30/2003	29
N. Symonds	Present	East	Surface	10/26/2003	10/30/2003	15
N. Symonds	Present	East	Bottom	10/26/2003	10/30/2003	80
N. Symonds	Present	West	Surface	10/26/2003	10/30/2003	6
N. Symonds	Present	West	Bottom	10/26/2003	10/30/2003	32
S. Symonds	Cleared	East	Surface	10/26/2003	10/30/2003	4
S. Symonds	Cleared	East	Bottom	10/26/2003	10/30/2003	72
S. Symonds	Cleared	West	Surface	10/26/2003	10/30/2003	1
S. Symonds	Cleared	West	Bottom	10/26/2003	10/30/2003	87
SE Shelter	Present	North	Surface	11/13/2003	11/16/2003	4
SE Shelter	Present	North	Bottom	11/13/2003	11/16/2003	0
SE Shelter	Present	South	Surface	11/13/2003	11/16/2003	3
SE Shelter	Present	South	Bottom	11/13/2003	11/16/2003	2
SW Shelter	Cleared	North	Surface	11/13/2003	11/16/2003	1
SW Shelter	Cleared	North	Bottom	11/13/2003	11/16/2003	16
SW Shelter	Cleared	South	Surface	11/13/2003	11/16/2003	2
SW Shelter	Cleared	South	Bottom	11/13/2003	11/16/2003	0
N. Symonds	Present	East	Surface	11/13/2003	11/17/2003	1
N. Symonds	Present	East	Bottom	11/13/2003	11/17/2003	48
N. Symonds	Present	West	Surface	11/13/2003	11/17/2003	2
N. Symonds	Present	West	Bottom	11/13/2003	11/17/2003	8
S. Symonds	Cleared	East	Surface	11/13/2003	11/17/2003	1
S. Symonds	Cleared	East	Bottom	11/13/2003	11/17/2003	10

Appendix 1.13 Number of snails sampled by SMURFs
during the canopy kelp experiment

Site	Canopy	Mooring	Location	Deployed	Retrieved	Snails
S. Symonds	Cleared	West	Surface	11/13/2003	11/17/2003	1
S. Symonds	Cleared	West	Bottom	11/13/2003	11/17/2003	5
SE Shelter	Present	North	Surface	2/25/2004	2/28/2004	1
SE Shelter	Present	North	Bottom	2/25/2004	2/28/2004	17
SE Shelter	Present	South	Surface	2/25/2004	2/28/2004	2
SE Shelter	Present	South	Bottom	2/25/2004	2/28/2004	0
SW Shelter	Cleared	North	Surface	2/25/2004	2/28/2004	2
SW Shelter	Cleared	North	Bottom	2/25/2004	2/28/2004	12
SW Shelter	Cleared	South	Surface	2/25/2004	2/28/2004	1
SW Shelter	Cleared	South	Bottom	2/25/2004	2/28/2004	10
N. Symonds	Present	East	Surface	2/25/2004	2/28/2004	2
N. Symonds	Present	East	Bottom	2/25/2004	2/28/2004	7
N. Symonds	Present	West	Surface	2/25/2004	2/28/2004	1
N. Symonds	Present	West	Bottom	2/25/2004	2/28/2004	3
S. Symonds	Cleared	East	Surface	2/25/2004	2/28/2004	0
S. Symonds	Cleared	East	Bottom	2/25/2004	2/28/2004	19
S. Symonds	Cleared	West	Surface	2/25/2004	2/28/2004	0
S. Symonds	Cleared	West	Bottom	2/25/2004	2/28/2004	13
SE Shelter	Present	North	Surface	3/25/2004	3/29/2004	0
SE Shelter	Present	North	Bottom	3/25/2004	3/29/2004	1
SE Shelter	Present	South	Surface	3/25/2004	3/29/2004	1
SE Shelter	Present	South	Bottom	3/25/2004	3/29/2004	4
SW Shelter	Cleared	North	Surface	3/25/2004	3/29/2004	1
SW Shelter	Cleared	North	Bottom	3/25/2004	3/29/2004	25
SW Shelter	Cleared	South	Surface	3/25/2004	3/29/2004	0
SW Shelter	Cleared	South	Bottom	3/25/2004	3/29/2004	12
N. Symonds	Present	East	Surface	3/25/2004	3/29/2004	4
N. Symonds	Present	East	Bottom	3/25/2004	3/29/2004	13
N. Symonds	Present	West	Surface	3/25/2004	3/29/2004	1
N. Symonds	Present	West	Bottom	3/25/2004	3/29/2004	6
S. Symonds	Cleared	East	Surface	3/25/2004	3/29/2004	2
S. Symonds	Cleared	East	Bottom	3/25/2004	3/29/2004	11
S. Symonds	Cleared	West	Surface	3/25/2004	3/29/2004	1
S. Symonds	Cleared	West	Bottom	3/25/2004	3/29/2004	5
SE Shelter	Present	North	Surface	4/18/2004	4/21/2004	0
SE Shelter	Present	North	Bottom	4/18/2004	4/21/2004	2
SE Shelter	Present	South	Surface	4/18/2004	4/21/2004	0
SE Shelter	Present	South	Bottom	4/18/2004	4/21/2004	1
SW Shelter	Cleared	North	Surface	4/18/2004	4/21/2004	1
SW Shelter	Cleared	North	Bottom	4/18/2004	4/21/2004	12
SW Shelter	Cleared	South	Surface	4/18/2004	4/21/2004	0
SW Shelter	Cleared	South	Bottom	4/18/2004	4/21/2004	3

Appendix 1.13 Number of snails sampled by SMURFs
during the canopy kelp experiment

Site	Canopy	Mooring	Location	Deployed	Retrieved	Snails
N. Symonds	Present	East	Surface	4/18/2004	4/21/2004	4
N. Symonds	Present	East	Bottom	4/18/2004	4/21/2004	14
N. Symonds	Present	West	Surface	4/18/2004	4/21/2004	0
N. Symonds	Present	West	Bottom	4/18/2004	4/21/2004	3
S. Symonds	Cleared	East	Surface	4/18/2004	4/21/2004	0
S. Symonds	Cleared	East	Bottom	4/18/2004	4/21/2004	2
S. Symonds	Cleared	West	Surface	4/18/2004	4/21/2004	0
S. Symonds	Cleared	West	Bottom	4/18/2004	4/21/2004	7
S. Symonds	Present	West	Surface	5/23/2004	5/26/2004	3
S. Symonds	Present	West	Bottom	5/23/2004	5/26/2004	3
S. Symonds	Present	East	Surface	5/23/2004	5/26/2004	0
S. Symonds	Present	East	Bottom	5/23/2004	5/26/2004	13
S. Symonds	Cleared	West	Surface	5/23/2004	5/26/2004	0
S. Symonds	Cleared	West	Bottom	5/23/2004	5/26/2004	0
S. Symonds	Cleared	East	Surface	5/23/2004	5/26/2004	1
S. Symonds	Cleared	East	Bottom	5/23/2004	5/26/2004	10
S. Symonds	Present	West	Surface	6/18/2004	6/21/2004	0
S. Symonds	Present	West	Bottom	6/18/2004	6/21/2004	1
S. Symonds	Present	East	Surface	6/18/2004	6/21/2004	0
S. Symonds	Present	East	Bottom	6/18/2004	6/21/2004	18
S. Symonds	Cleared	West	Surface	6/18/2004	6/21/2004	0
S. Symonds	Cleared	West	Bottom	6/18/2004	6/21/2004	1
S. Symonds	Cleared	East	Surface	6/18/2004	6/21/2004	0
S. Symonds	Cleared	East	Bottom	6/18/2004	6/21/2004	6

Appendix 1.13 Number of snails sampled by SMURFs
during the canopy kelp experiment

Sample Reference Number	Site	Canopy	Mooring	Location	Deployed	Retrieved	Total Fish
1	SW Shelter	Cleared	South	Surface	7/9/2004	7/12/2004	1
2	SW Shelter	Cleared	South	Bottom	7/9/2004	7/12/2004	1
3	N. Symonds	Present	East	Bottom	7/9/2004	7/12/2004	1
4	N. Symonds	Cleared	East	Bottom	7/9/2004	7/12/2004	1
5	SW Shelter	Present	North	Bottom	7/22/2004	7/25/2004	1
6	N. Symonds	Cleared	East	Bottom	7/22/2004	7/25/2004	1
7	SW Shelter	Cleared	South	Bottom	7/26/2004	7/29/2004	1
8	N. Symonds	Present	West	Surface	7/26/2004	7/29/2004	1
9	SW Shelter	Present	South	Bottom	8/5/2004	8/8/2004	1
10	SW Shelter	Cleared	North	Bottom	8/5/2004	8/8/2004	1
11	SW Shelter	Cleared	South	Surface	8/5/2004	8/8/2004	1
12	N. Symonds	Present	West	Bottom	8/5/2004	8/8/2004	1
13	N. Symonds	Cleared	East	Bottom	8/5/2004	8/8/2004	1
14	SW Shelter	Present	South	Bottom	8/8/2004	8/11/2004	1
15	SW Shelter	Cleared	North	Bottom	8/8/2004	8/11/2004	2
16	N. Symonds	Present	East	Bottom	8/8/2004	8/11/2004	2
17	N. Symonds	Cleared	East	Surface	8/8/2004	8/11/2004	1

Appendix 1.14 Species identification and morphometrics for fish sampled by SMURFs during the sub-canopy kelp experiment.
Only SMURF samples that contained fish are listed; 80 samples taken total

Sample Reference Number	Total Fish	Fish 1	Weight (g)	SL (cm)	FL (cm)	TL (cm)	Fish 2	Weight (g)	SL (cm)	FL (cm)	TL (cm)
1	1	Silverspotted Sculpin	0.9188	4.3	5.7	5.7					
2	1	Penpoint Gunnel	2.579	11	11.6	11.6					
3	1	Crescent Gunnel	0.868	7.4	7.9	7.9					
4	1	Crescent Gunnel	11.9679	16.3	17.3	17.3					
5	1	Penpoint Gunnel	0.3685	5.3	5.6	5.6					
6	1	Silverspotted Sculpin	1.0332	4.3	5.7	5.7					
7	1	Penpoint Gunnel	5.7448	13.8	14.6	14.6					
8	1	Penpoint Gunnel	0.5706	5.6	6.1	6.1					
9	1	Smooth Lumpsucker	0.0253	0.9	1	1					
10	1	Penpoint Gunnel	18.3014	19.6	20.5	20.5					
11	1	Manacled Sculpin	0.1268	2.6	3.1	3.1					
12	1	Silverspotted Sculpin	1.2783	4.7	6.1	6.1					
13	1	Manacled Sculpin	0.1196	2.4	2.9	2.9					
14	1	Quilback Rockfish	0.0482	1.4	1.9	1.9					
15	2	Quilback Rockfish	0.0569	1.5	1.9	1.9	Quilback Rockfish	0.0505	1.5	1.9	1.9
16	2	Crescent Gunnel	6.5665	13.6	14.5	14.5	Manacled Sculpin	0.2999	3.3	3.9	3.9
17	1	Spotted Snailfish	6.0206	7.9	9.1	9.1					

Appendix 1.14 Species identification and morphometrics for fish sampled by SMURFs during the sub-canopy kelp experiment. Only SMURF samples that contained fish are listed; 80 samples taken total

Site	Understory	Mooring	Location	Deployed	Retrieved	Total Fish	Species	Weight (g)	SL (cm)	FL (cm)	TL (cm)
SW Shelter	Present	South	Surface	7/8/2004	7/9/2004	1	Larvae 1	0.0001			0.1
N. Symonds	Present	East	Bottom	7/21/2004	7/22/2004	1	Penpoint Gunnel	0.2785	5	5.3	5.3
N. Symonds	Cleared	East	Surface	7/21/2004	7/22/2004	1	Penpoint Gunnel	7.037	14	14.7	14.7
N. Symonds	Cleared	East	Surface	7/25/2004	7/26/2004	1	Larvae 1	0.0009			0.5
N. Symonds	Present	West	Surface	8/4/2004	8/5/2004	1	Prowfish	5.2574	7.4	8.9	8.9

Appendix 1.15 Species identification and morphometrics for fish sampled by light traps during the sub-canopy kelp experiment. Only samples that contained fish are listed; 80 samples taken total

Site	Depth	Understory	Transect	Date	Total Fish	Pelagic fish	Benthic fish
SW Shelter	Bottom	Present	1	7/8/2004	0	0	0
SW Shelter	Bottom	Present	2	7/8/2004	0	0	0
SW Shelter	Bottom	Present	3	7/8/2004	1	1	0
SW Shelter	Surface	Present	1	7/8/2004	0	0	0
SW Shelter	Surface	Present	2	7/8/2004	0	0	0
SW Shelter	Surface	Present	3	7/8/2004	0	0	0
SW Shelter	Bottom	Cleared	1	7/8/2004	0	0	0
SW Shelter	Bottom	Cleared	2	7/8/2004	1	1	0
SW Shelter	Bottom	Cleared	3	7/8/2004	0	0	0
SW Shelter	Surface	Cleared	1	7/8/2004	0	0	0
SW Shelter	Surface	Cleared	2	7/8/2004	0	0	0
SW Shelter	Surface	Cleared	3	7/8/2004	0	0	0
N. Symonds	Bottom	Present	1	7/12/2004	0	0	0
N. Symonds	Bottom	Present	2	7/12/2004	0	0	0
N. Symonds	Bottom	Present	3	7/12/2004	0	0	0
N. Symonds	Surface	Present	1	7/12/2004	0	0	0
N. Symonds	Surface	Present	2	7/12/2004	0	0	0
N. Symonds	Surface	Present	3	7/12/2004	0	0	0
N. Symonds	Bottom	Cleared	1	7/12/2004	0	0	0
N. Symonds	Bottom	Cleared	2	7/12/2004	0	0	0
N. Symonds	Bottom	Cleared	3	7/12/2004	0	0	0
N. Symonds	Surface	Cleared	1	7/12/2004	0	0	0
N. Symonds	Surface	Cleared	2	7/12/2004	0	0	0
N. Symonds	Surface	Cleared	3	7/12/2004	0	0	0
SW Shelter	Bottom	Present	1	7/13/2004	0	0	0
SW Shelter	Bottom	Present	2	7/13/2004	0	0	0
SW Shelter	Bottom	Present	3	7/13/2004	0	0	0
SW Shelter	Surface	Present	1	7/13/2004	0	0	0
SW Shelter	Surface	Present	2	7/13/2004	0	0	0
SW Shelter	Surface	Present	3	7/13/2004	0	0	0
SW Shelter	Bottom	Cleared	1	7/13/2004	1	1	0
SW Shelter	Bottom	Cleared	2	7/13/2004	2	0	2
SW Shelter	Bottom	Cleared	3	7/13/2004	0	0	0
SW Shelter	Surface	Cleared	1	7/13/2004	0	0	0
SW Shelter	Surface	Cleared	2	7/13/2004	0	0	0
SW Shelter	Surface	Cleared	3	7/13/2004	0	0	0
N. Symonds	Bottom	Present	1	7/13/2004	0	0	0
N. Symonds	Bottom	Present	2	7/13/2004	0	0	0
N. Symonds	Bottom	Present	3	7/13/2004	0	0	0
N. Symonds	Surface	Present	1	7/13/2004	0	0	0
N. Symonds	Surface	Present	2	7/13/2004	0	0	0

Appendix 1.16 Number of fish observed on visual surveys during the sub-canopy kelp experiment

Site	Depth	Understory	Transect	Date	Total Fish	Pelagic fish	Benthic fish
N. Symonds	Surface	Present	3	7/13/2004	0	0	0
N. Symonds	Bottom	Cleared	1	7/13/2004	2	0	2
N. Symonds	Bottom	Cleared	2	7/13/2004	1	0	1
N. Symonds	Bottom	Cleared	3	7/13/2004	1	0	1
N. Symonds	Surface	Cleared	1	7/13/2004	0	0	0
N. Symonds	Surface	Cleared	2	7/13/2004	0	0	0
N. Symonds	Surface	Cleared	3	7/13/2004	0	0	0
SW Shelter	Bottom	Present	1	7/21/2004	0	0	0
SW Shelter	Bottom	Present	2	7/21/2004	0	0	0
SW Shelter	Bottom	Present	3	7/21/2004	0	0	0
SW Shelter	Surface	Present	1	7/22/2004	0	0	0
SW Shelter	Surface	Present	2	7/22/2004	0	0	0
SW Shelter	Surface	Present	3	7/22/2004	0	0	0
SW Shelter	Bottom	Cleared	1	7/22/2004	2	1	1
SW Shelter	Bottom	Cleared	2	7/22/2004	1	0	1
SW Shelter	Bottom	Cleared	3	7/22/2004	0	0	0
SW Shelter	Surface	Cleared	1	7/22/2004	0	0	0
SW Shelter	Surface	Cleared	2	7/22/2004	0	0	0
SW Shelter	Surface	Cleared	3	7/22/2004	0	0	0
N. Symonds	Bottom	Present	1	7/21/2004	1	0	1
N. Symonds	Bottom	Present	2	7/21/2004	0	0	0
N. Symonds	Bottom	Present	3	7/21/2004	0	0	0
N. Symonds	Surface	Present	1	7/22/2004	0	0	0
N. Symonds	Surface	Present	2	7/22/2004	0	0	0
N. Symonds	Surface	Present	3	7/22/2004	0	0	0
N. Symonds	Bottom	Cleared	1	7/22/2004	1	1	0
N. Symonds	Bottom	Cleared	2	7/22/2004	0	0	0
N. Symonds	Bottom	Cleared	3	7/22/2004	0	0	0
N. Symonds	Surface	Cleared	1	7/22/2004	0	0	0
N. Symonds	Surface	Cleared	2	7/22/2004	0	0	0
N. Symonds	Surface	Cleared	3	7/22/2004	0	0	0
SW Shelter	Bottom	Present	1	7/26/2004	0	0	0
SW Shelter	Bottom	Present	2	7/26/2004	1	1	0
SW Shelter	Bottom	Present	3	7/26/2004	0	0	0
SW Shelter	Surface	Present	1	7/25/2004	0	0	0
SW Shelter	Surface	Present	2	7/25/2004	0	0	0
SW Shelter	Surface	Present	3	7/25/2004	0	0	0
SW Shelter	Bottom	Cleared	1	7/26/2004	1	1	0
SW Shelter	Bottom	Cleared	2	7/26/2004	1	1	0
SW Shelter	Bottom	Cleared	3	7/26/2004	0	0	0
SW Shelter	Surface	Cleared	1	7/25/2004	0	0	0

Appendix 1.16 Number of fish observed on visual surveys during the sub-canopy kelp experiment

Site	Depth	Understory	Transect	Date	Total Fish	Pelagic fish	Benthic fish
SW Shelter	Surface	Cleared	2	7/25/2004	0	0	0
SW Shelter	Surface	Cleared	3	7/25/2004	0	0	0
N. Symonds	Bottom	Present	1	7/25/2004	0	0	0
N. Symonds	Bottom	Present	2	7/25/2004	1	0	1
N. Symonds	Bottom	Present	3	7/25/2004	0	0	0
N. Symonds	Surface	Present	1	7/25/2004	0	0	0
N. Symonds	Surface	Present	2	7/25/2004	0	0	0
N. Symonds	Surface	Present	3	7/25/2004	0	0	0
N. Symonds	Bottom	Cleared	1	7/25/2004	0	0	0
N. Symonds	Bottom	Cleared	2	7/25/2004	0	0	0
N. Symonds	Bottom	Cleared	3	7/25/2004	0	0	0
N. Symonds	Surface	Cleared	1	7/25/2004	0	0	0
N. Symonds	Surface	Cleared	2	7/25/2004	0	0	0
N. Symonds	Surface	Cleared	3	7/25/2004	0	0	0
SW Shelter	Bottom	Present	1	8/4/2004	1	1	0
SW Shelter	Bottom	Present	2	8/4/2004	1	0	1
SW Shelter	Bottom	Present	3	8/4/2004	2	0	2
SW Shelter	Surface	Present	1	8/5/2004	0	0	0
SW Shelter	Surface	Present	2	8/5/2004	0	0	0
SW Shelter	Surface	Present	3	8/5/2004	0	0	0
SW Shelter	Bottom	Cleared	1	8/4/2004	1	1	0
SW Shelter	Bottom	Cleared	2	8/4/2004	0	0	0
SW Shelter	Bottom	Cleared	3	8/4/2004	0	0	0
SW Shelter	Surface	Cleared	1	8/5/2004	0	0	0
SW Shelter	Surface	Cleared	2	8/5/2004	0	0	0
SW Shelter	Surface	Cleared	3	8/5/2004	0	0	0
N. Symonds	Bottom	Present	1	8/5/2004	0	0	0
N. Symonds	Bottom	Present	2	8/5/2004	0	0	0
N. Symonds	Bottom	Present	3	8/5/2004	0	0	0
N. Symonds	Surface	Present	1	8/4/2004	0	0	0
N. Symonds	Surface	Present	2	8/4/2004	0	0	0
N. Symonds	Surface	Present	3	8/4/2004	0	0	0
N. Symonds	Bottom	Cleared	1	8/4/2004	1	0	1
N. Symonds	Bottom	Cleared	2	8/4/2004	1	1	0
N. Symonds	Bottom	Cleared	3	8/4/2004	0	0	0
N. Symonds	Surface	Cleared	1	8/4/2004	0	0	0
N. Symonds	Surface	Cleared	2	8/4/2004	0	0	0
N. Symonds	Surface	Cleared	3	8/4/2004	0	0	0

Appendix 1.16 Number of fish observed on visual surveys during the sub-canopy kelp experiment

Sample Reference Number	Site	Understory	Mooring	Location	Deployed	Retrieved
1	SW Shelter	Present	North	Surface	7/8/2004	7/9/2004
2	SW Shelter	Present	North	Bottom	7/8/2004	7/9/2004
3	SW Shelter	Present	South	Surface	7/8/2004	7/9/2004
4	SW Shelter	Present	South	Bottom	7/8/2004	7/9/2004
5	SW Shelter	Cleared	North	Surface	7/8/2004	7/9/2004
6	SW Shelter	Cleared	North	Bottom	7/8/2004	7/9/2004
7	SW Shelter	Cleared	South	Surface	7/8/2004	7/9/2004
8	SW Shelter	Cleared	South	Bottom	7/8/2004	7/9/2004
9	N. Symonds	Present	East	Surface	7/8/2004	7/9/2004
10	N. Symonds	Present	East	Bottom	7/8/2004	7/9/2004
11	N. Symonds	Present	West	Surface	7/8/2004	7/9/2004
12	N. Symonds	Present	West	Bottom	7/8/2004	7/9/2004
13	N. Symonds	Cleared	East	Surface	7/8/2004	7/9/2004
14	N. Symonds	Cleared	East	Bottom	7/8/2004	7/9/2004
15	N. Symonds	Cleared	West	Surface	7/8/2004	7/9/2004
16	N. Symonds	Cleared	West	Bottom	7/8/2004	7/9/2004
17	SW Shelter	Present	North	Surface	7/12/2004	7/13/2004
18	SW Shelter	Present	North	Bottom	7/12/2004	7/13/2004
19	SW Shelter	Present	South	Surface	7/12/2004	7/13/2004
20	SW Shelter	Present	South	Bottom	7/12/2004	7/13/2004
21	SW Shelter	Cleared	North	Surface	7/12/2004	7/13/2004
22	SW Shelter	Cleared	North	Bottom	7/12/2004	7/13/2004
23	SW Shelter	Cleared	South	Surface	7/12/2004	7/13/2004
24	SW Shelter	Cleared	South	Bottom	7/12/2004	7/13/2004
25	N. Symonds	Present	East	Surface	7/12/2004	7/13/2004
26	N. Symonds	Present	East	Bottom	7/12/2004	7/13/2004
27	N. Symonds	Present	West	Surface	7/12/2004	7/13/2004
28	N. Symonds	Present	West	Bottom	7/12/2004	7/13/2004
29	N. Symonds	Cleared	East	Surface	7/12/2004	7/13/2004
30	N. Symonds	Cleared	East	Bottom	7/12/2004	7/13/2004
31	N. Symonds	Cleared	West	Surface	7/12/2004	7/13/2004
32	N. Symonds	Cleared	West	Bottom	7/12/2004	7/13/2004
33	SW Shelter	Present	North	Surface	7/21/2004	7/22/2004
34	SW Shelter	Present	North	Bottom	7/21/2004	7/22/2004
35	SW Shelter	Present	South	Surface	7/21/2004	7/22/2004
36	SW Shelter	Present	South	Bottom	7/21/2004	7/22/2004
37	SW Shelter	Cleared	North	Surface	7/21/2004	7/22/2004
38	SW Shelter	Cleared	North	Bottom	7/21/2004	7/22/2004
39	SW Shelter	Cleared	South	Surface	7/21/2004	7/22/2004
40	SW Shelter	Cleared	South	Bottom	7/21/2004	7/22/2004
41	N. Symonds	Present	East	Surface	7/21/2004	7/22/2004

Appendix 1.17 Invertebrate identifications for light trap samples during the sub-canopy kelp experiment

Sample Reference Number	Site	Understory	Mooring	Location	Deployed	Retrieved
42	N. Symonds	Present	East	Bottom	7/21/2004	7/22/2004
43	N. Symonds	Present	West	Surface	7/21/2004	7/22/2004
44	N. Symonds	Present	West	Bottom	7/21/2004	7/22/2004
45	N. Symonds	Cleared	East	Surface	7/21/2004	7/22/2004
46	N. Symonds	Cleared	East	Bottom	7/21/2004	7/22/2004
47	N. Symonds	Cleared	West	Surface	7/21/2004	7/22/2004
48	N. Symonds	Cleared	West	Bottom	7/21/2004	7/22/2004
49	SW Shelter	Present	North	Surface	7/25/2004	7/26/2004
50	SW Shelter	Present	North	Bottom	7/25/2004	7/26/2004
51	SW Shelter	Present	South	Surface	7/25/2004	7/26/2004
52	SW Shelter	Present	South	Bottom	7/25/2004	7/26/2004
53	SW Shelter	Cleared	North	Surface	7/25/2004	7/26/2004
54	SW Shelter	Cleared	North	Bottom	7/25/2004	7/26/2004
55	SW Shelter	Cleared	South	Surface	7/25/2004	7/26/2004
56	SW Shelter	Cleared	South	Bottom	7/25/2004	7/26/2004
57	N. Symonds	Present	East	Surface	7/25/2004	7/26/2004
58	N. Symonds	Present	East	Bottom	7/25/2004	7/26/2004
59	N. Symonds	Present	West	Surface	7/25/2004	7/26/2004
60	N. Symonds	Present	West	Bottom	7/25/2004	7/26/2004
61	N. Symonds	Cleared	East	Surface	7/25/2004	7/26/2004
62	N. Symonds	Cleared	East	Bottom	7/25/2004	7/26/2004
63	N. Symonds	Cleared	West	Surface	7/25/2004	7/26/2004
64	N. Symonds	Cleared	West	Bottom	7/25/2004	7/26/2004
65	SW Shelter	Present	North	Surface	8/4/2004	8/5/2004
66	SW Shelter	Present	North	Bottom	8/4/2004	8/5/2004
67	SW Shelter	Present	South	Surface	8/4/2004	8/5/2004
68	SW Shelter	Present	South	Bottom	8/4/2004	8/5/2004
69	SW Shelter	Cleared	North	Surface	8/4/2004	8/5/2004
70	SW Shelter	Cleared	North	Bottom	8/4/2004	8/5/2004
71	SW Shelter	Cleared	South	Surface	8/4/2004	8/5/2004
72	SW Shelter	Cleared	South	Bottom	8/4/2004	8/5/2004
73	N. Symonds	Present	East	Surface	8/4/2004	8/5/2004
74	N. Symonds	Present	East	Bottom	8/4/2004	8/5/2004
75	N. Symonds	Present	West	Surface	8/4/2004	8/5/2004
76	N. Symonds	Present	West	Bottom	8/4/2004	8/5/2004
77	N. Symonds	Cleared	East	Surface	8/4/2004	8/5/2004
78	N. Symonds	Cleared	East	Bottom	8/4/2004	8/5/2004
79	N. Symonds	Cleared	West	Surface	8/4/2004	8/5/2004
80	N. Symonds	Cleared	West	Bottom	8/4/2004	8/5/2004

Appendix 1.17 Invertebrate identifications for light trap samples during the sub-canopy kelp experiment

Sample Reference Number	Fish	Shrimp	Shrimp Biomass (g)	Cumaceans	Snails	Amphipods	Isopods	Copepods	Krill	Krill Biomass (g)	Mysids	Ostracod	Other
1	0	0	0	0	1	0	0	2	0	0	0	0	0
2	0	6	0.1	423	28	117	0	126	0	0	0	0	1
3	1	0	0	0	0	2	0	3	0	0	0	0	6
4	0	3	0.05	385	7	103	1	167	0	0	0	0	2
5	0	0	0	0	0	2	0	0	0	0	0	0	0
6	0	0	0	117	1	7	0	4	0	0	0	0	0
7	0	0	0	1	0	2	0	0	0	0	0	0	1
8	0	0	0	576	0	11	0	67	0	0	1	0	0
9	0	0	0	11	0	9	0	0	0	0	1	0	2
10	0	1	0.01	408	6	94	5	142	0	0	4	0	3
11	0	0	0	10	0	6	0	2	0	0	0	0	0
12	0	0	0	262	4	21	0	23	0	0	3	0	2
13	0	0	0	9	0	3	0	29	0	0	1	0	0
14	0	0	0	110	0	8	11	8	0	0	3	1	0
15	0	0	0	3	0	1	0	13	0	0	0	0	0
16	0	1	1.5	168	2	48	23	187	0	0	1	0	0
17	0	0	0	1	1	1	0	0	0	0	0	0	0
18	0	4	0.05	495	16	54	6	151	0	0	0	0	0
19	0	0	0	0	0	2	0	3	0	0	0	0	0
20	0	1	0.01	355	5	107	0	137	0	0	0	0	0
21	0	0	0	0	0	0	0	1	0	0	0	0	0
22	0	1	0.01	109	0	18	0	52	0	0	0	0	0
23	0	0	0	0	0	1	0	0	0	0	0	0	1
24	0	0	0	27	2	7	0	9	0	0	0	0	0
25	0	0	0	0	0	0	0	18	0	0	0	0	0
26	0	13	0.2	681	2	84	12	23	0	0	0	2	1
27	0	0	0	1	1	0	0	7	0	0	0	0	0
28	0	16	0.1	238	9	49	7	50	0	0	5	2	1
29	0	0	0	0	2	1	0	7	0	0	0	0	0
30	0	0	0	56	0	6	0	2	0	0	0	1	0
31	0	0	0	3	1	1	0	6	0	0	0	0	0
32	0	1	0.01	23	0	14	2	27	0	0	0	3	0
33	0	0	0	1	0	0	0	5	0	0	0	0	0
34	0	2	0.01	13	1	2	0	198	0	0	0	0	0
35	0	0	0	2	1	0	0	1	0	0	0	0	0
36	0	0	0	21	0	31	0	253	0	0	0	0	0
37	0	0	0	0	0	0	0	0	0	0	0	0	0
38	0	0	0	20	4	13	1	319	0	0	0	0	0

Appendix 1.17 Invertebrate identifications for light trap samples during the sub-canopy kelp experiment

Sample Reference Number	Fish	Shrimp	Shrimp Biomass (g)	Cumaceans	Snails	Amphipods	Isopods	Copepods	Krill	Krill Biomass (g)	Mysids	Ostracod	Other
39	0	0	0	0	0	0	0	0	0	0	0	0	0
40	0	0	0	2	5	3	0	0	0	0	0	0	0
41	0	0	0	0	0	1	0	0	0	0	0	0	0
42	1	7	0.05	101	2	80	0	390	0	0	2	1	0
43	0	0	0	0	0	1	0	5	0	0	0	0	0
44	0	11	0.5	156	1	51	0	241	0	0	0	2	0
45	1	0	0	0	0	0	0	0	0	0	0	0	0
46	0	14	1	97	1	65	1	201	0	0	0	0	0
47	0	0	0	0	0	2	0	12	0	0	0	0	0
48	0	2	0.6	37	1	37	2	42	0	0	0	0	0
49	0	0	0	2	0	0	0	0	0	0	0	0	0
50	0	1	0.01	270	2	24	1	5	1	0.01	0	0	4
51	0	0	0	0	0	1	0	1	0	0	0	0	0
52	0	17	0.2	257	19	28	3	17	0	0	0	0	0
53	0	1	0.01	0	0	0	0	0	0	0	0	0	0
54	0	2	0.05	162	0	20	1	9	0	0	0	0	0
55	0	0	0	0	0	0	0	0	0	0	0	0	0
56	0	3	0.05	16	1	6	1	1	0	0	1	0	2
57	0	0	0	15	0	0	0	3	0	0	0	0	2
58	0	2	0.01	43	4	34	6	93	0	0	2	1	1
59	0	0	0	0	0	1	0	10	0	0	0	0	5
60	0	2	0.01	44	5	22	1	25	0	0	1	0	1
61	1	0	0	1	0	0	0	1	0	0	0	0	0
62	0	27	0.2	56	3	39	80	44	0	0	0	1	2
63	0	0	0	0	0	3	0	12	0	0	0	0	2
64	0	12	0.05	46	4	50	12	102	0	0	0	1	3
65	0	0	0	0	0	1	0	0	0	0	0	0	4
66	0	3	0.05	17	12	4	0	9	0	0	0	0	11
67	0	0	0	0	0	0	0	12	0	0	0	0	5
68	0	8	0.1	90	1	26	0	8	0	0	0	0	4
69	0	0	0	0	1	0	0	0	0	0	0	0	6
70	0	1	0.01	71	2	17	0	22	0	0	0	0	0
71	0	0	0	0	1	0	0	3	0	0	0	0	4
72	0	1	0.01	15	0	2	0	11	0	0	0	0	4
73	0	1	0.01	17	0	4	0	4	0	0	0	0	4
74	0	1	0.01	34	6	8	2	11	8	0.2	4	0	1
75	1	0	0	1	0	0	0	0	0	0	1	0	0
76	0	3	0.01	42	5	34	2	50	0	0	1	0	0

Appendix 1.17 Invertebrate identifications for light trap samples during the sub-canopy kelp experiment

Sample Reference Number	Fish	Shrimp	Shrimp Biomass (g)	Cumaceans	Snails	Amphipods	Isopods	Copepods	Krill	Krill Biomass (g)	Mysids	Ostracod	Other
77	0	0	0	89	1	6	0	2	0	0	0	0	0
78	0	1	0.01	17	2	6	0	2	0	0	0	0	0
79	0	0	0	8	0	2	0	9	0	0	0	0	4
80	0	5	0.05	61	0	37	0	10	0	0	0	1	0

Appendix 1.17 Invertebrate identifications for light trap samples during the sub-canopy kelp experiment

Site	Canopy	Mooring	Location	Deployed	Retrieved	Snails
SW Shelter	Present	North	Surface	7/9/2004	7/12/2004	0
SW Shelter	Present	North	Bottom	7/9/2004	7/12/2004	27
SW Shelter	Present	South	Surface	7/9/2004	7/12/2004	1
SW Shelter	Present	South	Bottom	7/9/2004	7/12/2004	95
SW Shelter	Cleared	North	Surface	7/9/2004	7/12/2004	3
SW Shelter	Cleared	North	Bottom	7/9/2004	7/12/2004	12
SW Shelter	Cleared	South	Surface	7/9/2004	7/12/2004	2
SW Shelter	Cleared	South	Bottom	7/9/2004	7/12/2004	19
N. Symonds	Present	East	Surface	7/9/2004	7/12/2004	8
N. Symonds	Present	East	Bottom	7/9/2004	7/12/2004	17
N. Symonds	Present	West	Surface	7/9/2004	7/12/2004	2
N. Symonds	Present	West	Bottom	7/9/2004	7/12/2004	14
N. Symonds	Cleared	East	Surface	7/9/2004	7/12/2004	2
N. Symonds	Cleared	East	Bottom	7/9/2004	7/12/2004	6
N. Symonds	Cleared	West	Surface	7/9/2004	7/12/2004	0
N. Symonds	Cleared	West	Bottom	7/9/2004	7/12/2004	7
SW Shelter	Present	North	Surface	7/22/2004	7/25/2004	1
SW Shelter	Present	North	Bottom	7/22/2004	7/25/2004	45
SW Shelter	Present	South	Surface	7/22/2004	7/25/2004	1
SW Shelter	Present	South	Bottom	7/22/2004	7/25/2004	25
SW Shelter	Cleared	North	Surface	7/22/2004	7/25/2004	3
SW Shelter	Cleared	North	Bottom	7/22/2004	7/25/2004	20
SW Shelter	Cleared	South	Surface	7/22/2004	7/25/2004	1
SW Shelter	Cleared	South	Bottom	7/22/2004	7/25/2004	13
N. Symonds	Present	East	Surface	7/22/2004	7/25/2004	3
N. Symonds	Present	East	Bottom	7/22/2004	7/25/2004	34
N. Symonds	Present	West	Surface	7/22/2004	7/25/2004	3
N. Symonds	Present	West	Bottom	7/22/2004	7/25/2004	12
N. Symonds	Cleared	East	Surface	7/22/2004	7/25/2004	1
N. Symonds	Cleared	East	Bottom	7/22/2004	7/25/2004	12
N. Symonds	Cleared	West	Surface	7/22/2004	7/25/2004	1
N. Symonds	Cleared	West	Bottom	7/22/2004	7/25/2004	16
SW Shelter	Present	North	Surface	7/26/2004	7/29/2004	0
SW Shelter	Present	North	Bottom	7/26/2004	7/29/2004	37
SW Shelter	Present	South	Surface	7/26/2004	7/29/2004	1
SW Shelter	Present	South	Bottom	7/26/2004	7/29/2004	15
SW Shelter	Cleared	North	Surface	7/26/2004	7/29/2004	2
SW Shelter	Cleared	North	Bottom	7/26/2004	7/29/2004	9
SW Shelter	Cleared	South	Surface	7/26/2004	7/29/2004	0
SW Shelter	Cleared	South	Bottom	7/26/2004	7/29/2004	7
N. Symonds	Present	East	Surface	7/26/2004	7/29/2004	3
N. Symonds	Present	East	Bottom	7/26/2004	7/29/2004	25

Appendix 1.18 Number of snails sampled by SMURFs during the sub-canopy kelp experiment

Site	Canopy	Mooring	Location	Deployed	Retrieved	Snails
N. Symonds	Present	West	Surface	7/26/2004	7/29/2004	4
N. Symonds	Present	West	Bottom	7/26/2004	7/29/2004	10
N. Symonds	Cleared	East	Surface	7/26/2004	7/29/2004	0
N. Symonds	Cleared	East	Bottom	7/26/2004	7/29/2004	9
N. Symonds	Cleared	West	Surface	7/26/2004	7/29/2004	3
N. Symonds	Cleared	West	Bottom	7/26/2004	7/29/2004	11
SW Shelter	Present	North	Surface	8/5/2004	8/8/2004	0
SW Shelter	Present	North	Bottom	8/5/2004	8/8/2004	61
SW Shelter	Present	South	Surface	8/5/2004	8/8/2004	0
SW Shelter	Present	South	Bottom	8/5/2004	8/8/2004	35
SW Shelter	Cleared	North	Surface	8/5/2004	8/8/2004	0
SW Shelter	Cleared	North	Bottom	8/5/2004	8/8/2004	8
SW Shelter	Cleared	South	Surface	8/5/2004	8/8/2004	0
SW Shelter	Cleared	South	Bottom	8/5/2004	8/8/2004	3
N. Symonds	Present	East	Surface	8/5/2004	8/8/2004	3
N. Symonds	Present	East	Bottom	8/5/2004	8/8/2004	51
N. Symonds	Present	West	Surface	8/5/2004	8/8/2004	2
N. Symonds	Present	West	Bottom	8/5/2004	8/8/2004	36
N. Symonds	Cleared	East	Surface	8/5/2004	8/8/2004	1
N. Symonds	Cleared	East	Bottom	8/5/2004	8/8/2004	7
N. Symonds	Cleared	West	Surface	8/5/2004	8/8/2004	3
N. Symonds	Cleared	West	Bottom	8/5/2004	8/8/2004	12
SW Shelter	Present	North	Surface	8/8/2004	8/11/2004	0
SW Shelter	Present	North	Bottom	8/8/2004	8/11/2004	119
SW Shelter	Present	South	Surface	8/8/2004	8/11/2004	0
SW Shelter	Present	South	Bottom	8/8/2004	8/11/2004	19
SW Shelter	Cleared	North	Surface	8/8/2004	8/11/2004	3
SW Shelter	Cleared	North	Bottom	8/8/2004	8/11/2004	4
SW Shelter	Cleared	South	Surface	8/8/2004	8/11/2004	1
SW Shelter	Cleared	South	Bottom	8/8/2004	8/11/2004	3
N. Symonds	Present	East	Surface	8/8/2004	8/11/2004	1
N. Symonds	Present	East	Bottom	8/8/2004	8/11/2004	42
N. Symonds	Present	West	Surface	8/8/2004	8/11/2004	1
N. Symonds	Present	West	Bottom	8/8/2004	8/11/2004	52
N. Symonds	Cleared	East	Surface	8/8/2004	8/11/2004	2
N. Symonds	Cleared	East	Bottom	8/8/2004	8/11/2004	16
N. Symonds	Cleared	West	Surface	8/8/2004	8/11/2004	2
N. Symonds	Cleared	West	Bottom	8/8/2004	8/11/2004	6

Appendix 1.18 Number of snails sampled by SMURFs during the sub-canopy kelp experiment

General Conclusions

Our results do not directly agree with the pattern of increased species abundance in areas of increased structure as has been reported previously (Allen and Griffiths 1981, Bodkin 1988, Carr 1989, Anderson 1994, Levin and Hay 1996, Willis and Anderson 2003, Arroyo et al 2004). Our results support the importance of discrete depth sampling and of benthic habitats for fish and invertebrate populations in southeastern Alaska. Others have found that water column depth also affects fish distributions (Carr 1991, Findlay and Allen 2002, Steele et al 2002). The predominant fishes sampled within the canopy kelp systems did not utilize the increased available habitat provided by *Nereocystis*. However, an indirect effect of the canopy or habitat modification may cause fish to prefer the bottom of these systems. Results from the sub-canopy kelp experiment showed no effect of sub-canopy kelps on fish distributions. However, sub-canopy kelps were important in structuring invertebrate assemblages which are a food source to fishes.

Results from both experiments indicated that *Nereocystis* had direct and indirect effects on fish distributions through behavioral and habitat modifications. Overall, canopy kelp systems with associated sub-canopy kelps promoted the most abundant and diverse fish assemblages in southeastern Alaska, while invertebrate assemblages were greatest in sub-canopy areas. While these mixed systems provided the most structural complexity, experimental designs should consider the potential for indirect interaction and habitat modifications. Direct and indirect effects (Siddon and Witman 2004) of habitats must be incorporated into experimental designs to more fully understand the role of the habitat (DeMartini and Roberts 1990).

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