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ABSTRACT

Higgins, P.S., I.K. Birtwell, B.T. Atagi, D. Chilton, M. Gang, G.M. Kruzynski, H. Mahood, G.E. Piercey, B.A. Raymond, I.H. Rogers and S. Spohn. 1987. Some characteristics of the eulachon (Thaleichthys pacificus) captured in the the Fraser River Estuary, April 1986. Can. MS. Rep. Fish. Aquat. Sci. 1913: 47 p.

Morphometric characteristics of eulachons (Thaleichthys pacificus), captured in gill nets (2.50, 3.75 cm mesh size) and undergoing spawning migrations through the Fraser River estuary between April 8 and 29, 1986 were examined. Site specific and sexually based differences in length-weight relationships, length frequency, gonad and liver development and age frequency were documented in relation to an investigation of organic contaminants in these fish.

Variation in fish size was found to be dependent on the sex of the fish and unrelated to the site of capture. Male eulachons (mean fork length ± S.D.: 181 ± 13.82 mm, n=325) were found to be larger than females (mean fork length ± S.D.: 161 ± 23.52 mm, n=95). Notwithstanding gill net selectivity, length frequency analysis revealed that 60% of the fish were between 175-195 mm fork length, and males outnumbered females by a ratio of 3.4 to 1. Evidence of a unimodal length distribution of males and a bimodal distribution of females were also observed.

Based upon the burnt otolith technique of age determination, it was deduced that age IV^{+}, V^{+}, VI^{+} and VII^{+} fish were represented in our catches, most fish were from age IV^{+} (40%) and V^{+} (45%) cohorts.

Variation in gonadal and hepatic development, based on gonadal and hepatosomatic indices, was most significant between the sexes than between the capture sites. Female eulachons had greater development in both organ systems than did males as did males over immatures.

Correlation analysis between morphometric characteristics and the distance of the capture site from the river mouth revealed further sexual differences. Male fork length, gonad and liver size increased with capture distance from the mouth. While female liver size increased with distance from the river mouth, there was no similar correlation between fork length or gonad size.

RÉSUME

Higgins, P. S., I. K. Birtwell, B. T.Atagi, D. Chilton, M. Gang, G. M. Kruzynski, H. Mahood, G. E. Piercey, B. A. Raymond, I. H. Rogers and S. Spohn. 1987. Some characteristics of the eulachon (Thaleichthys pacificus) captured in the Fraser River Estuary, April 1986. Can. MS Rep. Fish. Aquat. Sci. 1913: 47 p.

Les auteurs ont étudié les caractéristiques morphométriques d'eulakanes (Thaleichthys pacificus) capturés entre le 8 et le 29 avril 1986 à l'aide de filets maillants (maillage de 2,50 et 3,75 cm) au cours de la montaison dans l'estuaire du fleuve Fraser. Les différences entre les relations longueur-poids selon les sites étudiés et les sexes, la fréquence des longueurs, le stade de développement des gonades et du foie ainsi que la fréquence des âges ont été étudiés en fonction des polluants organiques présents dans ces poissons.

La variation de la taille du poisson dépend du sexe mais non du site de capture. Les eulakanes mâles (longueur moyenne à la fourche ± É.-T = 181 ± 13,82 mm, n=325) sont plus longs que les femelles (longueur moyenne à la fourche ± É.-T = 161 ± 23,52 mm, n=95). Sans tenir compte de la sélectivité des filets maillants, l'analyse de la fréquence des longueurs a révélé que 60% des poissons mesuraient de 175 à 195 mm (longueur à la fourche) et que les mâles surpassaient les femelles en nombre dans un rapport de 3,4 à 1. On a aussi observé une distribution unimodale et bimodale des longueurs chez les mâles et les femelles respectivement.

Selon la technique de détermination de l'âge basée sur le brûlage des otolithes, on a déterminé que des poissons de IV+, V+, VI+ et VII+ étaient présents dans les captures et que la plupart appartenaient aux cohortes d'âges IV+ (40%) et V+ (45%).

Les variations du stade de développement des gonades et du foie, déterminé à l'aide des indices gonadosomatiques et hépatosomatiques, étaient plus marquées entre les sexes qu'entre les sites de capture. Chez les femelles, ces deux systèmes organiques étaient plus développés; c'étaient aussi le cas des mâles par rapport aux individus immatures.

Une analyse de corrélation entre les caractéristiques morphométriques et la distance entre le site de capture et l'embouchure du fleuve a révélé d'autres différences sexuelles. Chez les mâles, la longueur à la fourche et la taille du foie et des gonades augmentaient avec la distance entre le site de capture et l'embouchure. Chez les femelles, la taille du foie augmentait de la même façon, mail il n'y avait aucune corrélation semblable entre la longueur à la fourche et la taille des gonades.

INTRODUCTION

The lower Fraser River and its estuary provides habitat for many commercially and recreationally important fish species (Northcote 1974). The input of deleterious substances through the discharge of industrial and municipal effluent, storm waters, land runoff and spills combine to degrade habitat quality (Garrett 1980). In recognition of this aquatic contamination, the need for toxic chemical research in the lower Fraser River has been emphasized (Hall 1985). Given the nature of estuarine systems, where both river discharge and tidal cycles vary, quantifying pollutant residence times and understanding the effects of contaminants is a complex task. The difficulty and expense of initiating and managing water quality management programs has tended to hinder this research. Our objective was to find a means to partially circumvent this difficulty and to obtain a suitable method for identifying relative changes in contaminant concentrations that is unbiased by the effects of point source sampling.

Many investigators have suggested that instream aquatic organisms be used as indicator species to monitor toxic contaminants. Presence or absence of organisms is a method that has been used to reflect levels of aquatic contamination but it will not always reveal sublethal effects and the health of organisms (Birtwell 1985). Jacob and Hall (1985) and Johnstone et al. (1975) investigated contaminants in tissues of organisms in the Fraser River and found a contaminant load. However, the absence of information on the residency of the organisms, hence an assessment of exposure, detract from the utility of tissue analysis to reflect overall aquatic habitat quality.

Biological characteristics of the eulachon (Thaleichthys pacificus) make it a possible receptor species for revealing general chlorinated organic pollution. Behaviourally, eulachons are suitable indicators; they migrate into the Fraser River estuary during relatively low flow conditions and are less susceptible to point source concentrations of contaminants than non-migrant species which may reside in the vicinity of discharges. Physiologically, they are suitable due to a high (approximately 15% wet weight) lipid content and it is expected that they will readily accumulate lipophilic organic contaminants. Thus, during migration eulachons may integrate the effects of multiple contaminant sources, assuming negligible effects of selective accumulation and depuration.

The validity of using eulachons as "indicator" species relies upon the assumption that uptake and accumulation of lipophilic organic compounds will reflect the relative exposure concentrations that fish experience. Using indices of migration timing, it may also be possible to estimate time spent in transit through the estuary and therefore exposure times to organic contaminants in the environment.

Upriver spawning migration generally occurs in early spring (March or April) and is believed to be initiated by a number of factors. Water temperature and river discharge have been cited as important variables by Ricker et al (1954), Smith and Saalfeld (1955) and Langer et al (1977). The presence of bird and mammalian predators were also used to identify timing of eulachon migrations in the Nass River by Langer et al (1977). Spawning in the Fraser River has been documented to occur primarily between Chilliwack and Mission in areas of coarse sand but also in localized areas of the North and South Arms as well as in the vicinity of the Pitt and Alouette Rivers (Hart and McHugh 1944, Samis 1977). Information from local fishery officers also suggests that potential spawning sites exist in the lower Fraser River adjacent to Barnston, McMillan and Matsqui Islands (Samis 1977) which are approximately 100 km, 130 km, and 175 km from the Fraser River mouth respectively.

The intention of this work was to provide biological information in support of an assessment of contaminant levels in eulachons. Information on the biology of eulachons is sparse, and it is expected that the data we present will supplement knowledge of the species in the Fraser River system.

METHODS

Study Location

Five sites were chosen at which eulachons would be captured during the initial phase of their spawning migration through the Fraser River estuary. Figure 1 identifies the relative positon of each site. Site 1 (Steveston), adjacent to the Albion dyke, was chosen for its proximity to Georgia Strait, thus a reference site for the South Arm. Site 2 (Annacis Island) was located on the South Arm downstream of the bifurcation of the mainstem at New Westminster and upriver of an area of industrial and municipal effluent discharge. Site 3 (MacDonald Beach) provided a reference point on the North Arm of the Fraser River. Site 5 (New Westminster) was in the North Arm, just downstream of the bifurcation, but above a number of effluent discharge locations. Site 4 (Port Mann), located outside the region of saline water incursion, was used as an upstream reference location.

Fish Capture and Preparation

Various methods of fish capture were attempted, including the use of beach seines, anchored floating and sunken gill nets, and drifting floating and sunken gill nets. It was concluded that beach seining was ineffective and that the drifting nets were the most successful and efficient. Accordingly, drifting floating and sunken nets, deployed from an inflatable boat, were used. Anchored nets were also used at the Annacis Island sampling site (Figure 1).

The nets comprised three panels, each measuring 30 m X 2.5 m. Mesh sizes used were 2.5 cm, 3.75 cm and 5.0 cm. Each net consisted of two or more different mesh sizes. The 2.5 cm and 3.75 cm mesh sizes captured the most eulachons.

Fishing times varied from 0800 to 2300 hr, thus encompassing different tidal and light regimes.

Table 1 summarizes information on the number of eulachons that were retained for morphometric and contaminant analysis from each of the five samping sites.

Eulachons were quickly removed from the gill net, killed, and then placed in tin foil that had been previously rinsed in methylene chloride. The fish were then stored on ice in plastic bags for laboratory analysis and dissection. All personnel who handled the fish wore plastic gloves which had been rinsed in methylene chloride.

At each fish capture site, water samples (2 L) were taken in methylene chloride-rinsed glass containers 0.5 m below the water surface. The samples were then kept in coolers and packed with ice. Temperature and salinity were also measured with a hand-held mercury thermometer (±0.1°C) and a Yellow Springs Instruments Model 33 temperature-salinity-conductivity meter at 0.5 m depth.

Lengths and weights of eulachons were recorded before the removal of the livers (plus gall bladders) and gonads were weighed separately. Whole body and gonad weights were measured with a Mettler PL300 balance (±0.01g). Livers and gall bladders were measured with a Mettler H6T DIG 160g balance (±0.0001g).

A subsample of twenty fish was retained for age determination. Five methods were investigated by the aging laboratory at the Pacific Biological Station, Nanaimo, B.C. The methods were scale readings, dorsal and pectoral fin ray section readings, otolith surface and cross sectional readings, and burnt otolith surface readings. Scales of the eulachons had 12-18 evenly spaced circuli, giving the appearance of juvenile fish; no observable change in growth rate was apparent. Similarly, fin ray examination also did not display growth patterns and were difficult to prepare as they were fragile and opaque. Direct surface readings and cross-section reading of otoliths were unclear, leading to inconsistent determinations. Surface readings of burnt otoliths were found to give the best resolution and consistency and hence were used in the analysis.

RESULTS

The size, length-frequency characteristics, age distribution, gonadal and hepatic development of 441 eulachons captured from the five sampling sites were recorded and the basic data are given in Table 2.

Length and Weight

A summary (by site and by sex) of the mean fork length and mean body weight of eulachons is given in Table 3. From this table it is apparent that males are larger than females at each of the sites. The weight-length relationship for the sampled population was calculated and Figure 2 shows regression lines for male, female and immature fish. This relationship was also calculated for fish captured at each site (male, female and/or immature) to investigate site-specific and sexually based variations; the equations describing these relationships are presented in Table 4. Although Figure 2 suggests that male and female weight-length relationships are similar, Table 4 demonstrates that sexual differences in size are consistent in samples taken at different sites.

To quantify the sources of observed variation in fish size, a general linear model procedure for unbalanced analysis of variance (GLM ANOVA) was employed, utilizing SAS statistical software. This method enabled the use of factorial analysis on data with unequal sample size on the basis of site and sex. The results of this analysis suggest that sexual differences contributed the most variation to fork length ($p<0.0001$) and that significant differences resulting from site of capture were also observed ($p<0.001$). Interactive effect between site and sex was the least significant ($p<0.020$) suggesting that there is little variation in fork length between males and females from different sites. One-way GLM ANOVA's on the site and sex variables were warranted to determine the source of variation. Site-specific differences were shown to be significant and mean fork length was then compared by a Student-Newman-Keuls multiple comparison (SNK:$p<0.05$). This comparison showed no significant difference between the mean fork length of fish collected at all sites except that from MacDonald Beach (Table 5). This was presumed to be due to the fact that only immature fish were captured at this site hence the expectation of a smaller size.

Sexually based differences were tested in the same fashion. Male eulachons were significantly larger than females and immatures, and females were shown to be significantly larger than immatures (Table 5).

Length Frequency

Length frequency data were compiled and compared in Figure 3. Examination of the size distribution of all fish combined indicates that approximately 60% were between 175 and 195 mm fork length. Figure 4 suggests a unimodal distribution of males and a bimodal distribution of females, indicating that one cohort of males and two cohorts of females are present in the spawning migrations at the time of capture. Length frequency is similar among Annacis Island, Port Mann and New Westminster sites but in general, smaller fish were captured at the Steveston and MacDonald sites (Figure 5).

Age Distribution

Data from this analysis is given in Table 6 and the age distributions of male, female, and immature fish are presented in Figure 6.

Fish from age groups IV^+, V^+, VI^+, and VII^+ were detected in our subsample. Size-at-age relationships were calculated for each sex using a GLM procedure. The resulting linear equations are:

MALES FL=127.64 + 11.16(AGE) R^2=0.50; n=10

FEMALES FL= 78.00 + 19.00(AGE) R^2=0.47; n=10

Where FL = fork length (mm)

Histograms of length frequency of the observed age groups were then compiled to investigate the possible use of size as an estimator of age. Figure 7 suggests that little overlap occurs between age groups. The mean size at a specific age was compared by the SNK procedure. This comparison demonstrated that overlap occurred, but the sizes of age IV^+ and V^+ fish were significantly different from the sizes of age VII^+ eulachons (see Table 5). Therefore size may not be a satisfactory indicator of age in these fish.

Gonadal and Hepatic Development

To evaluate gonadal and hepatic development we calculated indices relative to somatic body weight (by capture site and sex). The results are summarized in Table 7. Examination of the indices regressed against fork length demonstrate differences between males and females. Comparing data for all sites and fish of equivalent size, females had higher gonadosomatic indices (GSI) and hepatosomatic indices (HSI) than males, with differences in GSI values being the largest (see Figures 8 and 9).

To investigate variation in GSI and HSI values, the data were transformed (arcsine square root) to allow the binomial proportion data to be used in ANOVA procedures. Utilizing the factorial GLM ANOVA, differences in GSI and HSI between males and females were observed to be the most significant. Differences due to the site of capture were also shown to be significant, whereas the interactive effect between was the least significant (Table 8).

One way GLM ANOVA with SNK multiple comparisons were used to delineate the effects due to site and sex. Females were shown to have higher GSI and HSI values than males. Males had more gonad development but less hepatic development than immature fish ($p<0.05$). The results from these tests are summarized in Table 5.

Site-specific differences were less defined than sexual differences in gonadal and hepatic development. For GSI, fish from Steveston and New Westminister had the highest values, those fish from Annacis Island and Port Mann sites were intermediate and the lowest indices were from immature fish captured at MacDonald Beach. Mean hepatic development was shown to be nontransitive, where only the mean values of HSI from the Steveston and Port Mann sites were separated significantly.

Morphometric Changes and Capture Site

To investigate the existence of a relationship between distance from the estuary mouth and morphometric variables mean values, (where n=70-128 for males and n=15-33 for females) of fork length, HSI, GSI, and Fulton's condition factor (Ricker 1975), were compared to the distance from the Steveston sampling site. The distance of each site of capture from this site was estimated from an hydrographic chart (scale of 1 to 50000). These distances are given in Table 9 with their respective mean morphometric value, and Table 10 summarizes the correlation analysis. This analysis suggested that fork length and HSI were significantly related to the upriver distance of the capture site. For both sexes, mean fork length increased and mean HSI values decreased as upriver distance increased. Male GSI values decreased but female GSI were not significantly correlated to distance of the capture site from the river mouth. Condition factor of both sexes was unrelated to the upriver distance of the capture site.

DISCUSSION

The method of capture was qualitatively assessed. Smith and Saalfeld (1955) and Langer et al. (1977) report three types of gear have been used in commercial and recreational fisheries: dip nets, gill nets and trawls. Due to the physical topography of the Fraser River estuary, that is, no extreme constrictions in the river or known locations of eulachon schools, it was not feasible to use dip nets. Towed or stationary trawls were not utilized due to logistical problems. Gill nets were intially set to fish surface waters but when catches were observed to be in the lower portion of the net, submerged nets were used. The merit of anchored and drift fishing techniques was evaluated using a standardized soak time (approximately 0.5 hr). Both techniques were effective but site characteristics (i.e. depth, current) dictated the best method of net deployment.

Time of capture was also assessed. It had been reported that flooding tides aided in the migration of fish against downstream flow (Smith and Saalfeld 1955, Langer et al 1977). Langer et al. (1977) also found that catch could be forecasted from the height and timing of the tides. Communication with local fishery officers suggested that migration was also crepuscular. Effort was made to quantitatively discriminate between the effects of light and tide but due to the confounding interaction of natural photoperiod and tidal state during the period of migration this was not possible. However, the most successful fishing was, qualitatively, at dusk on the high slack tide.

Variations in morphometric characteristics between male and female eulachon were marked. Males were larger but had lower indices of organ development than did the females of equivalent size (Table 4). This is in accordance with reports by Langer et al (1977), Scott and Crossman (1973), and Hart and McHugh (1944), who found greater body rigidity in males relative to females, due to increased development of musculature.

Our data indicate that, based on otolith readings, individuals of ages IV$^+$ to VII$^+$ were present in the 1986 spawning migration of the Fraser River eulachon. Investigations by Hart and McHugh (1944) and Ricker et al. (1954) suggest that cohorts of ages II$^+$ and III$^+$ predominate in the spawning population in the Fraser River stock. However, these deductions were based on scale readings; the actual age may have been underestimated. Differences between otolith and scale readings exist, primarily due to absorption of the outer edge of scales in conjunction with spawning migrations (Smith and Saalfeld 1955). When these methods are compared, differences range between one to three years less for scale determinations (Ricker et al. 1954, Langer et al. 1977). Langer et al. (1977) and Smith and Saalfeld (1955) suggest that ages II^+ to V^+ were present with ages III^+ and IV^+ being dominant in spawning migrations of the Nass River and Columbia River systems. It is clear that ambiguity exists in the determination of the age of spawning eulachons, but we cannot discount the probability of different age classes spawning in different river systems. Generally ages II^+ to VII^+ are present, with ages III^+, IV^+ and V^+ being dominant in spawning migrations in varying proportions.

Sexually-based differences in age and length distribution were also more prevalent than site specific variation. Figure 4 gives the length frequency of fish by sex. These histograms suggest that most male eulachons were 190 mm fork length and that two groups of females, 150 mm and 180 mm fork length, were present. Comparison of the "mean size at age" information suggests that IV^+ and V^+ year age classes were most abundant. This is, however, a tentative conclusion due to the overlap in fork length between "age classes" and ambiguity between the age determination methodologies.

Males predominated over females in catches by an average ratio of 3.4 to 1. This value is in agreement with estimates made by Hart and McHugh (1944) on the Fraser river stock in 1943 and with Smith and Saalfeld (1955) on the Columbia (mean value for all tributaries was 4.5 to 1). Langer et al. (1977) found that the sex ratio of eulachons was related to the distance of the sampling site up the river and to the time of sampling. They found males in greater proportions farther up the river and further into the migration period. However, our sampling did not indicate that sex ratio significantly changed as the fish were captured farther up the river, hence there was no evidence of sexual dominance in the waves of spawning eulachons in the Fraser River.

Distance from Georgia Strait (Steveston capture site) and morphometric variables are significantly correlated. Fork length increased, while GSI and HSI values declined in males in relation to the upstream distance of the capture site. Female variables demonstrated the same trend, except that gonadal tissue did not decline, but remained constant relative to body weight (see Figure 5). It can be deduced from these data that larger fish may migrate farther up the river than smaller fish due to an increased swimming ability and that hepatic organs may decrease in size (possibly in relation to the growth of reproductive tissue).

Spawning has been documented to occur both in the upper reaches of the lower Fraser River (i.e. between Chilliwack and Mission, Hart and McHugh 1944) as well as in the north and south arms of the lower Fraser River (Samis 1977). Langer et al. (1977) report that two separate spawning "waves" may be present in the Nass River: a male-dominated population migrating farther upstream to spawn and a female-dominated group remaining and spawning in the lower reaches of the river. Our results, of lower GSI values in the vicinity of Annacis Island and New Westminster contrast with the higher values in eulachons captured at Steveston and at Port Mann. Thus, there is an indication of similar situation in the lower Fraser River. However, although some spawning may occur in the vicinity of the New Westminster and Port Mann sites, it is believed that the majority of spawning occurs further upstream.

The biological data we gathered in relation to organic contaminant research adds a small amount of information to that already known about eulachons in the Fraser River system. It points out, however, the need for more biological research in order to understand the life cycle of the species in the watershed.

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TABLE 1. THE NUMBER OF EULACHONS RETAINED FROM FIVE SITES IN THE FRASER RIVER ESTUARY FOR ORGANIC CONTAMINANT ANALYSIS.

SITE	DATE	MALE	FEMALE	IMMATURE
Steveston	08 April 1986	2	2	
	09 April	50	9	
	29 April	30*	22*	
Annacis Island	10 April		4	
	14 April	60	4	
	21 April	42	7	
MacDonald Beach	22 April	1	1	21
Port Mann	23 April	70	18	
New Westminster	24 April	70	28	
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Total		325	95	21

* 10 male and female fish were retained from this sample for age analysis.

TABLE 2. MORPHOMETRIC DATA FOR EULACHONS CAPTURED IN THE FRASER RIVER ESTUARY, APRIL 1986.

KEY

OBS = Observation number

FISH = Fish number

DATE = Date of capture (day/month/year)

SITE = Site number
1 Steveston
2 Annacis Island
3 MacDonald Beach
4 Port Mann
5 New Westminster

TIDE = Tidal regime
1 Slack
2 Flood
3 Ebb

LIGHT = Light Regime
1 Full illumination
2 Full darkness
3 Dusk

SEX
1 Male
2 Female
3 Immature

FL = Fork length in millimeters

SL = Standard length in millimeters

BODYWT = Whole body weight in grams

LIVERWT = Liver and gall bladder weight in grams

HSI = Hepatosomatic index

GONADWT = Gonad weight in grams

GSI = Gonadosomatic index

FISH	DATE	SITE	TIDE	LIGHT	SEX	FL	SL	BODYWT	LIVERWT	HSI	GONADWT	GSI
1	80486	1	2	1	1	156	147	26.87	0.1974	0.74	1.66	6.59
2	80486	1	2	1	1	140	132	19.60	0.1106	0.57	1.02	5.49
3	80486	1	2	1	2	135	132	19.87	0.3558	1.82	3.87	24.19
4	80486	1	2	1	2	143	135	22.88	0.5044	2.25	4.77	26.32
5	90486	1	2	3	1	180	169	41.58	0.5774	1.41	2.85	7.36
6	90486	1	2	3	1	181	170	42.83	0.2989	0.70	3.43	8.70
7	90486	1	2	3	1	182	171	43.95	0.4634	1.07	3.19	7.82
8	90486	1	2	3	1	181	170	43.72	0.4930	1.14	2.94	7.21
9	90486	1	2	3	1	183	171	44.20	0.3582	0.82	3.00	7.29
10	90486	1	2	3	1	194	181	55.64	0.5921	1.08	3.99	7.73
11	90486	1	2	3	1	180	170	44.32	0.6547	1.50	2.94	7.10
12	90486	1	2	3	1	170	166	42.58	0.4054	0.96	4.01	10.40
13	90486	1	2	3	1	180	170	46.99	0.4723	1.02	2.92	6.63
14	90486	1	2	3	1	180	169	41.34	0.4173	1.02	3.44	9.07
15	90486	1	2	3	2	156	144	26.61	0.6200	2.39	5.16	24.05
16	90486	1	2	3	2	155	149	22.26	0.6181	2.86	4.38	24.52
17	90486	1	2	3	2	150	141	21.80	0.5519	2.60	4.22	23.97
18	90486	1	2	3	2	160	152	31.96	0.7120	2.28	5.84	22.35
19	90486	1	2	3	2	161	152	31.59	0.6611	2.14	5.99	23.38
20	90486	1	2	3	2	154	148	28.92	0.5725	2.02	6.19	27.25
21	90486	1	2	3	2	156	146	26.35	0.4946	1.91	5.46	26.16
22	90486	1	2	3	2	154	145	26.18	0.6188	2.42	4.43	20.35
23	90486	1	2	3	2	142	136	21.77	0.3181	1.48	3.82	21.29
24	90486	1	2	3	2	146	137	22.97	0.4213	1.87	3.62	18.71
25	90486	1	2	3	1	187	175	50.16	0.4878	0.98	3.31	7.08
26	90486	1	2	3	2	179	168	42.50	1.2110	2.93	7.48	21.35
27	90486	1	2	3	2	168	159	33.74	1.5058	4.67	6.04	21.79
28	90486	1	2	3	2	162	153	29.19	0.7160	2.51	6.47	28.48
29	90486	1	2	3	2	150	138	21.05	0.3492	1.69	4.35	26.02
30	90486	1	2	3	2	130	122	14.48	0.3909	2.77	2.86	24.60
31	90486	1	2	3	2	142	133	17.76	0.3143	1.80	3.66	25.91
32	90486	1	2	3	2	136	128	17.29	0.3760	2.22	2.46	16.60
33	90486	1	2	3	2	139	130	15.80	0.3072	1.98	3.08	24.25
34	90486	1	2	3	1	152	142	23.73	0.2228	0.95	1.54	6.95
35	90486	1	2	3	1	166	149	30.43	0.4126	1.37	1.82	6.36
36	90486	1	2	3	2	159	153	32.48	0.2179	0.68	2.28	7.54
37	90486	1	2	3	1	142	132	19.50	0.1537	0.79	1.19	6.49
38	90486	1	2	3	1	142	138	21.69	0.2254	1.05	1.36	6.70
39	90486	1	2	3	1	164	149	26.50	0.1605	0.61	1.71	6.90
40	90486	1	2	3	1	165	153	31.64	0.3314	1.06	2.32	7.90
41	90486	1	2	3	1	161	132	29.87	0.3467	1.17	1.86	6.63
42	90486	1	2	3	1	147	148	20.66	0.3200	1.57	1.05	5.37
43	90486	1	2	3	1	155	154	24.79	0.2234	0.91	1.81	7.87
44	90486	1	2	3	1	162	142	31.07	0.2714	0.88	1.98	6.79
45	90486	1	2	3	1	159	149	28.43	0.2771	0.98	1.64	6.13
46	90486	1	2	3	1	146	137	22.05	0.2440	1.12	1.53	7.46
47	90486	1	2	3	1	154	150	31.15	0.2959	0.96	1.88	6.43
48	90486	1	2	3	1	162	152	29.56	0.2197	0.75	2.18	7.95
49	90486	1	2	3	1	161	151	29.89	0.3225	1.09	2.22	8.03
50	90486	1	2	3	1	163	152	28.11	0.1814	0.65	1.60	6.03
51	90486	1	2	3	1	138	130	18.34	0.1389	0.76	0.96	5.52
52	90486	1	2	3	1	182	172	49.07	0.5393	1.11	3.76	8.29
53	90486	1	2	3	1	196	184	55.73	0.6571	1.19	3.65	7.00
54	90486	1	2	3	1	183	182	56.62	0.4855	0.86	3.99	7.59

FISH	DATE	SITE	TIDE	LIGHT	SEX	FL	SL	BODYWT	LIVERWT	HSI	GONADWT	GSI
55	90486	1	2	3	1	182	170	47.45	0.4914	1.05	3.65	8.32
56	90486	1	2	3	1	185	172	54.94	0.5705	1.05	4.13	8.13
57	90486	1	2	3	1	195	183	53.51	0.6186	1.17	3.65	7.32
58	90486	1	2	3	1	192	180	54.92	0.4200	0.77	4.38	8.66
59	90486	1	2	3	1	185	174	47.54	0.5116	1.09	3.08	6.92
60	90486	1	2	3	1	191	180	51.86	0.5129	1.00	3.91	8.14
61	90486	1	2	3	1	179	171	43.27	0.4016	0.94	2.37	5.80
62	90486	1	2	3	1	185	172	49.22	0.5314	1.09	3.17	6.88
63	90486	1	2	3	1	188	175	47.84	0.5377	1.14	3.78	8.57
64	90486	1	2	3	1	189	177	50.37	0.5367	1.08	3.02	6.37
65	100486	2	2	1	2	124	122	16.96	0.1915	1.14	2.21	14.96
66	100486	2	2	1	2	132	122	18.73	0.2909	1.58	2.81	17.64
67	100486	2	2	1	2	134	125	19.16	0.2654	1.40	2.38	14.16
68	100486	2	2	1	2	130	125	16.87	0.1605	0.96	1.89	12.63
69	140486	2	2	3	2	194	185	59.04	1.4627	2.54	11.82	25.04
70	140486	2	2	3	2	188	177	49.54	0.6379	1.30	0.34	0.68
71	140486	2	2	3	2	189	171	43.67	0.4371	1.01	8.77	25.12
72	140486	2	2	3	2	163	162	42.74	0.7937	1.89	9.88	30.07
73	140486	2	2	3	1	179	166	40.81	0.6017	1.50	2.50	6.54
74	140486	2	2	3	1	187	175	48.34	0.3771	0.79	3.38	7.52
75	140486	2	2	3	1	184	172	42.80	0.5576	1.32	3.09	7.78
76	140486	2	2	3	1	180	168	47.02	0.5571	1.20	3.32	7.60
77	140486	2	2	3	1	186	175	49.61	0.6548	1.34	3.37	7.28
78	140486	2	2	3	1	189	178	43.60	0.5146	1.19	0.46	1.08
79	140486	2	2	3	1	177	165	38.74	0.3912	1.02	2.20	6.01
80	140486	2	2	3	1	179	168	43.89	0.3127	0.72	3.34	8.24
81	140486	2	2	3	1	177	165	44.02	0.3384	0.77	2.74	6.64
82	140486	2	2	3	1	179	174	41.25	0.4567	1.12	0.66	1.62
83	140486	2	2	3	1	190	178	54.44	0.5522	1.02	3.88	7.68
84	140486	2	2	3	1	181	168	52.64	0.5157	0.99	4.02	8.27
85	140486	2	2	3	1	181	169	34.65	0.4236	1.24	0.91	2.71
86	140486	2	2	3	1	194	182	54.59	0.4856	0.90	3.82	7.53
87	140486	2	2	3	1	196	182	55.07	0.4539	0.83	3.98	7.79
88	140486	2	2	3	1	187	175	51.76	0.4912	0.96	3.36	6.95
89	140486	2	2	3	1	190	179	57.34	0.4629	0.81	4.03	7.55
90	140486	2	2	3	1	170	159	33.08	0.4511	1.38	1.80	5.77
91	140486	2	2	3	1	199	185	57.03	0.5175	0.92	3.92	7.38
92	140486	2	2	3	1	188	176	50.32	0.5165	1.04	3.71	7.96
93	140486	2	2	3	1	205	192	60.65	0.7155	1.19	2.78	4.80
94	140486	2	2	3	1	196	184	51.34	0.4568	0.90	3.72	7.81
95	140486	2	2	3	1	182	179	54.79	0.4813	0.89	4.42	8.77
96	140486	2	2	3	1	206	194	71.80	0.6512	0.92	4.42	6.56
97	140486	2	2	3	1	196	184	57.33	0.5901	1.04	3.98	7.46
98	140486	2	2	3	1	165	156	32.54	0.4214	1.31	1.04	3.31
99	140486	2	2	3	1	183	170	46.72	0.5151	1.11	3.22	7.39
100	140486	2	2	3	1	179	166	38.43	0.3670	0.96	0.98	2.61
101	140486	2	2	3	1	179	169	45.45	0.4904	1.09	3.63	8.69
102	140486	2	2	3	1	188	177	41.55	0.5672	1.38	0.92	2.25
103	140486	2	2	3	1	184	172	49.37	0.6538	1.34	2.84	6.11
104	140486	2	2	3	1	167	158	36.01	0.2881	0.81	2.68	8.03
105	140486	2	2	3	1	173	161	38.61	0.3925	1.03	2.46	6.81
106	140486	2	2	3	1	174	162	37.54	0.4871	1.31	1.20	3.30
107	140486	2	2	3	1	194	182	54.67	0.6492	1.20	3.38	6.59
108	140486	2	2	3	1	189	177	50.17	0.5075	1.02	3.88	8.38

FISH	DATE	SITE	TIDE	LIGHT	SEX	FL	SL	BODYWT	LIVERWT	HSI	GONADWT	GSI
109	140486	2	2	3	1	193	187	56.96	0.5029	0.89	3.41	6.37
110	140486	2	2	3	1	186	173	52.01	0.5878	1.14	3.53	7.27
111	140486	2	2	3	1	192	180	53.58	0.5263	0.99	2.16	4.19
112	140486	2	2	3	1	196	182	53.14	0.5240	1.00	3.47	6.98
113	140486	2	2	3	1	186	174	52.15	0.6267	1.22	3.31	6.77
114	140486	2	2	3	1	166	155	33.27	0.3714	1.13	2.53	8.22
115	140486	2	2	3	1	147	137	22.26	0.2127	0.96	1.20	5.68
116	140486	2	2	3	1	190	178	48.75	0.5401	1.12	3.37	7.43
117	140486	2	2	3	1	186	174	51.85	0.5347	1.04	3.93	8.20
118	140486	2	2	3	1	178	167	38.89	0.5010	1.31	0.66	1.71
119	140486	2	2	3	1	181	169	48.99	0.5189	1.07	1.55	3.26
120	140486	2	2	3	1	182	177	49.61	0.3818	0.78	3.09	6.64
121	140486	2	2	3	1	195	183	53.53	0.5371	1.01	3.11	6.18
122	140486	2	2	3	1	188	176	50.50	0.4706	0.94	3.74	8.00
123	140486	2	2	3	1	172	161	32.46	0.4229	1.32	0.70	2.22
124	140486	2	2	3	1	185	175	50.63	0.4166	0.83	3.56	7.56
125	140486	2	2	3	1	186	174	49.65	0.3591	0.73	3.98	8.72
126	140486	2	2	3	1	185	180	55.97	0.5595	1.01	4.14	7.99
127	140486	2	2	3	1	165	155	33.19	0.3842	1.17	1.07	3.34
128	140486	2	2	3	1	172	162	35.71	0.3814	1.08	2.40	7.22
129	140486	2	2	3	1	191	178	52.27	0.4928	0.95	3.89	8.04
130	140486	2	2	3	1	190	178	50.47	0.4952	0.99	3.74	7.99
131	140486	2	2	3	1	178	167	46.73	0.3899	0.84	3.00	6.85
132	140486	2	2	3	1	168	158	36.32	0.3447	0.96	2.97	8.89
133	210486	2	3	3	2	177	175	51.51	1.3170	2.62	8.40	19.50
134	210486	2	3	3	2	183	175	45.89	1.2619	2.83	9.40	25.76
135	210486	2	3	3	2	185	175	48.25	1.3009	2.77	8.96	22.82
136	210486	2	3	3	2	175	169	43.11	1.2760	3.05	1.29	3.08
137	210486	2	3	3	2	180	168	44.99	0.2033	0.45	1.40	3.21
138	210486	2	3	3	2	126	118	12.91	0.1733	1.36	1.40	12.13
139	210486	2	3	3	2	130	120	14.93	0.2540	1.73	1.80	13.74
140	210486	2	3	3	1	196	181	62.77	0.3388	0.54	4.50	7.72
141	210486	2	3	3	1	190	178	54.43	0.6033	1.12	4.13	8.22
142	210486	2	3	3	1	166	158	29.55	0.3926	1.35	0.54	1.86
143	210486	2	3	3	1	164	152	25.98	0.3130	1.22	0.69	2.72
144	210486	2	3	3	1	168	160	36.19	0.3914	1.09	2.71	8.11
145	210486	2	3	3	1	175	164	41.12	0.5223	1.29	2.96	7.76
146	210486	2	3	3	1	188	178	54.31	0.6364	1.19	4.34	8.69
147	210486	2	3	3	1	188	176	49.80	0.6216	1.26	3.18	6.81
148	210486	2	3	3	1	176	165	39.86	0.4613	1.17	2.77	7.48
149	210486	2	3	3	1	187	175	50.21	0.3836	0.77	3.72	8.00
150	210486	2	3	3	1	162	155	32.84	0.4231	1.31	1.31	4.15
151	210486	2	3	3	1	193	184	53.95	0.7648	1.44	0.65	1.21
152	210486	2	3	3	1	182	172	39.19	0.6112	1.58	0.68	1.75
153	210486	2	3	3	1	180	171	36.49	0.5153	1.43	0.37	1.01
154	210486	2	3	3	1	189	177	49.29	0.4635	0.95	3.63	7.94
155	210486	2	3	3	1	180	170	46.83	0.5482	1.18	3.50	8.08
156	210486	2	3	3	1	190	177	42.24	0.6102	1.47	0.49	1.16
157	210486	2	3	3	1	180	174	47.13	0.3876	0.83	3.47	7.94
158	210486	2	3	3	1	192	180	50.35	0.7652	1.54	0.88	1.78
159	210486	2	3	3	1	187	175	47.92	0.5104	1.08	3.31	7.41
160	210486	2	3	3	1	182	172	50.08	0.5018	1.01	3.75	8.10
161	210486	2	3	3	1	186	177	53.65	0.4578	0.86	4.41	8.95
162	210486	2	3	3	1	185	173	47.45	0.4715	1.00	4.14	9.57

FISH	DATE	SITE	TIDE	LIGHT	SEX	FL	SL	BODYWT	LIVERWT	HSI	GONADWT	GSI
163	210486	2	3	3	1	186	175	50.39	0.5348	1.07	4.08	8.80
164	210486	2	3	3	1	174	163	38.87	0.3066	0.80	2.56	7.06
165	210486	2	3	3	1	176	165	42.34	0.3614	0.86	2.59	6.52
166	210486	2	3	3	1	194	181	54.10	0.4836	0.90	3.84	7.64
167	210486	2	3	3	1	190	181	52.60	0.4257	0.82	4.21	8.70
168	210486	2	3	3	1	172	171	49.10	0.4867	1.00	3.20	6.97
169	210486	2	3	3	1	186	173	49.46	0.4378	0.89	3.47	7.55
170	210486	2	3	3	1	186	175	48.56	0.4600	0.96	3.46	7.67
171	210486	2	3	3	1	192	180	56.24	0.5390	0.97	4.07	7.79
172	210486	2	3	3	1	183	174	49.26	0.5439	1.12	3.43	7.48
173	210486	2	3	3	1	190	177	51.56	0.4254	0.83	4.25	8.98
174	210486	2	3	3	1	184	171	48.60	0.4382	0.91	3.50	7.76
175	210486	2	3	3	1	176	168	47.66	0.5510	1.17	3.16	7.10
176	210486	2	3	3	1	194	183	67.00	0.6284	0.95	5.08	8.21
177	210486	2	3	3	1	180	167	46.14	0.4389	0.96	2.96	6.84
178	210486	2	3	3	1	192	188	63.52	0.6075	0.97	4.84	8.25
179	210486	2	3	3	1	180	169	43.62	0.3988	0.92	3.39	8.44
180	210486	2	3	3	1	187	174	44.97	0.4230	0.95	2.99	7.12
181	210486	2	3	3	1	140	132	19.20	0.3420	1.81	3.61	23.13
182	220486	3	1	3	2	154	142	20.00	0.2800	1.42	0.24	1.23
183	220486	3	1	3	3	163	152	22.95	0.1256	0.55	0.17	0.76
184	220486	3	1	3	3	164	157	23.91	0.3100	1.31	0.33	1.39
185	220486	3	1	3	3	173	161	23.43	0.4300	1.87	0.22	0.95
186	220486	3	1	3	3	169	159	25.02	0.1819	0.73	0.71	2.90
187	220486	3	1	3	3	161	163	22.75	0.4800	2.16	0.24	1.06
188	220486	3	1	3	3	171	161	27.95	0.2281	0.82	0.30	1.08
189	220486	3	1	3	3	172	158	24.47	0.3858	1.60	0.29	1.22
190	220486	3	1	3	3	158	148	19.29	0.2493	1.31	0.22	1.14
191	220486	3	1	3	3	169	155	25.91	0.3540	1.39	0.25	0.97
192	220486	3	1	3	3	150	143	18.86	0.2800	1.51	0.17	0.90
193	220486	3	3	1	3	160	148	22.96	0.0000	0.00	0.00	0.00
194	220486	3	3	1	3	164	154	23.18	0.4146	1.82	0.28	1.24
195	220486	3	3	1	3	160	150	21.95	0.2674	1.23	0.23	1.08
196	220486	3	3	1	3	154	146	20.05	0.2945	1.49	0.22	1.10
197	220486	3	3	1	3	164	159	27.92	0.4331	1.58	0.35	1.28
198	220486	3	3	1	3	180	175	36.28	0.6465	1.81	0.38	1.07
199	220486	3	3	1	3	161	152	23.18	0.1750	0.76	0.22	0.97
200	220486	3	3	1	3	165	150	21.29	0.2828	1.35	0.14	0.67
201	220486	3	3	1	3	114	109	12.96	0.3514	2.79	0.06	0.44
202	220486	3	3	1	3	178	169	34.20	0.7300	2.18	0.35	1.03
203	220486	3	3	1	3	149	143	20.04	0.1033	0.52	0.14	0.69
204	220486	3	3	1	3	165	157	29.05	0.5163	1.81	0.34	1.19
205	230486	4	2	3	1	179	166	45.04	0.9749	2.21	2.53	5.95
206	230486	4	2	3	1	187	177	45.90	0.3897	0.86	2.75	6.37
207	230486	4	2	3	1	185	175	46.19	0.3369	0.73	3.08	7.14
208	230486	4	2	3	1	177	165	44.86	0.3097	0.70	2.94	7.01
209	230486	4	2	3	1	180	169	46.75	0.4151	0.90	2.91	6.64
210	230486	4	2	3	1	182	171	47.44	0.4283	0.91	2.81	6.30
211	230486	4	2	3	1	188	177	46.36	0.3648	0.79	2.84	6.53
212	230486	4	2	3	1	180	169	42.14	0.3924	0.94	1.86	4.62
213	230486	4	2	3	1	180	170	41.99	0.3118	0.75	3.03	7.78
214	230486	4	2	3	1	178	166	40.72	0.3296	0.82	2.74	7.21
215	230486	4	2	3	1	191	182	52.26	0.5198	1.00	2.58	5.19
216	230486	4	2	3	1	182	170	38.98	0.3441	0.89	1.96	5.29

FISH	DATE	SITE	TIDE	LIGHT	SEX	FL	SL	BODYWT	LIVERWT	HSI	GONADWT	GSI
217	230486	4	2	3	1	212	200	81.00	0.6192	0.77	4.72	6.19
218	230486	4	2	3	1	156	146	27.87	0.1818	0.66	1.42	5.37
219	230486	4	2	3	1	190	179	54.85	0.4001	0.73	3.72	7.28
220	230486	4	2	3	1	195	183	58.85	0.4771	0.82	3.61	6.54
221	230486	4	2	3	1	199	184	54.02	0.5282	0.99	2.70	5.26
222	230486	4	2	3	1	168	158	33.13	0.1653	0.50	1.42	4.48
223	230486	4	2	3	1	187	176	48.19	0.3305	0.69	3.21	7.14
224	230486	4	2	3	1	169	159	36.42	0.3053	0.85	2.33	6.83
225	230486	4	2	3	1	183	172	56.92	0.4217	0.75	3.57	6.69
226	230486	4	2	3	1	175	165	41.72	0.3286	0.79	2.51	6.40
227	230486	4	2	3	1	158	148	25.69	0.1997	0.78	0.95	3.84
228	230486	4	2	3	1	182	171	41.05	0.3780	0.93	1.40	3.53
229	230486	4	2	3	1	198	182	55.18	0.4045	0.74	4.01	7.84
230	230486	4	2	3	1	192	180	54.89	0.3913	0.72	3.13	6.05
231	230486	4	2	3	1	155	141	29.87	0.2809	0.95	1.46	5.14
232	230486	4	2	3	1	187	176	52.32	0.4522	0.87	3.19	6.49
233	230486	4	2	3	1	148	139	22.74	0.1572	0.70	1.09	5.03
234	230486	4	2	3	1	194	183	55.26	0.4073	0.74	3.57	6.91
235	230486	4	2	3	1	174	163	37.11	0.2836	0.77	1.70	4.80
236	230486	4	2	3	1	144	136	19.47	0.1638	0.85	0.31	1.62
237	230486	4	2	3	1	195	182	50.53	0.4734	0.95	1.46	2.98
238	230486	4	2	3	1	193	181	56.22	0.4002	0.72	2.35	4.36
239	230486	4	2	3	1	202	190	63.34	0.3933	0.62	3.36	5.60
240	230486	4	2	3	1	193	179	56.90	0.3654	0.65	4.01	7.58
241	230486	4	2	3	1	186	177	44.13	0.3976	0.91	1.66	3.91
242	230486	4	2	3	1	180	169	48.01	0.3065	0.64	3.29	7.36
243	230486	4	2	3	1	190	179	52.76	0.5078	0.97	3.80	7.76
244	230486	4	2	3	1	195	184	58.84	0.3335	0.57	4.69	8.66
245	230486	4	2	3	1	176	163	36.73	0.2453	0.67	1.32	3.73
246	230486	4	2	3	1	180	168	44.82	0.3491	0.79	1.69	3.92
247	230486	4	2	3	1	184	173	47.09	0.4258	0.91	1.15	2.50
248	230486	4	2	3	1	169	158	34.98	0.2363	0.68	2.05	6.23
249	230486	4	2	3	1	185	173	48.10	0.3383	0.71	3.15	7.01
250	230486	4	2	3	1	181	169	45.28	0.3447	0.77	2.08	4.81
251	230486	4	2	3	1	196	184	61.64	0.4279	0.70	3.98	6.90
252	230486	4	2	3	1	162	154	27.30	0.2671	0.99	0.25	0.92
253	230486	4	2	3	1	172	161	37.20	0.2472	0.67	1.82	5.14
254	230486	4	2	3	1	182	170	38.72	0.3121	0.81	1.10	2.92
255	230486	4	2	3	1	185	172	39.74	0.3925	1.00	0.83	2.13
256	230486	4	2	3	1	182	171	47.37	0.2992	0.64	3.17	7.17
257	230486	4	2	3	1	168	157	34.76	0.2696	0.78	2.14	6.56
258	230486	4	2	3	1	192	178	53.52	0.3957	0.74	4.01	8.10
259	230486	4	2	3	1	194	188	58.70	0.4863	0.84	4.20	7.71
260	230486	4	2	3	1	181	171	52.95	0.3659	0.70	3.20	6.43
261	230486	4	2	3	1	186	175	49.61	0.3863	0.78	2.95	6.32
262	230486	4	2	3	1	198	180	54.10	0.3786	0.70	4.14	8.29
263	230486	4	2	3	1	196	184	55.43	0.4966	0.90	3.95	7.67
264	230486	4	2	3	1	184	173	46.90	0.2940	0.63	2.55	5.75
265	230486	4	2	3	1	188	178	49.66	0.3951	0.80	3.77	8.22
266	230486	4	2	3	1	193	179	51.85	0.3187	0.62	3.60	7.46
267	230486	4	2	3	1	186	175	46.99	0.3576	0.77	3.05	6.94
268	230486	4	2	3	1	202	191	56.38	0.5217	0.93	2.97	5.56
269	230486	4	2	3	1	188	175	55.83	0.4733	0.86	3.60	6.89
270	230486	4	2	3	1	180	177	57.77	0.3940	0.69	3.95	7.34

FISH	DATE	SITE	TIDE	LIGHT	SEX	FL	SL	BODYWT	LIVERWT	HSI	GONADWT	GSI
271	230486	4	2	3	1	189	177	50.11	0.3042	0.61	2.74	5.78
272	230486	4	2	3	1	189	178	42.52	0.3311	0.78	0.84	2.02
273	230486	4	2	3	1	183	171	48.30	0.3741	0.78	2.68	5.87
274	230486	4	2	3	1	182	171	49.05	0.3746	0.77	3.10	6.75
275	230486	4	2	3	2	171	162	39.55	0.6552	1.68	7.95	25.16
276	230486	4	2	3	2	182	173	46.79	0.6737	1.46	10.62	29.36
277	230486	4	2	3	2	190	178	48.08	0.8157	1.73	8.35	21.02
278	230486	4	2	3	2	181	170	47.84	1.0337	2.21	10.12	26.83
279	230486	4	2	3	2	198	186	55.01	1.2014	2.23	11.00	24.99
280	230486	4	2	3	2	186	175	46.25	1.0043	2.22	10.89	30.80
281	230486	4	2	3	2	183	174	42.50	0.8884	2.13	8.39	24.60
282	230486	4	2	3	2	150	140	20.31	0.2297	1.14	3.01	17.40
283	230486	4	2	3	2	174	164	35.16	0.7451	2.17	7.87	28.84
284	230486	4	2	3	2	181	170	41.82	1.0445	2.56	7.37	21.39
285	240486	5	2	2	2	182	171	48.68	1.2021	2.53	9.73	24.98
286	240486	5	2	2	2	186	175	51.46	1.0523	2.09	10.27	24.93
287	240486	5	2	2	2	180	170	44.83	1.0799	2.47	9.30	26.18
288	240486	5	2	2	2	187	176	48.05	0.8563	1.81	9.24	23.81
289	240486	5	2	2	2	190	179	55.78	1.2587	2.31	11.41	25.72
290	240486	5	2	2	2	186	174	48.62	1.0130	2.13	8.76	21.98
291	240486	5	2	2	2	186	175	49.88	0.9850	2.01	9.24	22.74
292	240486	5	2	2	2	174	162	39.15	1.0383	2.72	7.73	24.60
293	240486	5	2	2	2	180	170	46.93	0.9551	2.08	9.59	25.68
294	240486	5	2	2	2	170	158	39.63	0.7111	1.83	8.53	27.43
295	240486	5	2	2	1	185	164	45.97	0.4338	0.95	2.87	6.66
296	240486	5	2	2	1	185	173	45.85	0.4656	1.03	3.44	8.11
297	240486	5	2	2	1	175	165	44.89	0.3656	0.82	2.87	6.83
298	240486	5	2	2	1	179	166	41.26	0.3288	0.80	3.50	9.27
299	240486	5	2	2	1	183	172	46.86	0.4225	0.91	3.43	7.90
300	240486	5	2	2	1	178	167	43.97	0.4001	0.92	3.15	7.72
301	240486	5	2	2	1	174	162	41.70	0.3346	0.81	2.87	7.39
302	240486	5	2	2	1	181	170	41.75	0.2834	0.68	2.83	7.27
303	240486	5	2	2	1	178	168	46.16	0.2877	0.63	2.66	6.11
304	240486	5	2	2	1	177	167	44.05	0.3943	0.90	2.59	6.25
305	230486	4	2	3	2	139	130	18.86	0.4227	2.29	3.57	23.35
306	230486	4	2	3	2	171	159	32.99	0.6309	1.95	6.02	22.32
307	230486	4	2	3	2	149	138	22.06	0.4927	2.28	4.75	27.44
308	230486	4	2	3	2	168	158	33.27	0.4174	1.27	4.83	16.98
309	230486	4	2	3	2	198	186	62.55	1.8222	3.00	12.39	24.70
310	230486	4	2	3	2	200	189	63.71	1.1195	1.79	14.25	28.81
311	230486	4	2	3	2	153	142	26.61	0.4184	1.60	6.37	31.47
312	230486	4	2	3	2	152	142	22.72	0.5768	2.60	4.54	24.97
313	240486	5	2	2	2	155	146	26.60	0.4822	1.85	5.71	27.33
314	240486	5	2	2	2	135	127	19.49	0.4584	2.41	3.20	19.64
315	240486	5	2	2	2	153	139	20.06	0.3803	1.93	4.12	25.85
316	240486	5	2	2	2	134	125	15.12	0.2717	1.83	2.88	23.53
317	240486	5	2	2	2	127	120	14.20	0.2413	1.73	1.11	8.48
318	240486	5	2	2	2	161	150	29.23	0.5951	2.08	6.75	30.03
319	240486	5	2	2	2	153	144	23.76	0.3463	1.48	3.79	18.98
320	240486	5	2	2	2	139	131	20.35	0.3156	1.58	4.36	27.27
321	240486	5	2	2	2	137	124	18.20	0.2730	1.52	3.35	22.56
322	240486	5	2	2	2	154	145	25.19	0.5004	2.03	5.08	25.26
323	240486	5	2	2	2	140	130	18.48	0.3886	2.15	3.66	24.70
324	240486	5	2	2	2	132	124	16.51	0.2594	1.60	3.36	25.55

FISH	DATE	SITE	TIDE	LIGHT	SEX	FL	SL	BODYWT	LIVERWT	HSI	GONADWT	GSI
325	240486	5	2	2	2	129	121	17.19	0.2079	1.22	2.58	17.66
326	240486	5	2	2	2	145	136	20.38	0.3520	1.76	4.35	27.14
327	240486	5	2	2	2	159	149	27.57	0.7317	2.73	5.89	27.17
328	240486	5	2	2	2	193	182	62.62	1.8352	3.02	10.47	20.08
329	240486	5	2	2	2	198	188	63.17	1.3478	2.18	12.95	25.79
330	240486	5	2	2	2	197	186	61.87	1.2000	1.98	13.59	28.15
331	240486	5	2	2	1	188	176	53.27	0.3596	0.68	3.00	5.97
332	240486	5	2	2	1	186	173	51.07	0.3828	0.76	3.47	7.29
333	240486	5	2	2	1	202	190	64.98	0.5414	0.84	4.81	7.99
334	240486	5	2	2	1	189	177	48.44	0.3799	0.79	3.71	8.29
335	240486	5	2	2	1	189	177	50.93	0.3910	0.77	3.59	7.58
336	240486	5	2	2	1	186	170	43.17	0.4389	1.03	3.25	8.14
337	240486	5	2	2	1	172	162	44.32	0.3512	0.80	2.95	7.13
338	240486	5	2	2	1	156	175	52.51	0.4776	0.92	3.87	7.96
339	240486	5	2	2	1	177	166	43.03	0.3477	0.81	2.96	7.39
340	240486	5	2	2	1	179	168	45.72	0.4592	1.01	2.66	6.18
341	240486	5	2	2	1	193	183	61.54	0.5420	0.89	4.68	8.23
342	240486	5	2	2	1	162	152	31.90	0.2317	0.73	1.94	6.48
343	240486	5	2	2	1	156	146	26.86	0.1527	0.57	2.00	8.05
344	240486	5	2	2	1	129	121	13.82	0.1073	0.78	0.79	6.06
345	240486	5	2	2	1	181	171	49.75	0.4416	0.90	3.79	8.25
346	240486	5	2	2	1	196	185	61.36	0.5523	0.91	4.35	7.63
347	240486	5	2	2	1	192	180	62.01	0.4866	0.79	5.45	9.64
348	240486	5	2	2	1	208	195	65.86	0.6855	1.05	4.92	8.07
349	240486	5	2	2	1	195	183	56.13	0.4669	0.84	4.60	8.93
350	240486	5	2	2	1	193	180	53.48	0.4218	0.79	4.06	8.22
351	240486	5	2	2	1	188	175	50.67	0.3233	0.64	3.77	8.04
352	240486	5	2	2	1	182	170	47.31	0.4466	0.95	3.40	7.74
353	240486	5	2	2	1	189	181	59.63	0.5731	0.97	4.12	7.42
354	240486	5	2	2	1	184	172	49.48	0.3800	0.77	3.80	8.32
355	240486	5	2	2	1	185	174	52.57	0.5103	0.98	3.02	6.09
356	240486	5	2	2	1	194	180	55.88	0.4194	0.76	4.14	8.00
357	240486	5	2	2	1	174	163	38.37	0.3093	0.81	2.74	7.69
358	240486	5	2	2	1	192	179	52.37	0.5089	0.98	3.65	7.49
359	240486	5	2	2	1	192	180	58.01	0.5455	0.95	3.70	6.81
360	240486	5	2	2	1	183	171	48.68	0.4769	0.99	3.12	6.85
361	240486	5	2	2	1	188	176	49.03	0.5193	1.07	3.37	7.38
362	240486	5	2	2	1	188	176	49.96	0.4620	0.93	3.00	6.39
363	240486	5	2	2	1	185	173	47.47	0.3766	0.80	3.20	7.23
364	240486	5	2	2	1	145	136	20.62	0.1385	0.68	0.98	4.99
365	240486	5	2	2	1	190	179	50.35	0.4302	0.86	3.39	7.22
366	240486	5	2	2	1	201	187	67.81	0.6930	1.03	5.35	8.57
367	240486	5	2	2	1	197	185	67.02	0.5112	0.77	4.80	7.71
368	240486	5	2	2	1	188	176	52.42	0.4906	0.94	4.10	8.49
369	240486	5	2	2	1	184	173	48.46	0.3391	0.70	3.05	6.72
370	240486	5	2	2	1	140	131	18.38	0.1741	0.96	0.64	3.61
371	240486	5	2	2	1	165	154	33.07	0.2733	0.83	2.39	7.79
372	240486	5	2	2	1	188	176	48.71	0.4359	0.90	3.03	6.63
373	240486	5	2	2	1	190	179	54.21	0.3481	0.65	3.98	7.92
374	240486	5	2	2	1	183	172	48.65	0.4096	0.85	3.40	7.51
375	240486	5	2	2	1	190	178	55.42	0.4631	0.84	4.95	9.81
376	240486	5	2	2	1	185	173	52.35	0.4465	0.86	4.29	8.93
377	240486	5	2	2	1	182	170	48.27	0.4195	0.88	2.70	5.92
378	240486	5	2	2	1	186	175	46.94	0.4172	0.90	3.85	8.93

FISH	DATE	SITE	TIDE	LIGHT	SEX	FL	SL	BODYWT	LIVERWT	HSI	GONADWT	GSI
379	240486	5	2	2	1	199	187	59.50	0.5145	0.87	4.33	7.85
380	240486	5	2	2	1	190	177	54.73	0.4981	0.92	4.15	8.20
381	240486	5	2	2	1	175	164	43.76	0.4309	0.99	2.75	6.71
382	240486	5	2	2	1	167	158	35.74	0.3185	0.90	2.46	7.39
383	240486	5	2	2	1	183	171	49.82	0.2972	0.60	3.54	7.65
384	240486	5	2	2	1	202	190	61.26	0.4982	0.82	4.61	8.14
385	240486	5	2	2	1	195	183	56.25	0.4927	0.88	4.00	7.66
386	240486	5	2	2	1	178	168	45.85	0.4394	0.97	2.97	6.93
387	240486	5	2	2	1	182	170	25.17	0.4296	1.74	3.37	15.46
388	240486	5	2	2	1	187	170	47.55	0.4550	0.97	3.52	7.99
389	240486	5	2	2	1	177	167	44.79	0.3550	0.80	2.80	6.67
390	240486	5	2	2	1	182	171	47.44	0.4963	1.06	3.35	7.60
391	290486	1	2	3	1	188	176	46.59	0.3929	0.85	4.13	9.73
392	290486	1	2	3	1	189	177	49.58	0.4084	0.83	3.80	8.30
393	290486	1	2	3	1	195	180	61.15	0.6862	1.13	4.26	7.49
394	290486	1	2	3	1	180	171	44.60	0.3960	0.90	3.47	8.44
395	290486	1	2	3	1	193	182	54.37	0.5012	0.93	4.37	8.74
396	290486	1	2	3	1	175	163	38.22	0.3647	0.96	3.07	8.73
397	290486	1	2	3	1	194	186	56.74	0.5379	0.96	3.96	7.50
398	290486	1	2	3	1	187	174	50.80	0.3824	0.76	3.67	7.79
399	290486	1	2	3	1	196	192	68.94	0.5748	0.84	5.48	8.64
400	290486	1	2	3	1	185	174	51.62	0.3666	0.72	4.40	9.32
401	290486	1	2	3	1	183	171	53.13	0.4951	0.94	3.30	6.62
402	290486	1	2	3	1	184	173	47.96	0.4752	1.00	2.63	5.80
403	290486	1	2	3	1	177	169	43.76	0.4166	0.96	3.18	7.84
404	290486	1	2	3	1	193	184	66.26	0.5724	0.87	4.53	7.34
405	290486	1	2	3	1	182	174	46.16	0.3791	0.83	2.92	6.75
406	290486	1	2	3	1	201	190	65.57	0.6818	1.05	5.02	8.29
407	290486	1	2	3	1	187	172	45.14	0.3942	0.88	3.42	8.20
408	290486	1	2	3	1	163	179	44.23	0.4121	0.94	4.06	10.11
409	290486	1	2	3	1	187	179	51.48	0.5474	1.07	4.21	8.91
410	290486	1	2	3	1	163	154	35.47	0.2674	0.76	2.84	8.70
411	290486	1	2	3	1	159	147	29.02	0.2458	0.85	1.93	7.12
412	290486	1	2	3	1	188	172	46.26	0.4486	0.98	3.40	7.93
413	290486	1	2	3	1	169	157	33.65	0.2276	0.68	2.55	8.20
414	290486	1	2	3	1	185	173	46.06	0.3710	0.81	4.05	9.64
415	290486	1	2	3	1	197	188	63.17	0.6383	1.02	4.63	7.91
416	290486	1	2	3	1	195	182	59.54	0.6654	1.13	4.86	8.89
417	290486	1	2	3	1	184	172	42.36	0.3780	0.90	2.87	7.27
418	290486	1	2	3	1	192	183	61.70	0.7821	1.28	4.90	8.63
419	290486	1	2	3	1	185	178	51.90	0.5747	1.12	3.43	7.08
420	290486	1	2	3	1	189	177	46.25	0.4521	0.99	3.10	7.18
421	290486	1	2	3	2	185	175	51.02	1.2680	2.55	9.99	24.35
422	290486	1	2	3	2	187	180	52.93	1.3318	2.58	10.22	23.93
423	290486	1	2	3	2	153	147	24.81	0.6878	2.85	5.10	25.88
424	290486	1	2	3	2	183	172	44.16	0.9760	2.26	8.54	23.98
425	290486	1	2	3	2	182	173	48.72	1.4646	3.10	9.85	25.34
426	290486	1	2	3	2	185	174	46.64	1.3864	3.06	8.93	23.68
427	290486	1	2	3	2	175	167	48.64	1.0105	2.12	9.76	25.10
428	290486	1	2	3	2	192	181	48.79	1.1790	2.48	10.26	26.63
429	290486	1	2	3	2	177	165	35.22	0.9532	2.78	6.45	22.42
430	290486	1	2	3	2	183	175	50.44	1.0221	2.07	12.02	31.29
431	290486	1	2	3	2	177	168	41.26	1.2480	3.12	8.18	24.73
432	290486	1	2	3	2	192	181	50.82	1.4859	3.01	10.12	24.86

FISH	DATE	SITE	TIDE	LIGHT	SEX	FL	SL	BODYWT	LIVERWT	HSI	GONADWT	GSI
433	290486	1	2	3	1	170	161	36.42	0.7427	2.08	7.90	27.70
434	290486	1	2	3	1	191	179	54.28	1.2548	2.37	10.75	24.70
435	290486	1	2	3	1	190	178	48.12	0.9462	2.01	10.83	29.04
436	290486	1	2	3	1	181	172	45.13	1.0742	2.44	9.91	28.14
437	290486	1	2	3	1	190	181	59.75	1.6678	2.87	11.77	24.53
438	290486	1	2	3	1	196	187	57.45	1.2817	2.28	12.11	26.71
439	290486	1	2	3	1	193	184	60.10	1.1951	2.03	12.94	27.44
440	290486	1	2	3	1	187	177	49.69	1.3475	2.79	9.73	24.35
441	290486	1	2	3	1	170	165	38.67	1.3295	3.56	7.38	23.59

TABLE 3. SUMMARY OF MEAN LENGTH AND WEIGHT OF EULACHONS CAPTURED IN THE FRASER RIVER ESTUARY APRIL 1986.

SAMPLING SITE		MALES	FEMALES	IMMATURES
		MEAN ± S.D.	MEAN ± S.D.	MEAN ± S.D.
STEVESTON	FL(mm)	177.78±15.60	162.06±18.29	
	WT(g)	43.96±12.35	32.45±12.22	-
	n	82	33	
ANNACIS ISLAND	FL(mm)	181.95±12.88	160.66±27.46	
	WT(g)	46.87± 9.02	35.22±16.29	-
	n	102	15	
MACDONALD BEACH	FL(mm)	165.00± 0.00	154.00± 0.00	161.85±13.61
	WT(g)	29.05± 0.00	20.00± 0.00	23.74± 5.04
	n	1	1	21
PORT MANN	FL(mm)	183.17±12.49	173.66±18.58	
	WT(g)	46.84±10.36	39.22±13.84	-
	n	70	18	
NEW WESTMINSTER	FL(mm)	182.55±13.71	162.92±23.40	
	WT(g)	48.09±10.61	34.75±16.48	-
	n	70	28	

TABLE 4. A LISTING OF THE WEIGHT-LENGTH RELATIONSHIP EQUATIONS FOR EULACHONS CAPTURED IN THE FRASER RIVER ESTUARY, APRIL 1986.

SITE	SEX		n	R^2
STEVESTON	MALE	log W = - 5.96 + 3.37 (log FL)	82	.93
	FEMALE	log W = - 5.84 + 3.31 (log FL)	33	.95
	IMMATURE	-	0	-
ANNACIS ISLAND	MALE	log W = - 5.42 + 3.09 (log FL)	102	.87
	FEMALE	log W = - 5.18 + 3.03 (log FL)	15	.95
	IMMATURE	-	0	-
MACDONALD BEACH	MALE	-	1	-
	FEMALE	-	1	-
	IMMATURE	log W = - 3.08 + 2.11 (log FL)	21	.78
PORT MANN	MALE	log W = - 5.72 + 3.26 (log FL)	70	.88
	FEMALE	log W = - 6.05 + 3.40 (log FL)	18	.96
	IMMATURE	-	0	-
NEW WESTMINSTER	MALE	log W = - 5.42 + 3.13 (log FL)	70	.81
	FEMALE	log W = - 5.92 + 3.36 (log FL)	28	.97
	IMMATURE	-	0	-

TABLE 5. STUDENT-NEWMAN-KEULS (SNK) MULTIPLE COMPARISON TEST SUMMARIES FOR VARIATION IN MORPHOMETRIC CHARACTERS OF EULACHONS OF DIFFERENT SEX AND CAPTURE SITES[1] IN THE IN THE FRASER RIVER ESTUARY, APRIL 1986.

MEAN FORK LENGTH BY SEX

SEX	MALE	FEMALE	IMMATURE
MEAN FORK LENGTH (mm)	181.2	164.2	161.8
GROUPING	I-----I	I-----I	I-----I

MEAN FORK LENGTH BY SITE OF CAPTURE

SITE	4	2	5	1	3
MEAN FORK LENGTH (mm)	181.2	179.2	176.9	173.2	161.5
GROUPING	I----------	----------	----------	----------I	I-----I

MEAN FORK LENGTH BY AGE GROUP

AGE	IV+	V+	VI+	VII+
MEAN FORK LENGTH (mm)	161.0	177.3	196.0	205.0
GROUPING	I----------	----------	----------I	
			I----------	----------I

SEXUAL DIFFERENCES IN GSI AND HSI

GSI

SEX	FEMALE	MALE	IMMATURE
TRANSFORMED GSI	.488	.269	.098
GROUPING	I----I	I----I	I----I

HSI

SEX	FEMALE	IMMATURE	MALE
TRANSFORMED HSI	.144	.112	.098
GROUPING	I----I	I----I	I----I

CAPTURE SITE DIFFERENCES IN GSI AND HSI

GSI

SITE	1	5	4	2	3
TRANSFORMED GSI	.364	.344	.298	.272	.098
GROUPING	I----------	----------I	I----------	----------I	I----I

HSI

SITE	1	3	5	2	4
TRANSFORMED HSI	.119	.113	.107	.106	.099
GROUPING	I----------	----------I			
		I----------	----------	----------I	
					I----I

[1](Horizontal bars refer to statistically homogeneous data subsets and site numbers refer to those given in Figure 1)

TABLE 6 ESTIMATED AGE (UTILIZING THE BURNT OTOLITH TECHNIQUE) OF SUBSAMPLED EULACHONS FROM THE FRASER RIVER ESTUARY, APRIL 1986.

FISH NUMBER	FORK LENGTH (MM)	SEX	AGE
1	183	M	5
2	190	M	4
3	203	M	5
4	164	M	4
5	170	M	5
6	205	M	7
7	175	M	5
8	194	M	6
9	164	M	4
10	198	M	6
11	180	F	5
12	174	F	5
13	134	F	4
14	157	F	5
15	180	F	5
16	154	F	4
17	165	F	4
18	165	F	4
19	174	F	4
20	152	F	5

TABLE 7 SUMMARY OF GONADAL AND HEPATIC SOMATIC INDICES OF DEVELOPMENT BY SITE AND BY SEX OF EULACHONS CAPTURED IN THE FRASER RIVER ESTUARY, APRIL 1986.

SAMPLING SITE	GSI[1]		HSI[2]	
	MALES MEAN±S.D.	FEMALES MEAN±S.D.	MALES MEAN±S.D.	FEMALES MEAN±S.D.
1. STEVESTON	9.64±5.98 n=82	23.67±3.97 n=33	1.14±0.53 n=82	2.40±0.66 n=33
2. ANNACIS ISLAND	6.69±2.78 n=102	16.03±8.94 n=15	1.06±0.21 n=102	1.77±0.80 n=15
3. MACDONALD BEACH[3]	1.04±0.52 n=21		1.37±0.64 n=21	
4. PORT MANN	5.86±1.72 n=70	25.02±4.15 n=18	0.80±0.20 n=70	2.01±0.48 n=18
5. NEW WESTMINSTER	7.59±1.39 n=70	24.04±4.21 n=28	0.86±0.15 n=70	2.03±0.41 n=28

1 GSI = $\frac{\text{(GONAD WEIGHT)}}{\text{(BODY WEIGHT-GONAD WEIGHT)}} \times 100$

2 HSI = $\frac{\text{(LIVER AND GALL BLADDER WEIGHT)}}{\text{(BODY WEIGHT - LIVER AND GALL BLADDER WEIGHT)}} \times 100$

3 IMMATURE FISH ONLY

TABLE 8. A SUMMARY OF RESULTS FROM GENERAL LINEAR MODEL FACTORIAL ANALYSIS OF VARIANCE OF TRANSFORMED (ARCSIN SQUARE ROOT) GSI AND HSI VALUES OF EULACHONS (n=441) CAPTURED FROM DIFFERENT SITES IN THE FRASER RIVER ESTUARY, APRIL 1986.

GONADOSOMATIC INDEX

	DEGREES OF FREEDOM	F VALUE	PROBABILITY OF A GREATER F
SITE	4	109.36	0.0000
SEX	2	425.83	0.0000
SITE-SEX INTERACTION	4	11.82	0.0001

HEPATOSOMATIC INDEX

	DEGREES OF FREEDOM	F VALUE	PROBABILITY OF A GREATER F
SITE	4	17.68	0.0001
SEX	2	254.63	0.0000
SITE-SEX INTERACTION	4	6.40	0.0001

TABLE 9. MEAN VALUES OF MORPHOMETRIC VARIABLES OF EULACHONS CAPTURED IN THE FRASER RIVER ESTUARY IN RELATION TO THE DISTANCE OF THE CAPTURE SITE FROM THE MOUTH OF THE FRASER RIVER ESTUARY.

SITE	DISTANCE FROM GEORGIA STRAIT[1] (km)		n	FORK LENGTH (mm)	HSI	GSI	CF[2]
STEVESTON	0	MALE	82	177.18	1.14	9.64	7.823
		FEMALE	33	162.06	2.40	23.67	7.624
ANNACIS ISLAND	22	MALE	102	181.95	1.06	6.69	7.781
		FEMALE	15	160.66	1.77	16.03	8.493
NEW WESTMINSTER	25	MALE	70	183.17	0.80	5.86	7.621
		FEMALE	18	173.66	2.01	25.02	7.448
PORT MANN	31	MALE	70	182.55	0.86	7.59	7.918
		FEMALE	28	162.95	2.03	24.04	8.035

1. Distance was calculated as distance from the site closest to Georgia Strait (Steveston).

2. $CF = Weight \div (Fork\ Length)^3 \times 10^6$.

FIGURES

Fig. 1. A map of the study area showing the location of the fish capture sites in the Fraser River estuary, April 1986 (1=Stevenson; 2=Annacis Island; 3=MacDonald Beach; 4=Port Mann; 5=New Westminster).

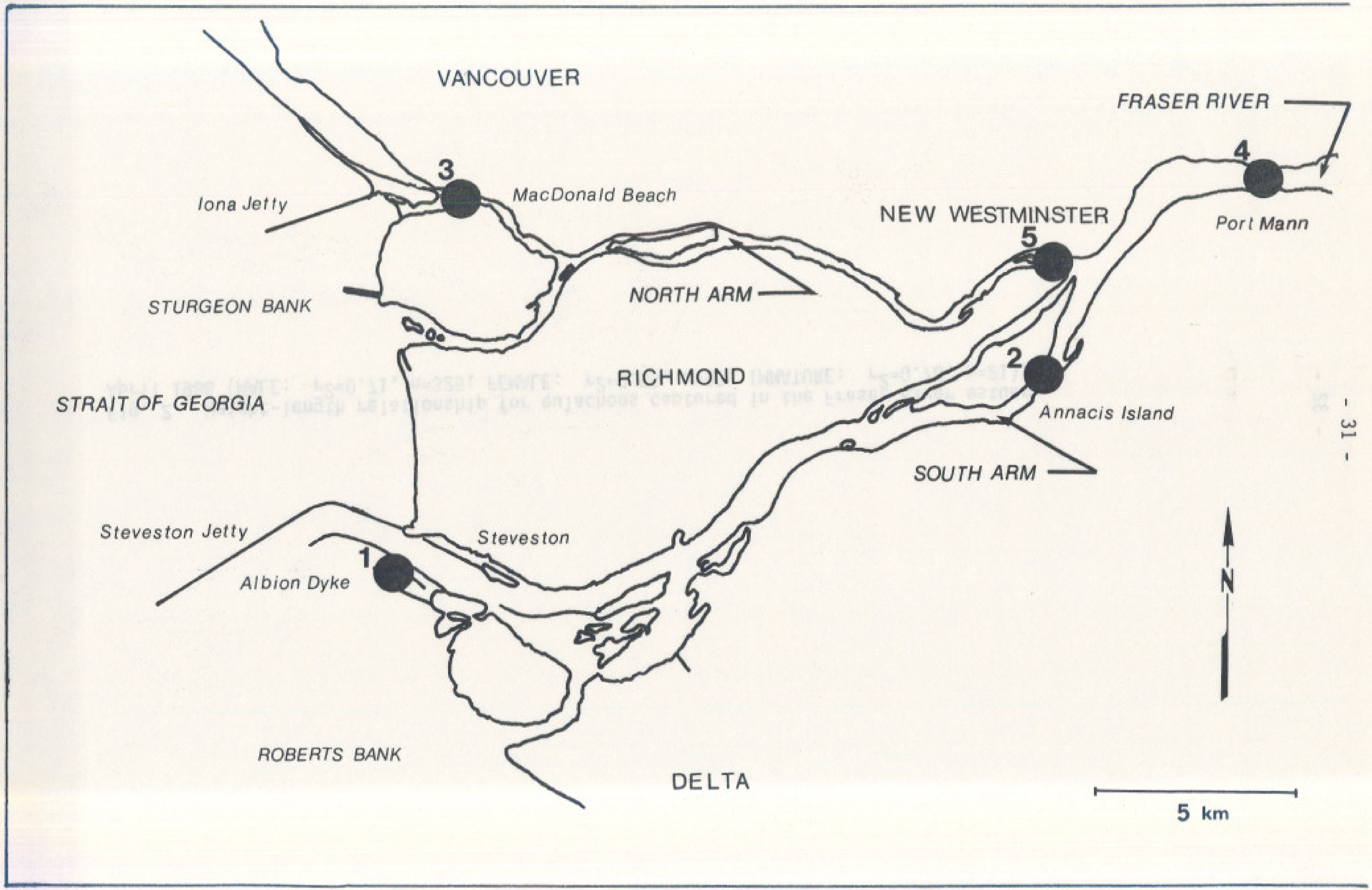

VANCOUVER
FRASER RIVER
3
4
Iona Jetty
MacDonald Beach
NEW WESTMINSTER
Port Mann
5
STURGEON BANK
NORTH ARM
2
RICHMOND
STRAIT OF GEORGIA
Annacis Island
SOUTH ARM
Steveston Jetty
Steveston
1
Albion Dyke
N
ROBERTS BANK
DELTA
5 km

Fig. 2. Weight-length relationship for eulachons captured in the Fraser River estuary, April 1986 (MALE: r^2=0.71, n=325; FEMALE: r^2=0.95, n=95; IMMATURE: r^2=0.78, n=21).

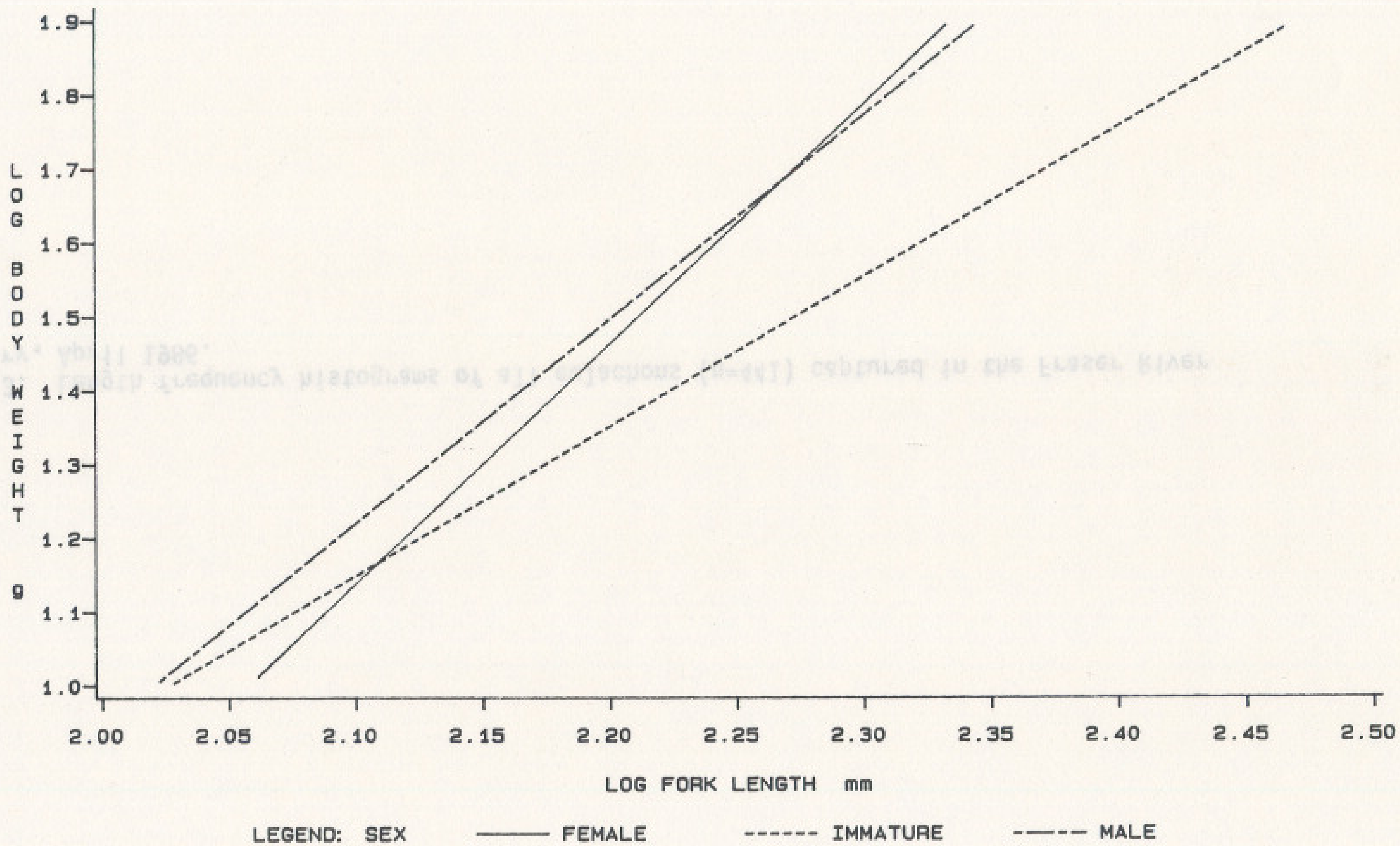
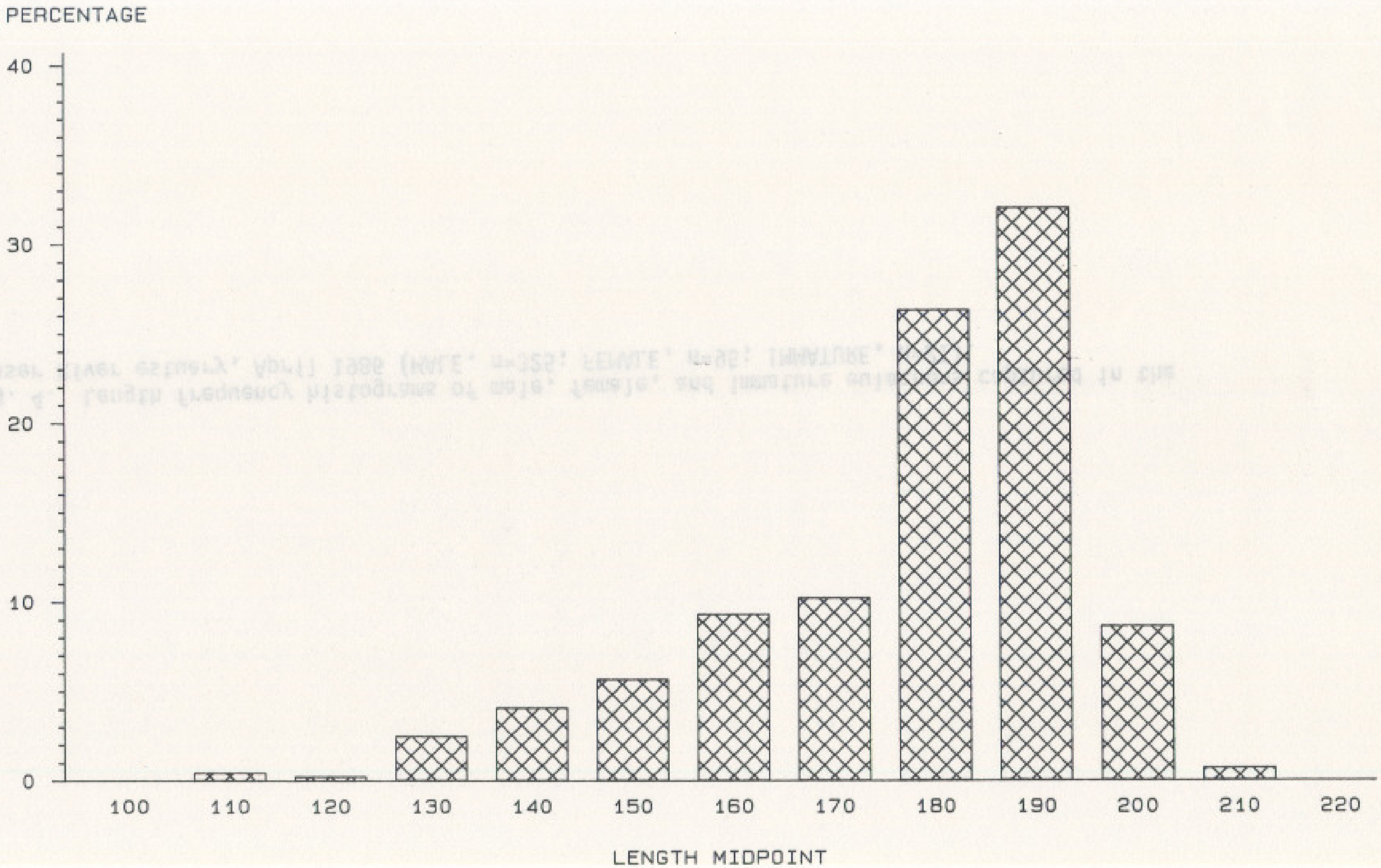

LOG BODY WEIGHT g
1.0
1.1
1.2
1.3
1.4
1.5
1.6
1.7
1.8
1.9
2.00
2.05
2.10
2.15
2.20
2.25
2.30
2.35
2.40
2.45
2.50
LOG FORK LENGTH mm
LEGEND: SEX
FEMALE
IMMATURE
MALE

Fig. 3. Length frequency histograms of all eulachons (n=441) captured in the Fraser River estuary, April 1986.



FORK LENGTH (mm)

Fig. 4. Length frequency histograms of male, female, and immature eulachons captured in the Fraser River estuary, April 1986 (MALE, n=325; FEMALE, n=95; IMMATURE, n=21).

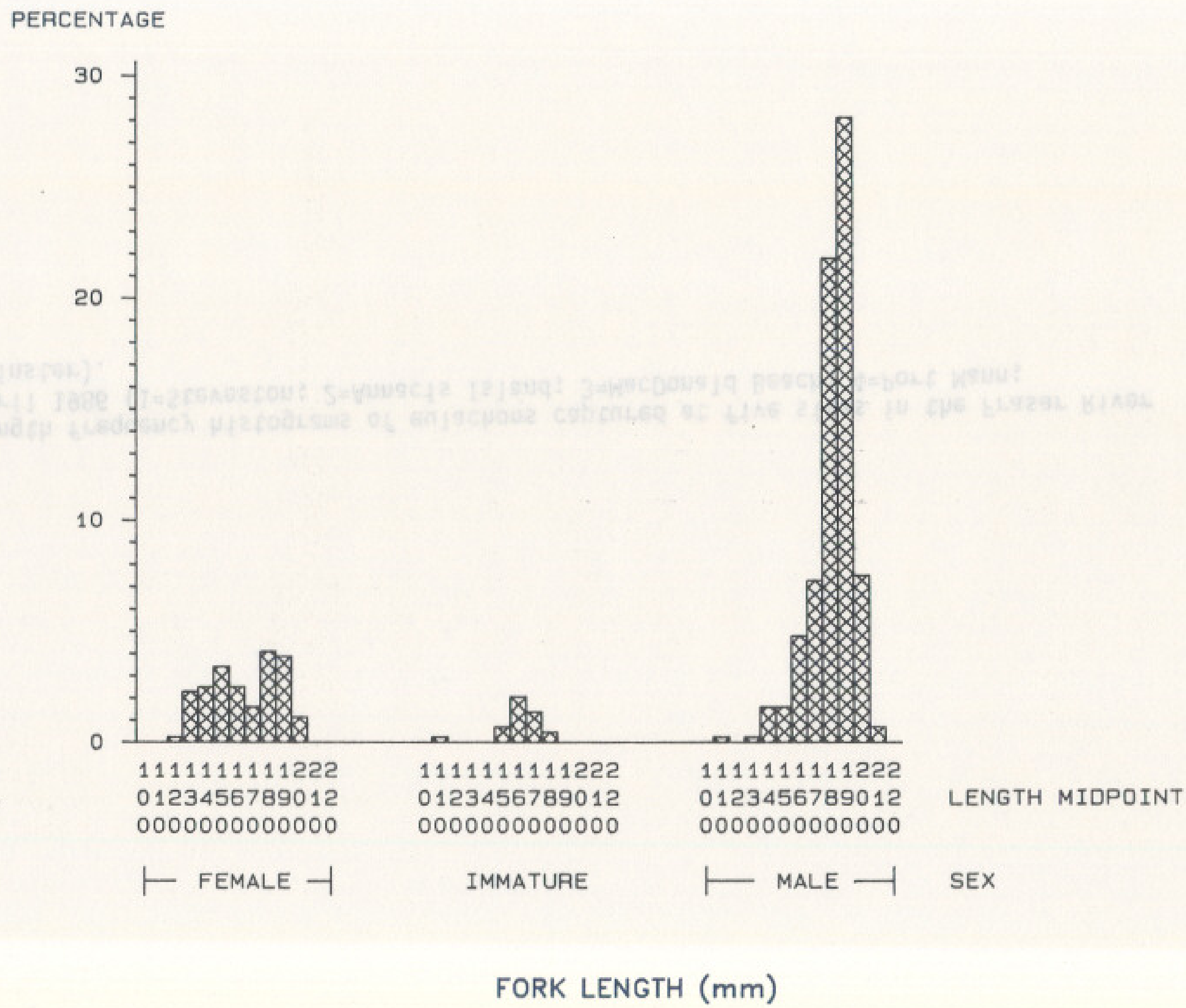

PERCENTAGE
30
20
10
0
1111111111222
0123456789012
0000000000000
1111111111222
0123456789012
0000000000000
1111111111222
0123456789012
0000000000000
LENGTH MIDPOINT
FEMALE
IMMATURE
MALE
SEX
FORK LENGTH (mm)

Fig. 5. Length frequency histograms of eulachons captured at five sites in the Fraser River estuary, April 1986 (1=Steveston; 2=Annacis Island; 3=MacDonald Beach; 4=Port Mann; 5=New Westminster).

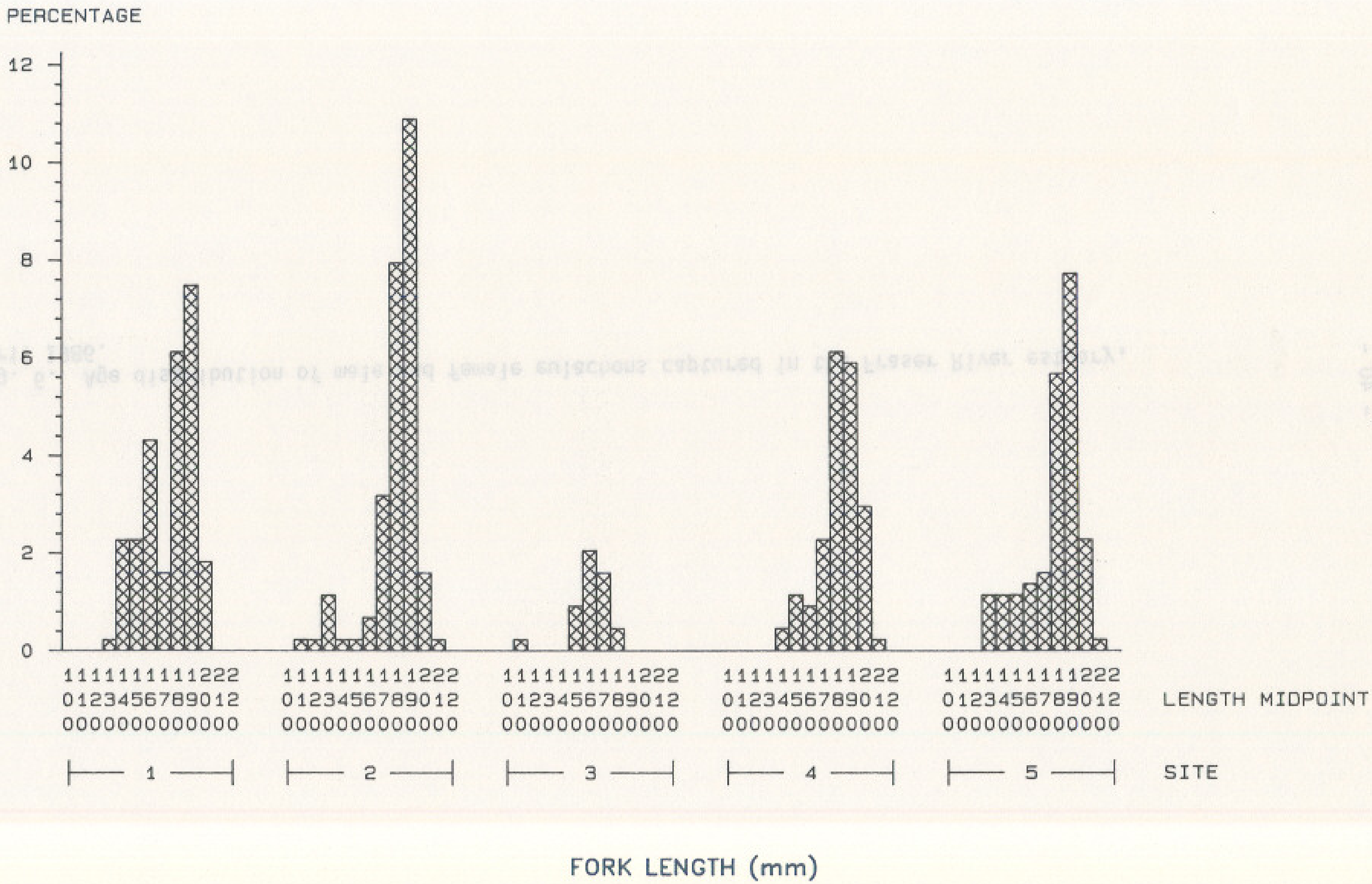

PERCENTAGE
12
10
8
6
4
2
0
1111111111222 1111111111222 1111111111222 1111111111222 1111111111222
0123456789012 0123456789012 0123456789012 0123456789012 0123456789012 LENGTH MIDPOINT
0000000000000 0000000000000 0000000000000 0000000000000 0000000000000
1 2 3 4 5 SITE
FORK LENGTH (mm)

Fig. 6. Age distribution of male and female eulachons captured in the Fraser River estuary, April 1986.

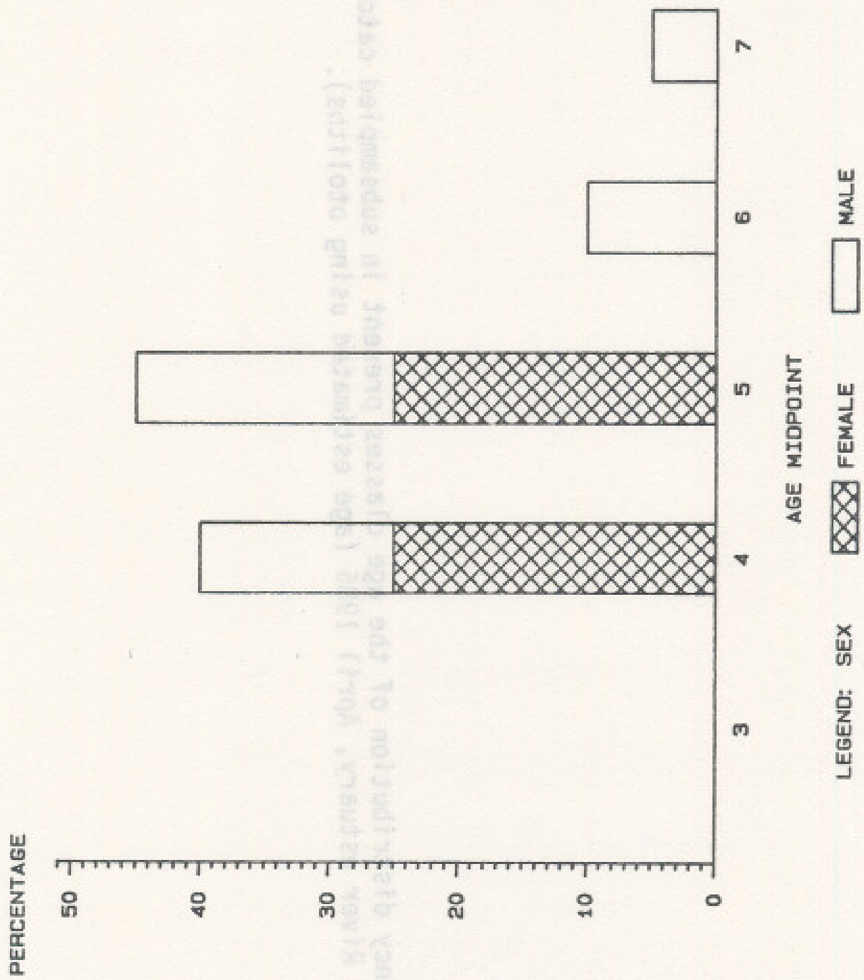

PERCENTAGE
50
40
30
20
10
0
3
4
5
6
7
AGE MIDPOINT
LEGEND: SEX
FEMALE
MALE

Fig. 7. Length frequency distribution of the age classes present in subsampled catch of eulachons captured in the Fraser River estuary, April 1986 (age estimated using otoliths).

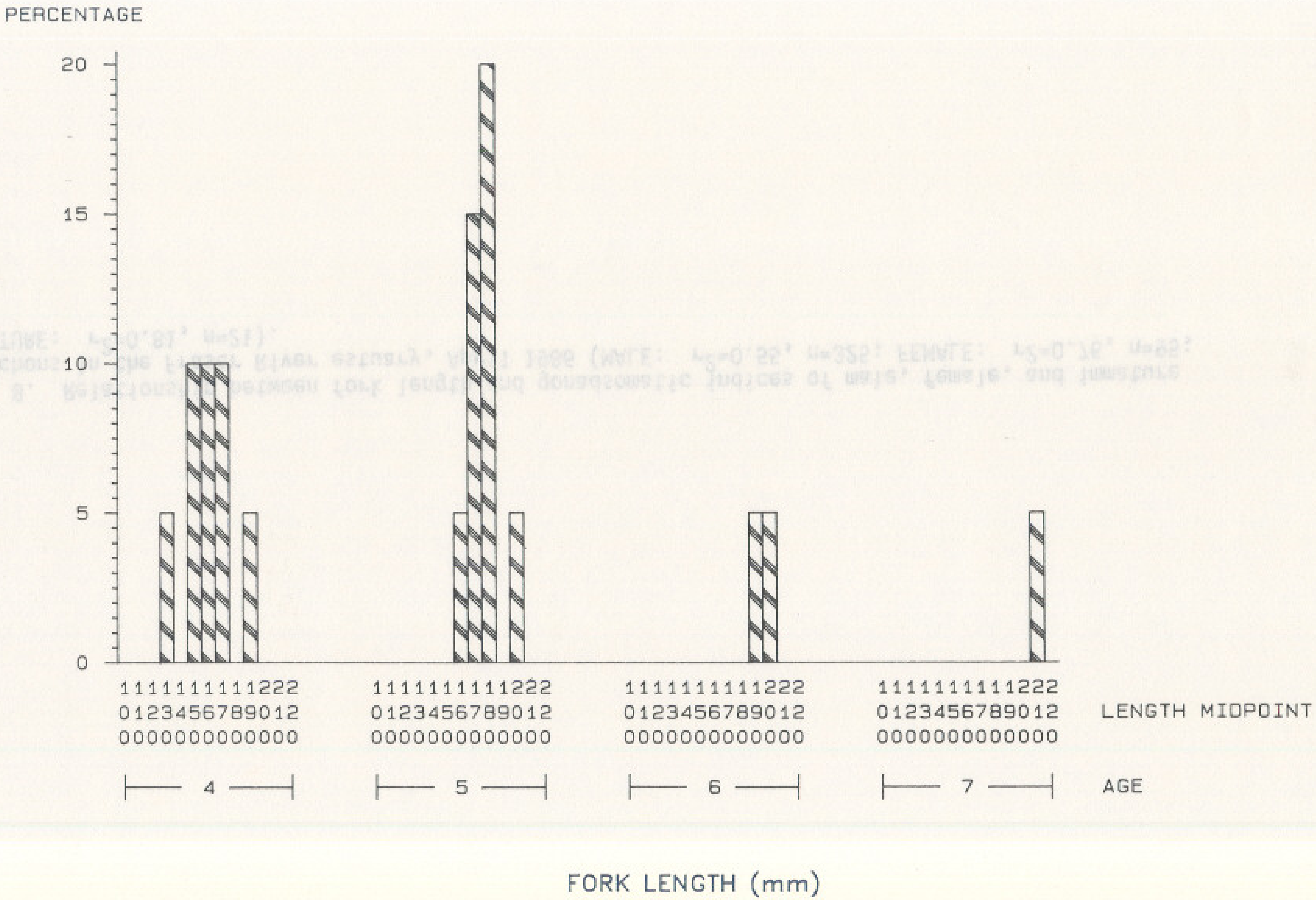

PERCENTAGE
20
15
10
5
0
1111111111222
0123456789012
0000000000000
LENGTH MIDPOINT
4
5
6
7
AGE
FORK LENGTH (mm)

Fig. 8. Relationship between fork length and gonadsomatic indices of male, female, and immature eulachons in the Fraser River estuary, April 1986 (MALE: r^2=0.55, n=325; FEMALE: r^2=0.76, n=95; IMMATURE: r^2=0.81, n=21).

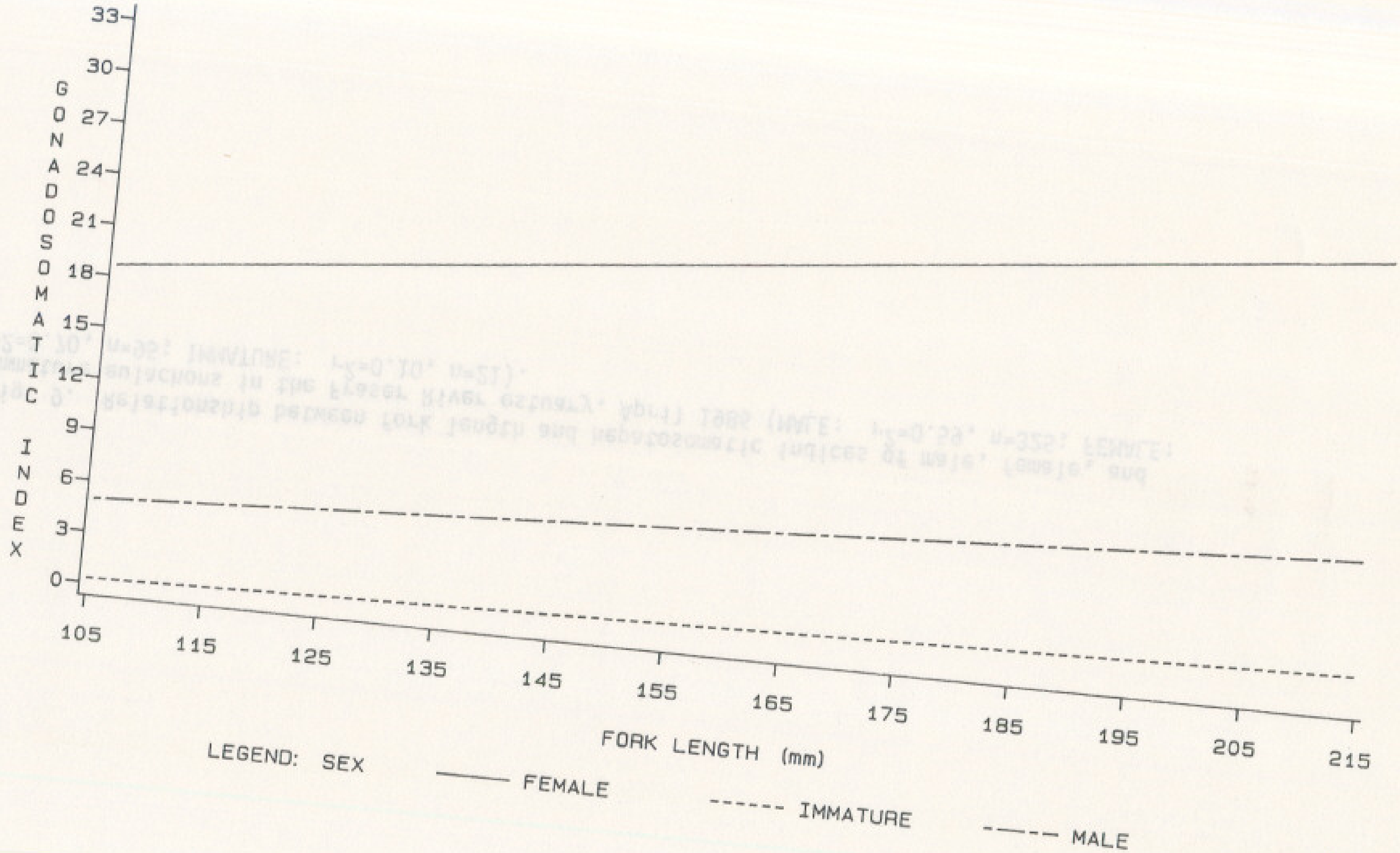
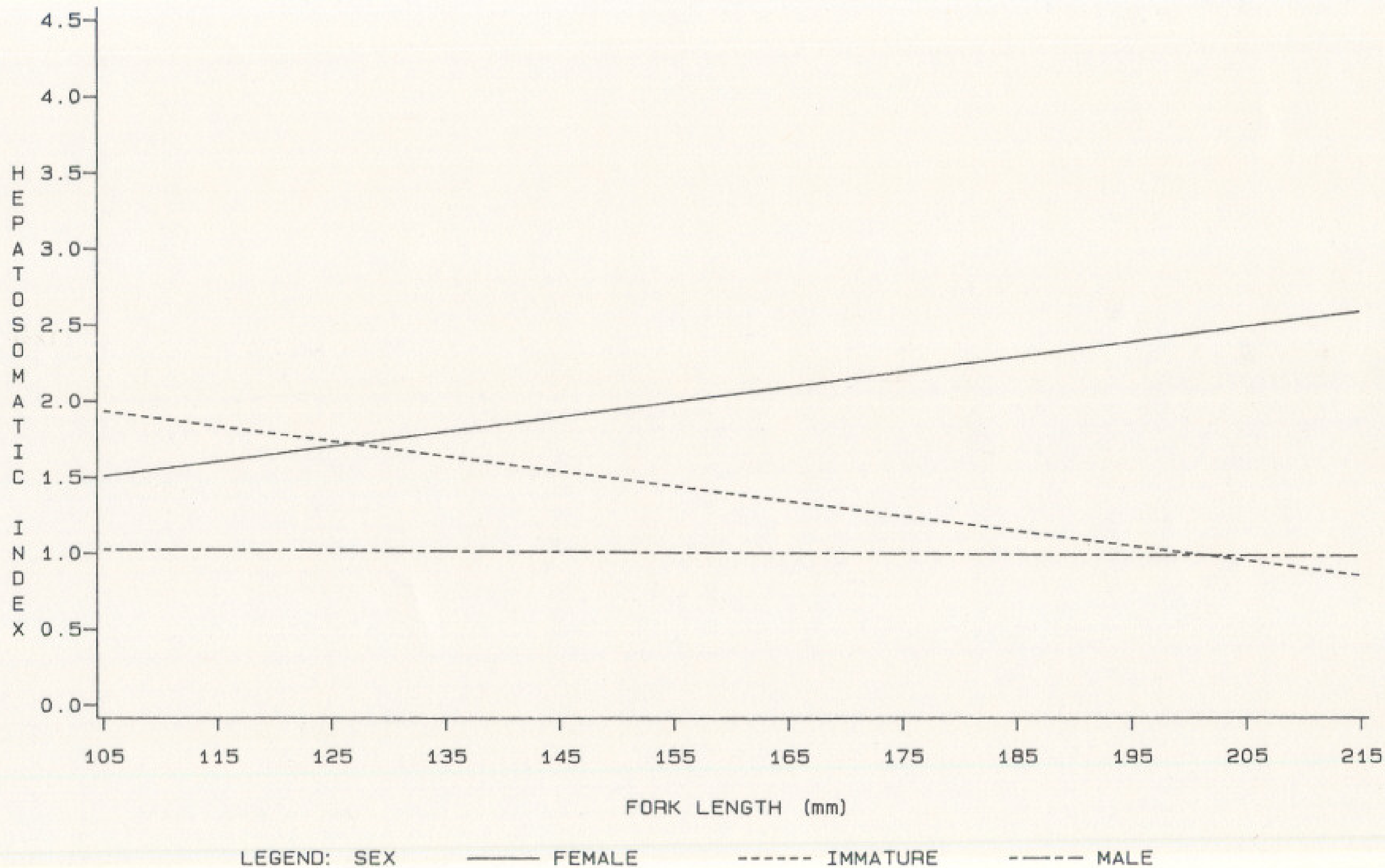

GONADOSOMATIC INDEX
33
30
27
24
21
18
15
12
9
6
3
0
105
115
125
135
145
155
165
175
185
195
205
215
FORK LENGTH (mm)
LEGEND: SEX
FEMALE
IMMATURE
MALE

Fig. 9. Relationship between fork length and hepatosomatic indices of male, female, and immature eulachons in the Fraser River estuary, April 1986 (MALE: r^2=0.59, n=325; FEMALE: r^2=0.70, n=95; IMMATURE: r^2=0.10, n=21).



HEPATOSOMATIC INDEX
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
105
115
125
135
145
155
165
175
185
195
205
215
FORK LENGTH (mm)
LEGEND: SEX
FEMALE
IMMATURE
MALE