Exxon Valdez **Oil Spill**
Restoration Project Final Report

Proximate Composition and Fatty Acid Signatures of Selected Forage Fish Species in Prince William Sound, Alaska

Restoration Project 95121
Final Report

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Study History: Restoration Project 95121 was undertaken to 1) collect data on proximate composition and energy density of selected forage fish species and 2) to provide additional data on fatty acid signatures of those forage fish to eventually gain a better understanding of sea bird and marine mammal foraging ecology in Prince William Sound.

Abstract: The proximate composition and fatty acid signatures of several prey species, which are important for sea birds and marine mammals in Prince William Sound, Alaska, were determined. Fish were collected as part of the SEA cruises in the fall of 1995 and were frozen immediately and then shipped to Galveston for analysis. Most species had relatively low lipid contents, less than 5% lipid (wet weight), except rock sole and English sole which were 6.0 ± 1.6% and 6.8 ± 0.5% lipid, respectively and herring which ranged from 13.2 ± 0.6% to 16.6 ± 0.8% lipid. Herring showed a trend to higher lipid content in fish of greater than 170 mm in standard length. "Protein" content was relatively uniform generally ranging from 13.5 ± 1.6% to 15.9 ● 1.6%, with exceptions being tomcod (11.0 ± 1.3%) and rock sole (19.0 ± 1.4%). Energy density values ranged from a low of 4.0 ± 0.4 kJ g^{-1} (pollock) to a high of 10.2 ± 0.2 kJ g^{-1} (herring). These data add to the existing database on fish composition. Fatty acid signatures of herring, pollock, and tomcod were consistent with previously reported data. Three different species of sole (English, rock, and flathead) were also consistent with previously reported data for yellowfin sole. Detailed analyses of individual rock fish suggest that this species may exhibit trends in some specific fatty acids (20:5 n-3, 22:6 n-3) which differ from herring or pollock. More data are needed to properly address this possibility.

Key Words: *Hippoglossoides elassodon*, *Clupea pallasi*, *Theragra chalcogramma*, *Pleuronectes bilineatus*, *Pleuronectes vetulus*, *Microgadus proximus*, English sole, flathead sole, Pacific herring, walleye pollock, rock sole, tomcod, forage fish, proximate composition, energy density, fatty acid signatures, Prince William Sound AK

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Executive Summary: The purpose of this study was twofold. The first priority was to examine the proximate composition and energetic value of species which may be significant prey for sea birds or marine mammals. The second priority was to add to the available database on fatty acid signatures to help support efforts currently underway to utilize fatty acid signature analysis to identify potential prey species (*e.g.*, Iverson *et al.* in press). This project was undertaken in conjunction with SEA Project sampling cruises in October and November 1995 in Prince William Sound. All samples were analyzed for their energetic value and proximate composition (lipid, protein, ash and water content), as well as their fatty acid signatures.

Proximate composition and energy density data collected in the present study have expanded the available database for fish species found in PWS and also expand the available information beyond the summer season. Most species had relatively low lipid contents, less than 5% lipid (wet weight), except rock sole and English sole which were 6.0 ± 1.6% and 6.8 ± 0.5% lipid, respectively, and herring which ranged from 13.2 ± 0.6% to 16.6 ± 0.8% lipid. Herring showed a trend to higher lipid content in fish of greater than 170 mm in standard length. "Protein" content was relatively uniform generally ranging from 13.5 ± 1.6% to 15.9 ± 1.6%, with exceptions being tomcod (11.0 ± 1.3%) and rock sole (19.0 ± 1.4%). Energy density values ranged from a low of 4.0 ± 0.4 kJ g^{-1} (pollock) to a high of 10.2 ± 0.2 kJ g^{-1} (herring). Data collected in the present study also enlarges the database of fatty acid signatures which could potentially be used in the identification of potential prey species of upper trophic level vertebrates in Prince William Sound AK. Further studies need to be undertaken which will expand the existing database even further with the goal of being able to identify a wide variety of species and to ultimately understand the trophic interactions within the Sound region. Data of this type are critical if we are ever going to truly understand the trophic relationships within any system such as Prince William Sound.

Introduction: As a result of damage assessment studies initiated after the T/V *Exxon Valdez* struck Bligh Reef in March 1989, it was noted that several pelagic-feeding marine mammal and seabird species found in Prince William Sound, AK were apparently not recovering back to pre disturbance population levels. This lack of recovery may be due to a number of factors, including possible food limitations. Before one can discuss the impacts of food imitations on a species, there needs to be some knowledge of the significant prey species which are consumed. Traditionally this has been determined through the analysis of scats or stomach contents, however, these techniques are limited to identifying items which had been consumed recently. Techniques such as stable isotope analysis can determine the trophic level of prey consumed but this technique has limitations in identifying specific prey species which have been consumed. Recently, a new technique - fatty acid signature analysis - has been developed (Iverson 1993, Iverson *et al.* in press). This technique is based on the fact that specific fatty acids cannot be synthesized by animals and therefore can only originate in the diet. It is therefore possible to trace fatty acids obtained from the diet and to compare arrays in the tissues of the predator to those in the prey consumed. Through the identification of the fatty acid signature for different potential prey species, the actual prey consumed can be identified. Food quality has been suggested to be a potential problem for a variety of species which are found throughout the Bering Sea and Gulf of Alaska (Wooster 1993) and preliminary data (Roby 1996) are showing that there is a high degree of variability between species in terms of their energy content and proximate composition. While cause-effect relationships are difficult to demonstrate, changes in the energetic value of prey species can be quantified and these values used in the interpretation of energy availability to the impacted species. It was the goal of this project to add to the available databases on the energetic value of the major prey species found in Prince William Sound and fatty acid signatures.

Objectives: In Prince William Sound, two marine mammal species [harbor seals (*Phoca vitulina*), and sea otters (*Enhydra lutris*)] and several seabird species [common murre (*Uria aalge*), harlequin duck (*Histrionicus histrionicus*), marbled murrelet (*Brachyramphus marmoratus*), and pigeon guillemot (*Cepphus columba*)] have been impacted and are not recovering (Anonymous 1993). Others, such as killer whales (*Orcinus orca*) are slowly recovering but may be indirectly inhibiting the recovery of other species if food competition is a problem. There is increasing interest in the use of energetic models to study interactions between marine mammals and seabirds and their prey species (*e.g.* Jones and DeGange 1988). Often these models are based upon energy transfer between predator and prey (*e.g.* Wooster 1993). Although these models require information on the prey species consumed as well as the energy content or proximate composition of these species, few data are available. Those data which have been published have limited application due to the inherent seasonal and annual variability in the value of the prey (Stansby 1976, Hislop *et al.* 1991, Perez 1994). The goal of this proposed research was to assess the value of the major prey species which would be of significance to the predators listed above and to add to the available data on fatty acid signatures. These data will allow for the development of a model which can describe the energetic dynamics of the PWS ecosystem and which could yield the reasons for the lack of recovery of these species.

Methods: All samples of prey species were collected throughout Prince William Sound during October and November 1995 (Table 1) in conjunction with sampling cruises organized by the SEA Project. Samples were frozen immediately after collection and later shipped to Galveston, TX and subsequently to Halifax, NS Canada for analysis.

Composition Analysis:

All analytical techniques for proximate composition are described in detail in Worthy and Lavigne (1983) and Hislop *et al.* (1991). Analyses were performed on freeze-dried, individual ground fish and included determinations of water content, total lipid content, total protein content, ash content, and energy density (kJ g^{-1}). Initially, wet mass (g) and standard lengths (mm) of each individual specimen were recorded. Prey were then ground and homogenized prior to freeze-drying. Water content was determined gravimetrically by lyophilization of ground homogenized prey until constant mass had been obtained. This was accomplished using a LabConco Lyophilizer over a period of 4-5 days. Once the samples were dried, they were finely ground using a Spex 8000 Mixer/Mill. This ground material was used in all future proximate composition analysis.

Lipid content was measured gravimetrically by Soxhlet extraction using petroleum ether as the solvent. Ash content was determined by ashing at 550°C for 24 h in an ashing oven. Protein content was calculated as the difference, and actually would include some minimal levels of carbohydrate. Energy content was calculated using published values for lipid and protein (Worthy and Lavigne 1983).

Fatty Acid Analysis:

Fish were initially thoroughly ground in a homogenizing grinder. Except for rock sole, which were analyzed on an individual basis, fish of other species were ground together and fatty acid analysis was performed on the combined homogenate. Fish samples were extracted in 2:1 chloroform/methanol (v:v) with 0.01% BHT (w:v) by the Folch method (Folch *et al.* 1957) as modified by Iverson (1988). Fatty acid methyl esters were prepared directly from aliquots of the chloroform extract by the addition of borontrifluoride in methanol, sealing under nitrogen, and heating at 100°C for one hour. Following transesterification, methyl esters were extracted and purified in hexane.

Analysis of fatty acid methyl esters were performed according to Iverson *et al.* (1992) using temperature programmed capillary gas liquid chromatography on a Perkin Elmer Autosystem II Capillary FID Chromatograph fitted with a 30m x 0.25mm i.d. column (J&W DB-23) and linked to a computerized integration system (Turbochrom 4 software). Identifications of fatty acids and isomers were determined from known standard mixtures (Nu Check Perp., Elysian MN) and silver nitrate chromatography (Iverson 1988, Iverson *et al.* 1992). Fatty acids are designated by shorthand IUPAC nomenclature of carbon chain length:number of double bonds and location (n-x) of the double bond nearest the terminal methyl group.

Results: The "protein" fraction ranged from a low of 11.0 ± 1.3% (tomcod) to 19.0 ± 1.4% (rock sole) (Table 2, Figure 1). This fraction contains, in addition to protein, a small proportion of carbohydrate of approximately 0.1% (Donnelly *et al.* 1990). Most other species analyzed showed very similar protein content ranging between 13.5 ± 1.5% and 16.6 ± 0.3% (Table 2).

Most species which were examined had relatively low lipid contents (Table 2, Figure 1, Figure 2). Some pollock and the unidentified flatfish had fat contents of approximately 2% (Table 2, Figure 1, Figure 2). Flathead sole, most pollock, most rock sole, and tomcod all had fat contents of less than 6% lipid (ww) (Table 2, Figure 1, Figure 2). English sole and some rock sole exhibited values as high as 8% (Table 2, Figure 1, Figure 2). Herring was the only species which exhibited high fat content, with values ranging from 13.2 ± 0.6% to 16.6 ± 0.8% lipid and with a trend to higher lipid content in fish of greater than 170 mm in standard length (Table 2, Figure 2).

Water content varied inversely with lipid content (Figure 3). This relationship was similar to that reported previously by Kizevetter (1973). The exceptions to this relationship were the rock sole which tended to have a lower lipid content than would be predicted by the line. Ash content was generally low (<5.3%) with the exception of tomcod (8.9 ± 0.8%) (Table 2, Figure 1).

Energy density values ranged from 4.0 ± 0.4 kJ g^{-1} (pollock) to 10.2 ± 0.2 kJ g^{-1} (herring) (Table 2, Figure 4). Pollock, tomcod and the unidentified flatfish had energy densities ranging between 4 and 6 kJ g^{-1}; English sole, rock sole, and some flathead sole had energy values ranging from 5 to 8 kJ g^{-1}; and herring ranged from 8 to 11 kJ g^{-1} (Figure 4). For an equivalent size, one herring would provide double the energy of a single pollock.

Fatty acid signatures of pooled fish samples showed differences between species (Figure 5, Appendix 2) which were consistent with previously published material (Iverson 1993, Iverson *et al.* in press). Iverson *et al.* (in press) have shown that certain fatty acids show strong relationships with body size for herring and pollock. Data in the present study show trends similar to those reported by Iverson *et al.* (in press). Rock sole, English sole, flathead sole, and, to a lesser extent, the unidentified flatfish species clustered together and showed low levels of 20:1 n-11 and 22:1 n-11, as well as the ratios of 20:1 n-11/n-9 and 22:1 n-11/n-9 (Figure 5). These differences suggest different diets for these demersal and pelagic species. When individual rock soles were examined, three fish stood out as unusual (Figure 6). Five of the ten rock sole analyzed contained roe, but these fish did not consistently show any fatty acid signature differences from the other rock sole (Appendix 2).

Discussion: Proximate composition data collected in the present study adds to that collected previously by Roby (1996). The present study describes values for species which were not previously described as well as adding a new seasonal element to the database with samples analyzed during the October-November period. Many species exhibit dramatic seasonal changes in lipid content and energy value which are of great significance to the consumer populations and may lead to prey switching. Values measured for the fish species collected in the present study are comparable to values described for the same, or similar, species in other studies (*e.g.*, Kizevetter 1973, Stansby 1976, Stansby 1987, Donnelly *et al.* 1990, Hislop *et al.* 1991, Perez 1994). It is of great importance to maintain the monitoring of proximate composition and energy values for important prey species as there can be dramatic seasonal and annual variability (Worthy unpubl. data) which will have major consequences on the interpretation of an energy budget or in the assessment of what may be preventing the recovery of any impacted population or species.

Because fish do demonstrate dramatic seasonal and annual differences in proximate composition and energetic value, it is unwise to generalize about the value of a given prey species to a predator. The energy value of members of the family Gadidae (such as tomcod and pollock) generally have low lipid contents and vary little seasonally (Hislop *et al.* 1991), whereas members of the family Clupeidae (such as herring) show dramatic seasonal changes with fat levels ranging from as low as 2% to as high as 25% (Worthy and Lavigne 1983, Hislop *et al.* 1991, Roby 1996), with corresponding changes in energy density. It is important to remember, however, that these changes are only attained by the larger maturing or mature herring. This would be important for marine mammal predators but would be unavailable to most avian predators. Thus although these large clupeids may be useful to some predators, they would be unavailable to young seabirds. The energy densities, and fat contents, of the members of the family Pleuronectidae (soles) which were analyzed were relatively low consistent with previous data (Stansby 1976, Stansby 1987). Fish of this size would also be unavailable to seabirds. While their energetic value of these fish may be low, the energetic cost incurred in catching them is also very low and they could therefore be an easily accessible food source for marine mammal predators.

Historically the only options available to determine the food preferences of a species revolved around either direct observation of feeding or the analysis of stomach contents or scats. These techniques have many limitations. In recent years there have been a number of studies undertaken using stable isotopes of carbon and nitrogen to determine trophic relationships of a variety of birds and mammals (*e.g.*, Hobson 1987, Schell *et al.* 1989, Hobson and Montevecchi 1991, Sukumar and Ramesh 1992, Hobson *et al.* 1994, Hobson *et al.* 1995, Abend and Smith 1995). The major limitation of this technique is that it can only give limited information about the actual species being consumed.

In the last few years there has been increasing interest in the use of fatty acid signatures for the actual identification of prey being consumed by a predator. There have been a number of suggestions in the literature that there is a strong relationship between the fatty acid composition of storage tissues in an animal and the fatty acid composition of its prey (*e.g.*, Iverson 1988, Iverson *et al.* 1992, Iverson 1993, Iverson *et al.* 1995, Iverson *et al.* in press). Some recent studies are combining both the use of fatty acid signatures with an analysis of stable isotopes to attempt to refine even further the resolution of trophic relationships (*e.g.*, Gilmour *et al.* 1995, Pond *et al.* 1995, Smith *et al.* 1996). Thus the analysis of the fatty acid composition of marine mammal blubber or stored fat reserves in birds could lead to the identification of individual prey types and thereby establish the species composition of diets (Iverson 1988, Iverson *et al.* 1992). This approach has shown very promising results in initial applications to harbor seals in Prince William Sound AK (Iverson *et al.* in press). The first step in deriving such a relationship is an analysis of the presumed prey species in question to determine whether there are adequate differences in fatty acid composition to warrant further study. The ability to access the appropriate samples for this determination also allows one to assess the proximate composition and energetic value of those same prey species.

Conclusions: Proximate composition and energetic analysis undertaken in the present study have expanded the available database for fish species found in PWS, as well as expanding the available information beyond the summer season. Protein content for all species examined ranged from 11.0% to 16.6%; with most species having relatively low lipid contents generally averaging less than 5% lipid. Exceptions were, rock sole and English sole which were 5.2% and 6.7% lipid, respectively and herring which ranged from 13.2% to 16.6%. Energy density values ranged from

4.0 kJ g^{-1} (pollock) to 10.2 kJ g^{-1} (herring). Fatty acid signature data, collected in the present study, will enlarge the available database for potential prey species and will ultimately aid in the ability to assess dietary preferences for predator species in Prince William Sound.

Acknowledgments: We would like to acknowledge all of the individuals who assisted in this project by collecting the fish samples, including Margaret Powell, Evelyn Brown and Malcolm McEwen of the SEA Project. Dr. Sara Iverson, Dalhousie University, undertook all of the fatty acid signature analysis. In Galveston, David Medford and Mandy Keogh assisted in the preparation and analysis of fish proximate composition.

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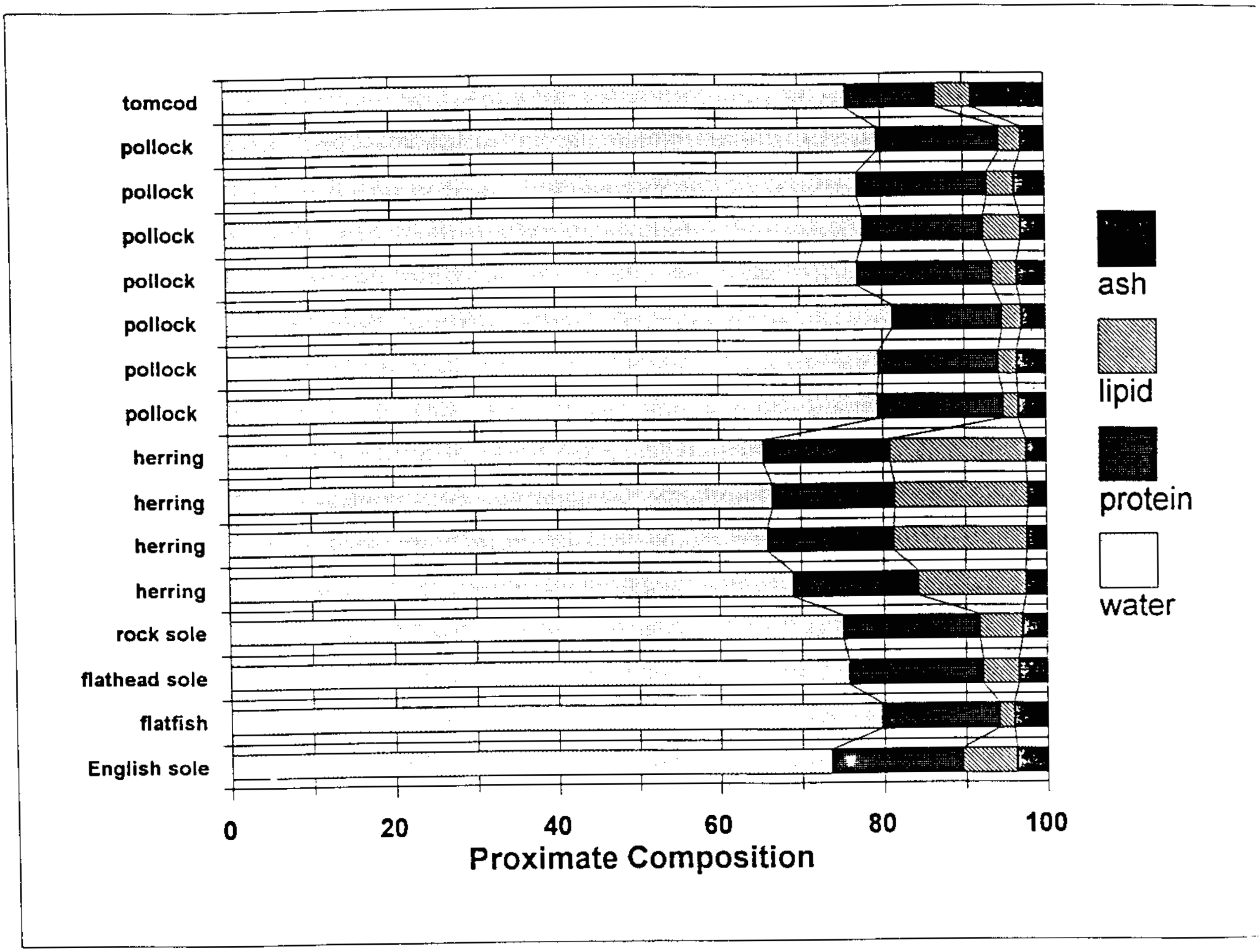

Figure 1: Proximate composition of each sample of fish analyzed in the present study. Values are means derived from all fish collected during each collection period (see Table 1).

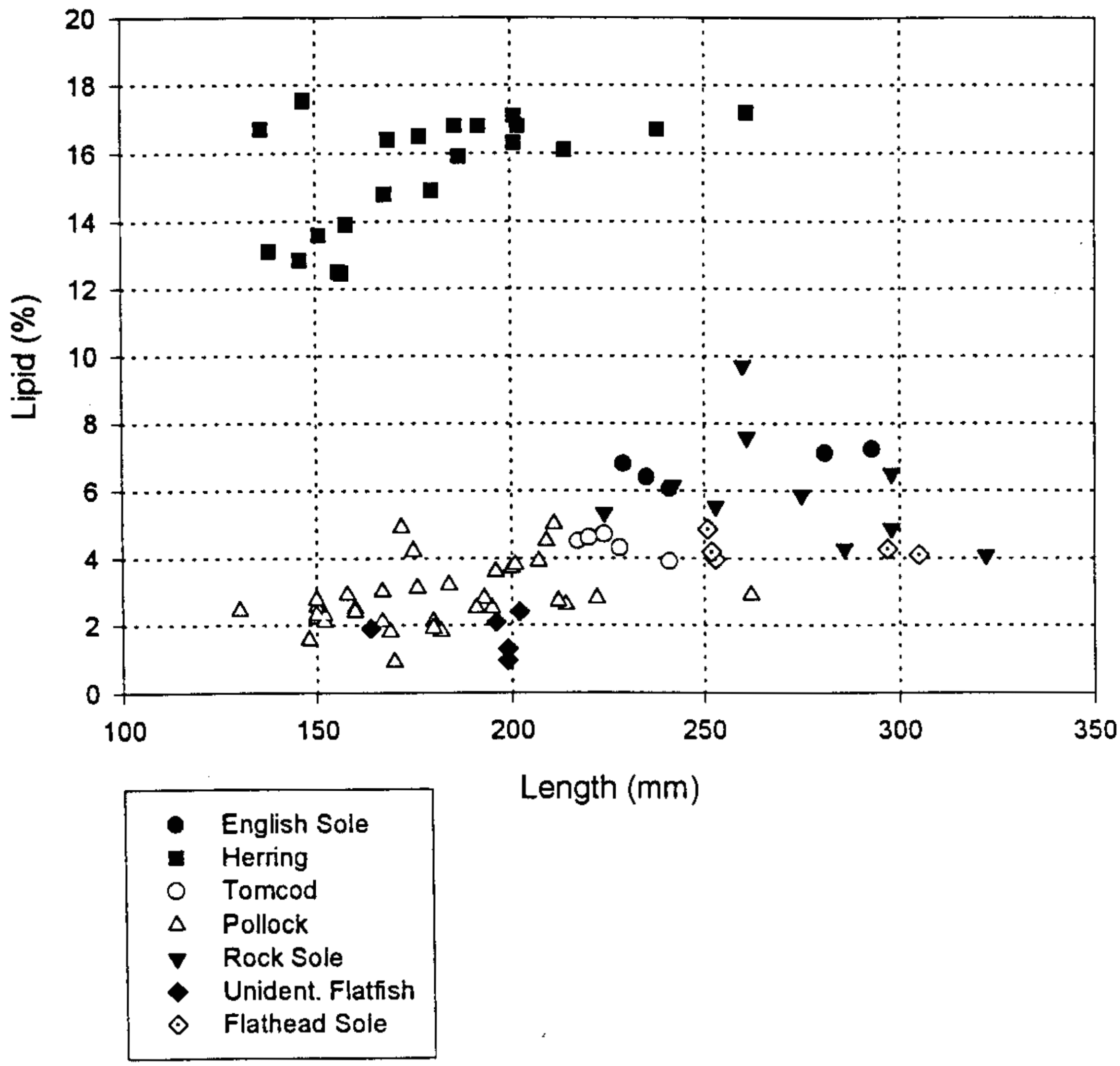

Figure 2: Lipid content as a function of standard length. Herring exhibited consistently high lipid contents (>13% ww) although there was an indication of larger herring having a greater lipid content. All other fish were uniformly low in lipid content (<8% w).

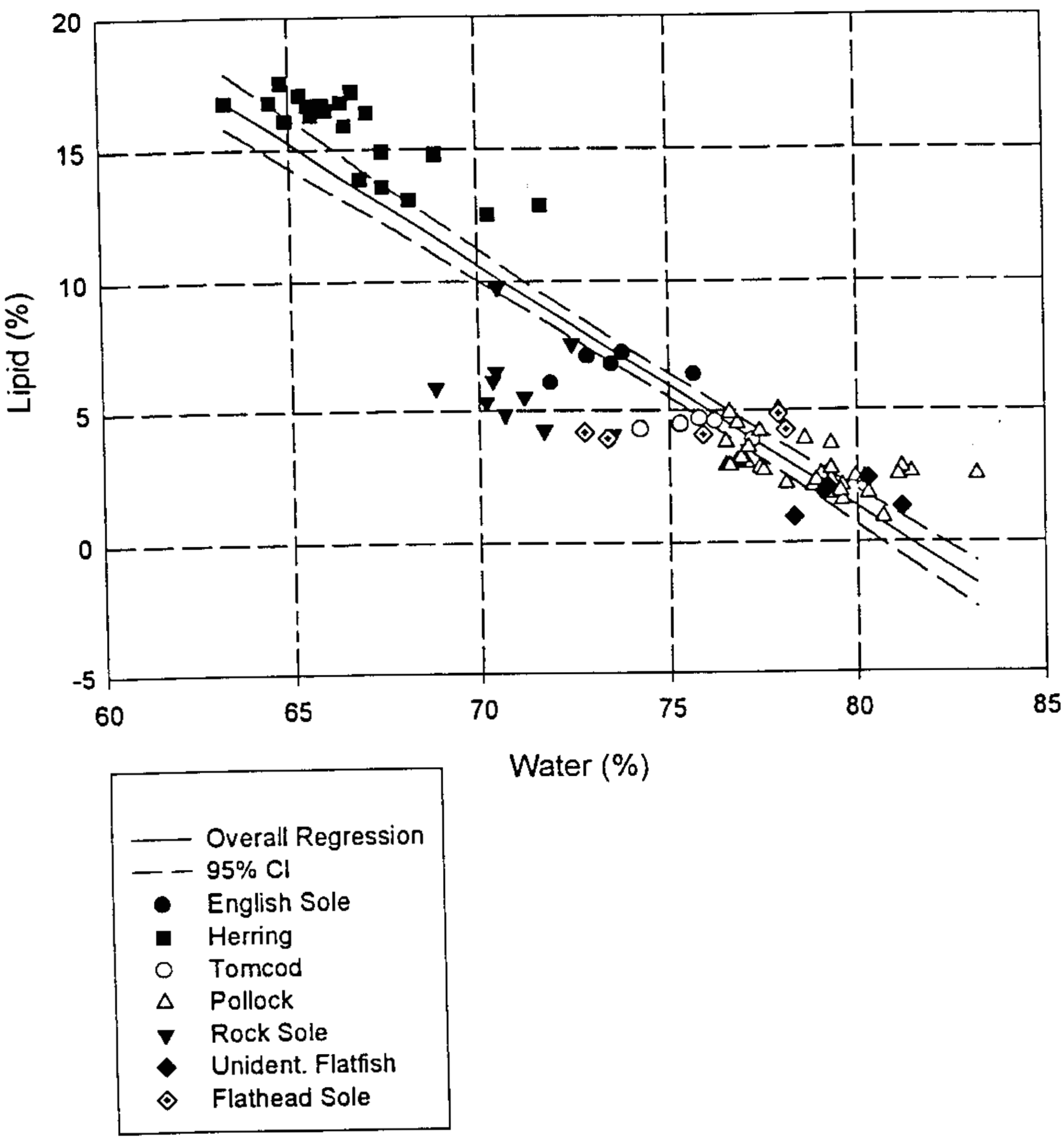

Figure 3: Lipid content as a function of water content of the same fish. The line describes the linear relationship between the two variable (± 95% CI). This relationship is similar to that described in Kizevetter (1973).

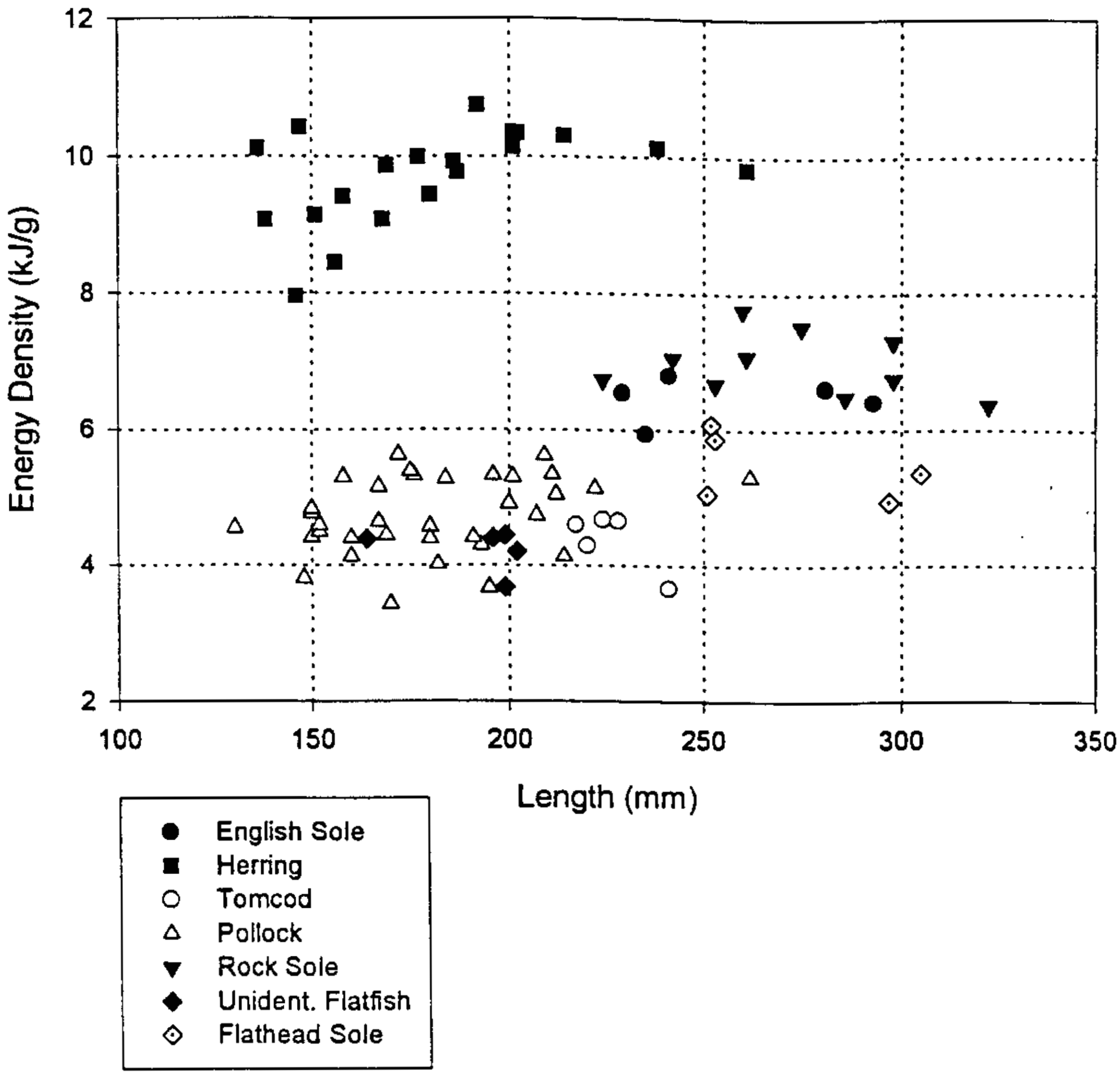

Figure 4: Energy density (kJ g^{-1}) as a function of standard length. Herring exhibited consistently high energy densities (>8 kJ g^{-1}) although there was an indication of larger herring having a greater energy density paralleling lipid contents. English sole and rock sole had intermediate densities (6-8 kJ g^{-1}). All other fish were uniformly low in energy density (<6 kJ g^{-1}).

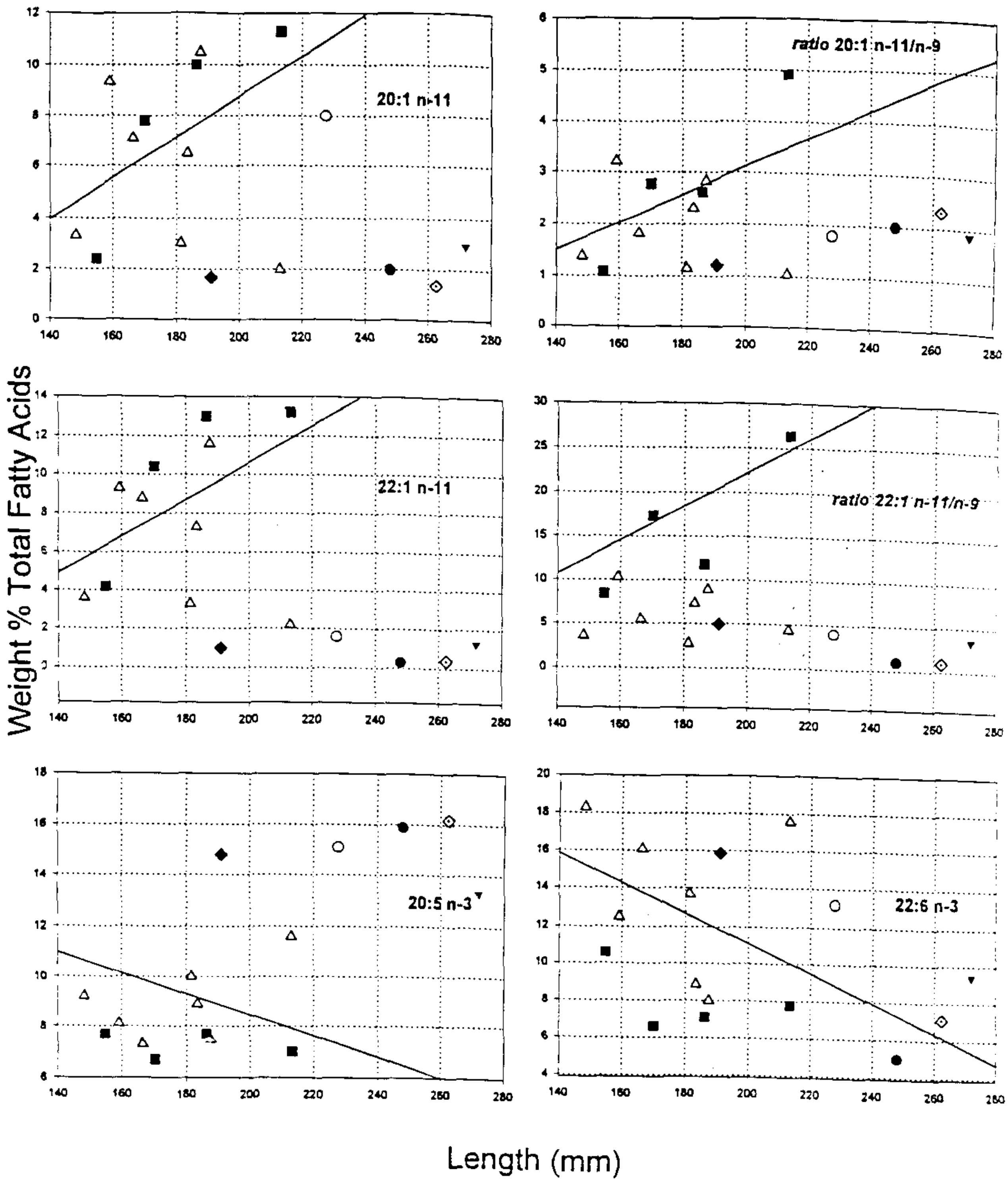

Figure 5: Variation in selected fatty acids and important isomers in fish from PWS as a function of body length. Lines are derived from Iverson *et al.* (in press) and represent the relationships for PWS herring. All values are derived from pooled fish samples, except rock sole which is an average value for 10 individually analyzed fish.

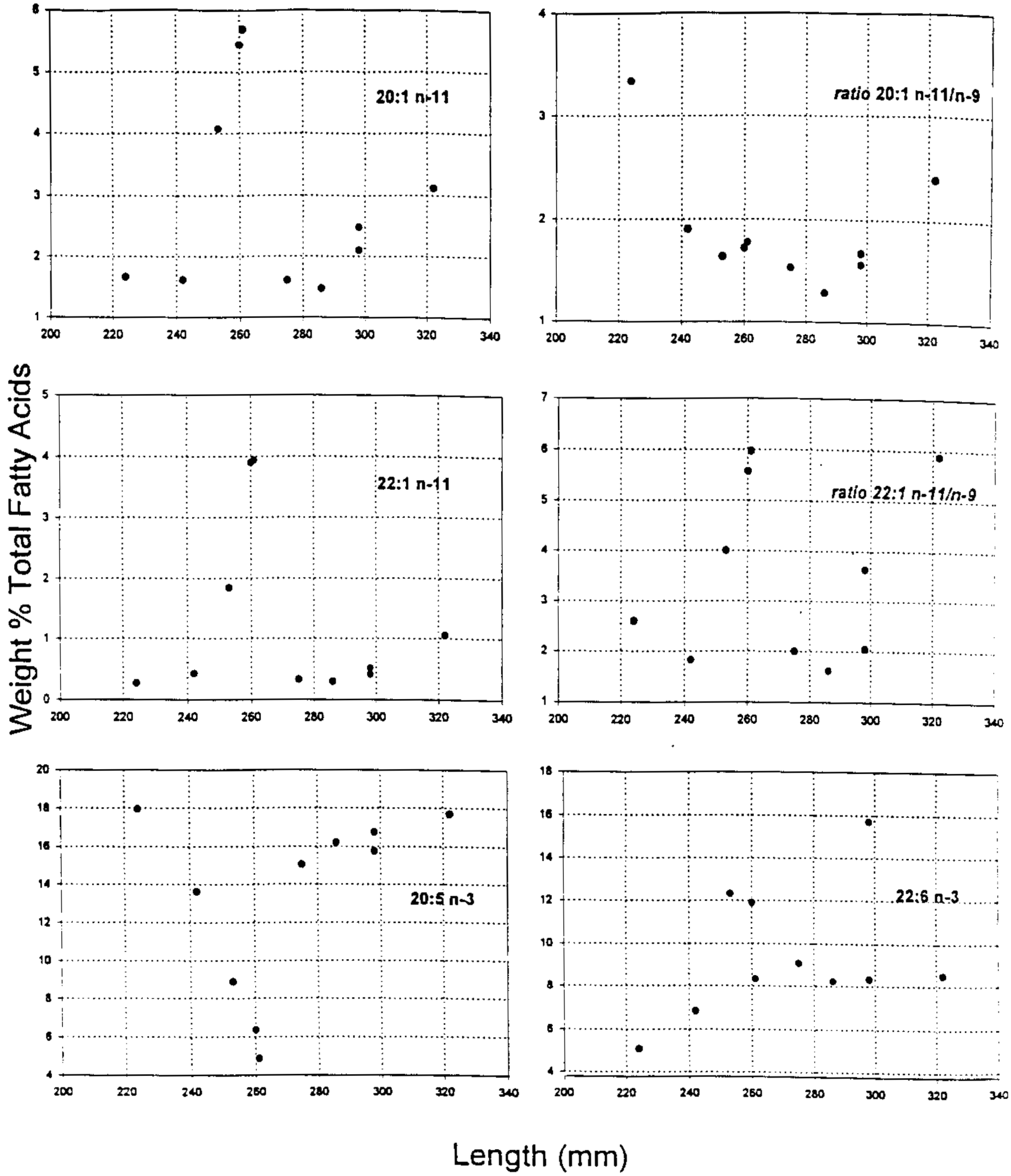

Figure 6: Variation in selected fatty acids and important isomers in rock sole from PWS as a function of body length.

Table 1: Catch information for all fish analyzed in the present study.

Species	Scientific Name	Location	Date	n	Set Number	Stop #
English sole	*Pleuronectes vetulus*	Simpson Bay	October 17, 1995	10	9511005	1
flatfish	unidentified flatfish	Jack Bay	November 4, 1995	10	9511054	13
flathead sole	*Hippoglossoides elassodon*	Simpson Bay	October 17, 1995	10	9511005	1
herring	*Clupea harengus pallasi*	Knowles Head	November 1, 1995	10	9512040	10
herring	*C. h. pallassi*	Green Island	October 25, 1995	10	9512038	3
herring	*C. h. pallassi*	Whale Bay	October 20, 1995	10	9512014	
herring	*C. h. pallassi*	Jack Bay	November 3, 1995	10	9515092	13
pollock	*Theragra chalcogramma*	Goose Island	November 3, 1995	10	9511051	13
pollock	*T. chalcogramma*	Jack Bay	November 3, 1995	10	9511053	13
pollock	*T. chalcogramma*	Hogg Bay	November 8, 1995	10	9511020	15
pollock	*T. chalcogramma*	Eaglek	November 5, 1995	10	9511059	14
pollock	*T. chalcogramma*	Sawmill	November 8, 1995	10	9511063	6
pollock	*T. chalcogramma*	Whale Bay	October 19, 1995	11	9515045	5
pollock	*T. chalcogramma*	Simpson Bay	October 18, 1995	10	9511005	1
rock sole	*Pleuronectes bilineatus*	Simpson Bay	October 17, 1995	10	9511005	1
tomcod	*Microgadus proximus*	Simpson Bay	October 16, 1995	10	9515002	1

Table 2: Proximate composition and energy density values for all fish sampled during fall 1995 cruises in Prince William Sound. All values are means (±SD)

Species	Location	Date	n	length (mm)	mass (g)	% H_2O	% lipid	% protein	% ash	energy (kJ/g)
English sole	Simpson Bay	Oct. 17	5	247.9 (41.6)	289.6 (87.2)	73.5 (1.2)	6.8 (0.5)	15.8 (1.2)	3.9 (0.2)	6.5 (0.3)
unident. flatfish	Jack Bay	Nov. 4	5	190.9 (13.9)	84.7 (16.3)	79.6 (1.0)	1.7 (0.5)	14.5 (1.3)	4.2 (0.2)	4.2 (0.3)
flathead sole	Simpson Bay	Oct. 17	5	262.6 (26.7)	336.7 (110.8)	75.6 (2.2)	4.3 (0.5)	15.5 (2.1)	3.5 (0.3)	5.5 (0.4)
herring	Knowles Head	Nov. 1	5	154.9 (9.0)	49.6 (9.0)	68.9 (1.8)	13.2 (0.6)	15.3 (1.6)	2.6 (0.3)	8.8 (0.5)
herring	Green Island	Oct. 25	5	170.2 (20.0)	72.8 (22.9)	65.9 (1.9)	16.4 (1.4)	15.3 (1.2)	2.4 (0.2)	10.0 (0.6)
herring	Whale Bay	Oct. 20	5	186.3 (14.0)	96.8 (20.9)	66.5 (1.8)	16.3 (1.1)	14.9 (0.5)	2.3 (0.3)	9.9 (0.3)
herring	Jack Bay	Nov. 3	5	213.3 (21.1)	132.0 (26.4)	65.4 (1.7)	16.6 (0.8)	15.4 (1.2)	2.5 (0.3)	10.2 (0.2)
pollock	Goose Island	Nov. 3	5	166.3 (17.6)	37.8 (9.9)	79.4 (0.8)	1.8 (1.1)	13.5 (0.7)	3.4 (0.6)	4.0 (0.4)
pollock	Jack Bay	Nov. 3	5	159.1 (10.2)	38.2 (5.8)	79.5 (0.8)	2.2 (0.4)	14.7 (0.9)	3.6 (0.3)	4.5 (0.2)
pollock	Hogg Bay	Nov. 8	5	183.4 (18.6)	52.3 (9.8)	81.2 (1.2)	2.4 (0.7)	13.5 (1.6)	3.0 (0.2)	4.2 (0.3)
pollock	Eaglek	Nov. 5	5	181.4 (32.1)	58.2 (23.0)	76.9 (1.3)	3.0 (0.2)	16.6 (0.3)	3.5 (0.2)	5.2 (0.1)
pollock	Sawmill	Nov. 8	5	187.5 (17.2)	62.7 (17.8)	77.6 (1.0)	4.5 (0.9)	14.9 (0.7)	3.1 (0.2)	5.4 (0.3)
pollock	Whale Bay	Oct. 18	5	213.1 (19.4)	134.5 (44.1)	77.1 (1.0)	3.4 (0.8)	15.9 (1.6)	3.7 (0.4)	5.2 (0.3)
pollock	Simpson Bay	Oct. 18	5	148.3 (9.8)	45.2 (9.7)	79.5 (0.9)	2.5 (0.5)	15.2 (0.6)	3.0 (0.2)	4.7 (0.2)
rock sole	Simpson Bay	Oct. 17	10	271.9 (29.6)	502.9 (87.9)	71.0 (1.2)	6.0 (1.6)	19.0 (1.4)	4.0 (0.8)	7.0 (0.4)
tomcod	Simpson Bay	Oct. 16	5	227.7 (7.7)	136.4 (13.7)	75.8 (1.0)	4.4 (0.5)	11.0 (1.3)	8.9 (0.8)	4.4 (0.4)

Appendix 1: Proximate composition of each of the fish samples. All values are expressed as percent wet weight.

SPECIES	LOCATION	DATE	%water	% lipid	%ash	%other	energy (kJ/g)	length (mm)	mass (g)
English Sole	Simpson Bay	10/17/95	73.5	6.8	3.7	16.1	6.6	229.0	185.53
			75.7	6.4	3.8	14.2	5.9	235.0	189.11
			71.9	6.1	3.8	18.3	6.8	241.0	215.51
			72.9	7.1	4.2	15.8	6.6	281.0	361.50
			73.8	7.2	4.2	14.8	6.4	293.0	407.96
								255.0	263.70
								176.0	68.83
								289.0	360.67
								289.0	333.04
								191.0	91.47
Flatfish, unid.	Jack Bay	11/4/95	81.2	1.3	4.6	12.9	3.7	199.0	111.36
			78.3	1.0	4.2	16.6	4.4	199.0	95.61
			79.2	2.1	4.0	14.7	4.4	196.0	75.01
			80.3	2.4	3.9	13.4	4.2	202.0	84.29
			79.1	1.9	4.1	14.9	4.4	164.0	59.55
								180.0	78.79
								200.0	85.93
								174.0	62.00
								187.0	79.30
								204.0	89.90
Flathead Sole	Simpson Bay	10/17/95	77.9	4.9	4.3	13.0	5.1	251.0	232.54
			78.1	4.3	4.2	13.4	4.9	297.0	416.57
			73.4	4.0	5.0	17.7	5.9	253.0	257.65
			72.8	4.2	4.8	18.2	6.1	252.0	258.30
			75.9	4.1	4.6	15.4	5.3	305.0	469.88
								225.0	209.72
								235.0	276.81
								275.0	496.17
								270.0	412.23
								270.0	412.23
Pacific Herring	Knowles Head	11/1/95	70.3	12.5	2.3	14.9	8.4	156.0	48.05
			71.7	12.9	3.1	12.4	8.0	146.0	38.60
			68.2	13.1	2.2	16.5	9.1	138.0	33.52
			67.5	13.6	2.9	16.0	9.1	151.0	44.63
			66.9	13.9	2.6	16.7	9.4	158.0	53.70
								149.0	49.06
								167.0	58.72
								157.0	49.33
								162.0	59.40
								165.0	60.55
Pacific Herring	Jack Bay	11/3/95	66.7	17.2	2.9	13.2	9.8	261.0	126.36
			64.9	16.1	2.2	16.9	10.3	214.0	138.45
			65.6	16.3	2.2	15.9	10.1	201.0	124.48
			65.5	16.7	2.6	15.2	10.1	238.0	197.40
			64.5	16.8	2.8	15.9	10.3	202.0	103.80
								199.0	117.68
								215.0	142.90
								192.0	111.32
								201.0	116.86

								210.0	140.94
Pacific Herring	Green Island	10/25/95	64.8	17.6	2.6	15.1	10.4	147.0	35.58
			68.9	14.8	2.4	13.9	9.1	168.0	80.36
			63.3	16.8	2.4	17.6	10.7	192.0	86.06
			65.9	16.7	2.3	15.2	10.1	136.0	43.57
			66.5	15.9	2.6	15.0	9.8	187.0	91.32
								174.0	82.31
								148.0	42.91
								176.0	79.61
								191.0	95.67
								183.0	91.14
Pacific Herring	Whale Bay	10/20/95	67.5	14.9	2.4	15.2	9.4	180.0	84.17
			65.3	17.1	2.1	15.5	10.4	201.0	121.93
			67.1	16.4	1.9	14.6	9.9	169.0	69.41
			66.4	16.8	2.6	14.2	9.9	186.0	114.46
			66.0	16.5	2.6	15.0	10.0	177.0	79.85
								191.0	99.68
								213.0	129.43
								190.0	106.91
								189.0	88.77
								167.0	73.69
Pacific Tomcod	Simpson Bay	10/16/95	77.2	3.9	10.1	8.8	3.7	241.0	169.55
			74.3	4.3	9.2	12.3	4.7	228.0	138.29
			75.3	4.5	8.5	11.7	4.6	217.0	134.69
			75.8	4.7	7.8	11.7	4.7	224.0	137.21
			76.2	4.6	8.9	10.3	4.3	220.0	140.96
								228.0	129.04
								227.0	136.04
								221.0	129.54
								235.0	115.38
								236.0	132.93
Walleye Pollock	Eaglek	11/5/95	77.4	2.8	3.3	16.5	5.1	222.0	108.25
			76.5	2.9	3.6	17.0	5.3	158.0	40.35
			77.1	3.0	3.7	16.3	5.1	167.0	42.21
			76.8	3.1	3.4	16.8	5.3	176.0	51.54
			76.9	3.2	3.5	16.4	5.3	184.0	64.37
								174.0	58.74
								162.0	40.56
								153.0	42.24
								254.0	87.96
								164.0	45.85
Walleye Pollock	Hogg Bay	11/8/95	79.6	2.1	3.0	15.3	4.6	180.0	61.70
			83.2	2.5	3.3	11.0	3.7	195.0	60.05
			81.5	2.6	3.2	12.8	4.1	214.0	66.52
			81.2	2.8	2.9	13.1	4.3	193.0	49.86
			80.3	1.8	2.7	15.3	4.4	169.0	36.45
								200.0	52.73
								182.0	47.09
								161.0	43.46
								153.0	44.07
								187.0	61.17

Walleye Pollock	Sawmill	11/7/95	79.3	3.7	2.8	14.2	4.9	200.0	73.68
			76.8	4.5	2.9	15.8	5.6	209.0	83.92
			76.6	4.9	3.3	15.2	5.6	172.0	45.20
			77.9	5.0	3.2	13.9	5.3	211.0	89.02
			77.4	4.2	3.1	15.3	5.4	175.0	49.51
								185.0	61.30
								199.0	77.82
								188.0	61.00
								178.0	49.15
								158.0	36.55
Walleye Pollock	Goose Island	11/3/95	80.7	0.9	5.9	12.5	3.4	170.0	34.88
			79.2	2.5	4.3	14.1	4.4	191.0	46.88
			78.1	2.2	5.2	14.5	4.4	150.0	30.34
			79.2	1.8	5.5	13.5	4.0	182.0	52.98
			79.6	1.6	5.8	13.1	3.8	148.0	27.87
								157.0	34.00
								145.0	31.30
								179.0	55.00
								153.0	28.60
								156.0	34.30
Walleye Pollock	Jack Bay	11/3/95	81.1	2.5	3.5	12.9	4.1	160.0	42.36
			78.8	2.1	4.1	15.0	4.5	152.0	30.72
			78.8	2.1	3.5	15.6	4.6	167.0	36.38
			79.3	2.3	3.3	15.1	4.6	152.0	31.31
			79.6	1.9	3.7	14.9	4.4	180.0	37.70
								149.0	34.03
								155.0	38.64
								167.0	50.40
								147.0	38.15
								162.0	41.94
Walleye Pollock	Whale Bay	10/18/95	78.6	3.9	4.3	13.2	4.7	207.0	107.32
			75.6	2.9	3.4	18.2	5.6	262.0	219.31
			77.5	2.7	3.5	16.3	5.0	212.0	113.72
			77.1	3.6	3.3	16.0	5.3	196.0	101.92
			76.5	3.8	4.1	15.6	5.3	201.0	107.36
								231.0	197.29
								197.0	103.20
								221.0	187.69
								206.0	106.21
								212.0	127.40
								199.0	107.66
Walleye Pollock	Simpson Bay	10/17/95	80.0	2.4	2.9	14.7	4.5	130.0	40.32
			79.0	2.5	3.0	15.4	4.8	150.0	37.48
			80.2	2.4	3.3	14.2	4.4	160.0	46.49
			79.3	2.8	2.9	15.1	4.8	150.0	37.36
			78.9	2.3	2.8	16.1	4.8	150.0	63.23
								260.0	252.12
								260.0	219.85
								290.0	259.25
								150.0	46.11
								210.0	251.30

Rock Sole	Simpson Bay	10/17/95	70.5	9.7	3.3	16.4	7.8	260.0	355.23
			68.9	5.9	3.9	21.4	7.5	275.0	472.82
			70.7	4.9	4.6	19.9	6.8	298.0	600.01
			71.7	4.3	4.3	19.7	6.5	286.0	492.66
			70.2	5.3	5.4	19.1	6.7	224.0	162.36
			71.2	5.5	4.7	18.6	6.7	253.0	336.42
			70.4	6.1	4.4	19.1	7.1	242.0	266.61
			70.5	6.5	3.4	19.6	7.3	298.0	557.35
			72.5	7.6	2.9	17.0	7.1	261.0	423.02
			73.5	4.1	2.9	19.5	6.4	322.0	765.34

Appendix 2: Fatty acid composition of each of the fish samples. All values are expressed as percent total fatty acid composition.

species	location	date	n	12:0	13:0	iso 14	14:0	14:1w9	14:1w7	14:1w5	iso15	anti15	15:0	15:1w8
English sole	Simpson Bay	10/17/95	5	0.00	0.10	0.00	3.90	0.50	0.10	0.10	0.30	0.20	0.80	0.00
flatfish (unid)	Jack Bay	11/4/95	5	0.00	0.00	0.00	3.00	0.40	0.00	0.00	0.10	0.00	0.50	0.00
flathead sole	Simpson Bay	10/17/95	5	0.00	0.00	0.00	3.30	0.80	0.10	0.10	0.10	0.10	0.70	0.10
pollock	Hogg Bay	11/8/95	5	0.00	0.00	0.00	4.40	0.20	0.00	0.10	0.10	0.00	0.30	0.00
pollock	Sawmill	11/7/95	5	0.00	0.00	0.00	5.60	0.30	0.00	0.10	0.20	0.00	0.30	0.00
pollock	Eaglek	11/5/95	5	0.00	0.00	0.00	4.00	0.20	0.00	0.10	0.10	0.00	0.30	0.00
pollock	Goose Island	11/3/95	5	0.00	0.00	0.00	4.30	0.30	0.00	0.00	0.10	0.00	0.30	0.00
pollock	Jack Bay	11/3/95	5	0.00	0.00	0.00	4.80	0.20	0.00	0.10	0.10	0.00	0.30	0.00
pollock	Whale Bay	10/19/95	5	0.00	0.00	0.00	3.40	0.20	0.00	0.10	0.10	0.00	0.30	0.00
pollock	Simpson Bay	10/17/95	5	0.00	0.00	0.00	4.00	0.30	0.00	0.10	0.20	0.00	0.40	0.00
herring	Jack Bay	11/3/95	5	0.20	0.00	0.00	7.90	0.20	0.00	0.10	0.20	0.10	0.30	0.00
herring	Knowles Head	11/1/95	5	0.10	0.00	0.00	6.90	0.50	0.10	0.00	0.30	0.10	0.50	0.00
herring	Green Island	10/25/95	5	0.20	0.00	0.00	8.50	0.40	0.00	0.10	0.20	0.10	0.40	0.00
herring	Whale Bay	10/20/95	5	0.30	0.00	0.00	8.70	0.30	0.00	0.10	0.20	0.10	0.30	0.00
tomcod	Simpson Bay	10/16/95	5	0.00	0.00	0.00	1.90	0.20	0.10	0.10	0.10	0.00	0.40	0.00
rock sole	Simpson Bay	10/17/95	1	0.05	0.03	0.03	3.46	0.29	0.07	0.13	0.69	0.16	0.41	0.02
rock sole	Simpson Bay	10/17/95	1	0.21	0.02	0.03	2.33	0.67	0.09	0.16	0.21	0.11	0.72	0.11
rock sole	Simpson Bay	10/17/95	1	0.09	0.03	0.04	4.45	0.21	0.04	0.13	0.25	0.09	0.53	0.01
rock sole	Simpson Bay	10/17/95	1	0.03	0.01	0.06	3.28	1.57	0.04	0.09	0.54	0.29	0.61	0.03
rock sole	Simpson Bay	10/17/95	1	0.04	0.02	0.02	3.82	0.13	0.04	0.13	0.18	0.07	0.37	0.00
rock sole	Simpson Bay	10/17/95	1	0.07	0.02	0.02	3.55	0.55	0.07	0.14	0.22	0.07	0.45	0.02
rock sole	Simpson Bay	10/17/95	1	0.07	0.02	0.01	4.57	0.30	0.05	0.10	0.11	0.05	0.50	0.03
rock sole	Simpson Bay	10/17/95	1	0.03	0.01	0.04	2.65	0.24	0.07	0.07	0.27	0.17	0.64	0.03
rock sole	Simpson Bay	10/17/95	1	0.04	0.01	0.02	3.81	0.27	0.04	0.09	0.14	0.07	0.45	0.02
rock sole	Simpson Bay	10/17/95	1	0.23	0.02	0.07	5.46	0.18	0.05	0.17	0.54	0.24	0.94	0.07

fattyacids

species	location	15:1w6	iso16	16:0	16:1w11	16:1w9	16:1w7	7me16:0	16:1w5	16:2w6	iso17	16:2w4
English sole	Simpson Bay	0.10	0.40	12.50	0.80	0.50	13.70	0.30	0.70	0.10	0.50	0.60
latfish (unid)	Jack Bay	0.00	0.20	15.30	0.00	0.40	10.30	0.20	0.20	0.00	0.40	0.50
lathead sole	Simpson Bay	0.10	0.30	14.50	0.50	0.70	13.70	0.30	0.40	0.10	0.30	0.80
pollock	Hogg Bay	0.00	0.10	18.90	0.50	0.20	4.10	0.40	0.20	0.00	0.20	0.40
pollock	Sawmill	0.00	0.10	14.70	0.50	0.20	5.80	0.40	0.20	0.10	0.10	0.50
pollock	Eaglek	0.00	0.20	19.20	0.40	0.20	6.20	0.30	0.10	0.00	0.10	0.30
pollock	Goose Island	0.00	0.20	16.80	0.00	0.10	4.80	0.30	0.10	0.00	0.30	0.30
pollock	Jack Bay	0.00	0.10	15.20	0.50	0.20	7.50	0.40	0.10	0.00	0.20	0.50
pollock	Whale Bay	0.00	0.10	17.80	0.60	0.20	5.20	0.30	0.20	0.00	0.10	0.30
pollock	Simpson Bay	0.00	0.10	18.00	0.50	0.30	5.50	0.20	0.20	0.00	0.10	0.30
herring	Jack Bay	0.00	0.10	13.80	0.50	0.10	7.80	0.30	0.20	0.10	0.10	0.50
herring	Knowles Head	0.00	0.00	21.30	0.80	0.20	7.00	0.40	0.20	0.10	0.10	0.30
herring	Green Island	0.00	0.00	17.50	0.70	0.20	7.70	0.40	0.20	0.10	0.10	0.50
herring	Whale Bay	0.00	0.00	13.90	0.50	0.10	7.70	0.20	0.10	0.10	0.00	0.30
tomcod	Simpson Bay	0.00	0.10	14.30	0.60	0.50	6.90	0.20	0.40	0.00	0.20	0.30
rock sole	Simpson Bay	0.00	0.41	13.85	0.62	0.57	6.97	0.28	0.66	0.05	0.57	0.85
rock sole	Simpson Bay	0.09	0.54	13.29	0.58	0.75	14.76	0.30	0.69	0.11	0.43	0.37
rock sole	Simpson Bay	0.01	0.22	14.51	0.80	0.56	7.24	0.40	0.21	0.05	0.23	0.79
rock sole	Simpson Bay	0.01	0.94	15.47	0.65	0.53	10.98	0.48	0.99	0.11	0.94	0.70
rock sole	Simpson Bay	0.00	0.17	12.55	0.65	0.47	6.84	0.32	0.15	0.06	0.18	0.69
rock sole	Simpson Bay	0.01	0.37	13.65	1.11	0.54	9.76	0.23	0.60	0.13	0.45	0.59
rock sole	Simpson Bay	0.02	0.39	15.20	0.91	0.43	7.37	0.17	0.28	0.08	0.17	0.40
rock sole	Simpson Bay	0.02	0.63	15.09	1.06	0.68	8.16	0.33	0.70	0.10	0.57	0.65
rock sole	Simpson Bay	0.03	0.36	15.06	0.87	0.47	6.19	0.19	0.34	0.06	0.19	0.64
rock sole	Simpson Bay	0.04	0.76	14.07	0.90	0.54	9.31	0.32	0.81	0.10	0.89	0.59

species	*location*	*16:3w4*	*17:1*	*16:3w1*	*16:4w1*	*16:4w3*	*18:0*	*18:1w13*	*18:1w11*	*18:1w9*	*18:1w7*	*18:1w5*
English sole	Simpson Bay	0.70	0.10	0.20	0.70	n/a	3.40	0.60	0.20	7.80	6.00	0.40
flatfish (unid)	Jack Bay	0.50	0.50	0.00	0.50	n/a	3.60	0.00	0.20	8.00	6.60	0.20
flathead sole	Simpson Bay	0.90	0.10	0.20	0.10	n/a	2.70	0.00	0.10	6.30	7.40	0.20
pollock	Hogg Bay	0.30	0.20	0.10	0.10	n/a	3.90	0.00	0.90	10.90	5.40	0.30
pollock	Sawmill	0.40	0.20	0.00	0.30	n/a	2.70	0.20	1.70	9.30	3.40	0.40
pollock	Eaglek	0.20	0.20	0.10	0.20	n/a	4.00	0.20	0.80	13.90	6.00	0.40
pollock	Goose Island	0.10	0.10	0.20	0.20	n/a	2.80	0.10	1.00	11.10	3.90	0.40
pollock	Jack Bay	0.20	0.10	0.00	0.20	n/a	2.70	0.20	1.90	9.40	3.80	0.60
pollock	Whale Bay	0.20	0.20	0.10	0.20	n/a	4.00	0.10	0.40	13.10	6.10	0.30
pollock	Simpson Bay	0.20	0.20	0.00	0.20	n/a	3.50	0.00	0.40	13.80	3.70	0.40
herring	Jack Bay	0.40	0.20	0.00	0.70	n/a	1.30	0.10	0.30	10.50	2.50	0.60
herring	Knowles Head	0.20	0.30	0.10	0.30	n/a	2.00	0.10	0.20	16.60	2.70	0.90
herring	Green Island	0.30	0.30	0.00	0.60	n/a	1.40	0.10	0.20	12.50	2.90	0.80
herring	Whale Bay	0.60	0.20	0.00	1.00	n/a	1.10	0.10	0.30	10.30	2.10	0.60
tomcod	Simpson Bay	0.60	0.00	0.10	0.20	n/a	3.40	0.80	0.70	13.60	5.30	0.40
rock sole	Simpson Bay	0.35	0.05	0.04	0.23	0.24	2.83	0.47	1.00	15.25	4.33	0.40
rock sole	Simpson Bay	0.69	0.18	0.26	0.29	1.07	3.01	0.46	0.00	3.83	7.59	0.22
rock sole	Simpson Bay	0.58	0.02	0.05	0.26	0.22	2.45	0.31	1.75	20.28	4.20	0.66
rock sole	Simpson Bay	0.35	0.10	0.17	0.24	0.55	2.99	0.40	0.17	9.08	7.40	0.40
rock sole	Simpson Bay	0.44	0.03	0.03	0.22	0.19	2.27	0.19	1.29	18.98	3.84	0.53
rock sole	Simpson Bay	0.36	0.05	0.03	0.24	1.32	3.04	1.44	0.17	7.57	4.48	0.31
rock sole	Simpson Bay	0.34	0.06	0.97	0.18	0.99	3.14	1.41	0.08	6.45	4.25	0.27
rock sole	Simpson Bay	0.41	0.09	0.77	0.24	0.56	3.75	1.28	0.08	5.97	5.30	0.43
rock sole	Simpson Bay	0.34	0.03	0.44	0.20	0.46	3.14	1.23	0.11	8.34	3.34	0.35
rock sole	Simpson Bay	0.87	0.22	0.22	0.70	0.16	2.76	0.46	0.00	7.64	5.99	0.41

species	location	18:2w6	18:2w4	18:3w6	18:3w4	18:3w3	18:3w1	18:4w3	18:4w1	20:0	20:1w11	20:1w9
English sole	Simpson Bay	0.70	0.30	0.00	0.20	0.30	0.20	1.50	0.10	0.10	2.00	1.00
flatfish (unid)	Jack Bay	0.70	0.20	0.00	0.00	0.20	0.00	1.30	0.00	0.00	1.70	1.40
flathead sole	Simpson Bay	0.90	0.40	0.20	0.10	0.30	0.20	1.90	0.10	0.00	1.40	0.60
pollock	Hogg Bay	1.00	0.10	0.00	0.10	0.80	0.00	1.60	0.00	0.00	6.50	2.80
pollock	Sawmill	0.80	0.10	0.10	0.10	0.70	0.00	1.90	0.20	0.10	10.50	3.70
pollock	Eaglek	0.80	0.10	0.00	0.10	0.50	0.10	1.10	0.10	0.00	3.00	2.60
pollock	Goose Island	0.70	0.10	0.00	0.00	0.40	0.10	0.80	0.10	0.10	7.10	3.90
pollock	Jack Bay	0.70	0.10	0.00	0.10	0.40	0.10	0.90	0.10	0.10	9.30	2.90
pollock	Whale Bay	0.90	0.10	0.10	0.10	0.70	0.10	1.80	0.10	0.10	2.00	1.90
pollock	Simpson Bay	1.00	0.10	0.00	0.10	0.80	0.20	1.70	0.10	0.00	3.30	2.40
herring	Jack Bay	0.80	0.10	0.10	0.10	0.70	0.10	1.80	0.20	0.20	11.30	2.30
herring	Knowles Head	1.20	0.10	0.10	0.10	1.30	0.20	2.40	0.10	0.10	2.40	2.20
herring	Green Island	0.80	0.10	0.10	0.10	0.70	0.10	1.80	0.20	0.20	7.80	2.80
herring	Whale Bay	0.70	0.10	0.00	0.10	0.60	0.00	2.00	0.20	0.20	10.00	3.80
tomcod	Simpson Bay	1.00	0.30	0.00	0.20	0.80	0.20	1.30	0.30	0.10	8.00	1.60
rock sole	Simpson Bay	1.40	0.19	0.08	0.07	0.48	0.15	0.64	0.09	0.07	4.08	2.49
rock sole	Simpson Bay	0.98	0.45	0.21	0.10	0.50	0.11	2.43	0.13	0.06	1.67	0.50
rock sole	Simpson Bay	1.32	0.18	0.09	0.05	0.73	0.15	1.41	0.10	0.09	5.70	3.21
rock sole	Simpson Bay	0.67	0.35	0.12	0.35	0.48	0.18	1.27	0.35	0.09	1.62	0.85
rock sole	Simpson Bay	1.34	0.16	0.09	0.05	0.70	0.14	1.02	0.09	0.09	5.45	3.17
rock sole	Simpson Bay	0.32	0.56	0.08	0.54	0.14	0.16	1.55	0.77	0.08	2.48	1.48
rock sole	Simpson Bay	0.80	0.28	0.15	0.07	1.30	0.12	2.33	0.20	0.10	3.12	1.30
rock sole	Simpson Bay	1.28	0.34	0.13	0.19	1.27	0.15	1.97	0.25	0.11	1.48	1.15
rock sole	Simpson Bay	1.09	0.22	0.12	0.06	1.23	0.15	2.45	0.13	0.06	2.10	1.34
rock sole	Simpson Bay	0.65	0.49	0.14	0.22	0.60	0.21	1.42	0.17	0.07	1.61	1.05

fattyacids

species	location	20:2w6	20:3w6	20:4w6	20:3w3	20:4w3	20:5w3	22:1w11	22:1w9	22:1w7	22:2w6
English sole	Simpson Bay	0.40	0.10	2.30	0.10	0.40	15.90	0.30	0.30	0.20	0.20
flatfish (unid)	Jack Bay	0.10	0.00	4.40	0.00	0.30	14.80	1.00	0.20	0.20	0.20
flathead sole	Simpson Bay	0.10	0.10	3.00	0.10	0.40	16.20	0.40	0.40	0.20	0.80
pollock	Hogg Bay	0.20	0.00	0.70	0.10	0.40	8.90	7.30	1.00	0.20	0.00
pollock	Sawmill	0.20	0.00	0.30	0.10	0.60	7.50	11.60	1.30	0.20	0.10
pollock	Eaglek	0.20	0.00	0.80	0.10	0.50	10.00	3.30	1.20	0.10	0.00
pollock	Goose Island	0.20	0.00	0.80	0.10	0.40	7.30	8.80	1.60	0.20	0.00
pollock	Jack Bay	0.20	0.00	0.60	0.10	0.40	8.10	9.30	0.90	0.20	0.00
pollock	Whale Bay	0.20	0.00	0.90	0.10	0.60	11.60	2.20	0.50	0.10	0.00
pollock	Simpson Bay	0.30	0.00	0.80	0.10	0.70	9.20	3.60	1.00	0.10	0.00
herring	Jack Bay	0.20	0.00	0.30	0.10	0.60	7.00	13.20	0.50	0.20	0.00
herring	Knowles Head	0.20	0.00	0.30	0.10	0.70	7.70	4.20	0.50	0.10	0.00
herring	Green Island	0.20	0.00	0.20	0.10	0.50	6.70	10.40	0.60	0.20	0.10
herring	Whale Bay	0.20	0.00	0.20	0.00	0.50	7.70	13.00	1.10	0.20	0.00
tomcod	Simpson Bay	0.50	0.10	1.30	0.20	1.00	15.10	1.60	0.40	0.10	0.20
rock sole	Simpson Bay	0.48	0.13	2.43	0.15	0.55	8.88	1.84	0.46	0.24	0.54
rock sole	Simpson Bay	0.23	0.09	2.92	0.10	0.46	17.96	0.26	0.10	0.55	0.79
rock sole	Simpson Bay	0.31	0.08	0.74	0.17	1.09	4.85	3.94	0.66	0.21	0.07
rock sole	Simpson Bay	0.26	0.07	1.09	0.09	0.57	13.63	0.42	0.23	0.26	0.14
rock sole	Simpson Bay	0.38	0.11	1.19	0.21	1.13	6.36	3.90	0.70	0.18	0.08
rock sole	Simpson Bay	0.32	0.08	1.52	0.05	0.40	16.76	0.41	0.20	0.46	1.38
rock sole	Simpson Bay	0.39	0.08	2.04	0.27	0.42	17.71	1.06	0.18	0.49	0.84
rock sole	Simpson Bay	0.68	0.13	2.50	0.33	0.51	16.21	0.29	0.18	0.40	0.39
rock sole	Simpson Bay	0.42	0.09	1.51	0.19	0.62	15.76	0.51	0.14	0.25	0.73
rock sole	Simpson Bay	0.43	0.15	1.97	0.15	0.46	15.04	0.32	0.16	0.33	0.10

species	*location*	*22:4w3*	*22:5w3*	*22:6w3*	*24:1*	*24:1w11*	*24:1w9*	
English sole	Simpson Bay	0.00	3.50	5.00	n/a	0.00	0.10	
flatfish (unid)	Jack Bay	0.00	2.40	15.90	n/a	0.00	0.20	
flathead sole	Simpson Bay	0.10	2.50	7.10	n/a	0.00	0.20	
pollock	Hogg Bay	0.00	0.80	8.90	n/a	0.30	0.90	
pollock	Sawmill	0.10	0.80	8.00	n/a	0.40	0.90	
pollock	Eaglek	0.10	1.00	13.70	n/a	0.00	0.70	
pollock	Goose Island	0.00	0.90	16.10	n/a	0.20	0.90	
pollock	Jack Bay	0.00	0.90	12.50	n/a	0.30	0.70	
pollock	Whale Bay	0.00	0.90	17.60	n/a	0.00	0.60	
pollock	Simpson Bay	0.00	1.00	18.30	n/a	0.00	0.80	
herring	Jack Bay	0.00	0.90	7.80	n/a	0.30	0.50	
herring	Knowles Head	0.00	0.50	10.60	n/a	0.10	0.80	
herring	Green Island	0.00	0.50	6.60	n/a	0.20	0.70	
herring	Whale Bay	0.00	0.70	7.10	n/a	0.30	0.60	
tomcod	Simpson Bay	0.10	2.80	13.20	n/a	0.00	0.30	
rock sole	Simpson Bay	0.02	2.98	12.33	0.65	n/a	n/a	
rock sole	Simpson Bay	0.02	2.66	5.08	0.37	n/a	n/a	
rock sole	Simpson Bay	0.03	2.25	8.34	0.61	n/a	n/a	
rock sole	Simpson Bay	0.07	4.90	6.85	0.46	n/a	n/a	
rock sole	Simpson Bay	0.04	3.94	11.90	0.81	n/a	n/a	
rock sole	Simpson Bay	0.10	2.92	8.35	0.26	n/a	n/a	eggs
rock sole	Simpson Bay	0.08	2.77	8.52	0.47	n/a	n/a	eggs
rock sole	Simpson Bay	0.08	4.85	8.24	0.55	n/a	n/a	eggs
rock sole	Simpson Bay	0.02	2.69	15.72	0.47	n/a	n/a	eggs
rock sole	Simpson Bay	0.07	4.57	9.10	0.34	n/a	n/a	eggs