

# **ROV Assessment of Rockfish Abundance, Distribution, and Habitat in Whatcom County Marine Waters.**

**Whatcom County Marine Resources Committee  
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**Prepared By:**

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# **ROV Assessment of Rockfish Abundance, Distribution, and Habitat in Whatcom County Marine Waters**

## **Introduction**

Rockfish landings in Washington State are at 50-year lows (Palsson 1998, Dinnel et al. 2001). Fishing pressure in northern Puget Sound is largely responsible for declines in populations of rockfish and other bottom fish (Tuya et al. 2000). Rockfish populations are sensitive to over fishing in part because of their life histories. Rockfish are long-lived and mature slowly; copper rockfish, for example, do not reach sexual maturity until six to eight years of age, but can live for more than 50 years. Rockfish mate and bear live young and larger rockfish are significantly more fecund (Love 2002). Following reproduction, rockfish larvae remain in the water as plankton for several months. It is thought that starvation and predation are the primary sources of larval mortality (Berkeley, 2004). These traits make rockfish sensitive to fishing pressures since fishing tends to remove the most sexually productive fish and successful recruitment in a particular area may require a large regional supply of larvae (McConnell et al. 2001).

Rockfish are frequently caught as a by-catch when fishing for salmon or bottom fish. They are relatively easy to catch and when brought quickly to the surface from depths as shallow as 10 meters they can suffer damage to their swim bladders and die of barotrauma (Starr et al. 1999). For this reason traditional management strategies such as bag limits and fishing season restrictions are ineffective. Other promising management strategies for rockfish include habitat protection or no-take reserves that help to eliminate by-catch (Tuya et al. 2000, Eisenhart 2001). Rockfish, aptly named, are usually associated with rocky reef habitats, but different species of rockfish prefer different

bottom types and depth ranges (Love et al. 2002). In the Strait of Georgia, including Whatcom County, rockfish are primarily associated with high relief rock walls and boulder fields (Pacunski and Palsson 1998). Previous ROV surveys by Western Washington University students have identified copper, Puget Sound, and black rockfish (*Sebastes caurinus*, *S. emphaeus*, and *S. melanops*) inhabiting steep rock walls on the southwest portion of Lummi Island. Aside from these short surveys the size and abundance of rockfish in Whatcom County waters are not well documented. A 2002 study of the population structure and genetics of copper rockfish (*Sebastes caurinus*) found that while rockfish in the North Puget Sound region were not considered vulnerable due to a large census population estimate in the San Juan Islands in 1994, there may be evidence for a recent reduction in effective population size, possibly due to over-fishing (Buonaccorsi et al. 2002). This indicates the need for additional survey work to be done in this region to better determine the state of rockfish populations. The survey described in this report, supported by the Whatcom County Marine Resource Committee and the Northwest Straights Commission, is a preliminary step in assessing the abundance and spatial distribution of rockfish and critical habitat in Whatcom County. We expect the data reported here will serve as a baseline when assessing future changes in rockfish abundance and distribution to determine whether rockfish populations in Whatcom County are declining or recovering. These data will also help identify locations of critical rockfish habitat that are worthy of conservation. To accomplish these goals we identified likely habitat based on bathymetry and reports of bottom type (Pacunski and Palsson 1998) and investigated these areas using a ROV.

## Methods

We assessed rockfish populations in Whatcom County marine waters by conducting surveys using a VideoRay Pro 3 XEGTO remotely operated vehicle (hereafter referred to as an ROV) equipped with 10-cm parallel lasers. Video was recorded onto DVD using a Sony VRD-MC3 DVD recorder to collect video transect data at locations throughout Whatcom county (Fig 1, & Appendix A). The R/V Zoea (WWU, Shannon Point Marine Center) was used as the survey platform. Potential survey locations were narrowed based on bathymetry and the underwater habitat survey of Pacunski and Palsson (1998). We focused our surveys on regions possessing relatively high relief and rocky substratum. The timing of the ROV surveys was chosen to correspond with long slack tides during the spring of 2008 in order to maximize visibility and ROV maneuverability. Data from five ROV transects from previous surveys on Lummi Island conducted by WWU students in the spring and fall of 2007 were also examined (Fig 2).

Specific transect locations were selected by identifying the steep bottom slopes using NOAA charts, and identifying rocky reef habitats based on the bottom-type survey (Pacunski and Palsson 1998). We also examined sites where visible shoreline morphology suggested rocky and high relief bottom offshore. The research vessel was operated without setting anchor, which made efficient use of time and allowed the boat to follow the ROV, keeping slack in the tether, extending the potential range and depth of a transect beyond the 100-m length of the tether. The boat followed the ROV by comparing ROV depth readouts on the video feed to depth sounder readings on the Zoea's instruments. Dive length, depth and ROV maneuverability, however, were limited by current and wind. Even at slack tide, the areas surveyed were exposed to substantial

currents in the Strait of Georgia. Allowing the research vessel to drift with the ROV enabled us to keep tether length to a minimum, which reduced total drag on the tether on the ROV.

Bottom slopes were determined at survey sites by piloting the research vessel along the proposed transect route and taking GPS and depth sounder readings at 10 to 20 foot depth intervals until we reached the end of the proposed transect (Appendix B). This method of bottom slope determination was limited in some cases by the proximity of the shore or kelp beds. The vessel would then return to the deepest point of the transect and the ROV would be launched there, or at the deepest portion of the transect that was less than 50 m in depth. In several cases, the ROV was launched as deep as 64 m. A compass bearing along the transect was taken to help guide the ROV up slope along the transect using the ROV's onboard electronic compass.

Video data including a digital display of magnetic heading and water depth (in meters) were imprinted onto the video image and recorded. Data were referenced by both "Elapsed dive time" which began as soon as the ROV reaches the bottom, and elapsed time on the video. In order to determine the area surveyed, observations of depth, screen width, and substrate were made at one minute intervals beginning with 0 minutes of elapsed dive time when the lasers on the bottom were visible and the ROV was oriented properly along the transect. If bottom conditions were not suitable for video at the start of the transect (i.e. bottom sediment stirred up, no strong slope apparent, etc.) then observations started after about 1 minute of elapsed dive time. Substrate composition was quantified using a habitat complexity index (Dinnel et al. 2003). This index assigns numerical values from 0 to 3 indicating the mean substrate particle size. A value of 0

was given to sand and mud, 1 for gravel, 2 for cobbles, and 3 for rock. Half values were added for combination habitats, such as 2.5 for cobbles strewn with many large boulders, 1.5 for gravel scattered with rocks, and 0.5 for sand scattered with large cobbles and rocks. The 10-cm parallel lasers served three purposes. First, they were used to estimate the size of observed fish. The parallel lasers frequently did not land on the fish so the only way to estimate the size of the fish was to compare the size of the fish to an object the same distance from the ROV on the video screen. This object had to be painted with the lasers at some point either before or after the fish sighting to calculate its actual size and in turn provide an estimate of the fish length. Second, the lasers helped to estimate the size rocks, gravel, and shell on the substrate; this was essential in recording values for the habitat complexity index. Third, the lasers were used to calculate the width of the field of view at one-minute intervals. Given the measured bottom slope, we calculated the total length of our transects from the change in depth using the formula:  $L = \Delta d / \sin(\theta)$ , where L is transect length,  $\Delta d$  is the change in bottom depth, and  $\theta$  is the bottom slope. Total survey area was calculated as the product of transect length and width (determined using the parallel lasers). Survey area was not determined at transects at Point Roberts or at some at Alden Bank transects where no suitable rockfish habitat was found.

## **Results**

ROV surveys were conducted in six general areas: South Beach Point Roberts, Alden Bank, Lummi Rocks, Lummi Island, Portage Island, and Eliza Island. A total of 39 video transects were surveyed, and video was recorded along 35 transects. An additional five video transects using the same ROV in 2007 were combined with this

dataset for a total of 44 transects and greater than 300 minutes of bottom survey time. In all the video transects we have collected thus far, we have observed copper, Puget Sound, yelloweye, black, and quillback rockfish (*Sebastes caurinus*, *S. emphaeus*, *S. ruberrimus*, *S. melanops*, and *S. maliger*). Our observations indicate that rockfish are strongly associated with steep rocky habitat (Fig 3, 4). Bottom slopes at sites possessing rockfish were steep. Few rockfish were observed in bottoms with a slope of less than 24 degrees and the highest number of rockfish was observed in an area with a bottom slope of 70 degrees. These habitats also possessed large boulders. In areas with low habitat complexity (below 1) we only observed flatfish and sculpins. The deepest depth surveyed was 64 m. Rockfish counts at sites ranged from 0 to 24 (Fig 5). Rockfish observed per minute of ROV bottom time ranged from 0 to 4, and rockfish densities ranged from 0 to 0.63 fish m<sup>-2</sup>.

#### *Observed habitat and rockfish abundance at different regions*

We observed no rockfish at Point Roberts. Majority of the habitat was flat and composed of sand and a few cobbles. The only significant bottom slope observed was calculated at 8 degrees. The rockiest habitat, found at the southernmost site at Point Roberts was a sandy bottom with 0.5 to 1-m diameter boulders. At two areas that had been classified as rock minor habitats by Pacunski and Palsson (1998) at the north end of Point Roberts we observed primarily sandy and relatively flat bottom.

We observed few rockfish habitat at Alden Bank. These sites were sandy, with occasional cobbles. The slope at most sites was between 5 and 11 degrees. However, there was a steep slope on the southern end of Alden Bank mentioned as a potential

rockfish habitat by local divers. At 16 degrees, this area has the steepest slope on Alden Bank judging by the NOAA charts. At this location we observed several juvenile Puget Sound rockfish (*S. emphaeus*) as well as some nearby rocky habitat. This was the shallowest slope that we observed to support rockfish in Whatcom County.

We observed more rockfish near Lummi Island than at any other location in Whatcom County. The high relief walls and large boulders found near Lummi Rocks and northwest of Carter point held the highest population densities of rockfish. The steepest slopes averaged 70 degrees, and we frequently encountered sections of vertical wall during the ROV transects. Habitats here were also remarkably rocky, with maximum habitat complexity values. Observed rockfish densities dropped to zero in the region between Lummi Rocks and Carter Point along the west side of Lummi Island, where the bottom slope flattened and boulders were replaced by gravel and sand as the primary bottom type. The seafloor on the east side of Lummi Island and in area surveyed north of Eliza Island was primarily composed of sand and was shallower than the bottom west of Lummi Island. No rockfish were observed in these areas.

The habitat complexity index developed by Paul Dinnel and Andrew Weispfenning (Dinnel et al. 2003) was useful for summarizing bottom type in the areas we surveyed. Our surveyed areas possessed a range of habitat complexities, from “zero” habitat complexity at Alden Bank to areas along the west side of Lummi Island which were scored as 3 (the maximum complexity). Ten different transects had habitat complexity indices of over 2.5, or rock dominant. Six transects were between 2.0 and 2.5, and were classified as rock minor. The remaining transects were classified as

“sandy” or soft bottom with few or moderate numbers of cobbles. All but two transects with documented rockfish presence fell into the category of rock dominant (Fig 1, 2).

Bottom slope was correlated with rockfish abundance. All but one transect with rockfish present had a slope of over 20 degrees. Bottom slope and habitat complexity were also related; every bottom with a slope greater than 20 degrees also had a habitat complexity index of at least 2.0. We also noted that the amount of sediment visibly covering hard substrata appeared to be inversely related to bottom slope.

The depth distribution of Puget Sound rockfish peaked between 20m and 30m but the total depth range of this species documented in this survey was from 11.3m to 50.2m. The depth distribution of other rockfish (primarily copper and quillback rockfish) ranged from 15m to 50.2m and there were many sightings between the 15m to 30m range (Fig7). However, the lower depth limit of rockfish in our surveys was likely due to changes in bottom type that occurred at the deepest portions of our transects rather than depth per se. On many deep dives at Lummi Island, even on exceptionally rocky transects, below 50 meters the bottom tended to level and transition into a bottom composed of sand or shell hash.

## **Discussion**

Rockfish abundance in Whatcom County is strongly associated with high-relief rocky-reef habitat. This is consistent with the findings of Love et al. (2002) and Pacunski and Palsson (1998). All rockfish sightings but one occurred in areas with bottom slopes greater than about 20 degrees, with most occurring at sites with slopes greater than 30 degrees. The habitats where rockfish were observed had several other features in

common as well. Hard surfaces at sites occupied by copper and quillback rockfish in particular were comparatively devoid of sediment, which was observed to coat hard substrate surfaces in adjacent sites. The bottom was very complex at sites with high densities of rockfish, possessing many holes, gaps and overhangs large enough to conceal a large rockfish. Because of this feature, our video transects could have underestimated rockfish abundance at the sites with highest rockfish densities.

Whereas the depth distribution of Puget Sound rockfish appeared to be roughly Gaussian or perhaps log-normal, peaking at a depth of approximately 25 m, the depth distribution of the other observed rockfish species showed greater variation. This could indicate a greater depth range by the other species, but it could be a consequence of low sample size. It appeared as though the only factor limiting the maximum depth of the other rockfish in the areas we surveyed was bottom type. During one especially deep investigation near Lummi rocks we found sand and large numbers of unbroken bivalve shells, not scattered about the bottom, but rather a huge pile at the base of the rocky reef composed of nothing but intact mollusk shells, approximately 8-cm across. We often observed the rocky reef to transition into a cobble bottom at depth.

While complex rocky reef habitat is generally accepted as prime rockfish habitat, other types of habitat are important for different life stages. As rockfish mature and increase in size they often move to steep reef habitat with caves and crevices that provide refuges (Love et al. 2002). Smaller fish can find cover on bottoms with less complexity and still avoid larger predators. This suggests that the rock minor areas we observed along Lummi Island, as well as the south point of Alden Bank and several spots around Point Roberts might be suitable habitat for juvenile rockfish or smaller species such as

Puget Sound rockfish. Puget Sound rockfish was the only species found in habitats we characterized as rock minor.

One of the motivations for this survey was to assess whether Whatcom County possesses regions suitable for protection in order to help maintain or enhance rockfish populations. Marine reserves have been shown to be effective as a means of restoring populations suffering from over fishing (Baskett et al. 2006). The Edmonds Underwater Park is a marine reserve that has had tremendous success (Palsson and Pacunski 1995). The primary habitat for rockfish in Whatcom County, and hence the best candidate location for a marine reserve is clearly along the southwestern shore of Lummi Island extending northwest from Carter point, as well as the area surrounding Lummi Rocks. One unanswered question is whether rockfish populations in Whatcom County would increase if critical habitats were protected and fishing pressure were eased in these areas.

During Skagit County's assessment of rockfish populations in 8 candidate marine reserves by ROV (Dinnel et al. 2003), rockfish densities of up to 12.4 Puget Sound rockfish per minute of ROV dive time and up to 0.22 other rockfish per minute of ROV dive time were observed in areas with habitat complexity values similar to those found on Lummi Rocks. The maximum rockfish per minute of ROV dive time for the Whatcom County survey was 4 Puget Sound rockfish per minute and 1.16 other rockfish per minute. These numbers are not directly comparable because of differences in field of view and travel velocity of the two different ROVs. But, the pattern suggests that Skagit County possesses relatively high densities of Puget Sound rockfish compared to Whatcom County. Comparing the findings of the Dinnel et al. (2003) survey with ours indicates that there is more suitable rockfish habitat in Skagit County, especially near Hat

Island and Burrows Island, compared to Whatcom County. There are also higher densities of Puget Sound rockfish in Skagit County. By comparison, the only area surveyed that had a significant population of Puget Sound rockfish was near Carter Point. It is not clear why the available rockfish habitat in Whatcom County would appear to have lower Puget Sound rockfish densities compared to similar habitat in Skagit County. It is possible that the greater amount of habitat and larger rockfish populations in Skagit County provide a larger larval pool so that Skagit County habitats are not limited by recruitment to the same extent as habitats in Whatcom County. However, given the relatively long development times of planktonic rockfish larvae and the close proximity of Skagit and Whatcom Counties and San Juan County (which also has a relatively large rockfish populations), it is difficult to conclude that Puget Sound rockfish populations in Whatcom County experience more recruitment limitation than adjacent counties.

Although data on Puget Sound rockfish dispersal are limited, large genetic divergence between copper rockfish populations in Puget Sound, in the Gulf Islands, and populations on the Pacific coast suggest relatively limited long-range larval dispersal (Buonaccorsi et al. 2002). Copper rockfish and other rockfish species living on high-relief rocky reefs have relatively small home ranges on the order of 10 to 30 m<sup>2</sup> (Love et al. 2002). This tends to limit adult migration once they have become established at a rocky reef (Lea et al. 1999). The relatively low densities of Puget Sound rockfish in Whatcom County could also be due to differences in habitat that were not readily observable by our survey methods. The other possibility is that rockfish habitat in Whatcom County is currently under populated suggesting that rockfish densities might increase in the future if the populations and critical habitat were protected.

The methods we used in this survey have limitations. All sites inspected had at least some degree of “marine snow” or settling particulate matter that hampered visibility. Also, the ROV has limited peripheral vision. Because the ROV was flown relatively close enough to the bottom so that the lasers could be seen on the bottom and so that we could identify fish species, rockfish that remained more than a meter or so off the bottom might have escaped observation. We also occasionally observed rockfish that spotted the ROV to swim away and watch from a distance. It is not clear how this much kind of avoidance behavior might have biased our data. But, we believe we were able to observe rockfish before they exhibited avoidance behavior and thus this source of error is likely small.

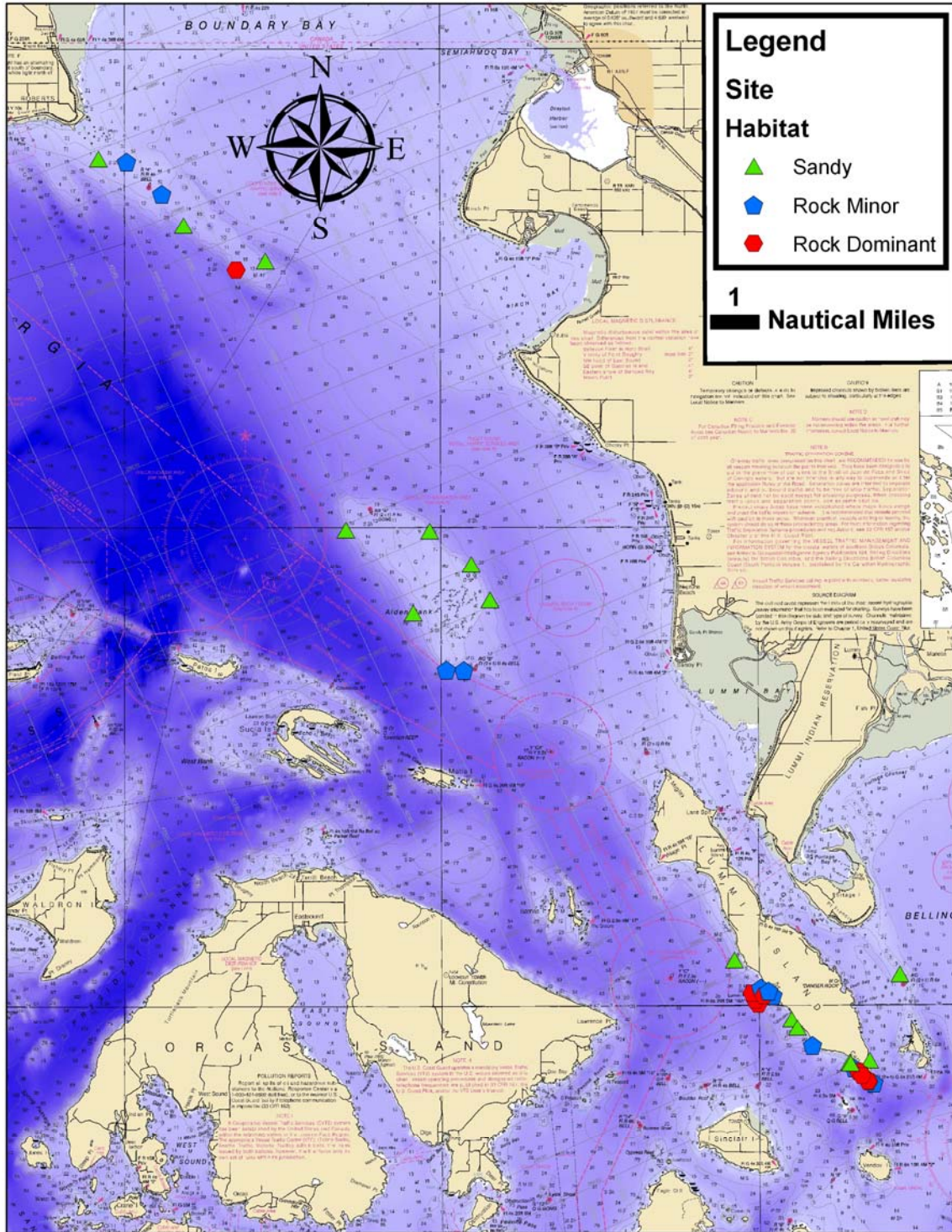
### **Acknowledgements**

This research was supported by a grant from the Whatcom County Marine Resources Committee. We gratefully acknowledge the assistance of Nathan Schwark, skipper of the R/V Zoea and the director and staff of the Shannon Point Marine Center. We also thank Paul Dinnel for providing advice and resources.

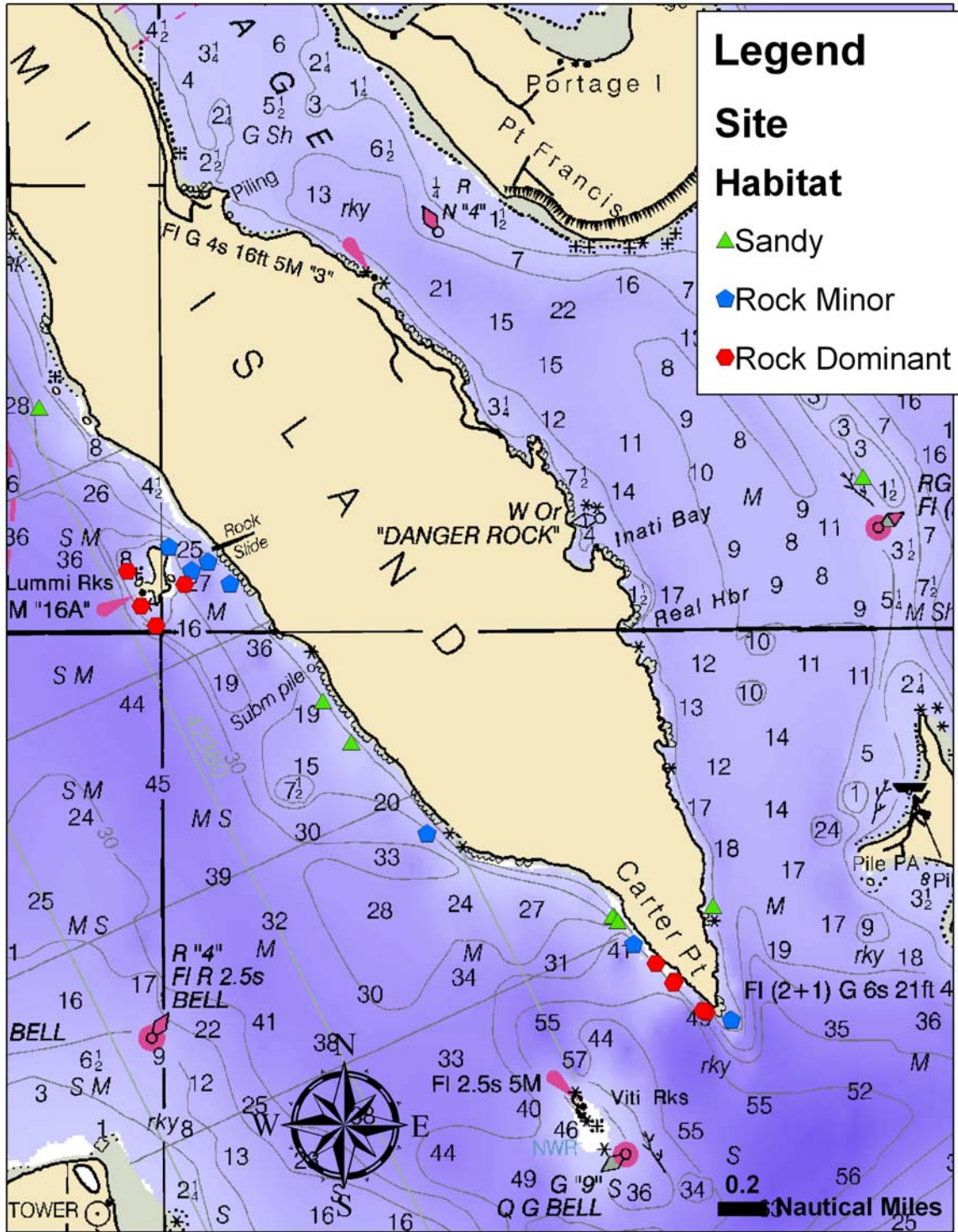
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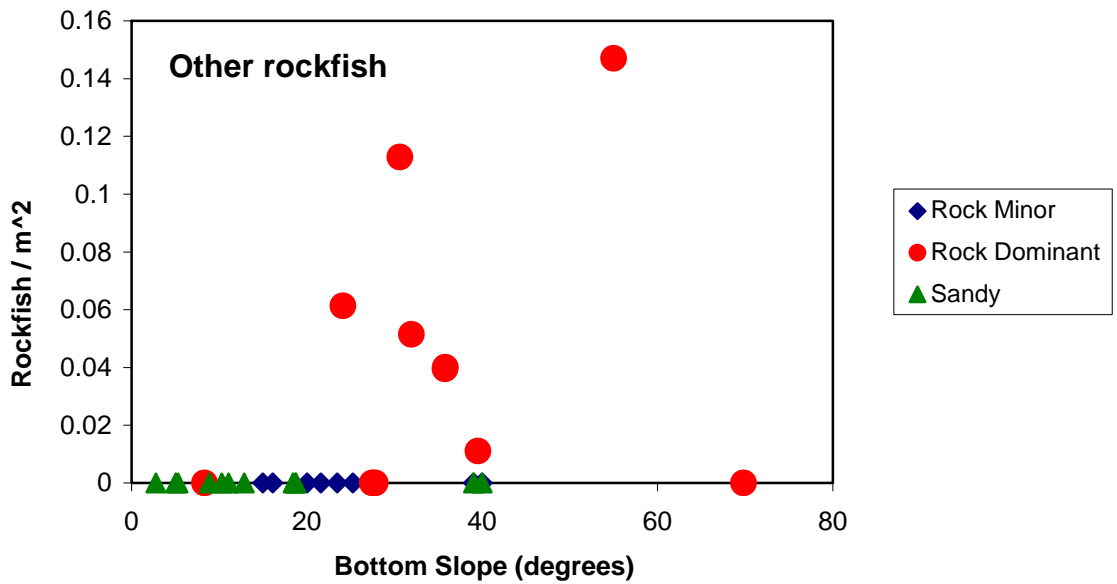
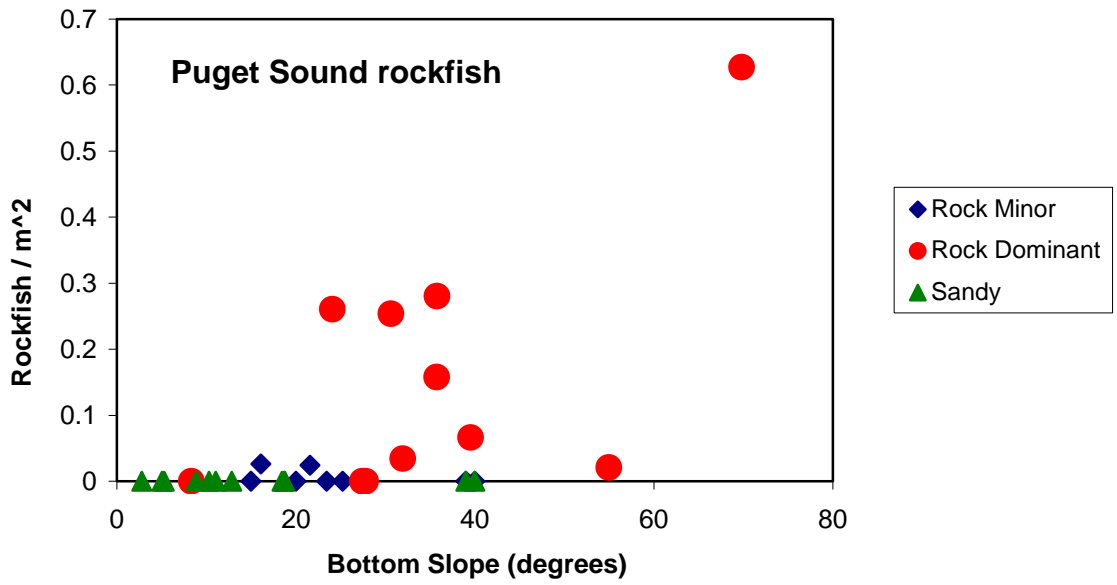
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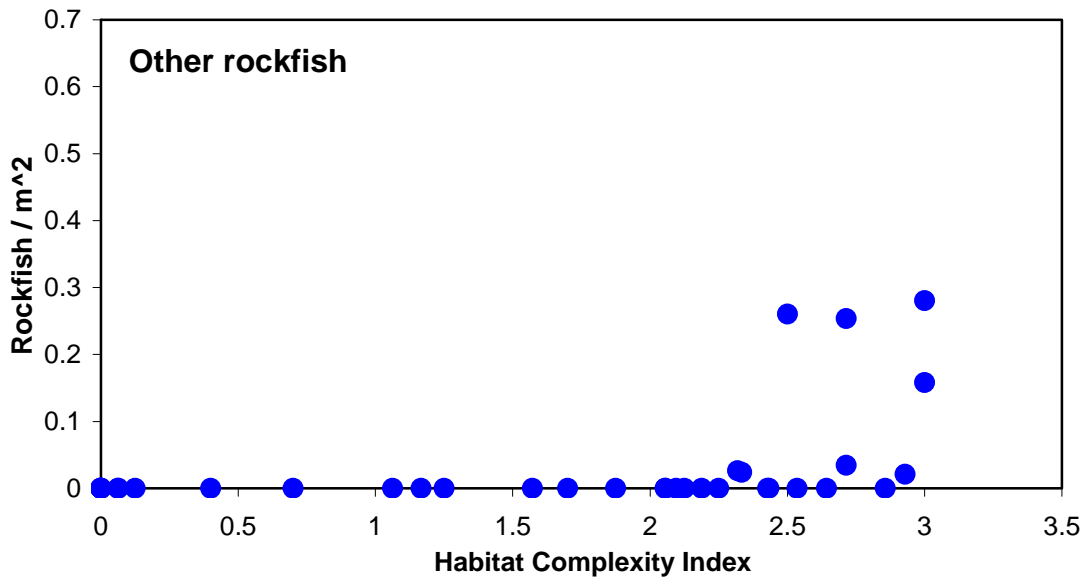
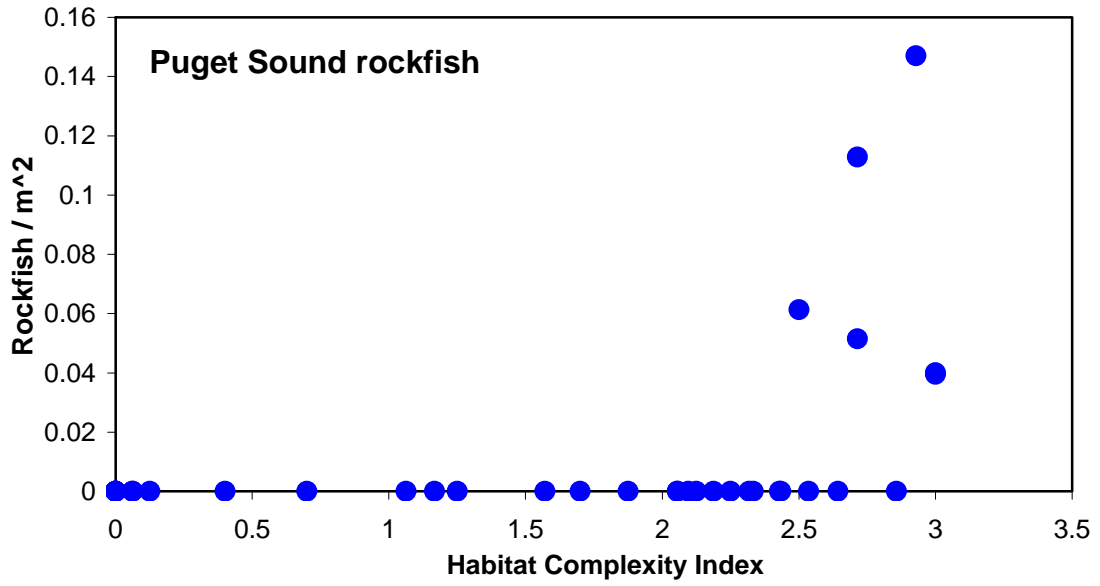
**Figure 1.** Transect locations in Whatcom County. Bottom type is indicated by symbols.



**Figure 2.** Transect locations on Lummi Island. Symbols represent different bottom types. Overlapping points represent multiple survey dates at a single location.

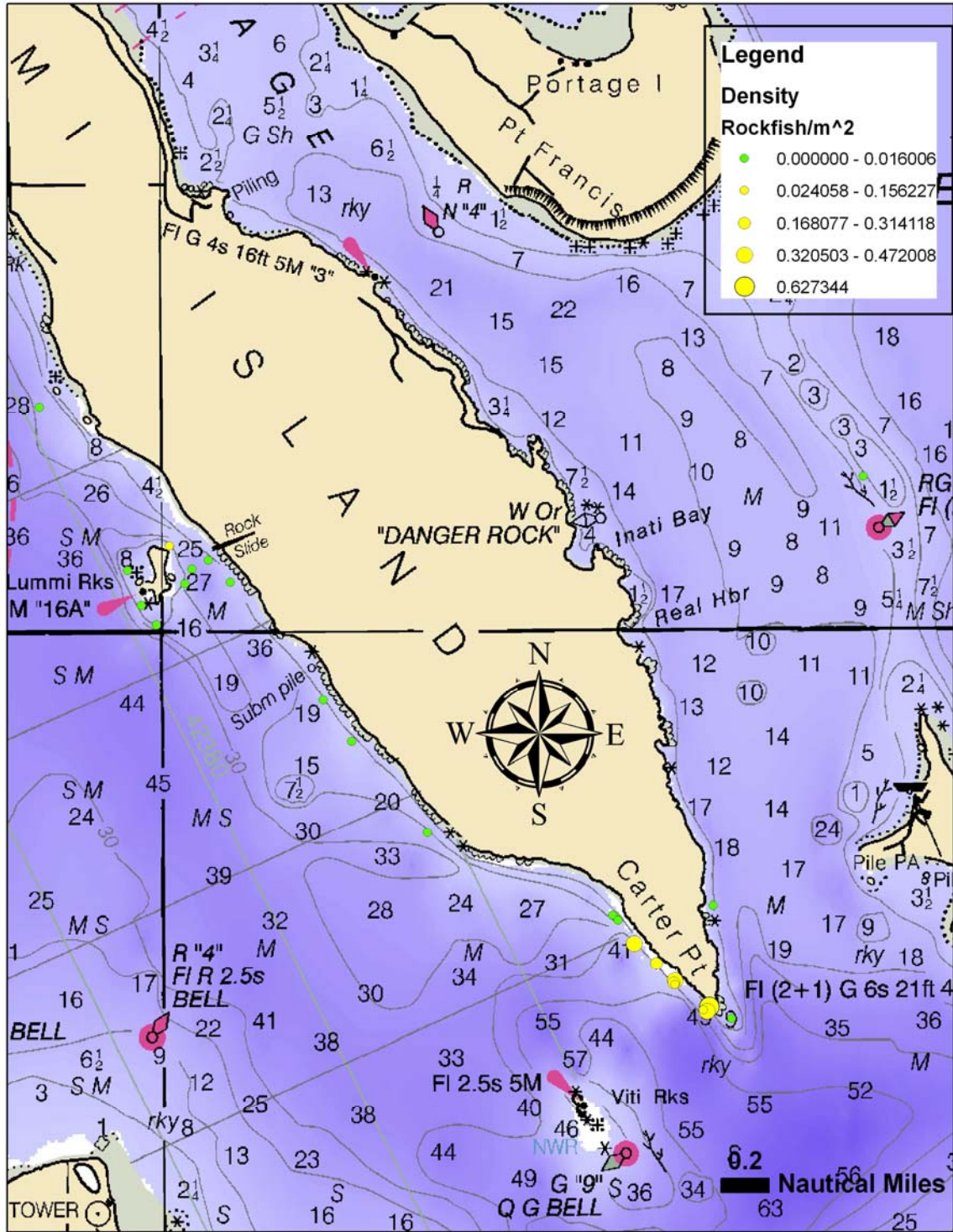


**Figure 3.** Relationships between rockfish density and bottom slope. Symbols represent bottom characteristics.

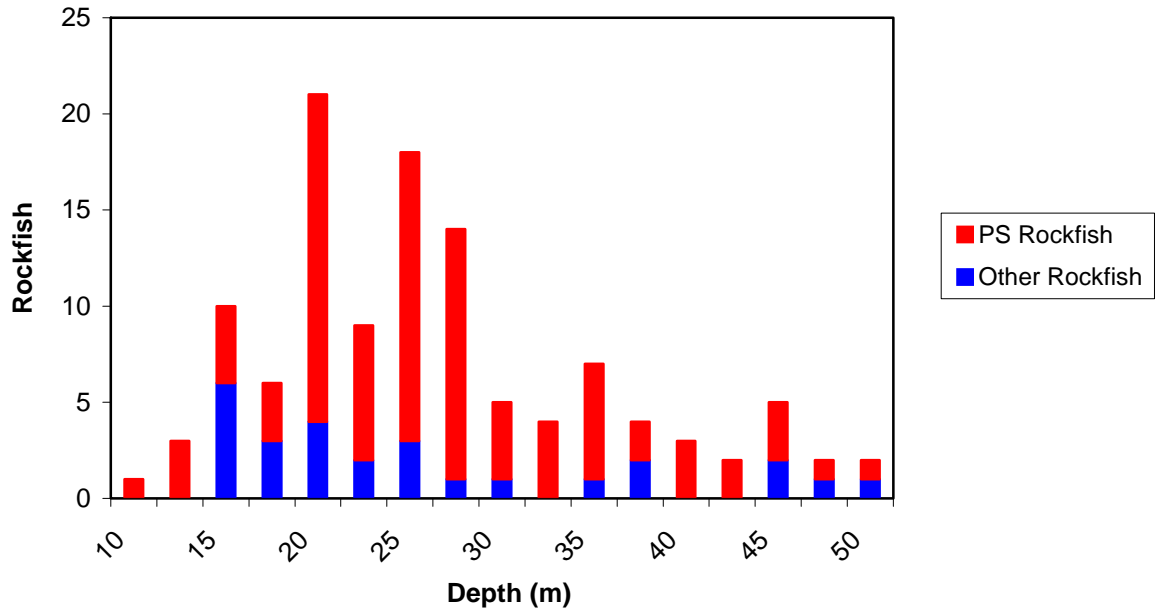


**Figure 4.** Relationships between rockfish density and habitat complexity index.

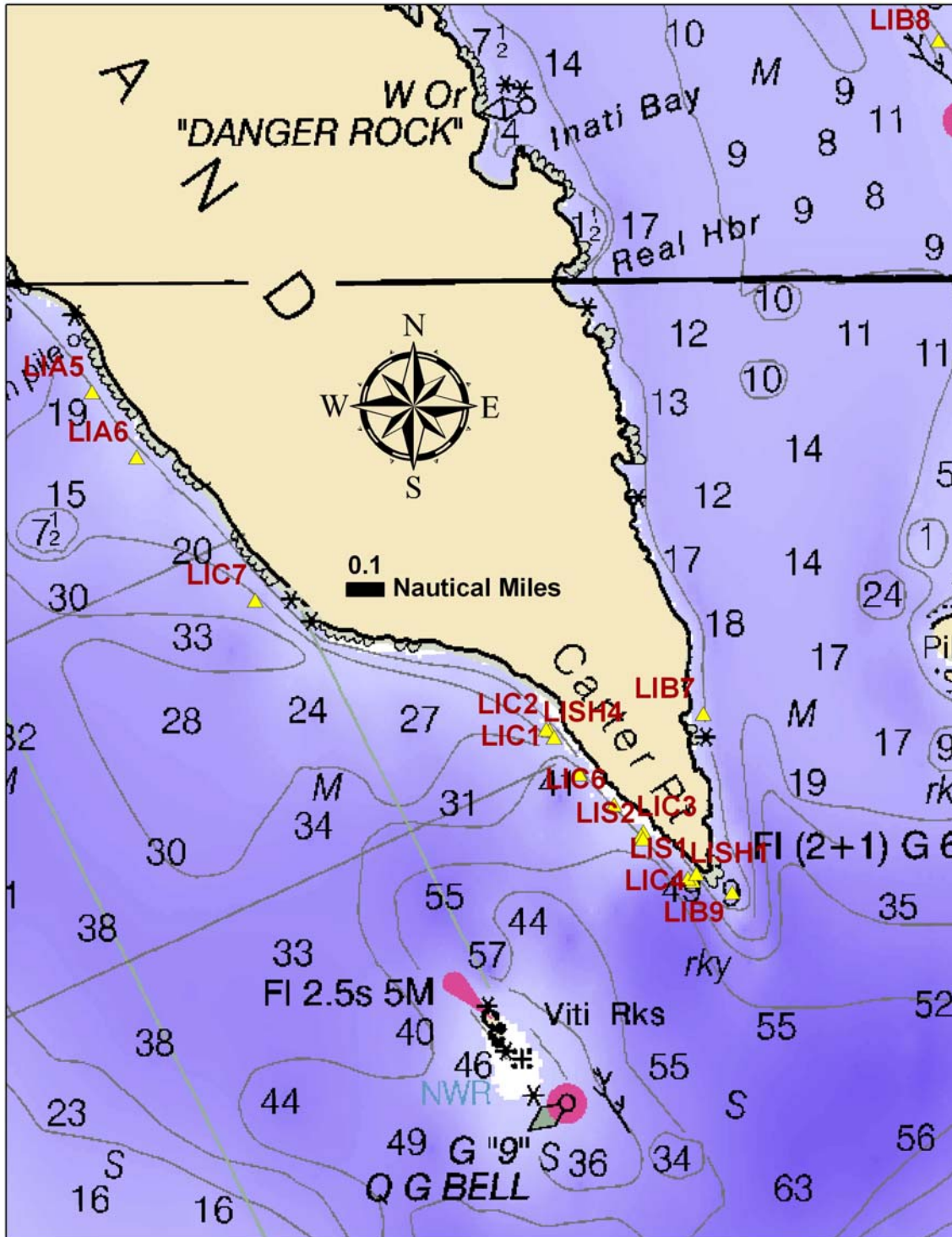




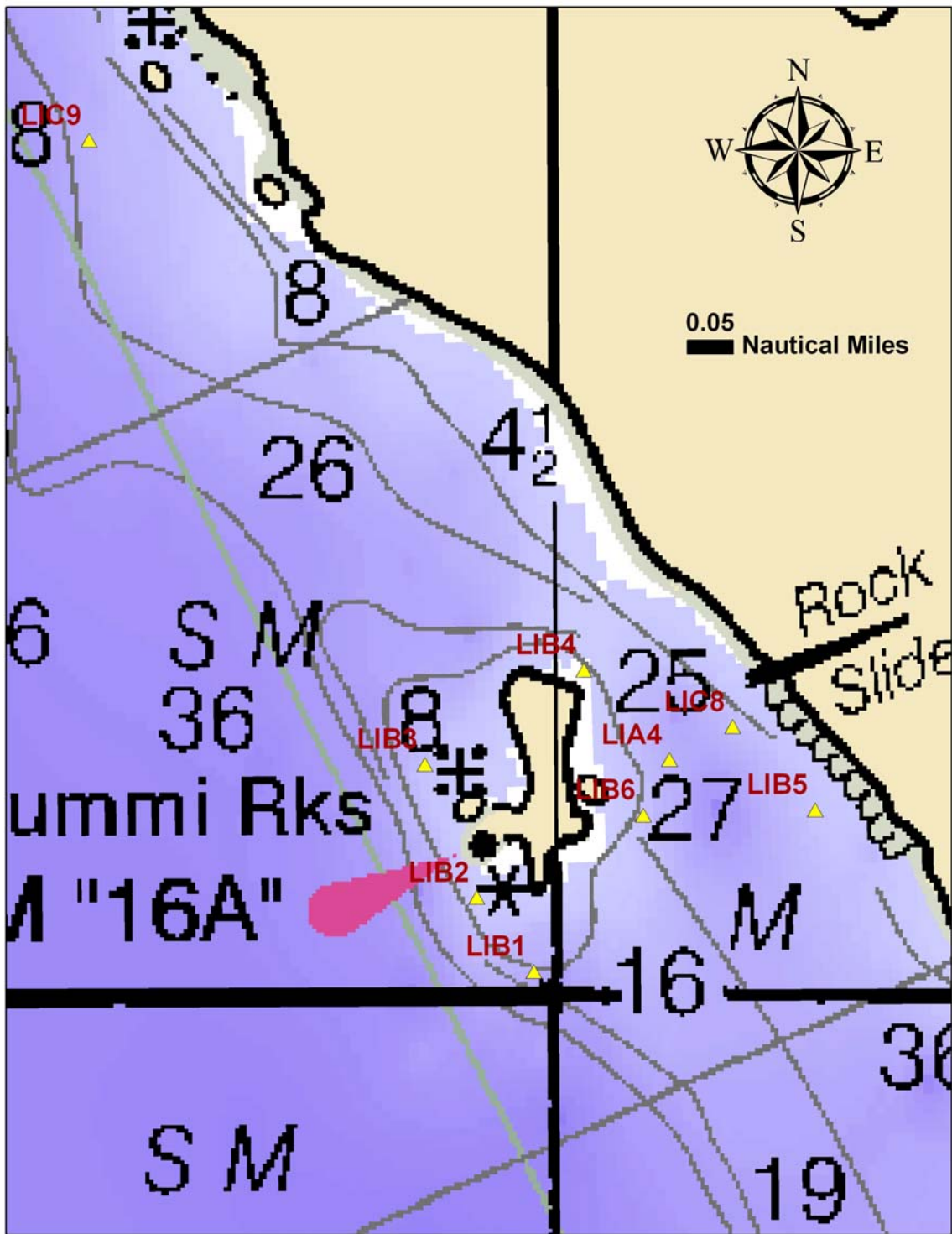
**Figure 6.** Rockfish densities at each location near Lummi Island. Overlapping points represent multiple survey dates at a single location



**Figure 7.** Depth distribution of rockfish broken up into Puget Sound rockfish and other rockfish.

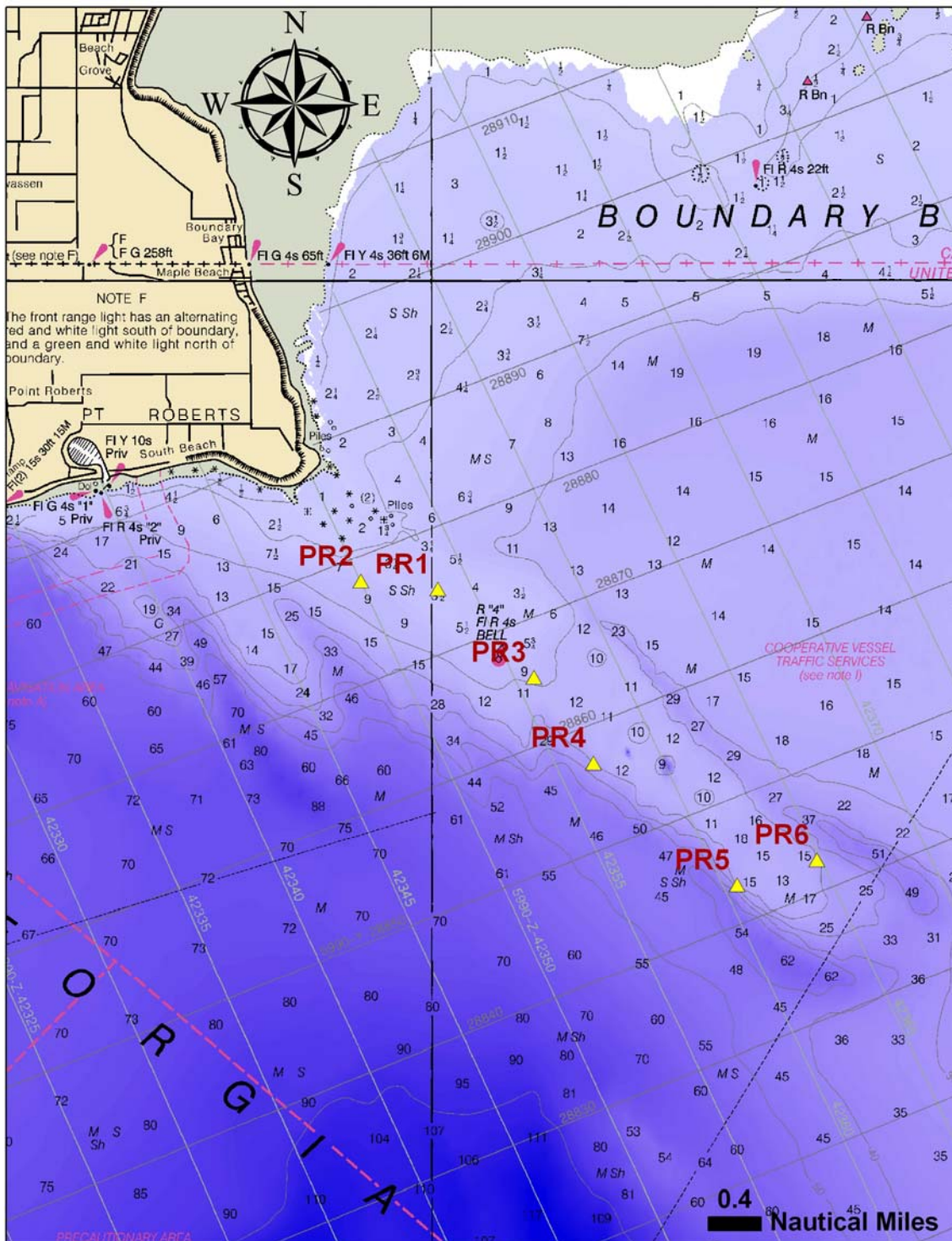


**Appendix A-1.** Individual transect locations labeled with location codes and transect numbers. **LIS** for Spring 2007 transects on Lummi Island, **LISH** for fall 2007 transects on Lummi Island, **LIA**, **LIB**, **LIC**, for trips A, B, and C to Lummi Island, **AB** for Alden Bank, and **PR** for Point Roberts.

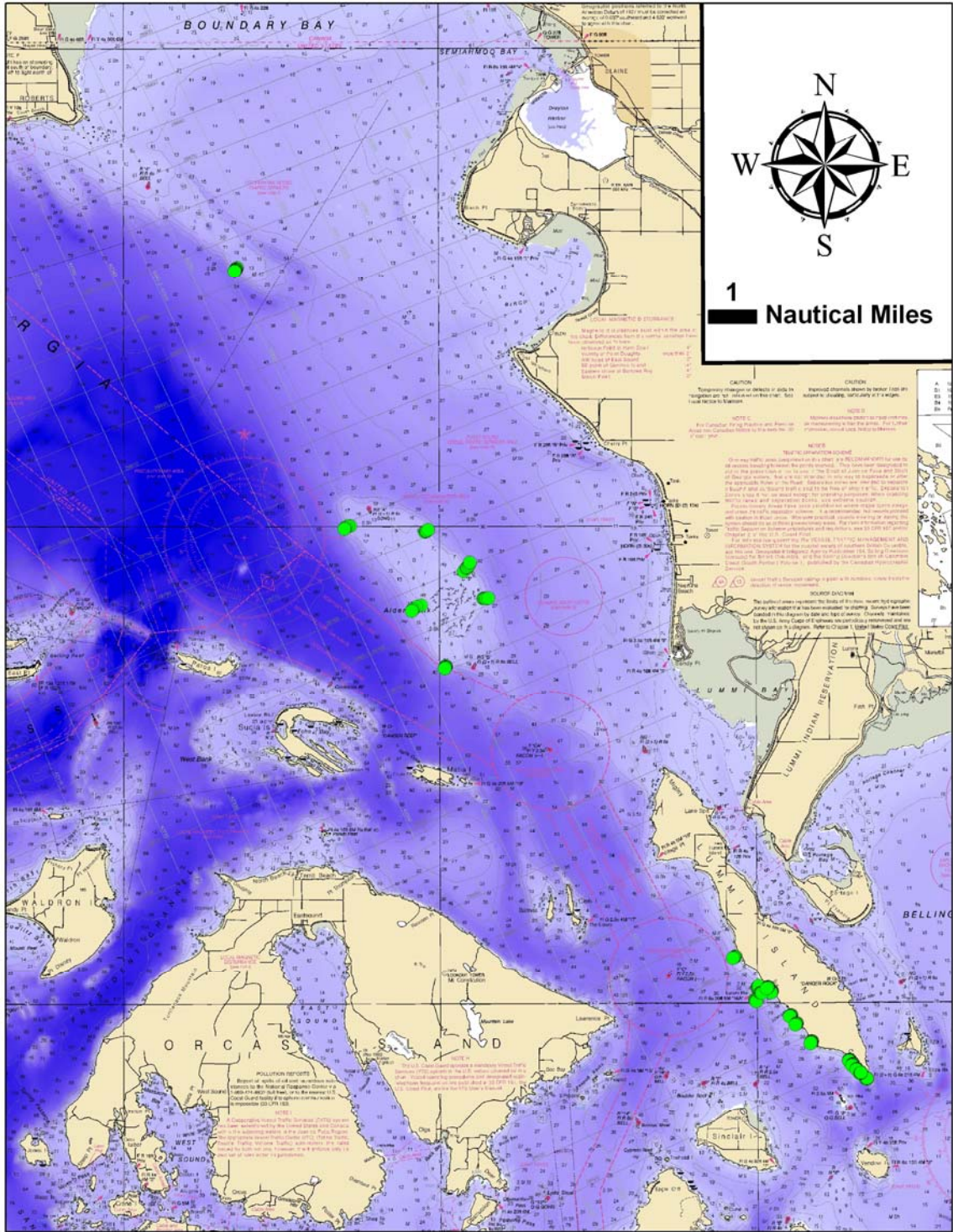


**Appendix A-2.** Individual transect locations labeled with location codes and transect numbers. **LIS** for Spring 2007 transects on Lummi Island, **LISH** for fall 2007 transects on Lummi Island, **LIA**, **LIB**, **LIC**, for trips A, B, and C to Lummi Island, **AB** for Alden Bank, and **PR** for Point Roberts.





**Appendix A-4.** Individual transect locations labeled with location codes and transect numbers. **LIS** for Spring 2007 transects on Lummi Island, **LISH** for fall 2007 transects on Lummi Island, **LIA**, **LIB**, **LIC**, for trips A, B, and C to Lummi Island, **AB** for Alden Bank, and **PR** for Point Roberts.



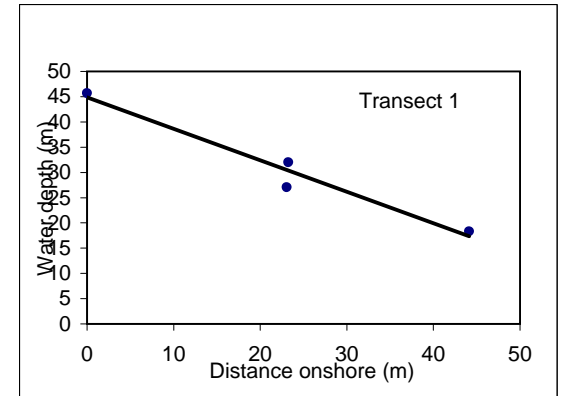
**Appendix B.** GPS points for boat-driven transects in Whatcom County.

**Appendix C.** Data sheets from each transect including fish identifications, habitat assessments, ROV profiles, and bottom profiles.

1 nm = 1852 m

**LISH1**

				Distance		Average latitude	
Transect 1				nautical mi	(m)	Depth (ft)	Depth (m)
Longitude	Latitude			0	0	150	45.72
48	38.415	122	36.591	0.012549	23.24016	105	32.004
48	38.419	122	36.573	0.012442	23.04168	88.8	27.06624
48	38.424	122	36.578	0.023816	44.10666	60	18.288
48	38.436	122	36.574				
Depth start	29						
Depth stop	5	Transect length (m)		slope	0.623433	(m/m)	
Change	24	45.36499689		angle	0.557472	radians	
					31.94077	degrees	
Avg width (m)	Transect area (m2)		Total Rockfish			Rockfish/m^2)	
1.285	58.294021		5			0.085772	

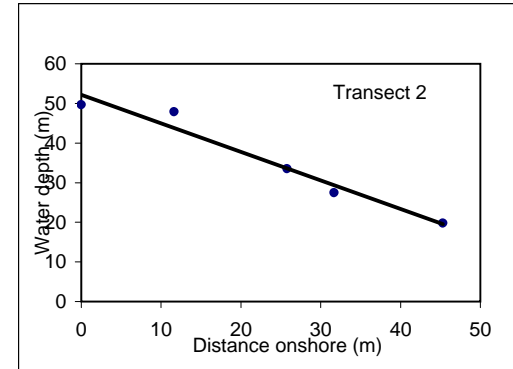


Transect 1									
Observation	Screen width a (cm)	Distance between dots l (cm)	Distance between L (cm)	Width of video A (cm)	depth (m)	Puget #	Sour #	Copper #	Ro Black #
1	25.7	3	10	85.66667	24.4	2	1		
2	25.7	2	10	128.5	19.5			1	
3	25.7	1.5	10	171.3333	15			1	
Average screen width (cm)=				128.5					

**BOTTOM HABITAT**

Rocky habitat with abundant boulders

LISH2				Distance		Average latitude	
Transect 2	Longitude	Latitude	Longitude	nautical mi	(m)	Depth (ft)	Depth (m)
48	38.53	122	36.779	0	0	163	49.6824
48	38.532	122	36.77	0.006274	11.62008	157	47.8536
48	38.536	122	36.76	0.013915	25.77042	110	33.528
48	38.539	122	36.757	0.017098	31.66491	90	27.432
48	38.546	122	36.751	0.024461	45.30104	65	19.812
Depth start	38						
Depth stop	5	Transect length (m)				slope	0.720142 (m/m)
Change	33	56.47003906				angle	0.624117 radians
							35.75925 degrees
Avg width (m)		Transect area (m2)		Total Rockfish			Rockfish/m^2)
0.895931		50.59323347		10			0.197655

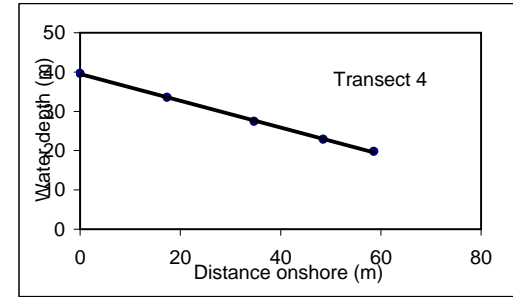


Transect 2	Screen width	Distance between dots	Distance between lasers	Width of video	Puget Sou	Copper Ro	Black Rockfish
Observatio	a (cm)	l (cm)	L (cm)	A (cm)	depth (m)	#	#
1	25.7		2	10	128.5	37.8	1
2	25.7		2	10	128.5	36.5	
3	25.7		3	10	85.66667	35.3	3
4	25.7		4	10	64.25	34.8	1
5	25.7		4	10	64.25	34.2	1
6	25.7		4.5	10	57.11111	33.1	1
7	25.7		2.5	10	102.8	30.8	1
8	25.7		3	10	85.66667	17.6	1
Average screen width (cm)=				89.59306			

#### BOTTOM HABITAT

Rocky habitat with abundant boulders

LISH4				Average latitude		
Transect 4	Longitude	Latitude	Distance nautical mi	Distance (m)	Depth (m)	Depth (m)
48	38.794	122	37.129	0	130	39.624
48	38.803	122	37.125	0.00938	110	33.528
48	38.811	122	37.117	0.018758	90	27.432
48	38.817	122	37.11	0.026204	75	22.86
48	38.821	122	37.104	0.031653	65	19.812
Depth start	27					
Depth stop	6	Transect length (m)		slope	0.339807 (m/m)	
Change	21	65.27027239		angle	0.327566 radians	
					18.76813 degrees	
Avg width (m)		Transect area (m2)				
?		#VALUE!				



Total area surveyed  
#VALUE!

Transect 4	Screen width	Distance between dots	Distance between lasers	Width of video	Puget Sound	Copper	Black Rockfish
Observation	(cm)	(cm)	(cm)	(cm)	#	#	#
	25.7			10	#DIV/0!	9.7	
	25.7			10	#DIV/0!	10.2	

BOTTOM HABITAT

Few boulders

Average screen width (cm)=

#DIV/0!

What was the average distance between laser dots?

Average screen width (cm)=

#DIV/0!

Location: Lummi Island Trip C    Transect: #1  
 Start GPS: 48° 38.812' N    Date: 5/29/2008  
                   122° 37.147' W    Time: 11:00  
 Video Start Title 1 00:00    Visibility: fair  
 Video End: Title 1 02:40    Depth Range 21.3 - 7.7  
                   Substrate Types: 3 = Rocky, 2 = Cobble, 1 = Gravel, 0 = Sand or Mud

Notes: Shull #4 moderate "marine snow" \* Cable teather malfunction aborted dive at 2:40

Habitat		screen: 40.5cm		
Disc Location	Elapsed Time (min.)	Depth (m)	Habitat	Lasers (cm)
	0	0	21.3	0
	1	1	13.6	0
	2	2	11.6	0
2:39	2:39	7.7	0	3.6

Disc Location	Depth (m)	Fish Observed	Length (cm)
1:28	12.4	unidentified small	n/a
1:57	12	sculpin	25

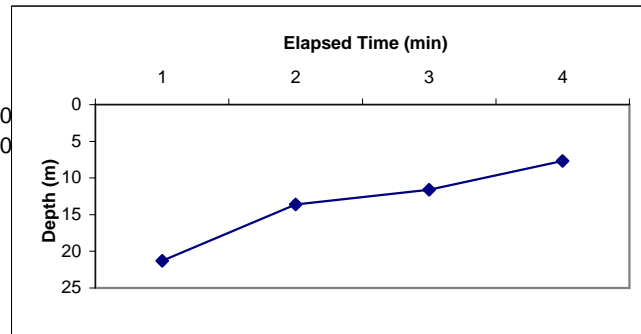
**Summary**

Target Species    #

**Habitat Summary**

**Habitat Complexity:**  
**% Rock Bottom:**

Estimated transect area  
 53.60297719 m<sup>2</sup>

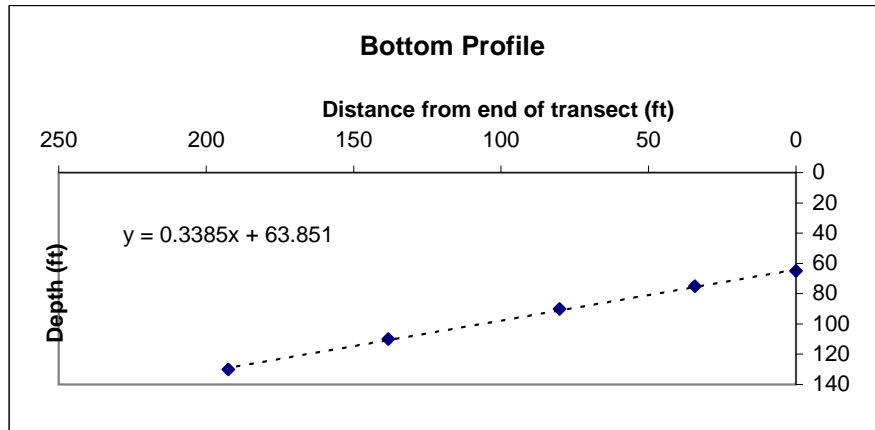


**Bottom Slope**

	Latitude	Longitude	Depth	Distance (ft)
48°	38.821	122°	37.104	65
48°	38.817	122°	37.11	75
48°	38.811	122°	37.117	90
48°	38.803	122°	37.125	110
48°	38.794	122°	37.129	130

Slope    0.33853355  
           0.32642342  
           18.7026844 degrees

**Bottom Profile**



Location: Lummi Island Trip C    Transect: #2  
 Start GPS: 48° 38.815' N    Date: 5/29/2008  
                   122° 37.161' W    Time: 11:10  
 Video Start Title 2 00:00    Visibility: fair  
 Video End: Title 2 07:34    Depth Range 37 - 13.8  
 Substrate Types: 3 = Rocky, 2 = Cobble, 1 = Gravel, 0 = Sand or Mud

Notes: Shull # 4 Moderate "marine snow"

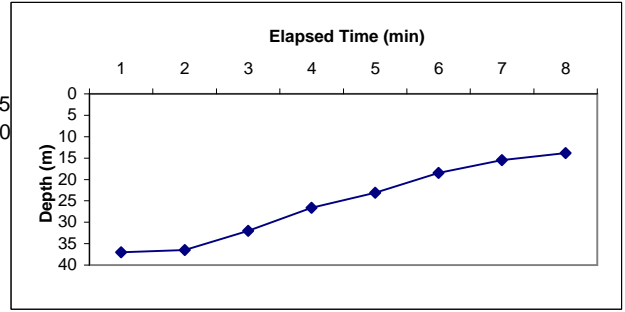
Habitat		screen: 40.5cm			
Disc Location	Elapsed Time (min.)	Depth (m)	Habitat	Lasers (cm)	
	0:20	0	37	0	2.5
	1	1	36.5	0	4.5
	2	2	32	0	4.7
	3	3	26.6	0.5	9.7
	4	4	23.1	0	3.3
	5	5	18.5	0	11.8
	6	6	15.5	0	5
	7	7	13.8	0	3

Disc Location	Depth (m)	Fish Observed	Length (cm)
2:08	31.6	Flatfish	15
4:57	18.5	goby	18
5:26	17.1	sculpin	28

Estimated transect area  
45.53241658 m<sup>2</sup>

**Summary**  
Target Species    #

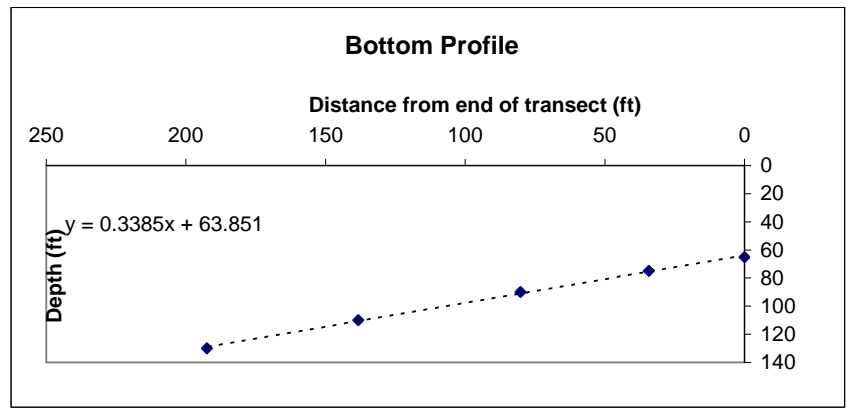
**Habitat Summary**  
Habitat Complexity: 0.0625  
% Rock Bottom: 0



**Bottom Slope**

Latitude	Longitude	Depth	Distance (ft)
48°	38.821 122°	37.104	65
48°	38.817 122°	37.11	75
48°	38.811 122°	37.117	90
48°	38.803 122°	37.125	110
48°	38.794 122°	37.129	130

Slope    0.33853355  
           0.32642342  
           18.7026844 degrees



Location: Lummi Island Trip C    Transect: #3  
 Start GPS: 48° 38.540' N    Date: 5/29/2008  
                   122° 36.770' W    Time: 11:20  
 Video Start Title 3 00:00    Visibility: fair    Notes: Shull #2  
 Video End: Title 3 05:36    Depth Range: 36.1 - surface  
 Substrate Types: 3 = Rocky, 2 = Cobble, 1 = Gravel, 0 = Sand or Mud

Habitat		screen: 40.5cm		
Disc Location	Elapsed Time (min.)	Depth (m)	Habitat	Lasers (cm)
	0	0	36	3
	1	1	33.3	3
	2	2	27.7	3
	3	3	21.5	3
	4	4	15.2	3
	5	5	8.2	3

Disc Location	Depth (m)	Fish Observed	Length (cm)
0:06	36.1	PS Rockfish	8
0:26	35.7	2 PS Rockfish	n/a
1:06	32.8	PS Rockfish	n/a
1:30	30.5	Whitespotted or Kelp?	60
1:55	28.5	PS Rockfish	8
2:15	26.1	4 PS Rockfish	n/a
2:28	25.2	Blackeye Goby	n/a
2:40	24	2 PS Rockfish	n/a
3:00	21.5	Copper Rockfish	n/a
3:26	19.1	*nearby juvenile kelp greeling	6
3:36	17.8	Blackeye Goby	8
3:34	17.4	PS Rockfish	n/a
3:47	16.9	Copper Rockfish	30
4:07	14.9	PS Rockfish	6

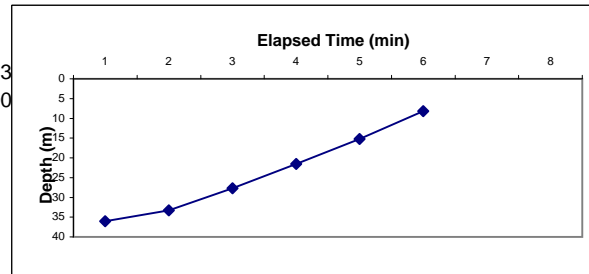
Total Rockfish: 16    Rockfish/min: 4    Rockfish/m^2: 0.320503  
 Estimated transect area: 49.92145864 m^2

**Summary**

Target Species	#
PS Rockfish	14
Copper Rockfish	2

**Habitat Summary**

Habitat Complexity:  
 % Rock Bottom:

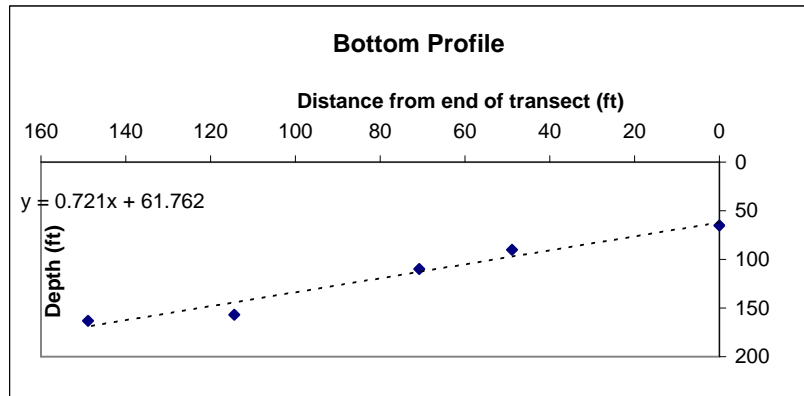


**Bottom Slope**

Latitude	Longitude	Depth	Distance (ft)
48° 38.546	122° 36.751	65	0
48° 38.539	122° 36.757	90	48.92444
48° 38.536	122° 36.76	110	70.76145
48° 38.532	122° 36.77	157	114.4466
48° 38.53	122° 36.779	163	148.9356

Slope: 0.72099672  
 0.62467917  
 35.7914801 degrees

**Bottom Profile**



Location: Lummi Island Trip C    Transect: #4  
 Start GPS: 48° 38.408' N    Date: 5/29/2008  
                   122° 36.571' W    Time: 11:35  
 Video Start Title 4 01:00    Visibility: fair to poor  
 Video End: Title 4 07:15    Depth Range: 38.1 - surface  
                   Substrate Types: 3 = Rocky, 2 = Cobble, 1 = Gravel, 0 = Sand or Mud

Notes: Shull #1

Habitat		screen: 40.5cm		
Disc Location	Elapsed Time (min.)	Depth (m)	Habitat	Lasers (cm)
1	0	38.1	3	3.7
2	1	32.3	3	4.2
3	2	24.9	3	4.6
4	3	18.1	3	7
5	4	15.2	3	4
6	5	11.2	3	12
7	6	2.2	1	n/a

Disc Location	Depth (m)	Fish Observed	Length (cm)
2:24	29	Gunnel	10
		2 unidentified small (possibly black rockfish)	8
2:48	26.4	3 PS Rockfish	7
3:12	23.2	Copper Rockfish	46
3:23	22.9	PS Rockfish	12
4:13	16.5	Copper Rockfish	30
		2 PS Rockfish	15
4:44	15.2	2 Copper Rockfish	28
5:14	14.8	PS Rockfish	12
5:44	12.6	PS Rockfish	7
5:54	11.3	PS Rockfish	6

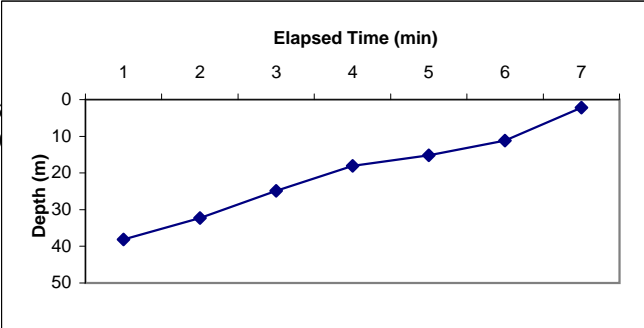
Total Rockfish Rockfish/min    Rockfish/m<sup>2</sup>  
 13    2.166666667    0.36675  
 Estimated transect area  
 35.44647506 m<sup>2</sup>

**Summary**

Target Species	#
PS Rockfish	9
Copper Rockfish	4

**Habitat Summary**

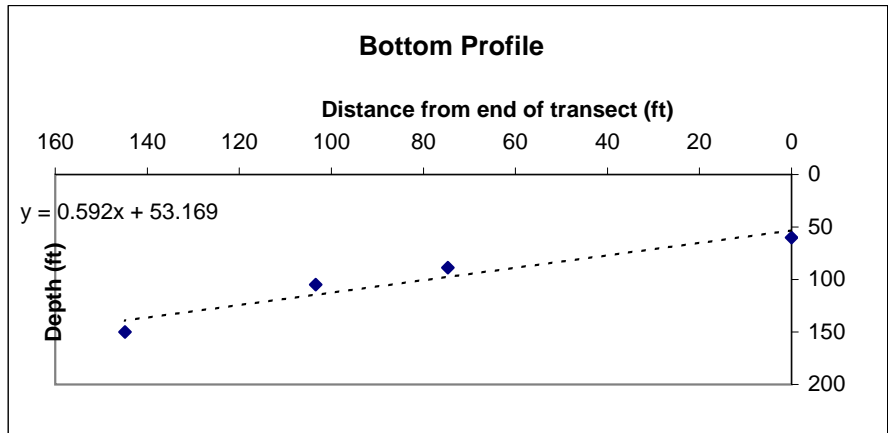
Habitat Complexity: 2.714286  
 % Rock Bottom: 90



**Bottom Slope**

Latitude	Longitude	Depth	Distance (ft)
48° 38.436	122° 36.574	60	0
48° 38.424	122° 36.578	88.8	74.67387
48° 38.419	122° 36.573	105	103.3725
48° 38.415	122° 36.591	150	144.8256

Slope    0.59195538  
           0.53448334  
           30.6236398 degrees



Location: Lummi Island Trip C    Transect: #5  
 Start GPS: 48° 38.696' N    Date: 5/29/2008  
                   122° 37.028' W    Time: 12:00  
 Video Start Title 5 00:00    Visibility: fair  
 Video End: Title 5 12:25    Depth Range 48.1 - surface  
 Substrate Types: 3 = Rocky, 2 = Cobble, 1 = Gravel, 0 = Sand or Mud

Notes: derelict net @48 m

Habitat		screen: 40.5cm		
Disc Location	Elapsed Time (min.)	Depth (m)	Habitat	Lasers (cm)
0	0	48.1	3	7
1	1	47.9	2	6
2	2	47.8	2	4.2
3	3	44.9	2	3.5
4	4	42.7	2	6.5
5	5	39.1	2.5	4
6	6	35.2	3	4.5
7	7	30.5	3	7
8	8	26.7	3	6
9	9	22.1	3	6.5
10	10	18.1	2.5	2.6
11	11	12.6	2.5	4.5
12	12	1.8	2	n/a
Total Rockfish		Rockfish/min	Rockfish/m <sup>2</sup>	
21		1.75	0.32197	
Estimated transect area				
65.22350232 m <sup>2</sup>				

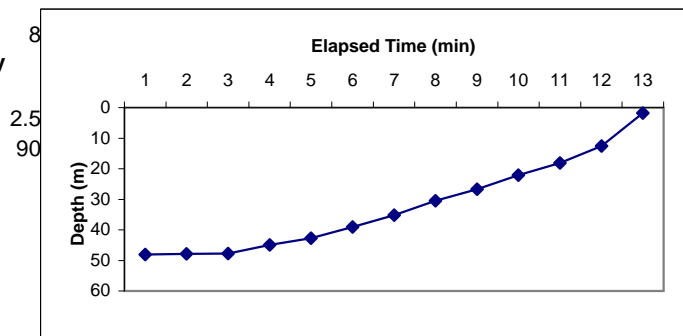
Disc Location	Depth (m)	Fish Observed	Length (cm)
0:16 Derelict net (large)	48.1		
3:31	44.1	Kelp Greenling (f)	30
5:26	37.9	Copper Rockfish	25
6:45	31.2	Kelp Greenling (f)	30
6:57	30.8	Copper Rockfish	25
7:54	26.5	Copper Rockfish	20
8:19	25.1	4 PS Rockfish	n/a
8:21	25	Copper Rockfish	20
8:42	23.7	Kelp Greenling (m)	30
8:47	23.6	PS Rockfish	n/a
9:08 small school	21.2	6 PS Rockfish	n/a
9:31 small school	20.1	5 PS Rockfish	n/a
10:29	15.8	PS Rockfish	

**Summary**

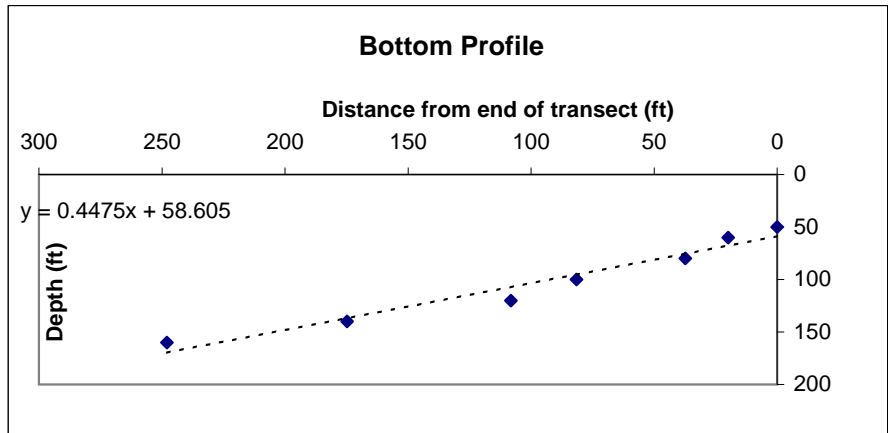
Target Species	#
PS Rockfish	17
Copper Rockfish	4

**Habitat Summary**

Habitat Complexity:  
 % Rock Bottom:



Bottom Slope				
Latitude	Longitude	Depth	Distance (ft)	
48°	38.733 122°	37.002	50	0
48°	38.73 122°	37	60	19.93027
48°	38.727 122°	37	80	37.33676
48°	38.72 122°	37.007	100	81.51833
48°	38.716 122°	37.01	120	108.2069
48°	38.706 122°	37.017	140	174.8347
48°	38.696 122°	37.028	160	248.0282
Slope		0.44750771		
		0.4207794		
		24.1088839 degrees		



Location: Lummi Island Trip C    Transect: #6  
 Start GPS: 48° 38.613' N    Date: 5/29/2008  
                   122° 36.888' W    Time: 12:30  
 Video Start Title 6 00:00    Visibility: fair  
 Video End: Title 6 06:32    Depth Range 50.1 - surface  
 Substrate Types: 3 = Rocky, 2 = Cobble, 1 = Gravel, 0 = Sand or Mud

Habitat		screen: 40.5cm		
Disc Location	Elapsed Time (min.)	Depth (m)	Habitat	Lasers (cm)
0		50.3	2.5	7.6
1		47.7	3	5.2
2		42.5	3	4.5
3		31.9	3	4
4		25.6	3	4.2
5		17.1	3	6
6		11.2	3	4.4

Disc Location	Depth (m)	Fish Observed	Length (cm)
1:17	46.2	Quillback Rockfish	20
1:32	45.2	Quillback Rockfish	18
1:56	42.7	PS Rockfish	12
3:41	26.4	Yelloweye Rockfish	10
4:32	20.5	2 Copper Rockfish	30
4:53	18.9	Copper Rockfish	25
5:27	16	Copper Rockfish	28

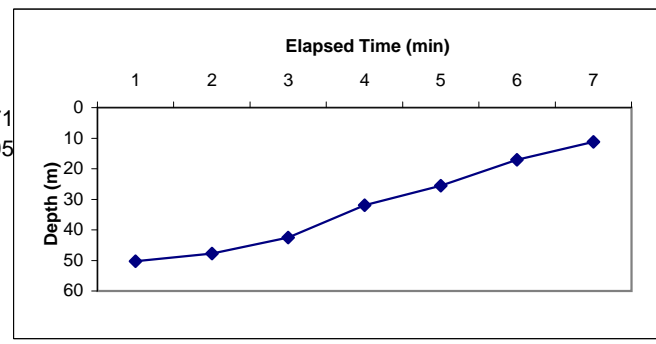
Total Rockfish Rockfish/min    Rockfish/m<sup>2</sup>  
 8    1.333333333    0.168077  
 Estimated transect area  
 47.59714932 m<sup>2</sup>

**Summary**

Target Species	#
Quillback Rockfish	2
PS Rockfish	1
Yelloweye Rockfish	1
Copper Rockfish	4

**Habitat Summary**

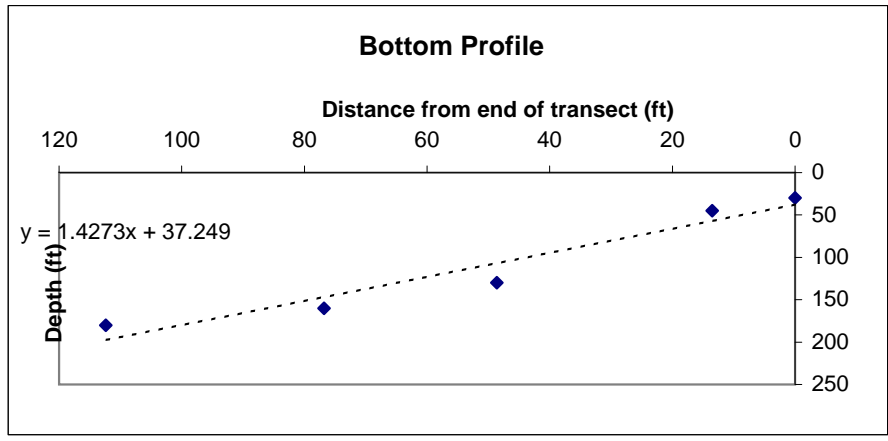
Habitat Complexity: 2.928571  
 % Rock Bottom: 95



**Bottom Slope**

Latitude	Longitude	Depth	Distance (ft)
48° 38.63 122°		36.877	30
48° 38.629 122°		36.874	45
48° 38.622 122°		36.877	130
48° 38.618 122°		36.883	160
48° 38.613 122°		36.888	180

Slope    1.42727102  
 0.95964245  
 54.9834622 degrees



Location: Lummi Island Trip C    Transect: #7  
 Start GPS: 48° 39.164' N    Date: 5/29/2008  
                   122° 38.331' W    Time: 13:00  
 Video Start Title 7 00:00    Visibility: fair to poor  
 Video End: Title 7 08:35    Depth Range 40.7 - 21.5  
                   Substrate Types: 3 = Rocky, 2 = Cobble, 1 = Gravel, 0 = Sand or Mud

Notes: tons of prawns following ROV, school of herring. Dive ended due to boat drag.

Habitat		screen: 40.5cm			
Disc Location	Elapsed Time (min.)	Depth (m)	Habitat	Lasers (cm)	
0		40.7	1.5	6	
1		39.8	1.5	6	
2		36.8	1.5	6.5	
3		34.1	2.5	7.5	
4		31.8	2.5	6.5	
5		28.7	2.5	6	
6		24.9	2.5	5	
7		22.3	2	5	
8		21.9	2	4	

Disc Location	Depth (m)	Fish Observed	Length (cm)
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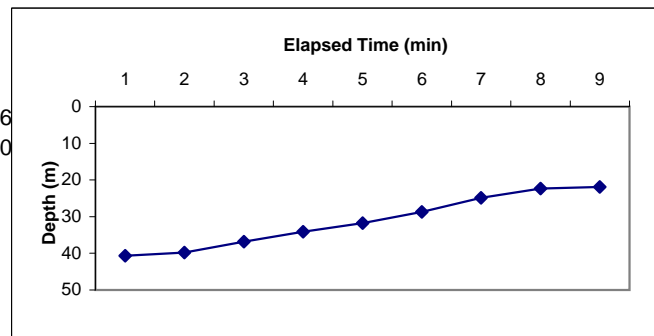
Estimated transect area  
71.9178746 m<sup>2</sup>

**Summary**

Target Species	#
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**Habitat Summary**

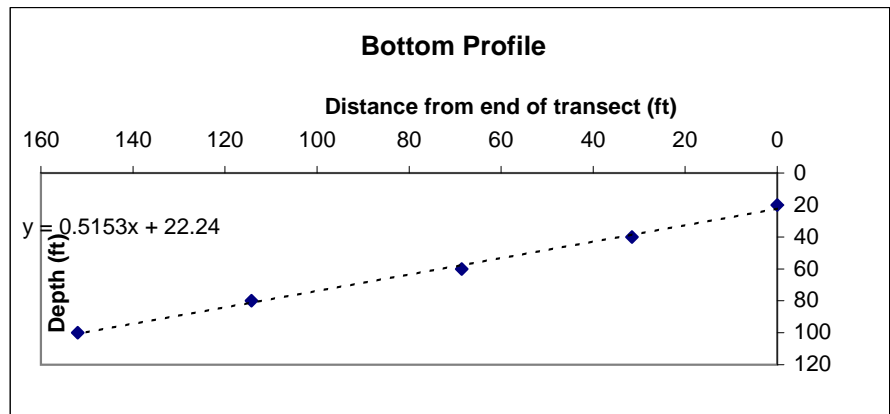
Habitat Complexity: 2.055556  
% Rock Bottom: 50



**Bottom Slope**

Latitude	Longitude	Depth	Distance (ft)
48°	39.203 122°	38.279	20
48°	39.199 122°	38.284	40
48°	39.195 122°	38.291	60
48°	39.192 122°	38.302	80
48°	39.187 122°	38.308	100
48°	39.182 122°	38.316	120
48°	39.177 122°	38.321	130
48°	39.164 122°	38.331	140

Slope  
0.36450359  
0.34953673  
20.0269796 degrees



Location: Lummi Island Trip C    Transect: #8  
 Start GPS: 48° 40.309' N    Date: 5/29/2008  
                   122° 39.708' W    Time: 13:30  
 Video Start Title 1 00:40    Visibility: fair to poor  
 Video End: Title 1 07:35    Depth Range 46.3 - surface  
                   Substrate Types: 3 = Rocky, 2 = Cobble, 1 = Gravel, 0 = Sand or Mud

Habitat		screen: 40.5cm			
Disc Location	Elapsed Time (min.)	Depth (m)	Habitat	Lasers (cm)	
0:40	1	46.3	1.5	6	
2	2	42.1	1	3.5	
3	3	37.3	3	7	
4	4	29.1	2.5	4	
5	5	22.2	3	9	
6	6	13.7	2.5	3.3	

Disc Location	Depth (m)	Fish Observed	Length (cm)
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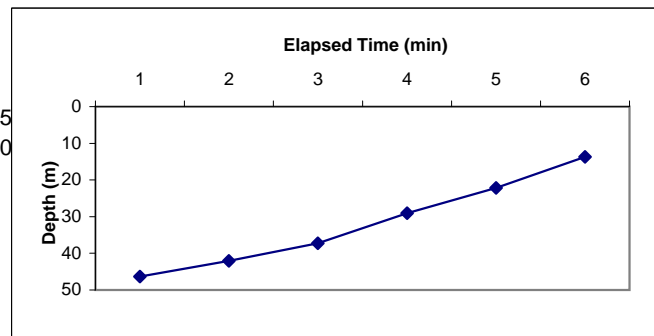
Estimated transect area  
 73.56377866 m<sup>2</sup>

**Summary**

Target Species    #

**Habitat Summary**

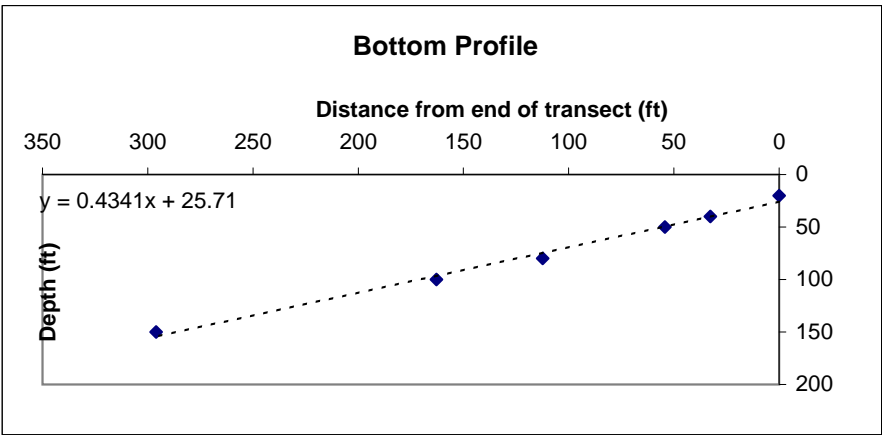
Habitat Complexity: 2.25  
 % Rock Bottom: 40



**Bottom Slope**

Latitude	Longitude	Depth	Distance (ft)
48° 40.347 122°	39.662	20	0
48° 40.342 122°	39.665	40	32.69474
48° 40.339 122°	39.668	50	54.28346
48° 40.33 122°	39.673	80	112.3926
48° 40.323 122°	39.68	100	162.8505
48° 40.309 122°	39.708	150	296.0242

Slope    0.43409099  
 0.40954553  
 23.4652305 degrees



Location: Lummi Island Trip C    Transect: #9  
 Start GPS: 48° 40.958' N    Date: 5/29/2008  
                   122° 40.775' W    Time: 13:45  
 Video Start Title 2 00:00    Visibility: fair  
 Video End: Title 2 07:00    Depth Range 27.4 - 11.1  
                   Substrate Types: 3 = Rocky, 2 = Cobble, 1 = Gravel, 0 = Sand or Mud

Notes: dive ended due to boat drag

Habitat		screen: 40.5cm		
Disc Location	Elapsed Time (min.)	Depth (m)	Habitat	Lasers (cm)
0	0	27.4	2	5
1	1	25.5	2	8
2	2	21.5	2	5
3	3	17.3	2	3
4	4	15.6	1	3
5	5	14.3	1	4
6	6	13.4	1	12

Disc Location	Depth (m)	Fish Observed	Length (cm)
6:05	13.4	Sculpin	20

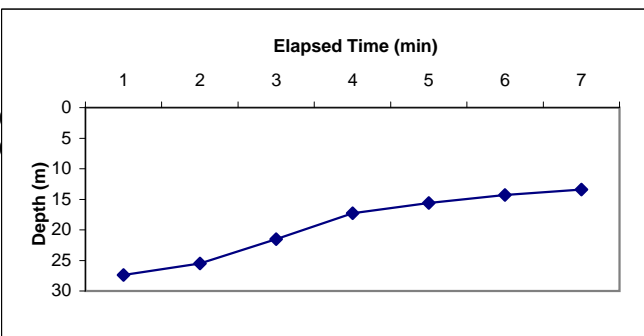
Estimated transect area  
72.19257826 m<sup>2</sup>

**Summary**

Target Species	#

**Habitat Summary**

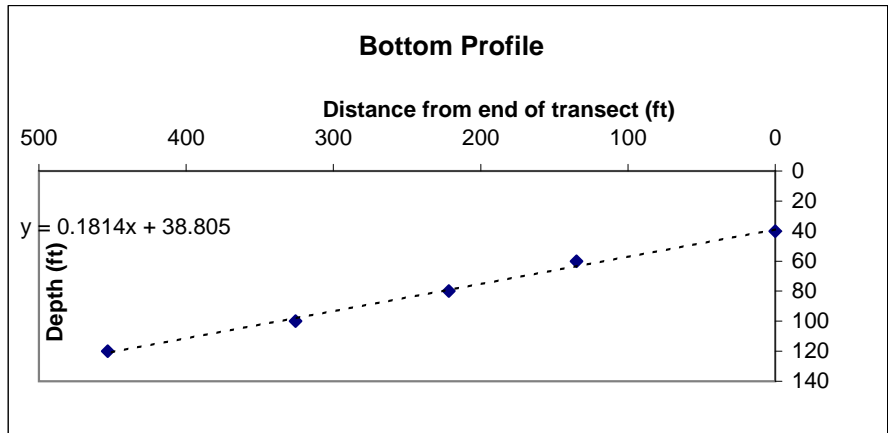
Habitat Complexity: 1.571429  
% Rock Bottom: 0



**Bottom Slope**

Latitude	Longitude	Depth	Distance (ft)
48°	41.001 122°	40.683	40
48°	40.987 122°	40.709	60
48°	40.98 122°	40.728	80
48°	40.97 122°	40.749	100
48°	40.958 122°	40.775	120

Slope            0.1813931  
                     0.17944199  
                     10.2812685 degrees



3 end Lummi Island, June 21, 2007 8:56am  
 DVD 1, Track 1

LIS1

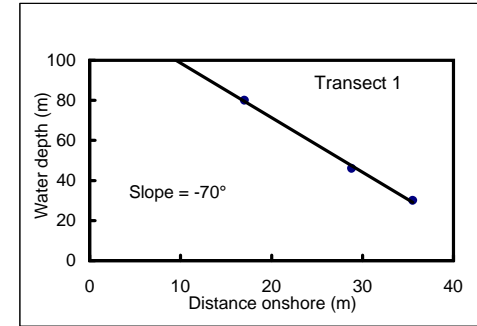
Frame	Screen width a (cm)	Distance between dots l (cm)	Distance between lasers L (cm)	Width of video A (cm)
1	30.5	2.6	10	117.3077
2	30.5	1.45	10	210.3448
3	30.5	1.05	10	290.4762
4	30.5	3.9	10	78.20513
5	30.5	1.95	10	156.4103
6	30.5	1.65	10	184.8485
7	30.5	2.95	10	103.3898
8	30.5	2.6	10	117.3077
9	30.5	2.85	10	107.0175
10	30.5	3.9	10	78.20513
11	52	6.25	10	83.2
12	52	11.25	10	46.22222
13	52	4.6	10	113.0435
14	52	6	10	86.66667
15	52	4.75	10	109.4737
16	52	2.7	10	192.5926
17	52	3.35	10	155.2239
18	52	3	10	173.3333
19	52	3.1	10	167.7419
20	52	2.95	10	176.2712
21	52	4.8	10	108.3333
22	52	4	10	130
23	52	6.25	10	83.2
24	52	4.35	10	119.5402
25	52	3	10	173.3333
26	52	2.95	10	176.2712
27	52	2.2	10	236.3636
28	52	2.9	10	179.3103
29	52	3.6	10	144.4444
30	52	9.8	10	53.06122
31	52	1	10	520
32	52	14.85	10	35.01684
33	52	16.65	10	31.23123
34	52	7.25	10	71.72414
35	52	5	10	104
36	52	2.4	10	216.6667
37	52	8.4	10	61.90476
38	52	6.3	10	82.53968

Average screen width (cm)= 138.7953

depth (m)	Time on DVD (min)
23.2	7:26
31.2	7:04
29.7	7:52
29.6	8:06
28.3	8:16
27.4	8:23
26.6	8:31
25.9	8:36
25.2	8:44
24.7	8:48
24.1	8:54
23.8	8:58
23.5	9:00
23.1	9:04
22.6	9:08
21.9	9:11
21.1	9:17
20.8	9:23
19.7	9:29
19	9:32
17.3	9:46
16.6	9:52
15.6	10:01
14.9	10:08
13.3	10:19
12.4	10:25
10	10:42
8.2	10:54
8.2	10:56
8.2	10:58
7.7	11:00
7.5	11:02
6.9	11:05
6.3	11:08
5	11:14
1.3	11:21
4	11:23

**FISH ABUNDANCE**

Depth (m)	Number of Species of fish
29.5	1 PSRF
29.3	3 PSRF
28.7	2 PSRF
28.4	1 PSRF
27.6	3 PSRF
27.5	2 PSRF
27.2	2 PSRF
26.9	1 PSRF
26.3	1 PSRF
23.1	1 PSRF
22.4	1 PSRF
22.3	2 PSRF
21.8	2 PSRF
22.1	1 PSRF
19.3	2 PSRF



**Total Fish Counted: 24**

Possible Fish:

29.5	1	These two are hard to see in the shadows on the right side
28.9	1	On the right
28	1	On the right
14.4	1	Swims out from the sand, I could not see the markings.

**Possible Fish: 4**

**BOTTOM HABITAT** Rocky habitat with abundant boulders

1 nm = 1852 m

Transect 1 Longitude	Latitude	Distance nautical mi (m)	Depth (m)
48	38.411	122	36.573
48	38.415	122	36.568
48	38.418	122	36.564
48	38.423	122	36.558
48	38.427	122	36.557

Distance nautical mi (m)	Depth (m)	Average latitude
0	0	48.64031
0.005188	9.608273	
0.009185	17.01095	80
0.015564	28.82482	46
0.019178	35.51683	30

depth change	Transect length (m)
27	28.7643

slope	2.722073 (m/m)
angle	1.218734 radians
	69.82833 degrees

Avg width (m)	Transect area (m2)
1.33	38.25652

Total Rockfish	Rockfish/m^2)
24	0.627344

North of Southern Tip of Lummi Island June 21, 2007 9:25am  
 DVD 1, Track 2

LIS2

Frame	Screen width a (cm)	Distance between dots l (cm)	Distance between lasers L (cm)	Width of video A (cm)	depth (m)	Time on DVD (min)
1	52	5.1	10	101.9608	51.2	4:23
2	52	6.4	10	81.25	50.2	4:32
3	52	8.45	10	61.53846	50.3	4:34
4	52	4.3	10	120.9302	49.8	4:38
5	52	4	10	130	49.1	4:43
6	52	9.4	10	55.31915	48.8	4:45
7	52	2.05	10	253.6585	48.2	4:05
8	52	1.9	10	273.6842	47.9	4:52
9	52	4.35	10	119.5402	47.4	4:56
10	52	4.05	10	128.3951	47.4	4:59
11	52	5.05	10	102.9703	46.6	5:02
12	52	2.6	10	200	46	5:06
13	52	3.5	10	148.5714	45.3	5:01
14	52	3.5	10	148.5714	44.9	5:13
15	52	4.4	10	118.1818	44.6	5:15
16	52	8.25	10	63.0303	44.2	5:17
17	52	4.65	10	111.828	43.7	5:02
18	52	2.35	10	221.2766	43.2	5:22
19	52	2.6	10	200	42.7	5:24
20	52	4.4	10	118.1818	42.5	5:28
21	52	5.1	10	101.9608	42.1	5:31
22	52	5	10	104	41.6	5:33
23	52	6.75	10	77.03704	40.8	5:38

This set of data was cut short by a skip in the DVD, the last 2.5 minutes of sample was not viewable.

Average screen width (cm)= 132.2559

depth change  
45

Transect length  
70.68831

slope 0.825468 (m/m)  
 angle 0.690078 radians  
 39.53857 degrees

Avg width (m)  
1.28

Trasect area (m2)  
90.48103

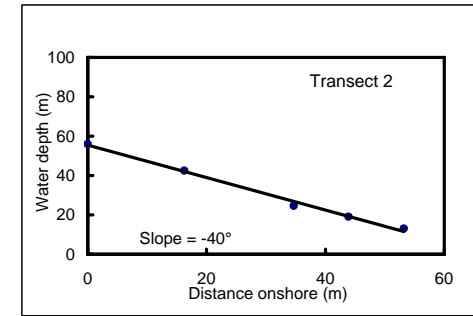
Total Rockfish 6  
 Rockfish/m^2 0.066312

**FISH ABUNDANCE**

Depth (m)	Number of Fish Counted:	Species of fish
50.2	1	Copper RF
50.2	1	PSRF
45.2	1	PSRF
44.9	1	PSRF
42.5	1	PSRF
40.1	2	PSRF
<b>Total Fish Counted: 6</b>		
Possible Fish:		
50.2	1	Can not see markings
<b>Possible Fish: 1</b>		

**BOTTOM HABITAT** Abundant boulders with some small vegetation and sediment

Transect 2 Longitude	Latitude	Distance nautical mi.	Distance (m)	Depth (m)	Average latitude
48	38.522	122	36.772	56	48.64224
48	38.529	122	36.764	42.4	
48	38.537	122	36.755	24.6	
48	38.539	122	36.747	19	
48	38.544	122	36.744	13	



Location: Point Roberts	Transect: #1	Notes: sandy with 2' boulders, current still present
Start GPS: 48° 57.657' N	Date: 3/18/2008	
122° 59.944' W	Time: 11:30	
Video Start: Ch 1 01:22 Title 2	Visibility: low	
Video End: Ch 1 16:20 Title 2	Depth Range 11 - 12.3	
Substrate Types: 3 = Rocky, 2 = Cobble, 1 = Gravel, 0 = Sand or Mud		

Habitat				
Disc Location	Elapsed Time (min.)	Depth (m)	Habitat	
	1:30	1	11.7	2.5
	2:30	2	11.1	2.5
	3:30	3	11.4	2.5
	4:30	4	12.3	2.5
	5:30	5	11.4	2
	6:30	6	11.6	2.5
	7:30	7	11.9	2.5
	8:30	8	11.8	2.5
	9:30	9	11.2	2.5
	10:30	10	11.6	2.5
	11:30	11	12	2.5
	12:30	12	11	2
	13:30	13	11.6	2.5
	14:30	14	11.5	2.5
	15:30	15	11.5	2.5

Disc Location	Depth (m)	Fish Observed	Length (cm)
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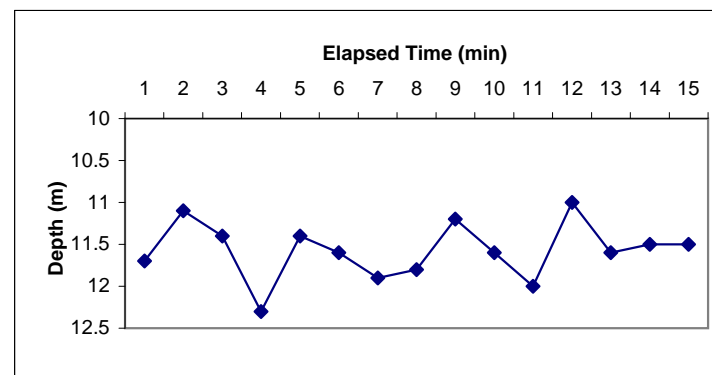
### Summary

Target Species	#
	0

### Habitat Summary

Habitat Complexity:	2.433333
% Rock Bottom:	25%

\*Estimate, all 1' to 3' boulders were spread out in sand.



Location: Point Roberts	Transect: #2	Notes: sandy with cobbles, current present
Start GPS: 48° 57.718' N	Date: 3/18/2008	
123° 00.834' W	Time: 12:00	
Video Start: Ch 2 23:28 Title 2	Visibility: low	
Video End: Ch2 32:45 Title 2	Depth Range 11 - 13.8	
Substrate Types: 3 = Rocky, 2 = Cobble, 1 = Gravel, 0 = Sand or Mud		

Habitat			
Disc Location	Elapsed Time (min.)	Depth (m)	Habitat
Ch 2 23:30	1	13.3	2
Ch 2 24:30	2	13.8	1.5
Ch 2 25:30	3	13.5	1.5
Ch 2 26:30	4	13	1.5
Ch 2 27:30	5	12.4	2
Ch 2 28:30	6	12.1	1.5
Ch 2 29:30	7	12.3	1.5
Ch 2 30:30	8	11.5	2
Ch 2 31:30	9	11	2
Ch 2 32:30	10	11.2	1.5

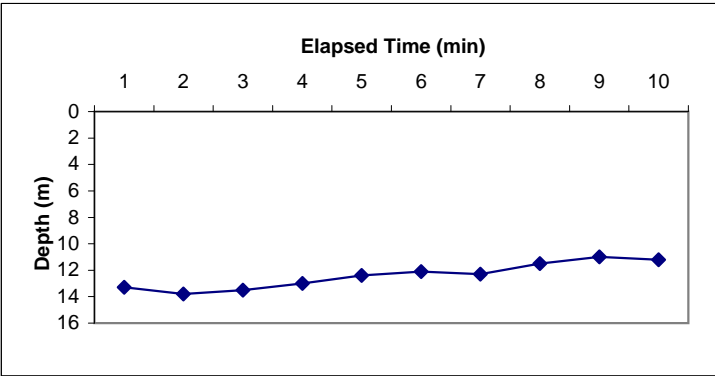
Disc Location	Depth (m)	Fish Observed	Length (cm)
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**Summary**

<b>Target Species</b>	<b>#</b>
	0

**Habitat Summary**

<b>Habitat Complexity:</b>	1.7
<b>% Rock Bottom:</b>	0



Location: Point Roberts	Transect: #3	Notes: sandy with 1' - 3' boulders current still present
Start GPS: 48° 56.985' N	Date: 3/18/2008	
122° 58.831' W	Time: 12:30	
Video Start: Ch 1 01:04 Title 3	Visibility: low	
Video End: Ch 1 14:15 Title 3	Depth Range 18.3 - 19.7	
Substrate Types: 3 = Rocky, 2 = Cobble, 1 = Gravel, 0 = Sand or Mud		

Habitat			
Disc Location	Elapsed Time (min.)	Depth (m)	Habitat
Ch 1 01:30	1	18.3	2.5
Ch 1 02:30	2	19.3	2
	3:30	3	19.4
	4:30	4	19.3
	5:30	5	19.7
	6:30	6	19.4
	7:30	7	19
	8:30	8	18.6
* Lost Bottom, Contact			
	10:30	10	18.6
	11:30	11	18.8
	12:30	12	18.6
	13:30	13	18.7

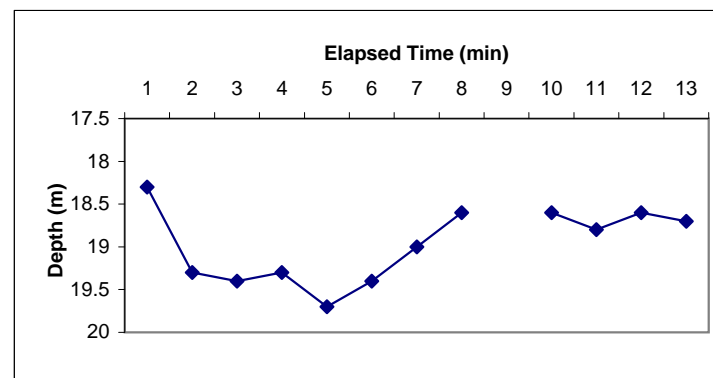
Disc Location	Elapsed Time (min.)	Depth (m)	Fish Observed	Length (cm)
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### Summary

Target Species	#
	0

### Habitat Summary

Habitat Complexity: 2.125  
 % Rock Bottom: 15% \*Estimate, larger boulders spaced out in sand.



Location: Point Roberts	Transect: #4	Notes: moderate "marine snow" and current
Start GPS: 48° 56.333' N	Date: 3/18/2008	
122° 58.141' W	Time: 13:00	
Video Start: Ch 2 18:30 Title 3	Visibility: fair	
Video End: Ch 2 26:26 Title 3	Depth Range 35 - 43.2	
Substrate Types: 3 = Rocky, 2 = Cobble, 1 = Gravel, 0 = Sand or Mud		

Habitat			
Disc Location	Elapsed Time (min.)	Depth (m)	Habitat
Ch 2 18:30	1	43.2	1.5
Ch 2 19:30	2	41.5	1.5
Ch 2 20:30	3	39.9	2
Ch 2 21:30	4	37.9	1.5
Ch 2 22:30	5	37	1.5
Ch 2 23:30	6	37	2
Ch 2 24:30	7	36	2.5
Ch 2 25:30	8	35	2.5

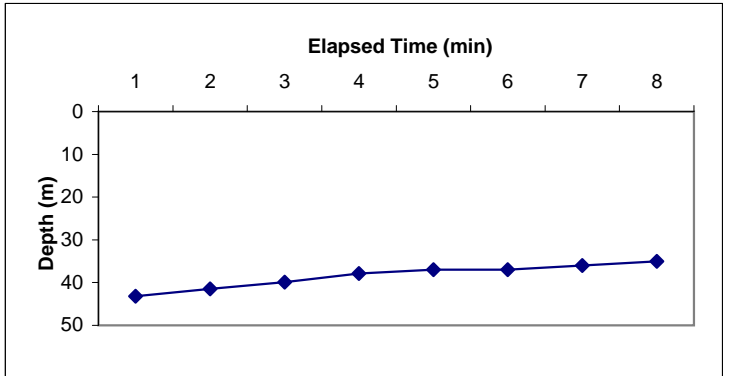
Disc Location	Depth (m)	Fish Observed	Length (cm)
Ch 2 19:15	42.3	Sculpin	20

**Summary**

Target Species	#
	0

**Habitat Summary**

**Habitat Complexity:** 1.875  
**% Rock Bottom:** 10% \* Estimate, 1' to 3' boulders spaced out in sand



Location: Point Roberts	Transect: #5	Notes: moderate "marine snow", heavy current
Start GPS: 48° 55.397' N	Date: 3/18/2008	
122° 56.479' W	Time: 13:30	
Video Start Ch 1 02:51 Title 1	Visibility: low	
Video End: Ch 1 17:20 Title 1	Depth Range 35.4 - 42.7	
Substrate Types: 3 = Rocky, 2 = Cobble, 1 = Gravel, 0 = Sand or Mud		

Habitat			
Disc Location	Elapsed Time (min.)	Depth (m)	Habitat
Ch 1 03:30	1	42.7	2.5
4:30	2	39.7	2.5
5:30	3	36.8	2.5
6:30	4	36.5	3
7:30	5	35.4	3
8:30	6	35.6	3
9:30	7	36.2	2.5
10:30	8	36	3
11:30	9	37.2	1.5
12:30	10	39	2
13:30	11	38.1	2.5
14:30	12	37.7	2.5
15:30	13	38.1	2.5
16:30	14	38.3	2.5

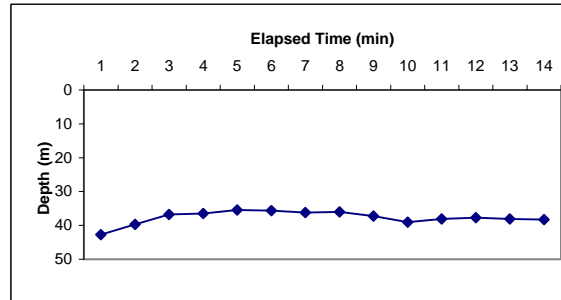
Disc Location	Elapsed Time (min.)	Depth (m)	Fish Observed	Length (cm)
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### Summary

Target Species	#
	0

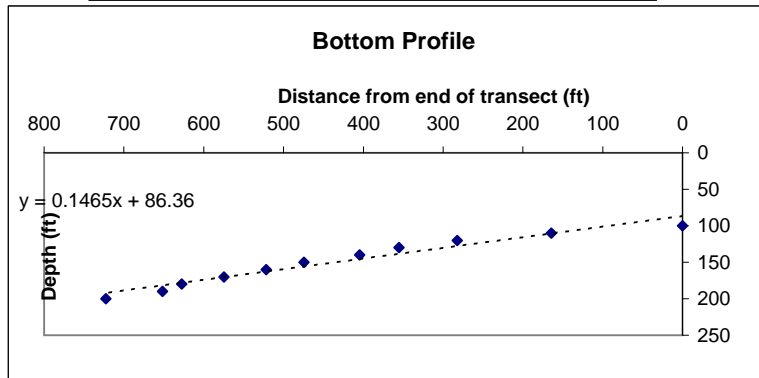
### Habitat Summary

Habitat Complexity: 2.535714  
 % Rock Bottom: 40 \*Estimate, many large boulders but sandy bottom



Bottom Slope				
Latitude	Longitude	Depth	Distance (ft)	
48°	55.441 122°	56.374	100	0
48°	55.428 122°	56.41	110	164.4672
48°	55.412 122°	56.429	120	282.1747
48°	55.402 122°	56.44	130	355.1062
48°	55.395 122°	56.447	140	404.5882
48°	55.386 122°	56.458	150	474.3239
48°	55.379 122°	56.464	160	521.5216
48°	55.372 122°	56.472	170	574.4486
48°	55.365 122°	56.48	180	627.4323
48°	55.362 122°	56.484	190	651.7001
48°	55.354 122°	56.497	200	722.7603

slope 0.14649702  
 0.14546231  
 8.33437624 degrees



Location: Point Roberts	Transect: #6	Notes: heavy "marine snow", wind pushing boat and influencing ROV, sandy bottom with misc. cobbles
Start GPS: 48° 55.590' N	Date: 3/18/2008	
122° 55.555' W	Time: 14:00	
Video Start: Ch 1 05:00 Title 2	Visibility: low	
Video End: Ch 1 13:45 Title 2	Depth Range 33.8 - 43.4	
Substrate Types: 3 = Rocky, 2 = Cobble, 1 = Gravel, 0 = Sand or Mud		

Habitat				
Disc Location	Elapsed Time (min.)	Depth (m)	Habitat	
	5:30	1	43.4	0.5
	6:30	2	42.3	0.5
	7:30	3	40.5	0.5
	8:30	4	38	0.5
	9:30	5	37	0.5
	10:30	6	35.4	0.5
	11:30	7	34	0.5
	12:30	8	33.8	0.5
	13:30	9	34	0.5

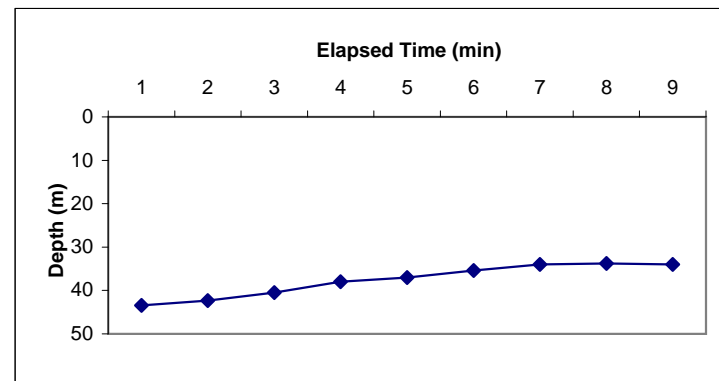
Disc Location	Depth (m)	Fish Observed	Length (cm)
Ch 1 05:05	43.6	Goby	9
5:55	43.4	Goby	10
		Sculpin	20
6:15	43	Goby	8

**Summary**

Target Species	#
	0

**Habitat Summary**

Habitat Complexity:	0.4
% Rock Bottom:	0



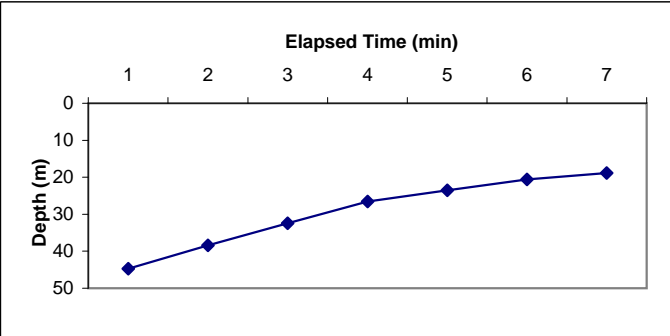
Location: Lummi Island Trip B    Transect: #1 (W rks.)  
 Start GPS: 48° 40.040' N    Date: 3/19/2008  
                   122° 40.040' W    Time: 12:15  
 Video Start: Ch 1 01:10 Title 1    Visibility: fair  
 Video End: Ch 1 08:50 Title 1    Depth Range 58.5' - 145.3'  
                   Substrate Types: 3 = Rocky, 2 = Cobble, 1 = Gravel, 0 = Sand or Mud

Notes: moderate "marine snow", large boulders and rock, no sand below 20m

Disc Location	Elapsed Time (min.)	Depth (m)	Habitat	Lasers (cm)
2	1	44.7	3	3
3	2	38.4	3	4
4	3	32.4	3	4.5
5	4	26.6	3	3.5
6	5	23.5	3	4.7
7	6	20.6	2.5	4
8	7	18.9	2.5	2.5

Disc Location	Depth (m)	Fish Observed	Length (cm)
1:50	45.4	Kelp Greenling (f)	30
2:11	42.5	Lingcod?	40
5:49	24	Kelp Greenling (f)	25
6:25	21.5	Kelp Greenling (?)	30

Estimated transect area  
54.45102868 m^2



**Summary**

Target Species	#
Kelp Greenling	3
Lingcod	1

**Habitat Summary**

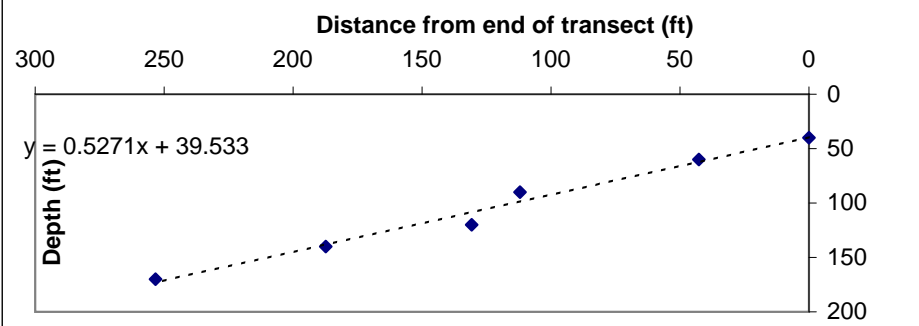
Habitat Complexity: 2.857143  
 % Rock Bottom: 100% \*2.5 or greater

**Bottom Slope**

Latitude	Longitude	Depth	Distance (ft)
48° 40.077 122°	40.069	40	0
48° 40.07 122°	40.068	60	42.72308
48° 40.059 122°	40.063	90	112.008
48° 40.057 122°	40.057	120	130.7806
48° 40.054 122°	40.038	140	187.4011
48° 40.04 122°	40.04	170	253.3472

slope            0.52708802  
                   0.48508245  
                   27.7931774 degrees

**Bottom Profile**



Location: Lummi Island Trip B    Transect: #2 (NW rks.)  
 Start GPS: 48° 40.122' N    Date: 3/19/2008  
 122° 40.135' W    Time: 12:30  
 Video Start: Ch 2 15:44 Title 1    Visibility: fair  
 Video End: Ch 2 29:40 Title 1    Depth Range 44.5' - 210'  
 Substrate Types: 3 = Rocky, 2 = Cobble, 1 = Gravel, 0 = Sand or Mud

Notes: deepest dive (210') large derelict gill net.

Habitat		screen: 40.5cm			
Disc Location	Elapsed Time (min.)	Depth (m)	Habitat	Lasers (cm)	
16	1	63.3	2	5	
17	2	59.6	2	5.1	
18	3	55	2.5	5	
19	4	51.8	2.5	4.5	
20	5	47.6	3	8	
21	6	44.7	3	3.8	
22	7	39.9	3	3.7	
23	8	35.2	2.5	3.3	
24	9	30.5	3	4.5	
25	10	24.1	3	6	
26	11	19.7	3	4	
27	12	17.6	3	4.2	
28	13	18	3	3	
29	14	13.7	3	3.5	

Disc Location	Depth (m)	Fish Observed	Length (cm)
17:37	56.9	unidentified small	10
20:00	47.6	Copper Rockfish	20
		Puget Sound Rockfish	12
20:21 Derelict hand net	46.6		
20:28	46.2	2 Puget Sound Rockfish	10
20:52	44.6	5 unidentified juveniles	10
21:53	40.9	Puget Sound Rockfish	12
22:11	39.7	Copper Rockfish?	20
25:39:00	20.4	Copper Rockfish	20
25:58:00	19.7	Lingcod	35
26:33:00 Derelict gill net	18.7	previous two fish sighted again	

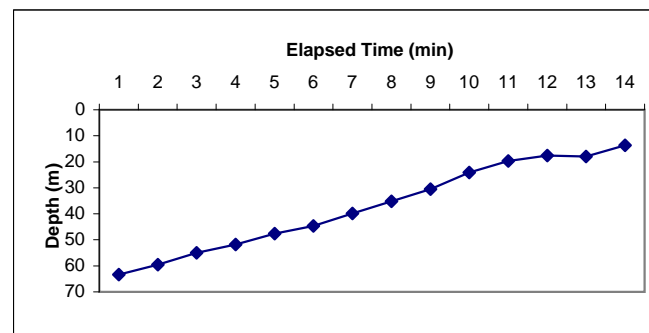
**Summary**

Target Species	#
Copper Rockfish	3
Puget Sound Rockfish	4+
Lingcod	1

**Habitat Summary**

Habitat Complexity: 2.75  
 % Rock Bottom: 100% (greater than 2.5)

Total Rockfish 7    Rockfish/min 0.5



Location: Lummi Island Trip B    Transect: #3 (N rks.)    Notes:  
 Start GPS: 48° 40.269' N    Date: 3/19/2008  
 122° 40.220' W    Time: 12:50  
 Video Start: Ch 3 31:42 Title 1    Visibility: good  
 Video End: Ch 3 39:40 Title 1    Depth Range 68.3' - 120.3'  
 Substrate Types: 3 = Rocky, 2 = Cobble, 1 = Gravel, 0 = Sand or Mud

Disc Location	Depth (m)	Fish Observed	Length (cm)
33:50:00	29.3	Copper Rockfish	40
38:16:00	23.4	Kelp Greenling (?)	25

Disc Location	Elapsed Time (min.)	Depth (m)	Habitat	Lasers (cm)
32	1	36.3	3	4
33	2	33.2	2.5	6
34	3	27.2	3	6
35	4	24.1	3	4.5
36	5	23.2	2.5	3.7
37	6	22.4	2.5	3
38	7	23.4	2.5	3
39	8	21.1	3	3

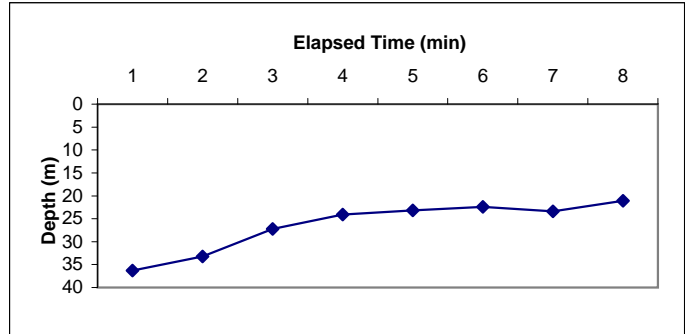
Total Rockfish Rockfish/min  
1                      0.125

**Summary**

Target Species	#
Copper Rockfish	1

**Habitat Summary**

Habitat Complexity: 2.75  
 % Rock Bottom: 100% (at least 2.5)



Location: Lummi Island Trip B    Transect: #4 (NE rks.)  
 Start GPS: 48° 40.372' N    Date: 3/19/2008  
 122° 39.955' W    Time: 13:10  
 Video Start Ch 4 43:29 Title 1    Visibility: good  
 Video End: Ch 4 49:50 Title 1    Depth Range 9.8' - 141.7'  
 Substrate Types: 3 = Rocky, 2 = Cobble, 1 = Gravel, 0 = Sand or Mud

Notes: Bow of boat up to shore at shallow end of transect.

Disc Location	Elapsed Time (min.)	Depth (m)	Habitat	Lasers (cm)
44	1	43	2.5	7
45	2	41.8	2.5	5
46	3	38.2	3	3.5
47	4	33.3	2.5	6.5
48	5	24.4	0.5	3.6
49	6	15.3	3	6

Disc Location	Depth (m)	Fish Observed	Length (cm)
44:25:00	42.7	gunnel	35
45:40:00	39.5	Puget Sound Rockfish	15

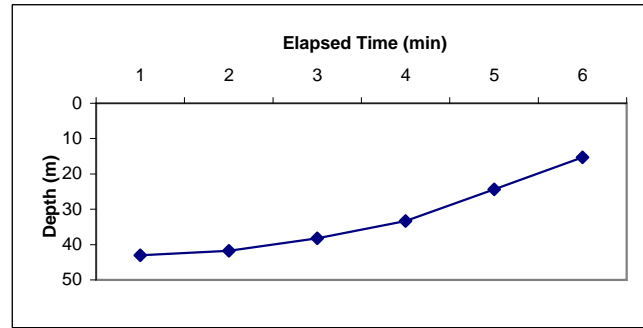
Total Rockfish Rockfish/min    Rockfish/m<sup>2</sup>)  
 1    0.166666667    0.024058  
 Estimated transect area  
 41.56672507 m<sup>2</sup>

**Summary**

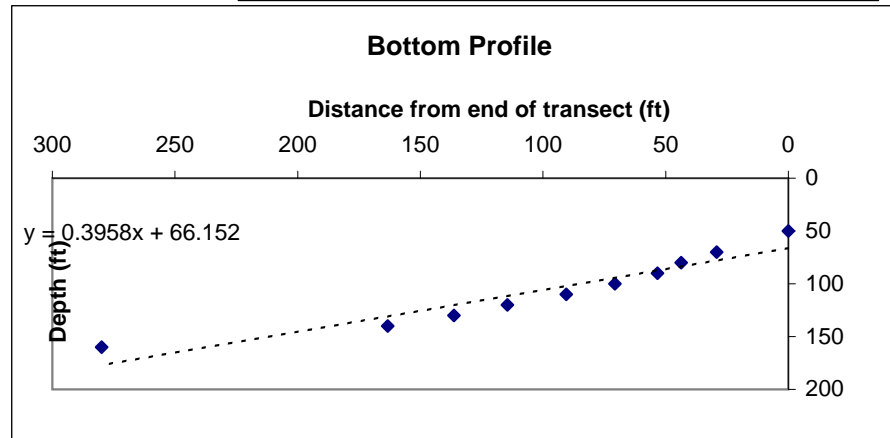
Target Species	#
Puget Sound Rockfish	1

**Habitat Summary**

Habitat Complexity: 2.333333  
 % Rock Bottom: 66% (at least 2.5)



Bottom Slope				
Latitude	Longitude	Depth	Distance (ft)	
48°	40.333 122°	39.992	50	0
48°	40.337 122°	39.988	70	29.15825
48°	40.339 122°	39.986	80	43.73736
48°	40.34 122°	39.984	90	53.35751
48°	40.343 122°	39.983	100	70.75036
48°	40.346 122°	39.981	110	90.56363
48°	40.349 122°	39.977	120	114.4572
48°	40.352 122°	39.974	130	136.3179
48°	40.356 122°	39.971	140	163.3479
48°	40.372 122°	39.955	160	279.9227



slope    0.39576016  
 0.37684601  
 21.5916857 degrees

Location: Lummi Island Trip B    Transect: #5    Notes: Repeat of trip A, site #2.  
 Start GPS: 48° 40.217' N    Date: 3/19/2008  
 122° 39.571' W    Time: 13:30  
 Video Start: Ch 1 03:21 Title 1    Visibility: Good  
 Video End: Ch 1 10:25 Title 1    Depth Range 55.6' - 163.8'  
 Substrate Types: 3 = Rocky, 2 = Cobble, 1 = Gravel, 0 = Sand or Mud

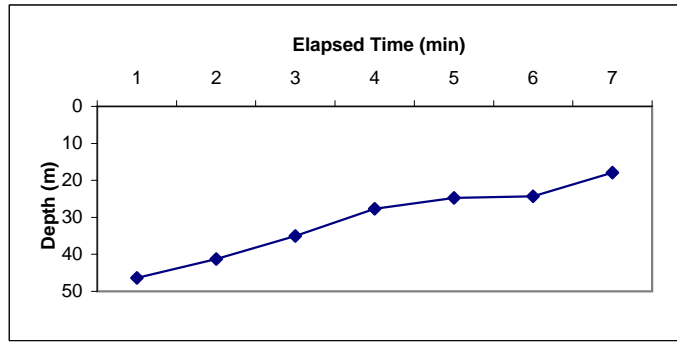
Disc Location	Elapsed Time (min.)	Depth (m)	Habitat	Lasers (cm)
4	1	46.4	2	5.2
5	2	41.3	2.5	6.5
6	3	35	2.5	4.2
7	4	27.7	3	6
8	5	24.7	2	3
9	6	24.3	3	3.5
10	7	17.9	2	2

**Disc Location**                      **Depth (m)**    **Fish Observed**    **Length (cm)**

Estimated transect area  
 88.36123427 m<sup>2</sup>

**Summary**  
**Target Species**    #  
 \_\_\_\_\_  
 0

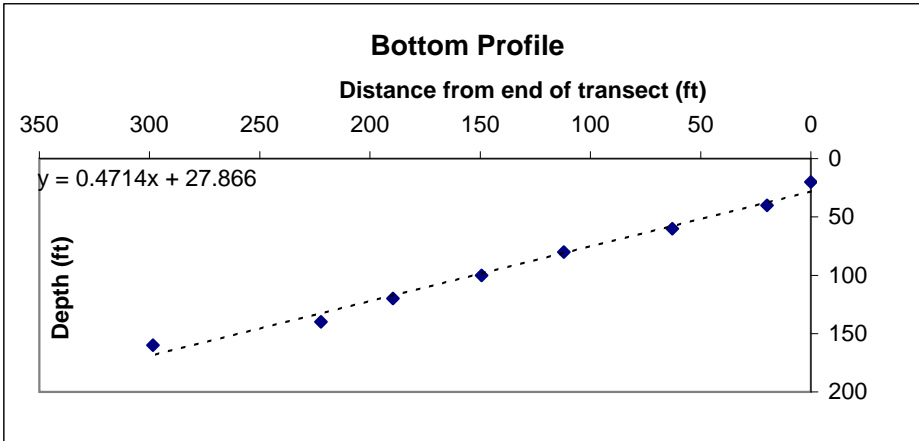
**Habitat Summary**  
**Habitat Complexity:** 2.428571  
**% Rock Bottom:** 50



**Bottom Slope**

Latitude	Longitude	Depth	Distance (ft)
48°	40.263 122°	39.545	20
48°	40.26 122°	39.547	40
48°	40.253 122°	39.549	60
48°	40.245 122°	39.551	80
48°	40.239 122°	39.553	100
48°	40.233 122°	39.558	120
48°	40.228 122°	39.561	140
48°	40.217 122°	39.571	160

Slope                      0.47139029  
                                  0.44049902  
                                  25.2387345 degrees

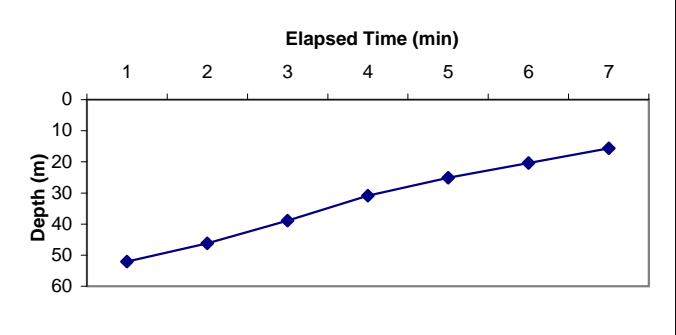


Location: Lummi Island Trip B	Transect: #6	Notes: Repeat of trip A, site #3.
Start GPS: 48° 40.212' N 122° 39.857' W	Date: 3/19/2008 Time: 13:50	
Video Start: Ch 2 12:00 Title 1	Visibility: good	
Video End: Ch 2 18:15 Title 1	Depth Range 50.7' - 169.3'	
Substrate Types: 3 = Rocky, 2 = Cobble, 1 = Gravel, 0 = Sand or Mud		

Disc Location	Elapsed Time (min.)	Depth (m)	Habitat	Lasers (cm)
12	1	52.1	3	7.5
13	2	46.2	2.5	7
14	3	38.9	3	7
15	4	30.9	2.5	5.5
16	5	25.1	2.5	5.5
17	6	20.4	2.5	3.5
18	7	15.6	2.5	3.4

Disc Location	Depth (m)	Fish Observed	Length (cm)
12:44		48 unidentified gunnel	
14:15		36.8 unidentified ling?	

Estimated transect area  
44.5703338 m<sup>2</sup>



**Summary**

Target Species	#
	0

**Habitat Summary**

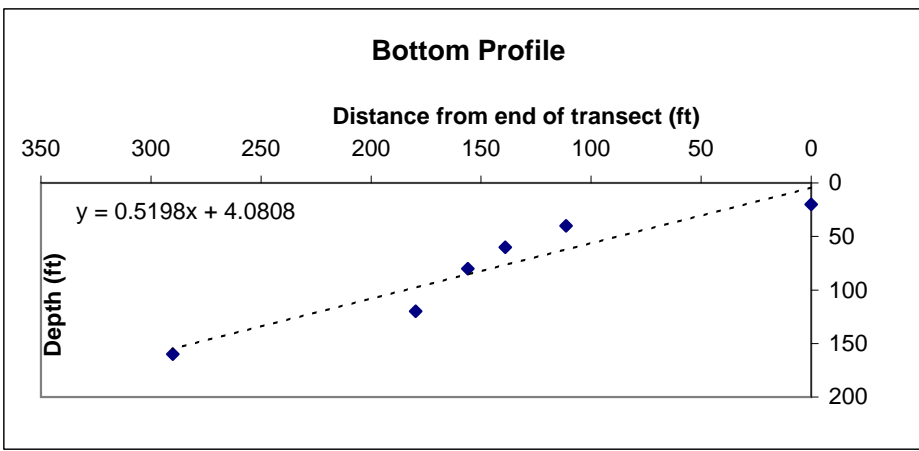
Habitat Complexity: 2.642857  
% Rock Bottom: 100% (at least 2.5)

**Bottom Slope**

Latitude	Longitude	Depth	Distance (ft)
48° 40.22 122°	39.928	20	0
48° 40.216 122°	39.901	40	111.4224
48° 40.216 122°	39.894	60	139.0713
48° 40.215 122°	39.89	80	156.027
48° 40.215 122°	39.884	120	179.7904
48° 40.212 122°	39.857	160	290.0469

slope 0.51978228  
0.4793479  
27.4646115 degrees

**Bottom Profile**



Location: Lummi Island Trip B    Transect: #7 (E Lummi)    Notes: steep and sandy  
 Start GPS: 48° 38.855' N    Date: 3/19/2008  
 122° 36.527' W    Time: 14:20  
 Video Start: Ch 1 02:24 Title 2    Visibility: good  
 Video End: Ch 1 05:45 Title 2    Depth Range 16.3' - 114.7'  
 Substrate Types: 3 = Rocky, 2 = Cobble, 1 = Gravel, 0 = Sand or Mud

Habitat		screen: 40.5cm			
Disc Location	Elapsed Time (min.)	Depth (m)	Habitat	Lasers (cm)	
3	1	35.3	0	6	
4	2	27.3	0	6	
5	3	10.9	0	3	

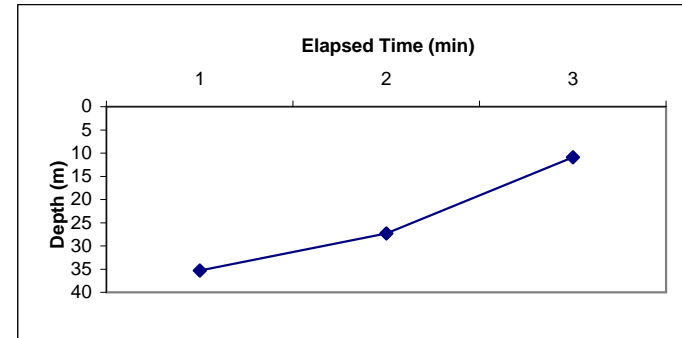
Disc Location	Depth (m)	Fish Observed	Length (cm)
2:24	35.3	Snow Crab	12 (body)
2:28 abundant goby at >28m	36	Goby (sp?)	10
4:20	23.2	sculpin	20
5:19	9	Snow Crab	8 (body)

### Summary

Target Species	#
	0

### Habitat Summary

Habitat Complexity: 0  
 % Rock Bottom: 0%



Location: Lummi Island Trip B	Transect: #8 (NW Eliza)	Notes: sandy with large cobbles spread out
Start GPS: 48° 40.651' N 122° 35.564' W	Date: 3/19/2008	
Video Start: Ch 2 07:44 Title 2	Time: 14:40	Substrate Types: 3 = Rocky, 2 = Cobble, 1 = Gravel, 0 = Sand or Mud
Video End: Ch 2 10:45 Title 2	Depth Range 26.3' - 31.9'	
Visibility: fair		

Habitat		screen: 40.5cm		
Disc Location	Elapsed Time (min.)	Depth (m)	Habitat	Lasers (cm)
8	1	9.8	1.5	4.1
9	2	8.9	1.5	6.5
10	3	8.4	0.5	4.3

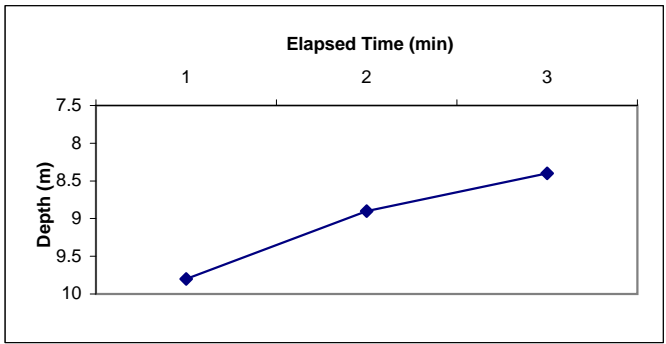
Disc Location	Depth (m)	Fish Observed	Length (cm)
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**Summary**

Target Species	#
	0

**Habitat Summary**

Habitat Complexity: 1.166667  
 % Rock Bottom: 0%



Location: Lummi Island Trip B	Transect: #9 (Carter Pt.)	Notes:
Start GPS: 48° 38.377' N	Date: 3/19/2008	
122° 36.413' W	Time: 15:05	
Video Start Ch 1 00:46 Title 3	Visibility: fair	
Video End: Ch 1 09:37 Title 3	Depth Range 29.9' - 128.7'	
Substrate Types: 3 = Rocky, 2 = Cobble, 1 = Gravel, 0 = Sand or Mud		

Disc Location	Elapsed Time (min.)	Depth (m)	Habitat	Lasers (cm)
1	1	39.6	2	6
2	2	37.4	2	4.8
3	3	34.7	2.5	6
4	4	32.5	1	5.5
5	5	33.9	2	4.7
6	6	27.9	1.5	5.5
7	7	23.2	1.5	3.2
8	8	15.7	3	6
9	9	9.2	3	8

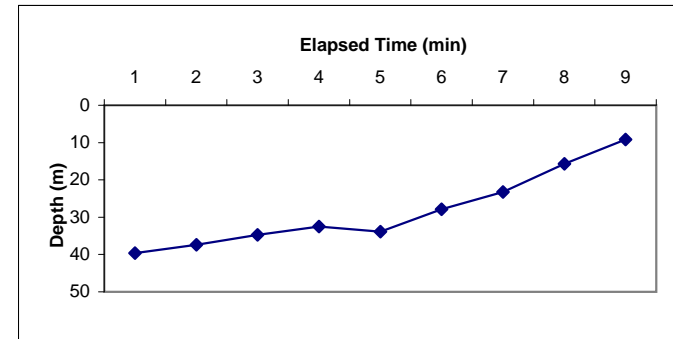
Disc Location	Depth (m)	Fish Observed	Length (cm)
1:51	37.8	gunnel	15
7:05	22.5	unidentified	15
7:22	19.8	unidentified (same?)	15
7:45	16.2	Kelp Greenling (f)	20
9:12	7.8	unidentified	15

### Summary

Target Species	#
	0

### Habitat Summary

Habitat Complexity: 2.055556  
 % Rock Bottom: 30% (at least 2.5)



Location: Lummi Island Trip A    Transect: #1  
 Start GPS: 48° 39.920' N    Date: 2/19/2008  
 122° 39.299' W    Time: 10:45  
 Video Start: n/a    Visibility:  
 Video End: n/a    Depth Range:  
 Substrate Types: 3 = Rocky, 2 = Cobble, 1 = Gravel, 0 = Sand or Mud

**Notes: Technical difficulties resulted  
 in loss of video data. Nearby  
 location on trip B.**

**Habitat**

Disc Location	Elapsed Time (min.)	Depth (m)	Habitat
		1	
		2	
		3	
		4	
		5	
		6	
		7	
		8	
		9	
		10	
		11	
		12	
		13	
		14	
		15	
		16	
		17	
		18	
		19	
		20	

**Disc Location      Elapsed Time (min.)    Depth (m)    Fish Observed      Length (cm)**

**Summary**

**Habitat Summary**

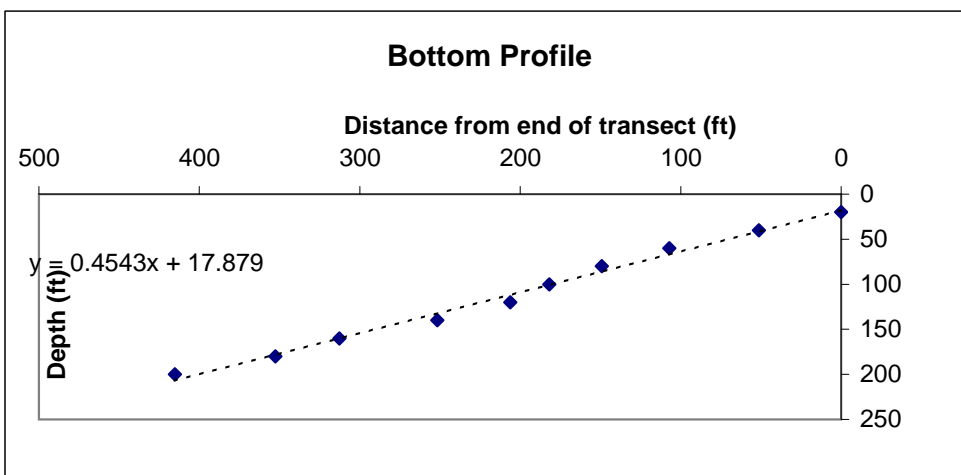
**Target Species      #**

**Habitat Complexity:**  
**% Rock Bottom:**

**Other      #**

**Bottom Slope**

Latitude	Longitude	Depth (ft)	Distance (ft)
48°	39.983 122°	39.259	20
48°	39.975 122°	39.263	40
48°	39.966 122°	39.266	60
48°	39.96 122°	39.272	80
48°	39.955 122°	39.275	100
48°	39.951 122°	39.276	120
48°	39.944 122°	39.28	140
48°	39.935 122°	39.287	160
48°	39.929 122°	39.291	180
48°	39.92 122°	39.299	200



Location: Lummi Rocks Trip A    Transect: #2  
 Start GPS: 48° 40.217' N    Date: 2/19/2008  
                   122° 39.571' W    Time: 11:45  
 Video Start: n/a    Visibility:  
 Video End: n/a    Depth Range:  
                   Substrate Types: 3 = Rocky, 2 = Cobble, 1 = Gravel, 0 = Sand or Mud

Notes: Technical difficulties resulted in loss of video data. Location Repeated.

**Habitat**

Disc Location	Elapsed Time (min.)	Depth (m)	Habitat
		1	
		2	
		3	
		4	
		5	
		6	
		7	
		8	
		9	
		10	
		11	
		12	
		13	
		14	
		15	
		16	
		17	
		18	
		19	
		20	

Disc Location	Elapsed Time (min.)	Depth (m)	Fish Observed	Length (cm)
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**Summary**

Target Species    #

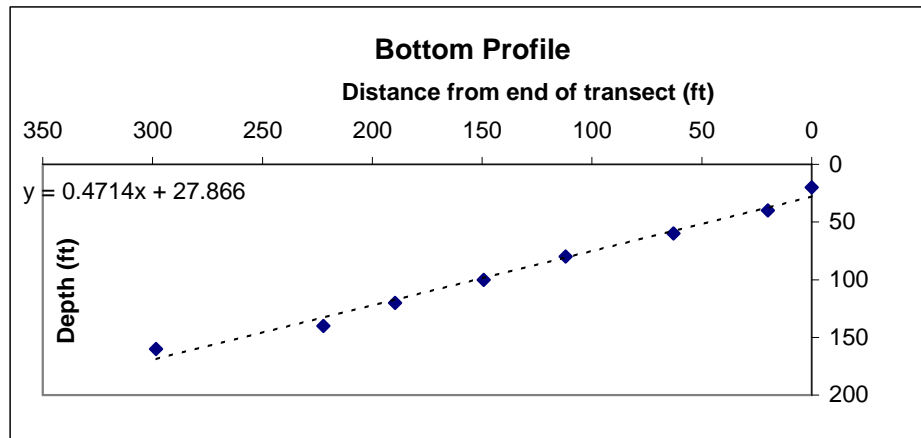
Other    #

**Habitat Summary**

Habitat Complexity:  
% Rock Bottom:

**Bottom Slope**

	Latitude	Longitude	Depth	Distance (ft)
48°	40.263	122°	39.545	20
48°	40.26	122°	39.547	40
48°	40.253	122°	39.549	60
48°	40.245	122°	39.551	80
48°	40.239	122°	39.553	100
48°	40.233	122°	39.558	120
48°	40.228	122°	39.561	140
48°	40.217	122°	39.571	160



Location:	Lummi Rocks Trip A	Transect:	#3
Start GPS:	48° 40.212' N	Date:	2/19/2008
	122° 39.957' W	Time:	12:00
Video Start:	n/a	Visibility:	
Video End:	n/a	Depth Range:	
Substrate Types: 3 = Rocky, 2 = Cobble, 1 = Gravel, 0 = Sand or Mud			

Notes: Technical difficulties resulted in loss of video data. Location Repeated.

Habitat		
Disc Location	Elapsed Time (min.)	Depth (m)
		1
		2
		3
		4
		5
		6
		7
		8
		9
		10
		11
		12
		13
		14
		15
		16
		17
		18
		19
		20

Disc Location	Elapsed Time (min.)	Depth (m)	Fish Observed	Length (cm)
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### Summary

Target Species #

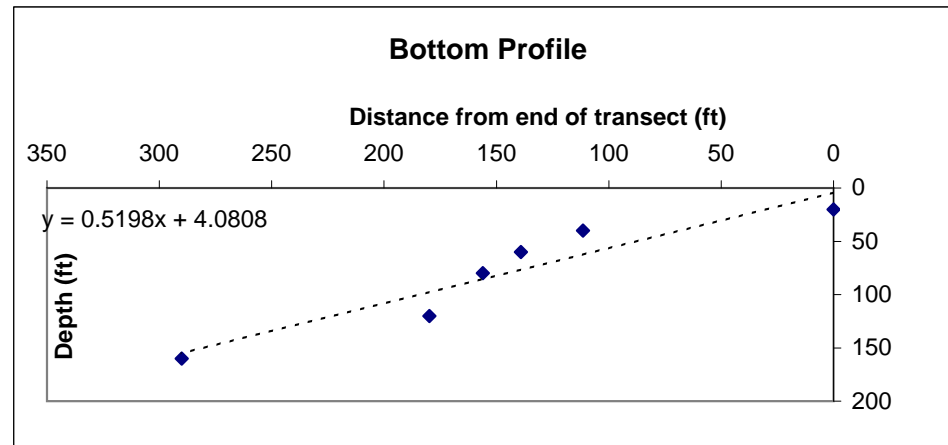
Other #

### Habitat Summary

Habitat Complexity:  
% Rock Bottom:

### Bottom Slope

Latitude	Longitude	Depth	Distance (ft)
48° 40.22 122°	39.928	20	0
48° 40.216 122°	39.901	40	111.4224
48° 40.216 122°	39.894	60	139.0713
48° 40.215 122°	39.89	80	156.027
48° 40.215 122°	39.884	120	179.7904
48° 40.212 122°	39.857	160	290.0469



Location: Lummi Rocks Trip A Transect: #4 Notes: "marine snow"  
 Start GPS: 48° 40.273' N Date: 2/19/2008  
 122° 39.813' W Time: 12:45  
 Video Start: Ch 1 00:37 Title 1 Visibility: fair  
 Video End: Ch 1 17:30 Title 1 Depth Range 26' - 148.2'  
 Substrate Types: 3 = Rocky, 2 = Cobble, 1 = Gravel, 0 = Sand or Mud

Habitat		screen: 40.5cm		
Disc Location	Elapsed Time (min.)	Depth (m)	Habitat	Lasers (cm)
1:30	1	45.6	2	5.3
2:30	2	43.4	2.5	3.8
3:30	3	41.4	2	3.3
4:30	4	37.9	2	4.1
5:30	5	36.7	2	7.7
6:30	6	35.5	2	4.5
7:30	7	33.2	2	4.2
8:30	8	30.5	1.5	7.5
9:30	9	29.7	1.5	5
10:30	10	32.1	3	5
11:30	11	33.3	2	5.5
12:30	12	34.3	1.5	2.6
13:30	13	35.1	2	3
14:30	14	35.2	3	2.5
15:30	15	26.4	3	2.7
16:30	16	16.5	3	2.1

Disc Location	Depth (m)	Fish Observed	Length (cm)
1:45	45	Flatfish	10
2:25	43.4	Sculpin or Cabezon	20
8:55	29.4	Kelp Greenling (f)	25
15:14	26.6	2 Kelp Greenling (m)	40

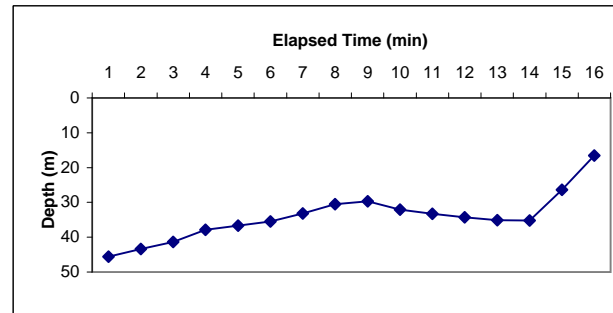
**Summary**

Target Species	#
Kelp Greenling	3

**Habitat Summary**

Habitat Complexity: 2.1875  
 % Rock Bottom: 75% (#2 or greater)

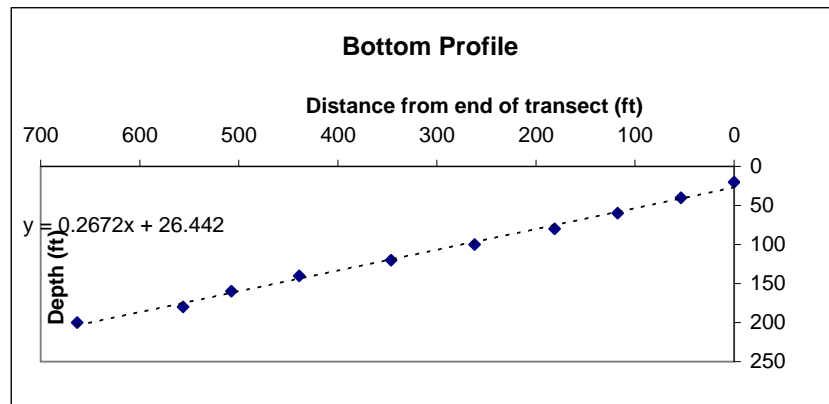
Estimated transect area  
 142.4869068 m<sup>2</sup>



**Bottom Slope**

Latitude	Longitude	Depth	Distance (ft)
48° 40.283 122°	39.977	20	0
48° 40.281 122°	39.964	40	53.74672
48° 40.281 122°	39.948	60	117.4222
48° 40.282 122°	39.932	80	181.3302
48° 40.282 122°	39.912	100	261.8448
48° 40.283 122°	39.891	120	346.3474
48° 40.283 122°	39.868	140	438.9752
48° 40.281 122°	39.851	160	507.585
48° 40.279 122°	39.839	180	556.2987
48° 40.273 122°	39.813	200	663.2676

Slope 0.26722922  
 0.26112752  
 14.9615048 degrees



Location: Lummi Island Trip A    Transect: #5  
 Start GPS: 48° 39.723' N    Date: 2/19/2008  
 122° 38.986' W    Time: 13:20  
 Video Start Ch 2 23:16 Title 1    Visibility: good  
 Video End: Ch 2 31:45 Title 1    Depth Range 12.7' - 75.4'  
 Substrate Types: 3 = Rocky, 2 = Cobble, 1 = Gravel, 0 = Sand or Mud  
 Notes: sandy flats with scattered cobbles, minimal "marine snow"

Habitat		screen: 40.5cm		
Disc Location	Elapsed Time (min.)	Depth (m)	Habitat	Lasers (cm)
	24	1	23.2	1.5 2.6
	25	2	19.8	1.5 2.2
	26	3	17.1	1.5 2.5
	27	4	15.2	1.5 3
	28	5	12.6	1 2.4
	29	6	10.2	1.5 2.9
	30	7	4	0
	31	8	4	0 *lasers covered by kelp

Disc Location	Depth (m)	Fish Observed	Length (cm)
27:47:00	derelict crab pot	12.5	

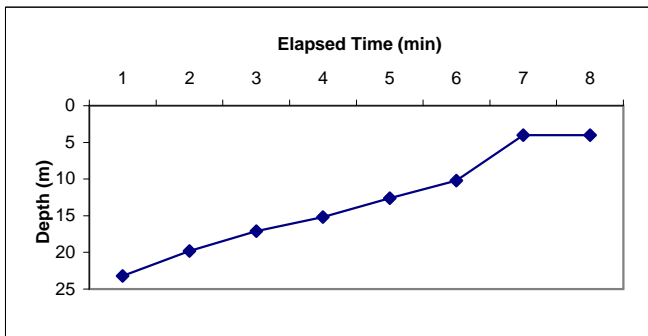
**Summary**

Target Species	#
	0

**Habitat Summary**

Habitat Complexity: 1.0625  
 % Rock Bottom: 0

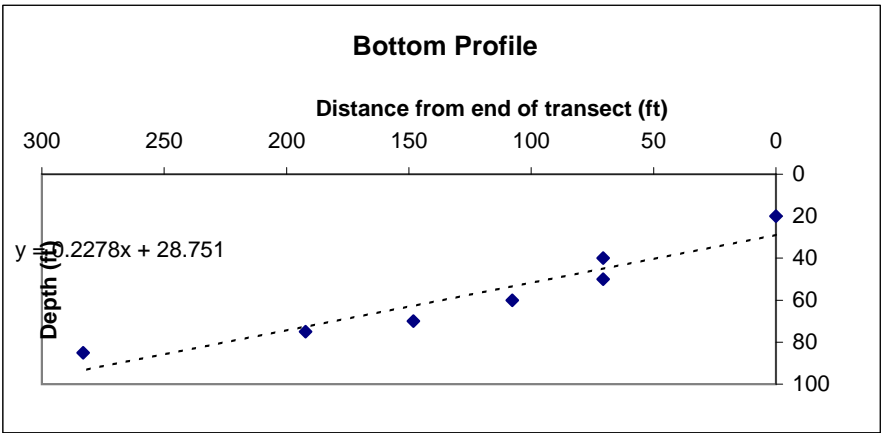
Estimated transect area  
 94.52835914 m<sup>2</sup>



**Bottom Slope**

Latitude	Longitude	Depth	Distance (ft)
48°	39.752 122°	38.931	20 0
48°	39.745 122°	38.945	40 70.63367
48°	39.745 122°	38.945	50 70.63367
48°	39.741 122°	38.952	60 107.8073
48°	39.737 122°	38.96	70 148.1621
48°	39.732 122°	38.968	75 192.3011
48°	39.723 122°	38.986	85 283.0724

Slope  
 0.22776029  
 0.22394016  
 12.8308263 degrees



Location: Lummi Island Trip A    Transect: #6  
 Start GPS: 48° 39.548' N    Date: 2/19/2008  
 122° 38.807' W    Time: 13:40  
 Video Start Ch 2 03:21 Title 2    Visibility: fair  
 Video End: Ch 2 11:05 Title 2    Depth Range 7.5' - 111.5'  
 Substrate Types: 3 = Rocky, 2 = Cobble, 1 = Gravel, 0 = Sand or Mud

Notes: moderate to minimal "marine snow"

Disc Location	Elapsed Time (min.)	Depth (m)	Habitat	Lasers (cm)
	4	34.3	0	2
	5	31.6	0	6
	6	27.8	0	4.6
	7	20.6	0	2.3
	8	14.8	0.5	3
	9	10.2	0.5	4
	10	5.5	0	
	11	2.3	0	

screen: 40.5cm

Disc Location	Depth (m)	Fish Observed	Length (cm)
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\* Lasers covered by kelp.

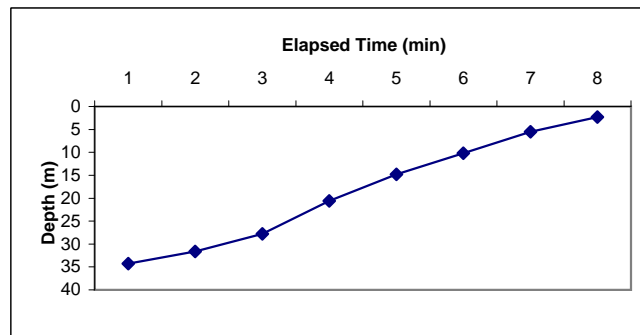
**Summary**

Target Species    #

**Habitat Summary**

Habitat Complexity: 0.125  
 % Rock Bottom: 0

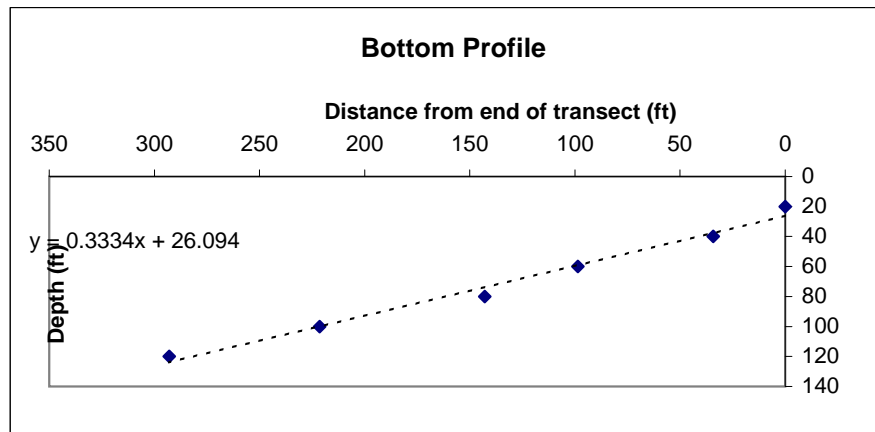
Estimated transect area  
 105.4088376 m<sup>2</sup>



**Bottom Slope**

Latitude	Longitude	Depth	Distance (ft)
48°	39.581 122°	38.754	20
48°	39.577 122°	38.76	40 34.27634
48°	39.57 122°	38.772	60 98.61383
48°	39.565 122°	38.78	80 142.9008
48°	39.556 122°	38.794	100 221.4442
48°	39.548 122°	38.807	120 292.8935

Slope  
 0.33340831  
 0.32181803  
 18.4388152 degrees



Location: Lummi Island Trip A    Transect: #7  
 Start GPS: 48° 39.262' N    Date: 2/19/2008  
                   122° 38.422' W    Time: 14:00  
 Video Start:                    Visibility:  
 Video End:                     Depth Range:  
                   Substrate Types: 3 = Rocky, 2 = Cobble, 1 = Gravel, 0 = Sand or Mud

Notes: technical difficulties resulted in loss of video data.

Habitat			
Disc Location	Elapsed Time (min.)	Depth (m)	Habitat
		1	
		2	
		3	
		4	
		5	
		6	
		7	
		8	
		9	
		10	
		11	
		12	
		13	

Disc Location	Elapsed Time (min.)	Depth (m)	Fish Observed	Length (cm)
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**Summary**

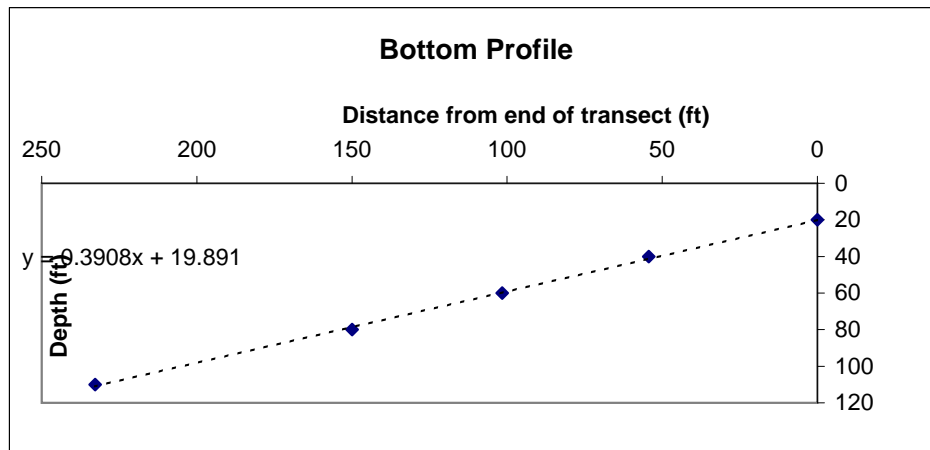
Target Species    #

Other    #

**Habitat Summary**

Habitat Complexity:  
% Rock Bottom:

Bottom Slope				
	Latitude	Longitude	Depth	Distance (ft)
48°	39.289	122°	38.381	20    0
48°	39.283	122°	38.391	40    54.33299
48°	39.278	122°	38.4	60    101.618
48°	39.272	122°	38.408	80    150.0042
48°	39.262	122°	38.422	110    232.8021



Location: Alden Bank      Transect: #1  
 Start GPS: 48° 49.963' N      Date: 2/20/2008  
                  122° 53.012' W      Time: 11:30  
 Video Start: Ch 1 00:30 Title 1      Visibility: Low  
 Video End: Ch 1 08:20 Title 1      Depth Range 34.2 - 29.8  
                  Substrate Types: 3 = Rocky, 2 = Cobble, 1 = Gravel, 0 = Sand or Mud

Notes: 02:15 to 04:40 lost bottom contact; heavy "marine snow"

Habitat			
Disc Location	Elapsed Time (min.)	Depth (m)	Habitat
CH 1 00:30	1	34.2	0.5
CH 1 01:30	2	32.7	1.5
CH 1 05:30	3	31.7	0.5
CH 1 06:30	4	30.2	0.5
CH 1 07:30	5	29.8	0.5

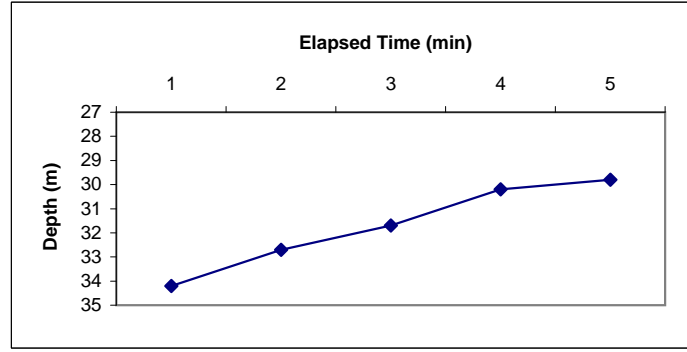
Disc Location	Elapsed Time (min.)	Depth (m)	Fish Observed	Length (cm)
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**Summary**

Target Species	#
	0

**Habitat Summary**

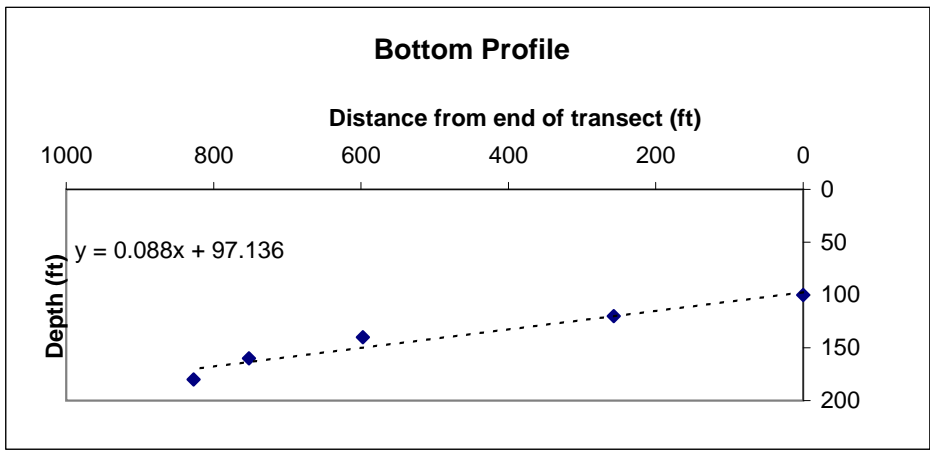
Habitat Complexity:	0.7
% Rock Bottom:	0



Bottom Slope				
	Latitude	Longitude	Depth	Distance (ft)
48°	50.023	122°	52.827	100
48°	50.025	122°	52.891	120
48°	49.998	122°	52.971	140
48°	49.974	122°	52.999	160
48°	49.963	122°	53.012	180

Slope	0.08804641
	0.08781994
	5.03171205 degrees



Location: Alden Bank      Transect: #2  
 Start GPS: 48° 49.943' N      Date: 2/20/2008  
                  122° 50.359' W      Time: 12:05  
 Video Start: Ch 1 00:00 Title 2      Visibility: fair  
 Video End: Ch 2 34:00 Title 2      Depth Range 50.6 - 19.3  
                  Substrate Types: 3 = Rocky, 2 = Cobble, 1 = Gravel, 0 = Sand or Mud

Notes: moderate "marine snow" 2  
 dives on video 06:22 - 11:15 lost  
 bottom, 20:30 to 25:00 surface  
 interval

Habitat			
Disc Location	Elapsed Time (min.)	Depth (m)	Habitat
Ch 2 00:30	1	50.4	0
Ch 2 01:30	2	50.1	0
Ch 2 02:30	3	49.3	0
Ch 2 03:30	4	47.4	0
Ch 2 04:30	5	45.2	0
Ch 2 05:30	6	42.8	0
Ch 2 11:30	7	50.8	0
Ch 2 12:30	8	51.2	0
Ch 2 13:30	9	50.6	0
Ch 2 14:30	10	47.8	0
Ch 2 15:30	11	45.1	0
Ch 2 16:30	12	41.1	0
Ch 2 17:30	13	39.2	0
Ch 2 18:30	14	37.5	0
Ch 2 19:30	15	35.2	0
Ch 2 20:30	16	37.2	0
Ch 2 25:30	17	24.3	0
Ch 2 26:30	18	19.6	0
Ch 2 27:30	19	19.3	0
Ch 2 28:30	20	18.6	0
Ch 2 29:30	21	21	0
Ch 2 30:30	22	18.8	0
Ch 2 31:30	23	21.8	0
Ch 2 32:30	24	19.4	0

Disc Location	Depth (m)	Fish Observed	Length (cm)
Ch 2 00:30	50.4	Sculpin (Bonehead)	30
		Flatfish	10
Ch 2 01:49	50.1	Sculpin	15
Ch 2 12:12	51.3	Flatfish	14
		Goby	10
Ch 2 12:48	51.3	2 Flatfish	20, 10
Ch 2 13:20	50.6	Flatfish	8
Ch 2 18:57	38.4	Flatfish	20

**Summary**

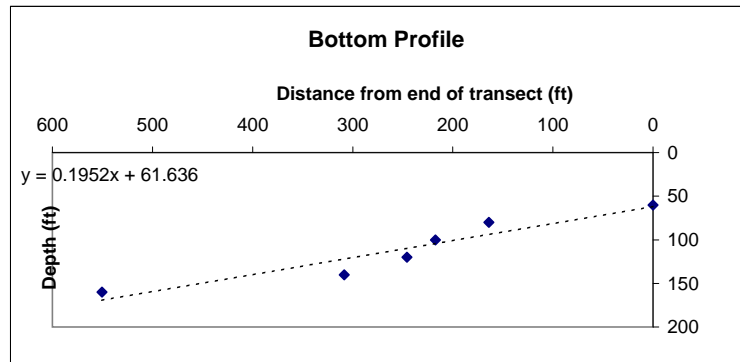
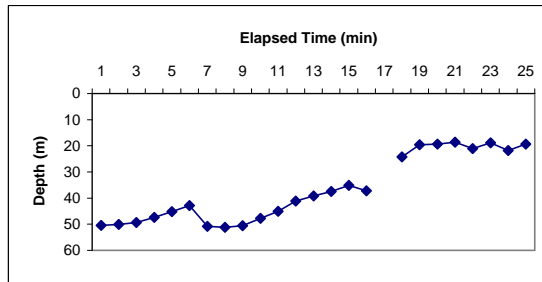
Target Species	#
	0

**Habitat Summary**

Habitat Complexity:	0
% Rock Bottom:	0

Bottom Slope				
Latitude	Longitude	Depth	Distance (ft)	
48°	49.898 122°	50.478	60	0
48°	49.906 122°	50.439	80	163.9374
48°	49.908 122°	50.426	100	217.4164
48°	49.911 122°	50.42	120	245.8736
48°	49.919 122°	50.408	140	308.6255
48°	49.943 122°	50.359	160	550.4328

Slope  
 0.19524244  
 0.19281683  
 11.0475904 degrees



Location: Alden Bank      Transect: #3      Notes: moderate "marine snow"  
 Start GPS: 48° 49.242' N      Date: 2/20/2008  
                  122° 49.045' W      Time: 13:50  
 Video Start: Ch 1 02:00 Title 3      Visibility: fair  
 Video End: Ch 1 09:05 Title 3      Depth Range 46.2 - 36.7  
                  Substrate Types: 3 = Rocky, 2 = Cobble, 1 = Gravel, 0 = Sand or Mud

Habitat			
Disc Location	Elapsed Time (min.)	Depth (m)	Habitat
Ch 1 02:30	1	46.2	0
Ch 1 03:30	2	43.7	0
Ch 1 04:40	3	40.6	0
Ch 1 05:30	4	39.8	0
Ch 1 06:30	5	39	0
Ch 1 07:30	6	37.9	0
Ch 1 08:30	7	36.7	0

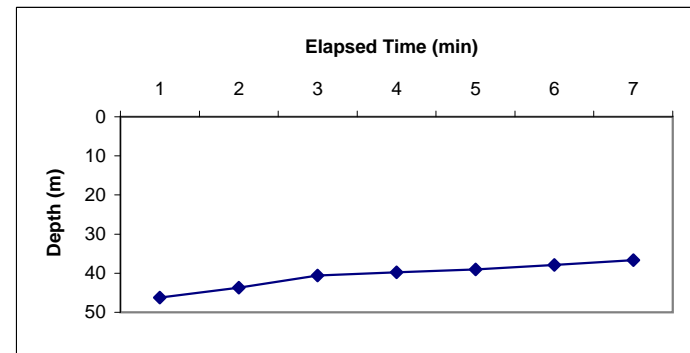
Disc Location	Depth (m)	Fish Observed	Length (cm)
Ch 1 07:00	38.4	Flatfish	20

**Summary**

**Target Species**      #  
 \_\_\_\_\_  
 0

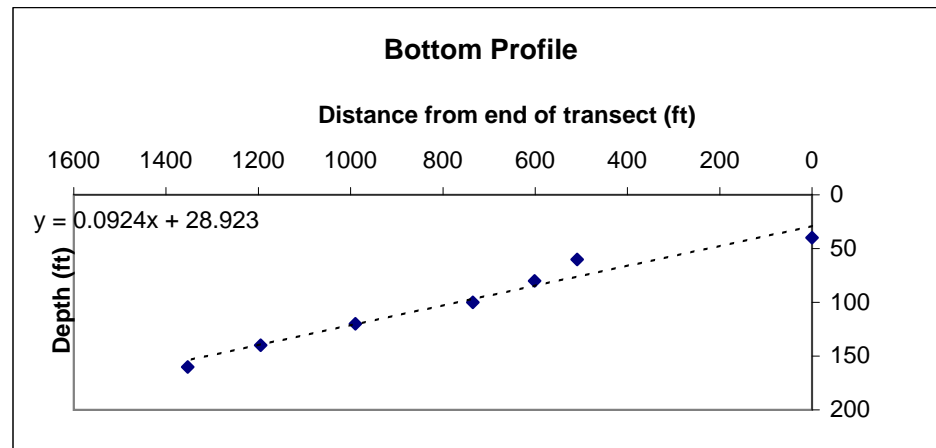
**Habitat Summary**

**Habitat Complexity:**      0  
**% Rock Bottom:**      0



Bottom Slope				
	Latitude	Longitude	Depth	Distance (ft)
48°	49.059 122°	49.237	40	0
48°	49.124 122°	49.157	60	509.0975
48°	49.135 122°	49.141	80	601.5375
48°	49.151 122°	49.118	100	735.4038
48°	49.184 122°	49.079	120	989.6352
48°	49.219 122°	49.064	140	1194.86
48°	49.242 122°	49.045	160	1353.053

Slope      0.09241756  
                  0.09215578  
                  5.28013745 degrees



Location: Alden Bank      Transect: #4      Notes: minimal "marine snow"  
 Start GPS: 48° 48.494' N      Date: 2/20/2008  
                  122° 48.464' W      Time: 14:00  
 Video Start: Ch 1 00:00 Title 1      Visibility: good  
 Video End: Ch 1 06:00 Title 1      Depth Range 27.9 - 12.0  
                  Substrate Types: 3 = Rocky, 2 = Cobble, 1 = Gravel, 0 = Sand or Mud

Habitat			
Disc Location	Elapsed Time (min.)	Depth (m)	Habitat
Ch 1 00:30	1	27.9	1
Ch 1 01:30	2	21.3	1
Ch 1 02:30	3	15.1	1
Ch 1 03:30	4	13	1.5
Ch 1 04:30	5	13	1.5
Ch 1 05:30	6	12	1.5

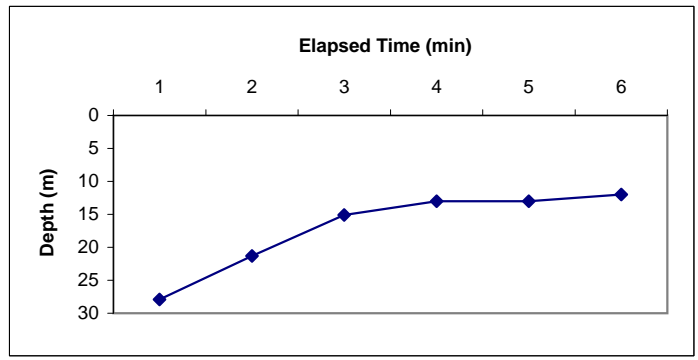
Disc Location	Elapsed Time (min.)	Depth (m)	Fish Observed	Length (cm)
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**Summary**

Target Species	#
	0

**Habitat Summary**

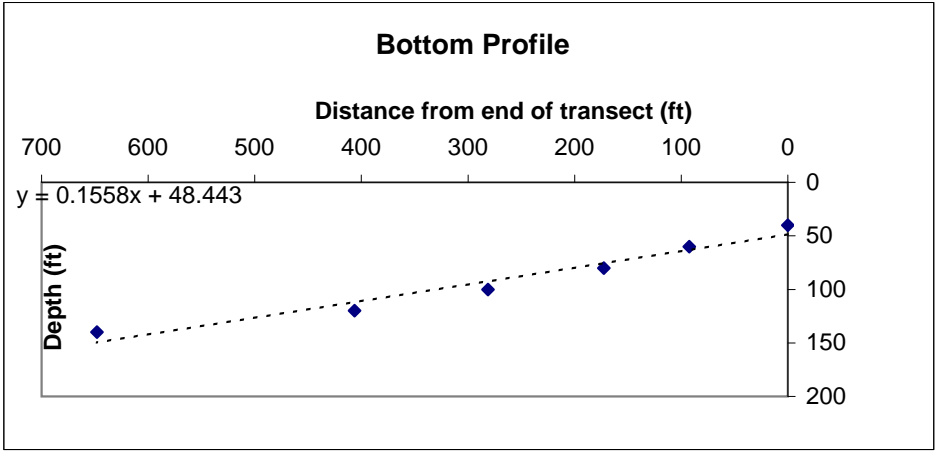
Habitat Complexity: 1.25  
 % Rock Bottom: 0



**Bottom Slope**

Latitude	Longitude	Depth	Distance (ft)
48°	48.487 122°	48.625	40 0
48°	48.487 122°	48.602	60 92.3767
48°	48.487 122°	48.582	80 172.7043
48°	48.489 122°	48.555	100 281.4088
48°	48.491 122°	48.524	120 406.3811
48°	48.494 122°	48.464	140 648.0327

Slope 0.15575202  
 0.1545106  
 8.85280511 degrees



Location: Alden Bank	Transect: #5	Notes:
Start GPS: 48° 48.494' N	Date: 2/20/2008	
122° 48.464' W	Time: 14:10	
Video Start: Ch 2 07:52 Title 1	Visibility: good	
Video End: Ch 2 12:10 Title 1	Depth Range 9.5 - 10.7	
Substrate Types: 3 = Rocky, 2 = Cobble, 1 = Gravel, 0 = Sand or Mud		

Habitat			
Disc Location	Elapsed Time (min.)	Depth (m)	Habitat
Ch 2 08:30	1	9.5	0
Ch 2 09:30	2	9.5	0
Ch 2 10:30	3	10.3	0
Ch 2 11:30	4	10.7	0

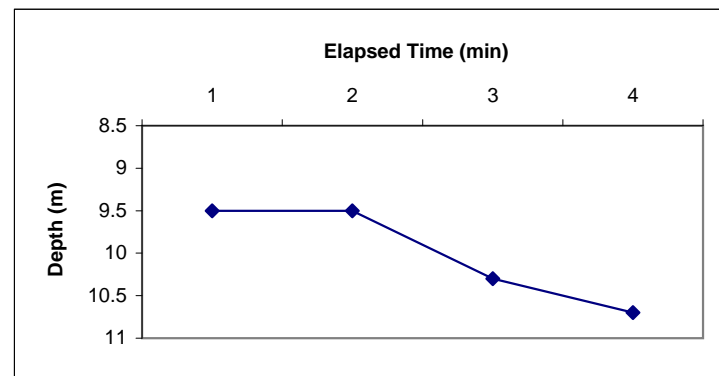
Disc Location	Elapsed Time (min.)	Depth (m)	Fish Observed	Length (cm)
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**Summary**

<b>Target Species</b>	<b>#</b>
	0

**Habitat Summary**

<b>Habitat Complexity:</b>	0
<b>% Rock Bottom:</b>	0



Location: Alden Bank      Transect: #6  
 Start GPS: 48° 48.231' N      Date: 2/20/2008  
                  122° 50.881' W      Time: 14:30  
 Video Start: Ch 1 01:30 Title 2      Visibility: fair  
 Video End: Ch 1 12:56 Title 2      Depth Range 43.5 - 32  
                  Substrate Types: 3 = Rocky, 2 = Cobble, 1 = Gravel, 0 = Sand or Mud

Notes: minimal "marine snow"

**Habitat**

Disc Location	Elapsed Time (min.)	Depth (m)	Habitat
Ch 1 01:30	1	43.5	0
Ch 1 02:30	2	42.5	0
Ch 1 03:30	3	41.4	0
Ch 1 04:30	4	39.7	0
Ch 1 05:30	5	37.3	0
Ch 1 06:30	6	36.3	0
Ch 1 07:30	7	35.9	0
Ch 1 08:30	8	34.4	0
Ch 1 09:30	9	33	0
Ch 1 10:30	10	32.3	0
Ch 1 11:30	11	32	0
Ch 1 12:30	12	32	0

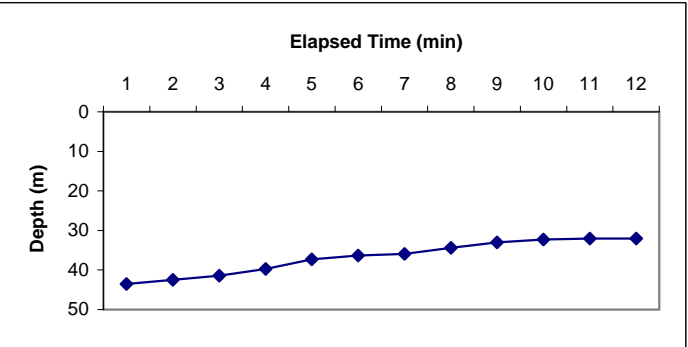
Disc Location	Depth (m)	Fish Observed	Length (cm)
Ch 1 06:60	36.3	Flatfish	25
Ch 1 07:25	36.9	Flatfish	20
Ch 1 11:16	31.9	Derelict crab pot and line	

**Summary**

Target Species      #

**Habitat Summary**

Habitat Complexity: 0  
 % Rock Bottom: 0

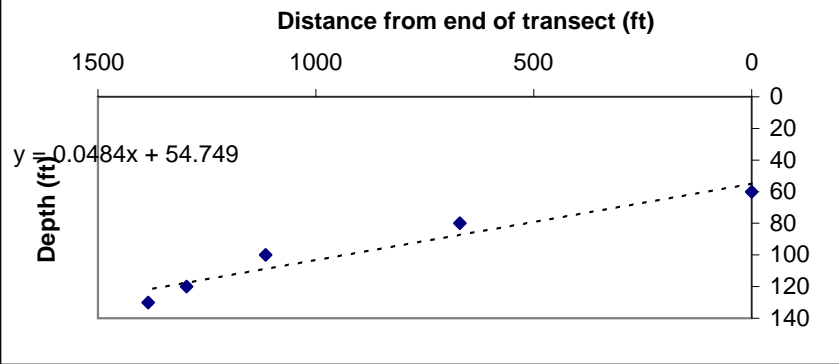


**Bottom Slope**

Latitude	Longitude	Depth	Distance (ft)
48°	48.35 122°	50.587	60 0
48°	48.319 122°	50.747	80 669.6913
48°	48.273 122°	50.839	100 1115.097
48°	48.245 122°	50.868	120 1296.527
48°	48.231 122°	50.881	130 1384.693

slope      0.04842273  
                  0.04838494  
                  2.77225294 degrees

**Bottom Profile**





Location: Alden Bank	Transect: #8	Notes: End of Lummi Trip C, many PS Rockfish?
Start GPS: 48° 47.042' N	Date: 5/29/2008	
122° 49.842' W	Time: 14:25	
Video Start Title 4 01:00	Visibility: fair to poor	
Video End: Title 4 11:14	Depth Range 47.9m - 26.8m	
Substrate Types: 3 = Rocky, 2 = Cobble, 1 = Gravel, 0 = Sand or Mud		

Disc Location	Elapsed Time (min.)	Depth (m)	Habitat	Lasers (cm)
1	0	47.9	2	3
2	1	43.6	2	3
3	2	38.1	2	4.5
4	3	36.1	2	4
5	4	35.8	2	3
6	5	35.1	2	3
7	6	32.6	2.5	3.4
8	7	30	2.5	8
9	8	30.7	2.5	5.5
10	9	27.8	3	4
11	10	26.8	3	3

Disc Location	Depth (m)	Fish Observed	Length (cm)
7:38	30.8	PS Rockfish	6
8:04	30	2 PS Rockfish	8

\*\*\*possible other juvenile PS Rockfish school sightings not clear on video.\*\*\*

Total Rockfish 3  
 Rockfish/min 0.3  
 Rockfish/m<sup>2</sup> 0.026075  
 Estimated transect area  
 115.0538867 m<sup>2</sup>

**Summary**

Target Species	#
PS Rockfish	>3

**Habitat Summary**

Habitat Complexity: 2.318182  
 % Rock Bottom: 15

**Bottom Slope**

Latitude	Longitude	Depth	Distance (ft)
48°	47.097 122°	49.81	50 0
48°	47.084 122°	49.813	60 79.90405
48°	47.071 122°	49.821	80 164.046
48°	47.062 122°	49.829	100 225.9533
48°	47.057 122°	49.832	120 258.6226
48°	47.042 122°	49.842	150 358.0709

Slope 0.28841417  
 0.28079399  
 16.0883107 degrees

