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Abstract: Epibenthic and demersal assemblages of fish and invertebrates on the Patton Seamount in the Gulf of Alaska, U.S.A., were studied in July 1999 using the Deep Sea Research Vehicle *Alvin*. Faunal associations with depth were described using video analysis of 8 dives from 151 to 3,375 m. A cluster analysis applied to the observations suggests three benthic faunal communities based on depth: 1) a shallow-water community (151–950 m) consisting mainly of rockfishes, flatfishes, sea stars, and attached suspension feeders, 2) a mid-depth community (400–1500 m) also consisting of numerous attached suspension-feeding organisms such as corals, sponges, crinoids, sea anemones, and sea cucumbers and fish such as the sablefish *Anoplopoma fimbria* and the giant grenadier *Albatrossia pectoralis* both of which were aggregated over a relatively narrow depth range, and 3) a deep-water community (500–3,375 m) consisting of fewer attached suspension feeders and more highly mobile species such as the Pacific grenadier *Coryphaenoides acrolepis*, popeye grenadier *C. cinereus*, Pacific flatnose *Antimora microlepis*, and large mobile crabs *Macroregonia macrochira* and *Chionoecetes* spp. that were less aggregated and covered a much greater depth range. Bottom depth was highly correlated with temperature and bottom substratum type where the upper 1,300 m was primarily a mixed habitat of boulders and large cobbles. The bottom substratum types were less diverse from 1,300 m to 3,300 m, which was composed of gravels and smaller sized particles. The absence of many near shore species on the Patton Seamount suggests this seamount is a unique subset of the near shore fauna but maintains distinct assemblage characteristics.

INTRODUCTION

Biological studies of the deep-sea organisms associated with seamounts have become increasingly important in recent years with growing concerns of over-exploitation and habitat disturbance on such long-lived species and fragile environments (Hughes 1981; Somerton 1981a, 1981b; Raymore 1982; Alton 1986; Rogers 1994; Vinnichenko 1997; Koslow and Gowlett-Holmes 1998; Haig-Brown 1999; Probert 1999). Interactions of biological and oceanographic processes at seamounts are not fully understood (Roden 1986; Rogers 1994), yet may be key in driving faunal recruitment (Calder 2000), life history modes and energetics (Tseytlin 1985; Koslow 1996, 1997; Vinnichenko 1998), community structure (Fujii 1986; Boehlert and Mundy 1993; Rogers 1994) and species composition (Genin et al. 1986; Kaufmann et al 1989; De Forges et al. 2000). Isolated ecosystems such as those found on seamounts have shown high rates of speciation, species endemism, and endemic populations (see Rogers 1994; Koslow and Gowlett-Holmes 1998; De Forges et al. 2000). A recent interest in the ecology of the Gulf of Alaska Seamounts has lead to a resurgence in investigations on these isolated systems and their conservation. A knowledge of the faunal community makeup, community structure, and habitat availability and associations can provide a basis for greater understanding of seamount ecosystems and how they may relate to the larger gulf ecosystem.

The Patton Seamount is situated approximately 166 nmi southeast of Kodiak Island in the Gulf of Alaska at lat 54.5728°N and long 150.4917°W. The Patton Seamount (Mernard and Dietz 1951) is composed of several seamounts, the largest of which is the Patton Seamount and several adjacent smaller peaks. Limited fishing (Haig-Brown 1999) and scientific investigations (Hughes 1981; Somerton 1981a, 1981b; Raymore 1982; Alton 1986) have occurred on the Patton Seamount and other Gulf of Alaska seamounts, due to the

Authors: Gerald R. Hoff is a Fisheries Biologist with the National Marine Fisheries Service, Alaska Fisheries Science Center 7600 Sand Point Way N.E., Seattle, Washington 98115. Email: jerry.hoff@noaa.gov. Bradley Stevens is a Fisheries Research Biologist with the National Marine Fisheries Service, Kodiak Fisheries Research Center, 301 Research Court, Near Island, Kodiak, Alaska 99615.
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difficulty of sampling over rugged habitat and at such great depths (Hughes 1981; Rogers 1994). The Patton Seamount, as well as many of the guyots and smaller underwater peaks and pinnacles in the Gulf of Alaska and the North Pacific, are all potential population and habitat island refuges for wide ranging coastal species and seamount endemics. The ecological importance of these isolated communities is difficult to assess using conventional fishing and other capture gear; it is more easily assessed using underwater video collected from *in situ* manned submersibles. Information on micro-habitat associations, species interactions, and cryptic species can best be gathered by direct observation.

The Deep Sea Research Vehicle *Alvin* was employed to explore the Patton Seamount in July of 1999. The goals were to assess the benthic and demersal community structure and habitat (substratum) associations from video analysis taken during a series of dives along the sides and top of Patton Seamount.

METHODS

Eight dives were conducted on the Patton Seamount located at 54.5728°N latitude and 150.4917°W longitude using the *Alvin* in July 1999. The combined dives covered depths from 151–3,375 m, and approximately 86,718 m^2 of area on the sloping flanks to the summit of the seamount. A Seabeam multibeam sonar array was used to map the seamount in the evening hours aboard the *Alvin* support vessel R/V *Atlantis.* A 3-dimensional, bathymetry map of the seamount (Figure 1. Duncan et al., Oregon State University, Corvallis Oregon, unpublished data) was used to plan the *Alvin* dives on site. Dives were planned out to cover a particular depth range, and start and end coordinates were selected which allowed the transect to be conducted with a constant heading up-slope. Data loggers aboard the *Alvin* recorded time, depth, dive number, seawater temperature, and magnetic course heading at 1 second

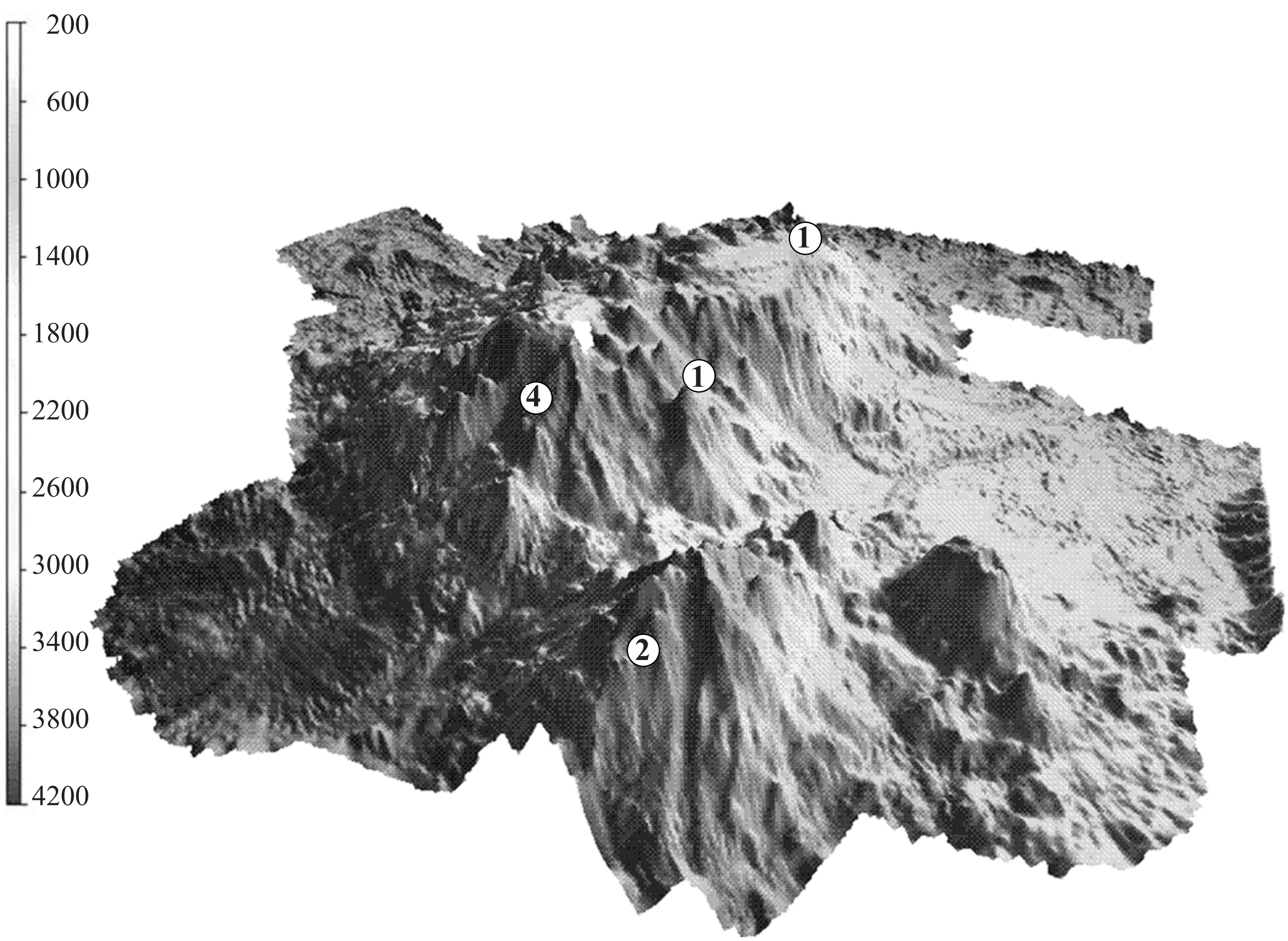

Figure 1. Multibeam sonar bathymetry map of Patton Seamount collected during the July 1999 *Alvin* cruise in the Gulf of Alaska. The circled numbers are the approximate location of each transect dive (Duncan et al. Oregon state University, Corvallis Oregon, unpublished data).

intervals with each dive covering a transect of 2.7–4.7 km (Table 1). Two video cameras, a fixed Hi-8 video camera with pan and tilt mount, and a 3-chip Betacam camera mounted on the starboard manipulator arm, recorded the entirety of each dive.

The video footage collected during *Alvin* dives was examined in the laboratory. The *Alvin* cameras faced forward, and the area of coverage for a single frame varied based on distance from the bottom and the angle of tilt. Most depths from 151–3,375 m were covered minimally twice; some depths were covered with as many as four passes. Although this unequal sampling could bias frequency in depths with increased coverage, we believe it would not change the general conclusions of the distinct assemblages concluded herein, due to relative equal sampling within each assemblages depth range. Twenty-five distinct organisms or groups of organisms (Table 2) were enumerated with the corresponding depth (m), time, temperature (°C), and bottom substratum type in Microsoft EXCEL 97 then converted to Microsoft ACCESS 97 for ease in data summarizing. Bottom substratum types were determined by estimating the percentage of boulder, cobble, or fine sediment present with a rounded minimum of 25% for each substratum type and cumulative substratum composition always totaling 100%. The substratum types were classified by size, approximating the Wentworth grade scale (Home and McIntyre 1984), with boulders being defined as large rocks (>.2 m diameter) to complete bedrock; cobble was rocks .2–.05 m diameter, and fines a bottom type of similar size gravels, sands and finer sediments <.05 m diameter. After video analysis, substrata were reclassified by grouping similar sizes and compositions. These new groups were assigned a numeric code between 1 and 14 based on overall composition of the bottom types. This created a spectrum of substrate types from largest sizes to smallest (Table 3). For example, a substrate code of 1 represented a substrate of 100% boulders and a code of 14 represented a substratum of 100% fine sediments and a 7 represented a heterogeneous mix of >50% cobbles, 25%, gravels and 25% finer sediments (see Table 3).

The continuous data collected from *Alvin*'s video transect line analysis was converted to discrete data by grouping observations every 50 m. This produced 64 samples (every 50 m from 150–3,375 m) with all occurrences of each organism summed within each depth group. Frequency of occurrences were then standardized as a percentage of the total frequency recorded for each organism from all dives combined. A dissimilarity matrix was produced In SYSTAT 10 using the standardized frequency data and the Bray-Curtis method (Romesburg 1984) for the organisms. A cluster analysis using SYSTAT 10 was produced using Euclidean Distance as a similarity measure and Ward's method for grouping clusters by choosing the least variance between joined groups (Romesburg 1984) with depth as a sampling factor.

RESULTS

Temperature data collected by *Alvin's* data logged during the dives were inversely related to bottom depth as described by the equation:

$$\text{Temperature (°C)} = -7^{-11}x^3 + 7^{-7}x^2 - 0.0025x + 4.4887 \quad (R^2 = 0.9955)$$

where x = Depth (m).

Bottom temperatures ranged from 1.44°C at the greatest depths (3,375 m) to 4.25°C near the pinnacle (151 m). Because of the close inverse relationship between depth and temperature, depth was used as the variable in further analyses and temperature was not further considered. An attempt was made to standardize the video angle and zoom throughout the

Table 1. Detail location, distance, depth and approximate area covered for the eight transect dives conducted by the *Alvin* on the Patton Seamount.

Transect Start and End Positions				Transect Depth Range, Distance, and Area Covered			
Start Long (W)	Start Lat (N)	End Long (W)	End Lat (N)	Minimum Depth (m)	Maximum Depth (m)	Distance (m)	Area (m^2)
–150.538	54.522	–150.550	54.492	389	1,082	4,726	14,178
–150.339	54.346	–150.365	54.326	1,155	2,373	3,542	10,626
–150.468	54.600	–150.485	54.570	2,080	2,732	2,920	8,760
–150.618	54.437	–150.591	54.445	2,212	3,375	4,644	13,932
–150.436	54.617	–150.444	54.592	151	971	3,212	9,636
–150.529	54.299	–150.528	54.326	1,635	2,078	2,706	8,118
–150.551	54.374	–150.567	54.422	300	948	3,725	11,175
–150.370	54.343	–150.389	54.303	506	1,222	3,431	10,293

Table 2. Depth ranges and number of individuals counted by species, genus, or by taxa group identified from *Alvin* video analysis on Patton Seamount.

Species	Depth Range (meters)	Total Seen
FISH		
Rockfishes (*Sebastes* spp.)	151–482	268
Thornyhead rockfishes (*Sebastolobus* sp.)	313–949	139
Sablefish (*Anoplopoma fimbria*)	506–707	7
Giant grenadier *(Albatrossia pectoralis)*	453–1,974	331
Grenadier *(Coryphaenoides* sp.)	896–3,283	99
Popeye grenadier *(Coryphaenoides cinereus)*	549–2,699	112
Pacific grenadier *(Coryphaenoides acrolepis)*	578–2,014	61
Pacific flatnose *(Antimora microlepis)*	729–2,600	22
Deepsea sole *(Embassichthys bathybius)*	350–931	15
ECHINODERMS		
Brown crinoid (*Florometra* sp.)*	160–550	12,324
Black crinoid (Crinoidea)	567–1,922	58
Sea stars (Asteroidea)	150–3,275	4,941
Brittlestars (Ophiuroidea)*	287–650	11,360
Scaled sea cucumber (*Psolus* sp.)	506–1,035	5,113
DECAPODS		
Golden king crab *(Lithodes aequispinosa)*	152–342	15
Spider crab (*Macroregonia macrochira*)	877–3,105	160
Pinch bugs (Galatheidae)	521–962	1,009
Grooved tanner crab (*Chionoecetes tanneri*) & triangle tanner crab (*C. angulatus*)	493–2,028	17
Lithodid crabs (*Lithodes couesi* & *Paralomis* spp.)	397–2,697	77
CNIDARIANS		
Purple sea anemone unidentified (Actiniaria)*	308–414	313
White sea anemone unidentified (Actiniaria)	319–753	374
Red sea anemone unidentified (Actiniaria)	320–2,940	314
Red mushroom coral (*Anthomastus* sp.)	393–3,209	210
Corals (unidentified species)	152–3,303	10,366
PORIFERA		
Sponges*	151–3,200	17,686

*Numbers are estimates due to difficulty in counting and great abundance

dives, however it varied during short portions of the dives. For density estimates we used 3 meters as the approximate width in the field of view from the video. For most fish species, and all invertebrates, we felt the *Alvin* did not affect the behavior for enumeration except for the sablefish, Pacific flatnose, and popeye grenadier which were observed to slowly flee the *Alvin* upon its approach. The abundance of these species is therefore deemed a lower estimate than the actual abundance. From the dive videos, 25 species or species groups were observed that were distinct enough to identify with minimal information (Table 2). Most fish and many invertebrate species could be readily identified when observed; however, several groups including lithodid crabs (*Lithodes couesi, Paralomis multispina*, *Paralomis verrilli*), Tanner crabs (*Chionoecetes tanneri,* and *C. angulatus*), rockfishes (*Sebastes* spp.), corals, sponges, and sea stars could not confidently be identified as to species from the video tapes and were grouped into larger categories. Other species were confidently identified to genus or given a common name, and appeared to be represented by a single unidentified species such as the scaled sea cucumber *Psolus* sp.; thornyhead rockfish *Sebastolobus* sp.; the purple sea anemone, and the white sea anemone.

The results of the cluster analysis of the 25 taxa, based on similarities of frequency occurrence with depth, suggested 3 faunal assemblages (Figures 2 and 3) composed of a relatively shallow community, a mid-depth community, and a deep community. The shallow community organisms occurred over a very narrow depth range (151–950 m) and were quite aggregated (Figure 3). The mid-depth community was similar to the shallow community in that organisms were aggregated within a relatively narrow depth range (400–1,500 m) but occurred at a slightly greater average depth than the shallow community. The deep community covered the greatest depth span (500–3,375 m) with no distinct aggregations and consisted of species that were broadly distributed over great depth ranges.

The shallow community consisted of demersal rockfishes *Sebastes* spp.*,* a benthic thornyhead rockfish *Sebastolobus* sp., and the benthic deep sea sole

Table 3. Percent composition of boulders, cobbles, or finer sediments used for assigning substrate codes to observed habitats viewed from video analysis from *Alvin* dives on the Patton Seamount.

Substrate Code	% of Each Substrate Type			Substrate Classification
	Boulder	Cobble	Fine Sediment	
1	100			Boulder
2	75	25		Boulder
3	75		25	Boulder
4	50	50		Boulder
5	50	25	25	Boulder
6	25	75		Cobble
7	25	50	25	Cobble
8		100		Cobble
9		75	25	Cobble
10	25	25	50	Fines
11		50	50	Fines
12	25		75	Fines
13		25	75	Fines
14			100	Fines

Embassichthys bathybius. The invertebrate members included the golden king crab *Lithodes aequispinus* and many benthic organisms such as the brown crinoid *Florometra* sp., brittlestars Ophiuroidea, sea anemones Actiniaria, and sea stars Asteroidea. The mid-depth community had a large component of attached suspension feeders such as corals, sponges, and the scaled sea cucumber *Psolus* sp., as well as more wide ranging species such as galatheid crabs and the demersal giant grenadier *Albatrossia pectoralis* and sablefish *Anoplopoma fimbria*. The deep assemblage was distinctly different from the two shallower communities in that it contained less sessile and more mobile species such as grenadiers *Coryphaenoides* spp. and Pacific flatnose *Antimora microlepis* as well as the highly mobile spider crab *Macroregonia macrochira*. Most notably, organisms within the deep assemblage were much less concentrated at any single depth but were more evenly distributed over a greater depth range (Figure 3).

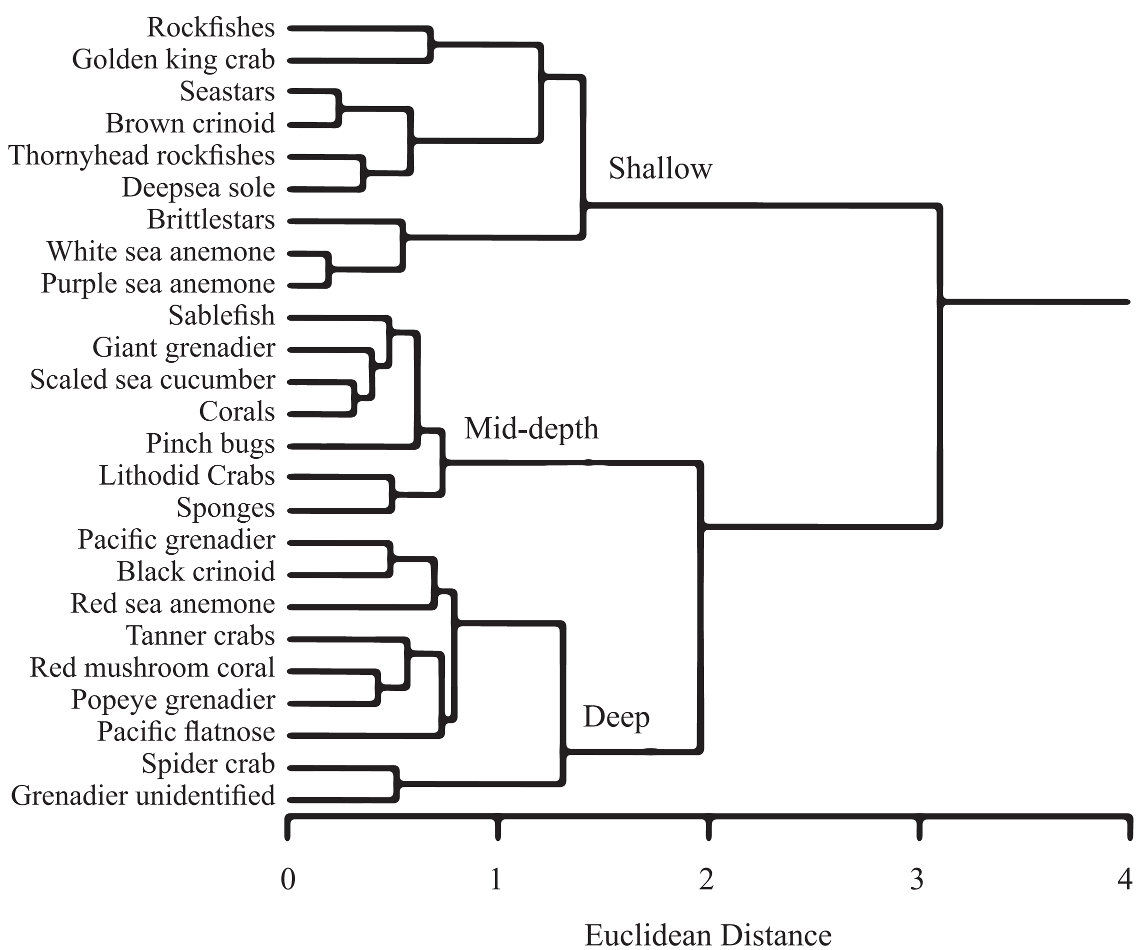

Figure 2. Dendrogram of the 25 species or species groups identified from *Alvin* video analysis on Patton Seamount. The cluster analysis suggests three faunal assemblages by depth: shallow (151–950 m), mid-depth (400–1,500 m), and deep (500–3,375 m).

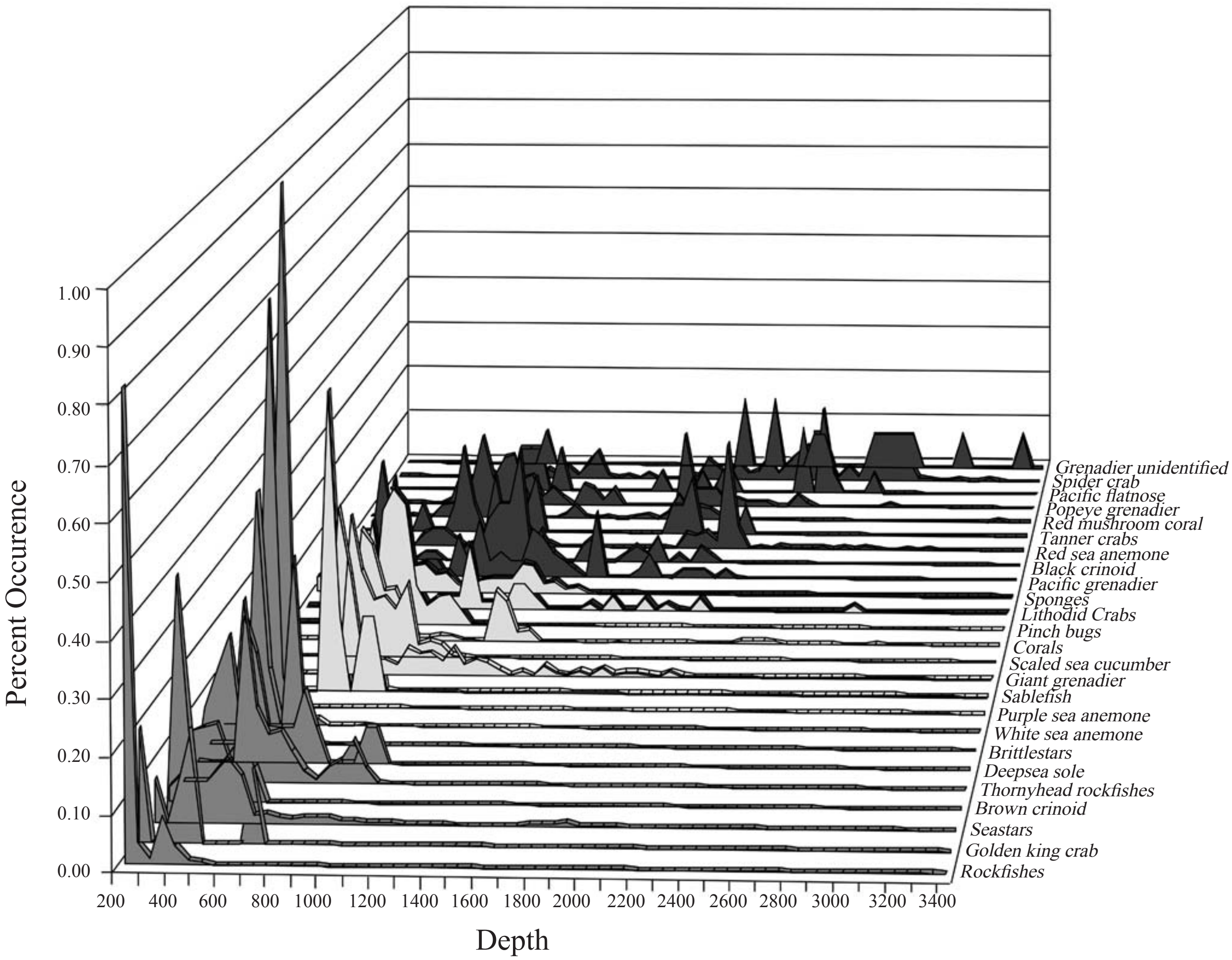

Figure 3. Depth distribution of three assemblage groups: shallow (151–950 m), mid-depth (400–1,500 m), and deep (500–3,375 m).

Substrata plotted with depth (Figure 4) showed that from 200–700 m, the substratum is a heterogeneous mix of boulders, cobbles, and cobble/fine sediment mixes. From 700–1,300 m, the substratum composition is more homogeneous with areas of cobbles and fine sediment. At depths greater than 1,350 m the substrata varied little; the composition was dominated by fine sediments and a single deepest depth group consisting of pure boulders (Figure 4). Each taxon occurred on a variety of substratum types, however, many occurred on a single type (Table 4).

In addition to the fauna described herein, many more organisms were collected and observed during the *Alvin* dives on the Patton Seamount. No less than 14 species of sea stars, 5 species of non-sea star echinoderms, 16 coral species, 12 sponge species, 3 sea anemones species,10 decapod crab species, 3 non-decapod crustacean species, 1 brachiopod species, 1 snail species, 1 octopus species, 1 nudibranch species and numerous additional assorted invertebrates were collected using the manipulator arms and water-tight boxes attached to *Alvin*. These specimens were all digitally photographed, and are catalogued at the California Academy of Sciences Museum. Additional fish species that were identified from video, but were not collected and not included in the analysis due to their extremely rare occurrence, included 1 large unidentified sculpin (probably in the family Psychrolutidae), several large snailfish (most likely in the genus *Careproctus*), a Notocantheid fish, and many small elongated zoarcid-like fish who moved too fast to identify. Increased observations of rare species and more detailed *in situ* identification of small and cryptic invertebrates could provide valuable new data for assemblage identification. Unfortunately limited transects and poor video technologies precluded informative identification of many invertebrate species.

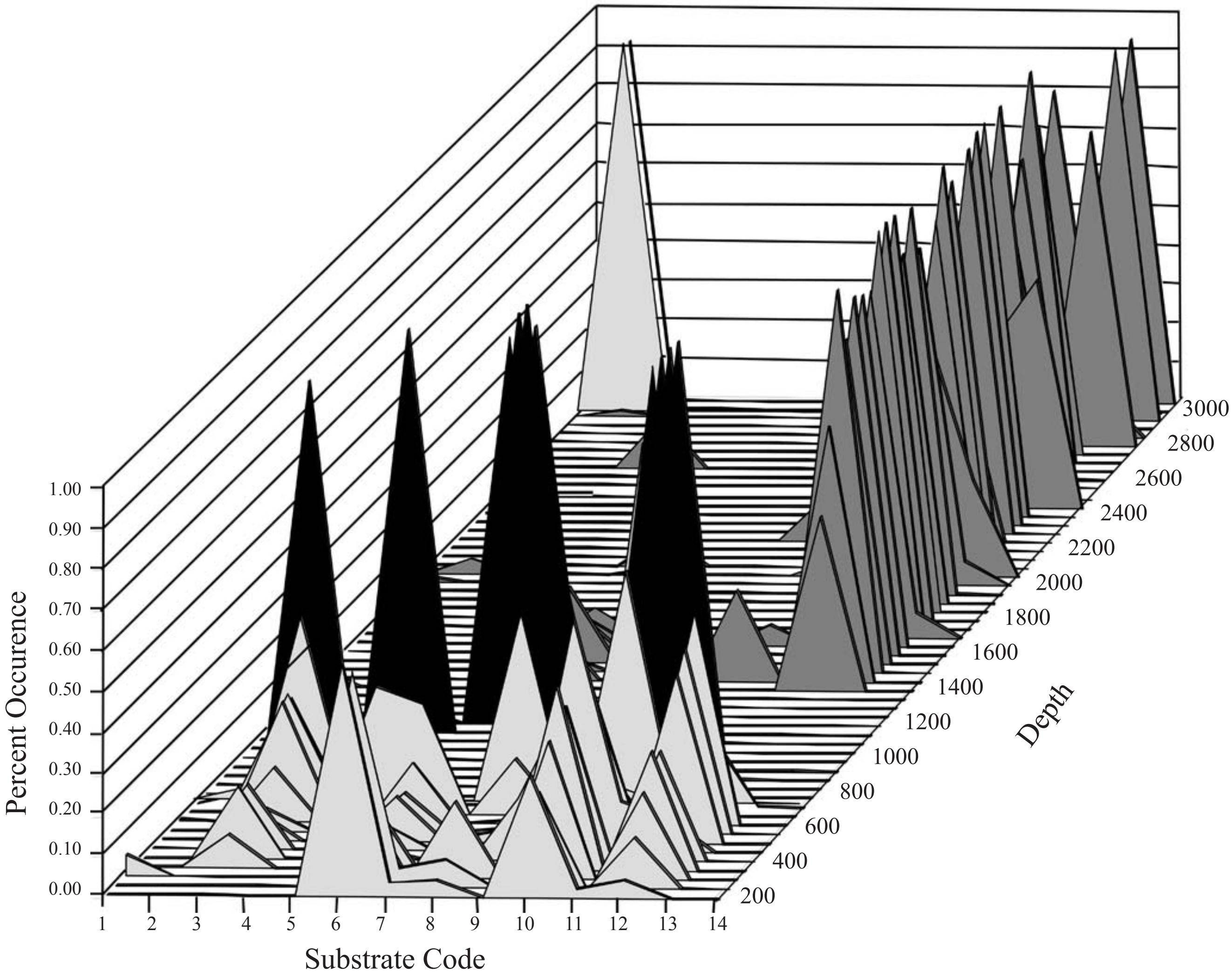

Figure 4. Depth distributions of substrates identified from *Alvin* video analysis on Patton Seamount. Substrate codes are a continuum from larger boulders =1, to mixed composition substrates = 7, to predominantly gravels and finer sediments = 14.

DISCUSSION

The multibeam sonar map and video analysis showed that the Patton seamount consists of a rugged environment made up of large boulder fields and various sized cobble on the upper slope and large fields of fine sediment at greater depths. The rugged nature of seamounts is common (Menard and Dietz 1951; Raymore 1982; Rogers 1994; Haig-Brown 1999) and theoretically defines the fauna associated with it. Due to upwelling, hard substrata in a highly productive area coupled with strong ocean currents provides a haven for attached suspension feeders such as corals and sponges and the fauna associated with them. The fauna of the Patton Seamount consists of many attached and sessile suspension feeders (corals, sponges, crinoids, brittlestars, and sea cucumbers) that were major components of the shallow and mid-depth communities. These communities were populous and concentrated in the upper 1,500 m, presumably taking advantage of the productive photic zone and the complex habitat created by heterogeneous hard substrata. In deeper waters, the faunal assemblage consisted of organisms that are less sessile in nature, including more wide-ranging fish species and highly mobile invertebrates. The deep assemblage exists in a more homogeneous, less complex habitat of fine sediment bottom and limited food resources because of the distance from the upper water column. It follows that generalist species with more wide-ranging lifestyles are suited to the deepest environments. The concept of greater depth range with depth of occurrence is expounded upon by Merrett

Table 4. Percent occurrence of each species or group on each coded substrate (see Table 3) for identified species or groups from *Alvin* dives on the Patton Seamount.

	Substrate code													
Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Rockfishes	0.7	2.2	0.0	0.0	0.0	0.0	95.9	0.0	0.0	0.0	1.1	0.0	0.0	0.0
Thornyhead rockfish	0.7	9.4	0.0	2.9	6.5	0.0	19.4	2.2	2.9	0.0	41.7	0.0	14.4	0.0
Sablefish	0.0	0.0	0.0	14.3	0.0	0.0	57.1	0.0	0.0	0.0	14.3	0.0	14.3	0.0
Giant grenadier	1.2	0.3	0.3	21.2	2.7	0.0	41.8	0.3	5.5	0.0	22.7	0.0	3.9	0.0
Grenadier unidentified	3.1	0.0	0.0	0.0	1.0	0.0	25.5	0.0	0.0	0.0	32.7	0.0	37.8	0.0
Popeye grenadier	2.7	1.8	0.9	10.0	0.0	0.9	9.1	0.0	2.7	0.0	29.1	0.0	42.7	0.0
Pacific grenadier	8.2	0.0	0.0	19.7	14.8	1.6	21.3	0.0	4.9	0.0	18.0	1.6	9.8	0.0
Pacific flatnose	9.1	0.0	9.1	0.0	0.0	0.0	9.1	0.0	4.5	0.0	4.5	0.0	63.6	0.0
Deepsea sole	0.0	6.7	0.0	0.0	0.0	0.0	26.7	0.0	6.7	0.0	33.3	0.0	26.7	0.0
Brown crinoid	3.0	10.8	0.0	0.0	2.4	0.0	48.8	0.7	0.0	0.0	34.3	0.0	0.0	0.0
Black crinoid	5.2	1.7	0.0	39.7	0.0	0.0	12.1	0.0	10.3	0.0	15.5	0.0	15.5	0.0
Sea stars	1.4	40.0	0.0	1.7	3.0	0.1	33.5	0.4	1.1	0.1	14.0	0.2	4.5	0.0
Brittlestars	1.7	17.4	0.0	0.1	2.6	0.0	39.8	0.9	0.0	0.0	36.2	0.4	0.9	0.0
Scaled sea cucumber	0.9	0.3	0.0	30.4	0.0	0.0	35.5	0.2	6.7	0.4	22.0	0.2	3.4	0.0
Golden king crab	15.4	15.4	0.0	0.0	7.7	0.0	61.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Spider crab	7.0	0.0	1.3	7.6	1.9	0.0	5.7	0.0	1.3	0.6	5.7	0.6	65.0	3.2
Pinch bugs	3.6	0.2	0.0	9.2	0.0	0.0	56.9	0.0	14.7	4.3	7.8	0.5	2.7	0.0
Tanner crabs	5.9	0.0	0.0	5.9	0.0	0.0	11.8	0.0	5.9	0.0	11.8	0.0	58.8	0.0
Lithodid crabs	10.3	0.0	0.0	12.8	0.0	0.0	20.5	12.8	12.8	0.0	12.8	0.0	17.9	0.0
Purple sea anemone	81.5	0.6	0.0	0.0	0.3	0.0	12.1	0.0	0.0	0.0	5.4	0.0	0.0	0.0
White sea anemone	2.9	27.0	0.0	0.3	1.9	0.0	8.3	0.0	0.0	0.0	58.8	0.0	0.8	0.0
Red sea anemone	5.4	0.3	0.6	5.8	0.0	2.2	35.5	0.0	2.9	0.0	6.4	0.0	40.9	0.0
Red mushroom coral	7.1	1.9	0.0	18.6	1.4	1.0	28.1	1.0	1.4	6.2	14.8	0.0	18.6	0.0
Corals	3.4	3.3	0.0	20.0	0.5	0.1	36.5	0.2	3.7	0.3	30.1	0.0	1.9	0.0
Sponges	0.7	1.6	0.0	29.4	2.0	0.0	26.3	0.0	2.0	0.0	37.5	0.0	0.4	0.0

and Haedrich (1997) for macrourids from the North Atlantic, and appears to be equally valid for North Pacific grenadiers.

Because of limited resources in a uniform environment, competition for food amongst the top predators, such as the grenadiers (Drazen et al. 2001) would be expected, resulting in some type of habitat partitioning (Connell 1983; Spina 2000). It was difficult to analyze habitat associations with depth due to the strong association with various substrate types and depth (Figure 4). However, two common grenadier species, Pacific grenadier *Coryphaenoides acrolepis* and popeye grenadier *Coryphaenoides cinereus*, present in the deep-water assemblage, overlap in distribution and depth range throughout the North Pacific (Cohen et al. 1990). Both also consume benthic and pelagic prey items (Cohen et al. 1990; Drazen et al. 2001). In this study these two species occurred on different substrates (Table 4); the Pacific grenadier occurred on larger substrates (>65% occurrence on substrates 1–7) and the popeye grenadier on finer substrates (>83% occurrence on substrata 7–14) suggesting a mode of habitat partitioning. Drazen et al. (2001) found that the giant grenadier *Albatrossia pectoralis* and Pacific grenadier *Coryphaenoides acrolepis*, which also had overlapping distributions in the mid-depth communities on the Patton Province, restrict food resource competitive interactions by partitioning feeding locations.

Possibly the most interesting find on the Patton Province was a complete immature right whale skeleton *Eubalaena glacialis* (Identified by K. Wynne, University of Alaska, Kodiak personal communication) lying in 545 m of (3.4°C) water. Considerable time was spent photographing and examining the whale-associated biota. There was no evidence of any flesh remaining and the attached biota was sparse. A single large reddish-orange sea anemone was attached to a lower jaw bone, and several bones were covered in small hydrozoan-like encrusting organisms. The surrounding fauna assemblage included several grenadiers *Coryphaenoides* sp., lithodid crabs, large vase sponges and corals, and was similar to faunal communities in adjacent areas away from the skeleton. Such large falls of organic material can provide sustenance for benthic scavengers in an otherwise nutrient poor environment (Smith 1992; Smith and Baco 1998). It is unknown how long (years?) such a large mass of tissue could remain at this depth and temperature, but potentially it could provide a long-term food source for scavaging megafauna. Smith and Baco (2003) identified 3 successional stages for whale carcasses after they settle to the bottom. From our examination the fall appeared to be in the sulphonic phase which is characterized by a rich fauna living off the remaining chemo-synthesis from the bone lipid break-down (Smith and Baco 2003). Such micro-habitats lead credence to the existence of additional faunal assemblage specific to whale falls as rich and distinct as the assemblages herein studied which were identifiable by depths.

In 1979, the National Marine Fisheries Service investigated Gulf of Alaska seamounts, including Patton Province, using pelagic and bottom trawl gear, crab pots, and long line gear, as well as fixed cameras (Hughes 1981, Raymore 1982, Alton 1986). In their sampling, they found distinct communities associated with water column depth above the seamount tops. They found an epipelagic assemblage consisting mainly of salmonids, a bathypelagic assemblage consisting of many species of deep water pelagic fishes and invertebrates (see Hughes 1981), and a benthic assemblage composed of many of the same species found in this study—such as tanner and lithodid crabs, grenadiers, thornyhead rockfish, and sablefish (Alton 1986). These 1979 investigations, in conjunction with this study, suggest that no less than 5 distinct faunal communities, (i.e. 2 pelagic and 3 benthic) exist on the Patton Seamount.

The degree of endemism and speciation on Patton Seamount is unknown, but from these investigations it can be suggested that the fauna represents a subset of the slope region in the Gulf of Alaska (Alton 1986); however, detailed collections and taxonomic work is required to substantiate this assumption. The population dynamics of the Gulf of Alaska seamounts is still unclear. Somerton (1981a) found that the snail Oregon triton *Fusitriton oregonensis* was the only gastropod to colonize Patton Province and suggested that this was linked to its pelagic larval stage. Many of the invertebrates such as corals, sponges, sea stars, brittlestars, sea cucumbers, crinoids, sea anemones, and lithodid crabs (Barnes 1980) found during this study have free-swimming larval stages. In addition, several fish species encountered during this study have protracted pelagic larval stages, such as grenadiers (Stein 1980; Stein and Pearcy 1982; Endo et al. 1993), Pacific flatnose, rockfishes, deep-sea sole and sablefish (Matarese et al. 1989). Pelagic larvel stages allow great spans of the abyss to be crossed before settling on suitable seamount habitat. The implication is that not all organisms are able to colonize the seamount environments and the existing assemblage is a unique subset of the coastal slope communities. Sablefish are known to be highly migratory. A multi-year and multi area tagging study has shown that these fish routinely migrate from Alaskan nearshore waters to Gulf of Alaska seamounts (Kimura et al. 1998). Such highly migratory behavior could allow all suitable seamount habitat to be exploited independent of currents and larval characteristics. Crabs on seamounts in the Gulf of Alaska have expanded depth distributions compared to their nearshore counterparts (Somerton1981b); this may be linked to the absence of competitors on the nearshore slope which have never colonized the seamount environment. Trawling surveys conducted by the Alaska Fisheries Science Center in the Gulf of Alaska (Kodiak Area, 1–1000 m, Britt and Martin 2001) report faunal assemblages dominated by Pleuronectids such as the Dover Sole *Microstomus pacificus*, Rex sole *Glyptocephalus zachirus*, Flathead sole *Hippoglossiodes elassodon*, Arrowtooth flounder *Atheresthes stomias* and Pacific halibut *Hippoglossus stenolepis* in near shore waters. These faunal assemblages were absent from Patton Seamount. Direct comparisons to nearshore faunal assemblages is difficult due to the lack of comparable investigations, but this study suggests that the faunal assemblages of the Patton Seamount are unique in their isolation, depth, and heterogeneous habitat.

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