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Food Habits of Dicamptodon Ensatus and Associated Fish Species of Maratta Creek, Washington

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FOOD HABITS OF DICAMPTODON ENSATUS AND ASSOCIATED FISH SPECIES OF MARATTA CREEK, WASHINGTON

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ABSTRACT

Three cold-blooded vertebrates, *Dicamptodon ensatus*, *Cottus tenuis*, and *Salmo gairdneri* were investigated as to food habits for a period of one year. The existence of competition between these animals for food was determined by means of stomach analysis. The results were compared relative to each vertebrate and the bottom fauna procurred from the stream. It was shown that the food habits of *D. ensatus* and *S. gairdneri* were diverse enough to warrant partial exclusion on the basis of food. *C. tenuis* demonstrated selectivity and was shown to be under competitive stress from the other two species.

INTRODUCTION

It has been observed that three species of cold-blooded vertebrates occur together in several northwestern streams. This study was undertaken to determine the degree of niche overlap between these species in Maratta Creek, Washington (Fig. 1). In such situations when two or more species occupy the same habitat and have the same requirements for space and food, supposedly limited in supply, then these species are in direct competition with one another. Ultimately, this excludes the least adapted species from that environment. This is a simplification of Gause's principle (1934) recently reduced to Hardin's "competitive exclusion principle", stating that complete competitors cannot occupy the same niche (Smith, 1966). If, however, the niches (niche is defined here as the residential and nutritional requirements of an organism) only partially overlap, then the animals involved can coexist. For example, if they occupy the same place but feed on different items or feed on the same items but live in different places they are not complete competitors. Behavioral aspects such as feeding time and feeding place of the animals may also aid in establishing "partial exclusion".

The following research attempted to determine which aspects of "partial exclusion" might be responsible for the coexistence of three cold-blodded vertebrates in a mountain stream in southwest Washington. The animals studied were Dicamptodon ensatus (giant

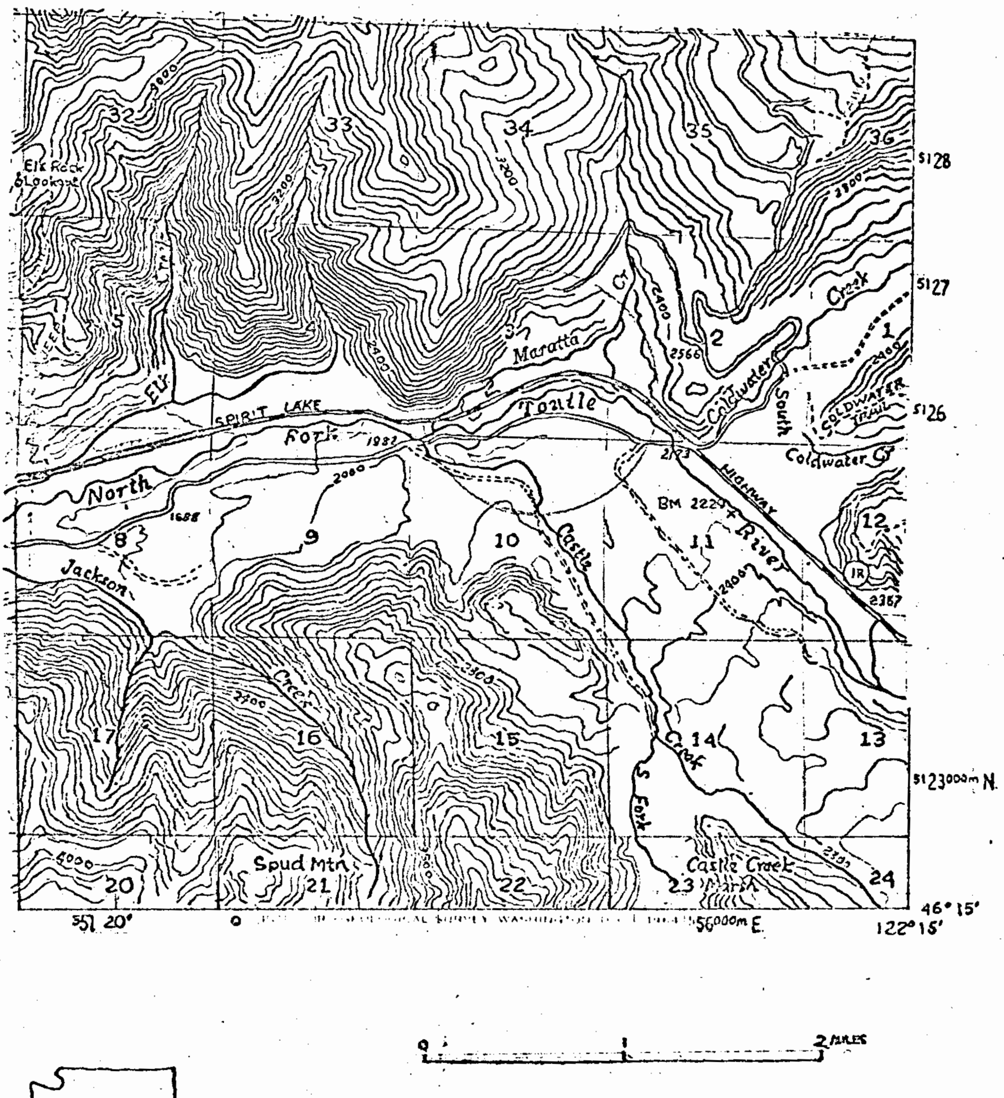


FIG. 1 STUDY SITE: MARATTA CK.
ELK ROCK QUADRANGLE

pacific salamander) a cold-water species (Fig. 2), Cottus tenuis (slender sculpin) a freshwater species (Fig. 3), and Salmo gairdneri (rainbow trout) a popular game fish (Fig. 4). Preliminary investigations suggested that the habitats of these animals were much the same, at least in smaller individuals. When rocks in the stream were dislodged or uplifted, any one of the three species was likely to be present. To fulfill the requirements of the principles mentioned above there should be some differentiating character in the biology of these animals. It was suggested that feeding habits, mainly selectivity, might be the factor responsible for the obvious coexistence. Most size classes were present indicating growth is occurring. Some restrictions according to sizes collected were necessary since the biology of some of these animals involves complete changes in their ecology and subsequently their places of residence as adults. Metamorphosis and migrations might play a part in this coexistence.

To determine the overlap in feeding habits of these three species, the benthic organisms of the ecosystem were sampled for a twelve month period so that relative availability could be established. Concurrently, animals of all three species were procurred and their stomach contents analysed. These stomach contents and the relative availability of benthos were compared to determine whether each of the vertebrates were feeding selectively or opportunistically. Comparisons between individuals were also made to determine if intraspecific competition existed.

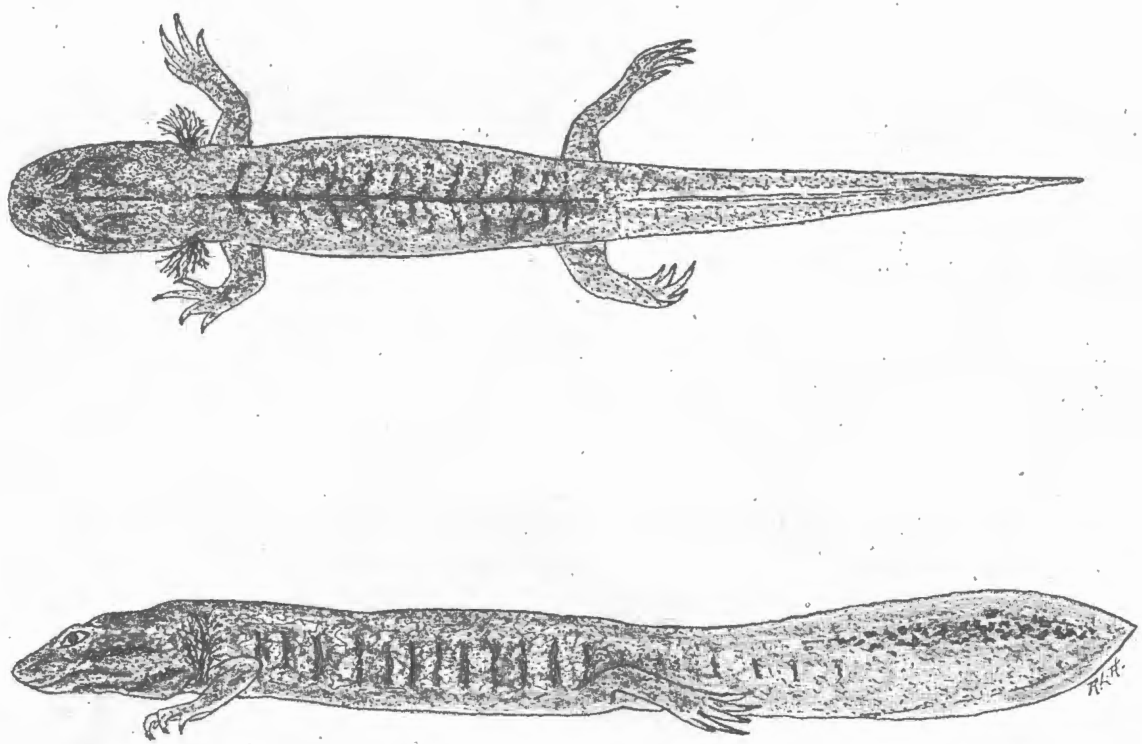


FIG. 2 DICAMPTODON ENSATUS

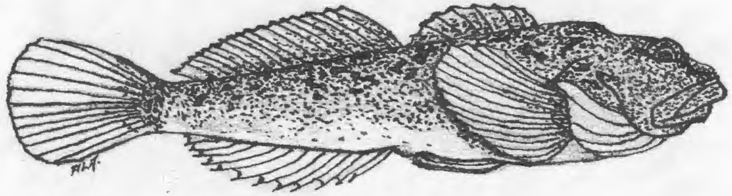


FIG. 3 COTTUS TENUIS

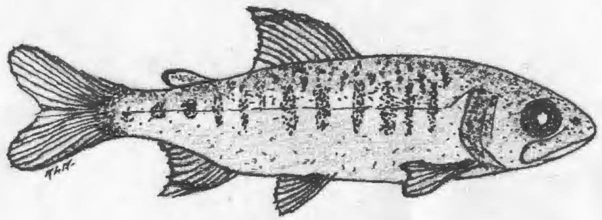


FIG. 4 SALMO GAIRDNERI

Stomach contents and stream samples were identified to family and counted. Much past work has included identifications only to ordinal level. Metter (1963) found that there were differences in stomach content between size classes of larval D. ensatus. Size classes were also considered in this study.

Dicamptodon ensatus belongs to the family Ambystomidae which is confined to North America. It is the only member of the genus. D. ensatus is usually found in a humid well-forested area in the transition, Canadian, and Hudsonian life zones. Like most amphibia there is a distinct larval stage lasting some time with a dependency upon water. The adults can be found in water as well as under logs and rocks. However, this species often exhibits neoteny and much of its life history is restricted to an aquatic environment. It is suggested that spawning may occur in March in a subterranean location. Mature larvae measure from about 50-100 mm in total length. The larvae possess a dorsal fin which extends anteriorly to the sacral region, short gills and toes. Color varies from solid brown to individuals with smokey grey mottling. Costal grooves vary from 11-13. Larvae may hatch in early winter but are not seen until the following spring. Metamorphosis, when it occurs takes place during the second summer (Stebbins, 1954). Feeding of the aquatic stages centers around aquatic insects, however it seems other forms are taken when available.

Cottus tenuis is a member of the family Cottidae. Biologies of the members of this family are poorly known and further work is necessary. Fresh water sculpins such as *C. tenuis* are found in habitats similar to those of *D. ensatus*, and *D. ensatus* and *C. tenuis* are often found together. Sculpins are bottom dwellers and are usually found in riffles where a rocky substrate is predominant. *C. tenuis* is characterized by an essentially scaleless body somewhat dorso-ventrally flattened and by possessing an unusually large head. The preopercular spine is single and the pectoral rays unbranched. Fresh water sculpins are oviparous fish (except for one genus) and exhibit parental care. Nests are excavated under a stone or other submerged materials with the eggs attached to the underside of the roof of the nest (Lagler, Bardach, and Miller, 1962). Mature individuals range from 40-60 mm. Food studies on individuals of the genus *Cottus* indicate a strong dependency on arthropods, chiefly insects.

Salmo gairdneri is a member of the family Salmonidae. It is unusual in that it exhibits two forms; an anadromous form which spawns in fresh waters but matures at sea, and a potamodromous form which spawns and matures exclusively in fresh water. Immature stages of both forms are commonly found in the headwaters of mountain streams. Young individuals are recognized by the presence of 8-12 anal rays; few or no spots on tail; 5-10 median parr marks along mid-dorsal line ahead of dorsal fin; black border of adipose fin with one or no breaks; hind margin of maxillary not reaching hind margin of eye; no red or yellow hyoid marks (Carl, Clemens, and Lindsey, 1959). S. gairdneri is an egglayer which does not exhibit parental care. Eggs are deposited in a well defined nest on a gravelly bottom and are deserted (Lagler, Bardach, and Miller, 1962). Spawning occurs in late winter or spring (Lagler, Bardach, and Miller, 1962) and eggs probably hatch in July or August. Insects comprise the majority of items in their diet, but while spawning they will often eat deposited eggs.

Several studies have been conducted investigating differential feeding in intraspecific and interspecific competition of vertebrates. A classic example is MacArthur's work (1958) performed on the blackburnian warbler, the myrtle warbler, and the black throated warbler. These birds all have similar feeding habits but were found to feed in different parts of the forest canopy. Some individuals, such as the may warbler, depend on a specific food item and were determined as selective feeders.

Little research has been conducted on food analysis of lower vertebrates. Most investigation has been limited to stomach analyses without consideration of food availability analysis. Metter (1963) presents a table showing frequency of occurence of food organisms in the stomach of larval D. ensatus which suggests a preference for trichopterans, plecopterans, and coleopterans. But the values given may only represent the relative abundance of food organisms, and therefore *D. ensatus* may be an opportunistic rather than a selective feeder.

Johnson and Schreck (1969) reported that odonates were the most frequent item in stomach contents of larval *Dicamptodon*. Their work suggests relative abundance or availability of food items is the only basis for differences in stomach content. A similar impression is given in Baileys' study on sculpins (1952) where frequencies of occurence in stomach contents are given but food availability data are lacking.

Perhaps one of the most thorough fish food studies performed is Dineen's (1951) competition study of salmonids and cottids. His work included information on food availability and stomach contents and indicated that major food items were similar but competition may be lessened by feeding behavior at certain times of the year. Also, cottids fed mainly on the bottom whereas salmonids fed at all levels.

Farner (1947) and Anderson (1968) indicated that there is a divergence of feeding habits by sympatric species of salamanders. Anderson suggested that behavioral differences in life histories may decrease competition.

DESCRIPTION OF STUDY AREA

Maratta Creek (Fig. 1) is a tributary of the Toutle River located on the western slope of the Cascades, northwest of Mt. St. Helens, in Cowlitz County, Washington, (T9N, R4E, Sect. 3). It is approximately one and one-half miles long, heading at 2740 feet and ending at 2100 feet with an eight per cent gradient.

The geology of Maratta Creek is an overlap of Eocene-Oligocene and Upper Eocene volcanic rocks. The substrate is predominantly andesite breccia with interbedded andesite and basalt flows, mudflows, and tuff beds (Hunting, et. al., 1961).

The stream (Fig. 5) is in a western red cedar (Thuja plicata) western hemlock (Tsuga heterophylla) association. There are approximately seventy-five inches of precipitation per year, with a few summer dry periods (Metter, 1967).

Maratta Creek is characterized by riffles and rapidly flowing water interspersed with shallow to deep pools. Current velocity and discharge decrease in the late summer and early fall. Within the portion worked, only one point can be described as a backwater area. Occasional bifurcations do occur depending on the water level of the stream. The maximum depth and width occured during March, 1969; the minimum occured during July, 1968.

The bottom is characterized by a mixture of boulders, rubble and coarse sand. The backwater and pool sites have, for the most part,

FIG. 5 MARATTA CK.
SEPT. 1968 (TOP)
DEC. 1968 (BOTTOM)

mixtures of gravel, sand, mud, and decaying organic material in varying degrees of concentration. Within the main body of the stream the only detected plant materials were filamentous algae and submerged terrestrial vegetation.

The average dissolved oxygen concentration was 11.2 ppm, with a high of 12.7 ppm and 102% saturation in February, 1969 and a low of 9.9 ppm and 85% saturation in July, 1968. The average CO_2 concentration was 6.5 ppm, with a high of 10 ppm in May and July, 1968 and a low of 5-7 ppm during the rest of the study. The average pH was approximately 7.0. Temperatures in the creek were as low as 1°C in December, 1968 and January, 1969 and as high as 11.5°C in September, 1968.

The morphometry of the stream changed with the seasons averaging twelve inches deep and fifteen feet wide. Summer minimums were eight inches deep and thirteen feet wide and spring maximums were eighteen inches deep and eighteen feet wide. During the summer months (with exception of the August, 1968 trip during which heavy rains increased total volume and flow) the stream became a gentle flow with many isolated pools along its length.

During the course of the study a record of animal signs within and in proximity to the stream was kept. Those animals within the creek were identified as Rhyacotriton olympicus (Olympic salamander), Bufo boreas (northwestern toad), Rana aurora (red-legged frog), and Ascaphus truei (Bell toad). Those in the vicinity of the stream were Plethodon vehiculum (western red-backed salamander), Ensatina eschscholtzi

(Oregon salamander), and *Thamnophis ordinoides* (northwestern garter snake). Fecal pellets of *Cervis canadensis* (elk) and *Odocoileus hemionus* (mule deer) were also found in and around the stream.

METHODS AND MATERIALS

Hydrographic Data

During the twelve month period physical parameters of the study site were measured. Those physical aspects considered were stream velocity and discharge. Initial data collecting for this demanded that a consistent spot on the creek be tested each time. This spot was approximately ten meters from that point where the stream flows under the road and on the left side of that road as one proceeds up towards its end. At this location, width, average depth and average surface velocity were determined. A Pitot tube was employed to procure values for velocity determination. The velocity was determined from the formula:

$$v = \sqrt{2gh}\ (.977)$$

where v = average velocity, g = 32.16 ft/sec, h = height of column of water in Pitot tube, and (.977) = an average constant. The discharge was computed from the formula:

$$V = wdav$$

where V = volume, w = average width, d = average depth, v = average velocity, and a = 0.8 (adjustment constant for stream bottom condition). The formulas used are those of Welch's (1948). These data are presented in Table 1.

Water Chemistry

Values for water chemistry were also obtained each trip. Those considered to be of general importance were dissolved oxygen, dissolved carbon dioxide, and hydrogen ion concentration. Carbon dioxide tests were performed in the field. Oxygen was fixed in the field but titrated in the laboratory. Carbon dioxide was determined by the methods described in Needham and Needham, (1962). Hydrogen ion concentration was obtained by mixing a few drops of Bromo-Methylene Blue with a sample of creek water. Color indicated the pH value. Oxygen was fixed and titrated according to the methods described in, (Anonymous, 1967). Results of these data are shown in Table 2.

Temperatures

Water temperatures were determined with maximum-minimum thermometers. Two readings were taken, one directly after arrival and one shortly before departure, usually twenty-four hours after the first reading. Air temperatures were recorded in a similar manner. Results are in Table 2.

Habitat sampling. Approximately 500 feet of Maratta Creek was sampled for potential food organisms. This area began at the junction of Maratta Creek and the Toutle River and proceeded up stream. Sampling was accomplished by using a number system which gave a value that determined how many feet should exist between each spot sampled. Seemingly the only bias factor should be the point of starting. Ten samples were taken each trip. These included a sample from both the side and middle of the stream at each station. The device used for sampling the creek was a Surber bottom sampler, (Needham and Needham, 1962). Only the lotic sections of the stream were effectively tested. Lentic conditions such as those found in relatively still ponds were avoided due to the mechanics of sampling with a Surber sampler and the unavailability of an Ekman Dredge.

The materials obtained with the sampler included rubble and debris as well as living organisms. Originally organisms were sorted out of debris after taking each sample and preserved in a vial. The amount of time spent sorting impeded other data collecting for field time was at a premium. After three months the procedure was altered so that all sorting was done in the laboratory. These materials were placed into half-pint jars containing 70% alcohol. Each sample was treated for separation of "living" and non-living materials. Occasionally carbon tetrachloride was employed to accomplish this processing. Its efficiency is commendable since heavier materials remain at the bottom of the container while lighter materials such as insects, etc. float to the surface making sorting somewhat easier than doing it by a search method. However, due to the danger factor inherent in the use of CCL_4 the search method was usually employed despite its tedium. After separation, organisms were sorted according to order and identified to genus and species where possible. All individuals are labeled and preserved and can be found in the school collection at Central Washington State College. A list of sources and aids in identification can be found both in the acknowledgements section and the appendix.

Collection and Preparation of Test Animals

Salamanders and fish were normally collected at night. Although some collections were made during daylight hours, the efficiency of obtaining animals in adequate numbers was somewhat impaired by distortion and reflections from the surface of the running water. No limit was imposed upon the number of individuals collected for animals were not particularly easy to trap. Even with good collecting conditions, however, not more than fifty individuals were taken at any one time. Under poor conditions extreme effort was taken to obtain at least ten.

Methods of collecting animals involved primarily three techniques. A standard fish shocker, a modified version of the model utilized by fisheries Ichthyologists, was employed at the beginning of the project. However, the low ion concentration of the water had much to do with determining maximum output of power. Thus, even when turned on high, the shocker used under these conditions did not produce the effect desired. This method was abandoned after the first two collecting trips. A seine net gave good results in trapping trout and was generally employed for catching these animals. Salamanders and sculpins could not be caught in this manner. The method used for trapping them can be described as a "chase and corral" techique whereby an individual was forced by hand into a dipnet.

As soon as possible after animals were captured they were anesthitized. Two per cent chlorotone was adequate for immobilizing the salamanders after which they were injected with 2-3 cc's of 10% formalin, put in formalin for several hours, and then preserved in 70% alcohol. The fish were put directly into 10% formalin, however, they were put in separate containers since formalin in several cases caused regurgitation of stomach content. Care had to be taken to prevent mixing of stomach contents in a common container.

The animals were measured according to the accepted methods employed by most herpetologists and ichthyologists. Salamander measurements were read by measuring the length from the vent to the tip of the snout. This is listed as the snout-vent length or SVL. Fish measurements comply with the Standard Length or SL found in the literature. SL is read by measuring tip of snout to the outermost edge of caudal peduncle. Values for such measurements can be found on Table 3. After measurements were taken the stomachs were removed and preserved in labeled vials containing 70% alcohol. Methods used for dissection follow those used by Bailey, (1952). Stomachs were removed by slitting the animal from the anus to the point beneath the gills. The gut was then severed just before the cardiac valve and just after the pyloric valve. For stomach analysis the stomachs were taken from these vials, carefully slit, and the contents gently washed out into a petri dish. Identifications and sources were similar to those used for bottom sample organisms. The individuals contained in the stomachs were not kept for future use.

The numerical values for frequency and density were not exacting enough to present a definitive picture in themselves. Results were examined by inspection and categorized as to sparse, moderately abundant, and abundant. This terminology was based on frequency where above forty per cent was described as abundant, below ten per cent as sparse, and anything in between as moderately abundant. Those families generally occuring in the "abundant category" are described as "stream staples".

RESULTS

The records for the bottom fauna collections can be found in the appendicies. They are listed as a frequency/density ratio from April, 1968 to March, 1969. Frequency is measured as occurrence per ten samples. Density is measured as number of individuals per sample. Mayflies, caddisflies, stoneflies, two families of dipterans, one family of beetles, and a small white oligochaete comprise the most abundant food organisms in the stream. In general this was true for the duration of the study. Of the mayflies, baetids, heptageniids, and ephemerellids were abundant. Siphlonurids and leptophlebiids were abundant to moderately abundant depending upon the time of year. Of the caddisflies, limnephileds, lepidostomids, and glossosomatids were abundant with a few exceptions. The other families of trichopterans were sparse to mederately abundant with a few cases of abundant, depending upon time of year. The stoneflies listed were abundant to moderately abundant with Perlodidae being the most common family. One exception was evident in the family Peltoperlidae. This group occurred only once in July, 1968, with one representative individual. Chironomidae and Tipulidae were the most commonly occurring families of Diptera. Tipulids were moderately abundant to abundant. Chironomids were never more than moderately abundant and not taken at all in some months. Elmidae was the only family of coleopterans that occurred significantly in the samples. They were abundant during the summer months and sparse at the beginning and end of the study. Except at the beginning of the study, oligochaetes were always at least moderately abundant. When each family was most or least abundant, can be determined by reference to Tables 4-9 in the appendix. Many other families occurred in the samples but in general they were sparse or infrequent.

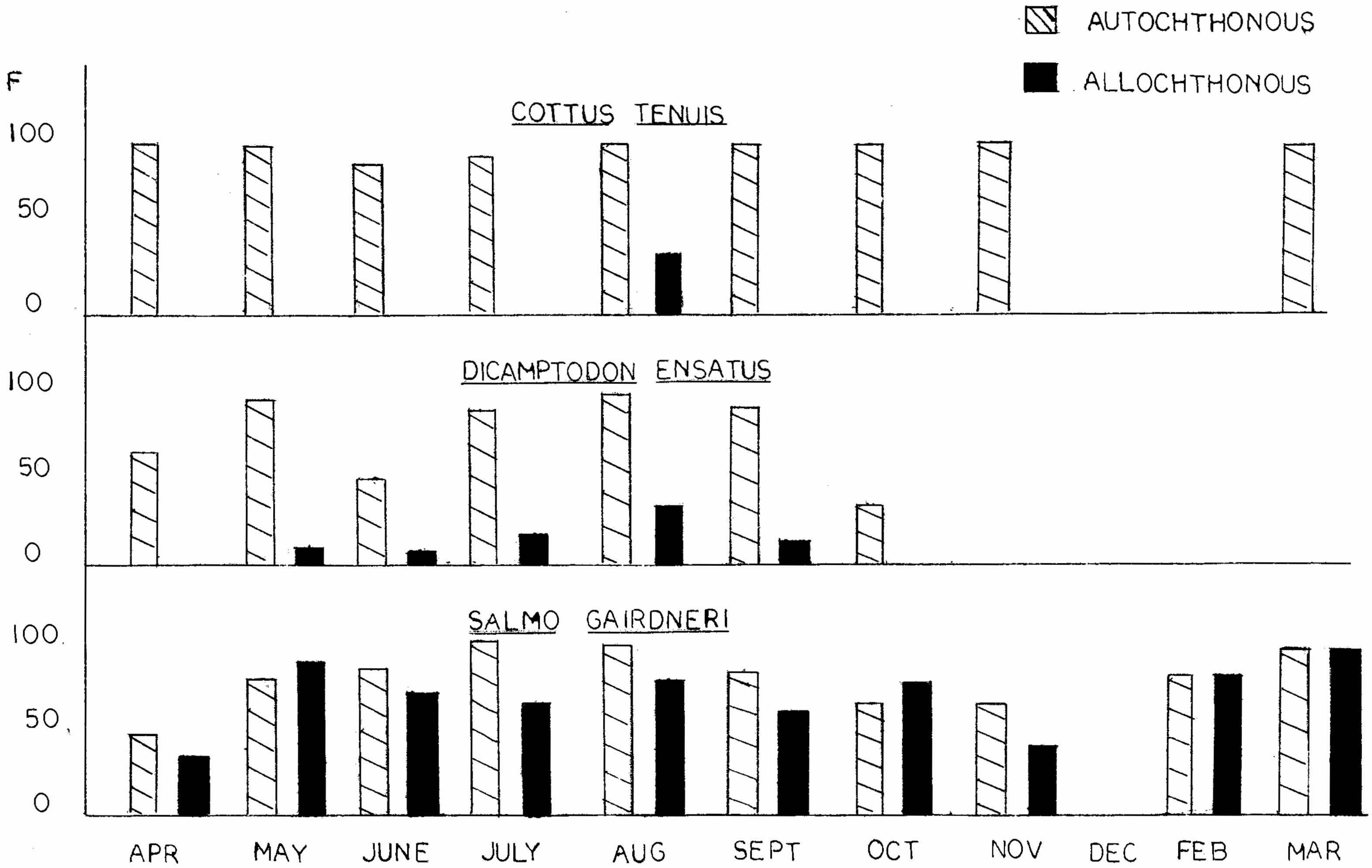
In general the common stream organisms, with the exception of oligochaetes, were eaten in proportion to their availability. The sculpins appear to be an exception to this. They seem to demonstrate a preference for three of the major staples: siphlonurids, limnephilids, and chironomids. Chironomids occured in their stomachs at all times in varying degrees of density. They did not occur in bottom samples in April, September, October, or November of 1968. Siphlonurids did not occur in bottom samples during September, November, or December of 1968 but did occur in sculpins in September and November. Siphlonurids did occur in the stomachs of D. ensatus and S. gairdneri to a limited degree in September but not when they did not occur in stream samples during November and December. Chironomids were frequent in both Salmo and Dicamptodon even in months when they did not occur in stream samples. The other staples did occur in sculpins but their importance was dwarfed by the three families already mentioned. Many of the families occurring in Salmo and Dicamptodon did not occur in sculpins. Two sculpins were collected which had eaten small trout. Nematodes were nearly always found in Cottus but determination as a food item was difficult since these organisms may well be parasites.

Dicamptodon appeared to be extremely opportunistic, feeding on what was available at the time. The stream staples comprised the bulk of their diet. Emergent adults and allochthonous or foreign individuals added variety to their diets but are sparse in occurrence relative to their overall diets. Young salmonids and sculpins frequent their diets during summer low water periods when the concentration of fish is greatest. The degree of success in obtaining Salmo by Dicamptodon is remarkable. I observed one subject take no less than four trout in less than a minute.

Salmo, as in the case of Dicamptodon, appears to be extremely opportunistic and feeds on all of the staples of the stream. But in addition to these families a great variety of non-aquatic families and emergent aquatic adults also occured. This was true throughout the year especially during the months of maximum emergence and activity over the stream. Adults tipulids, adult nemourids, leafhoppers, tree hoppers, spiders, centipedes, crickets, and a variety of terrestrial beetles are some examples of these allochthonous types. The occurrence of these individuals, in the diet of the trout is striking when compared to their occurrence in the diets of the other two vertebrates (Fig. VI). These items occur rarely in Dicamptodon and scarcely at all in Cottus. Dineen (1951) does not indicate this difference of autochthonous and allochthonous material in his comparison of trout and sculpin diets, but I suspect that it was true in his study as well.

Differences in diets of each size class for each vertebrate were not consistently significant as to density or frequency.

FIG.VI. FREQUENCY OF OCCURENCE OF TRULY AQUATIC FOOD ITEMS (AUTOCHTHONOUS) VERSUS THAT OF EMERGENT ADULTS AND NON AQUATIC ORGANISMS (ALLOCHTHONOUS)

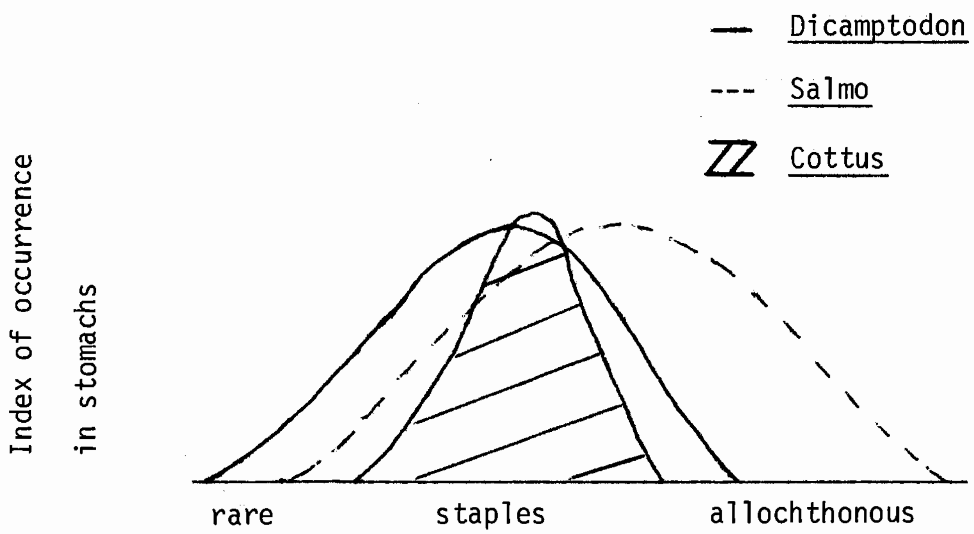


Differences in occurence of some families of bottom fauna between the size classes of each animal were noticeable. The most striking difference between size classes of D. ensatus is the occurrence of fish in the stomachs of a size classes II and III but not in I. Size class I also contained less detritus. Metter (1963) found similar results in his stomach analysis of D. ensatus. There were fewer representatives of allochthonous families in size class I of S. gairdneri than in size classes II and III. This may indicate that this size class feeds much in the benthic environment. There was little difference between the three size classes of C. tenuis. The only obvious difference was that there were fewer occurrences of limnephilids in size class I than in size classes II and III.

Frequency/density ratios for stomach contents of the three vertebrates can be found in the tables in the appendix. Frequency and density are measured in the same manner for the vertebrates as for bottom samples. The only difference being that values are given for organisms not samples.

DISCUSSION

The results indicate that there is considerable overlap in the diets of the three animals studied. With the exception of Cottus, stream organisms are consumed relative to their availability. The overlap is not absolute. Dicamptodon and Cottus are restricted to strictly autochthonous individuals where Salmo includes many allochthonous families. The feeding on these organisms as well as stream staples gives Salmo a broader food niche. The seeming selectivity of the sculpin narrows its food niche considerably in comparison with the other two vertebrates. The figure below gives a diagramatic representation of niche overlap in the stream relative to food.



The curves are not based on numerical exactness but rather the frequency of occurrence of food organisms in each animal. From this it can be assumed that complete competition is not occurring except in the case of Cottus whose selectivity puts it in the realm of complete competition with the other two vertebrates. Salmo and Dicamptodon exhibit enough diversity in feeding habits to describe them as partial competitors. In comparing the numbers of sculpins collected to those of the salamander and trout, there were proportionately fewer sculpins taken. This rareness of occurrence in sculpins may be an indication that Cottus is having difficulty coexisting with the other animals. During the winter months, Dicamptodon seems to disappear from the stream. Assuming some kind of subterranean overwintering, this may be another manner in which complete competition is avoided by Dicamptodon.

SUMMARY

Dicamptodon ensatus, *Salmo gairdneri* and *Cottus tenuis* were collected from Maratta Creek for a period of one year. Examination of their stomach contents relative to avaliability of stream organisms indicate that feeding is for the most part opportunistic. *Cottus tenuis* exhibits a degree of selectivity which imposes some competitive stress upon it. *D. ensatus* appears to be almost a benthos feeder where *Salmo gairdneri* feeds at all levels. The rare occurrence of the sculpins indicates that competition with the other two vertebrates is complete. Competition between *Salmo* and *Dicamptodon* is eased somewhat by diversity of feeding habits and the probable subterranean habits of *Dicamptodon* during part of the year. The feeding habits of the latter two give evidence that "partial exclusion" exists between them and that they can coexist without extreme stress.

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Table 1

Discharge and Velocity

Month	Yr.	Velocity=v	Discharge=V
Apr.	68	3.7 Ft./sec.	54 cu. Ft./sec.
May	68	2.05 Ft./sec.	42.5 cu. Ft./sec.
June	68	1.47 Ft./sec.	16.5 cu. Ft./sec.
July	68	.805 Ft./sec.	5.76 cu. Ft./sec.
Aug.	68	1.29 Ft./sec.	15.9 cu. Ft./sec.
Sept.	68	1.37 Ft./sec.	17.9 cu. Ft./sec.
Oct.	68	1.80 Ft./sec.	27.8 cu. Ft./sec.
Nov.	68	1.88 Ft./sec.	32.2 cu. Ft./sec.
Dec.	68	2.14 Ft./sec.	38.9 cu. Ft./sec.
Jan.	69	- - - - - - - -	- - - - - - - - - -
Feb.	69	1.24 Ft./sec.	15.8 cu. Ft./sec.
Mar.	69	3.08 Ft./sec.	118 cu. Ft./sec.

Table 2

Water Chemistry and Temperature

Mo.	Yr.	*Temperature °C Air		Water		O_2 ppm	CO_2 ppm	PH
Apr.	68	17°	1°	1.5°	1.0°	11.4	7	7.3
May	68	7°	2°	8.5°	7.8°	11	10	7.2
June	68	19°	9°	10°	7.5°	10.1	5	7.3
July	68	30°	15.5°	15°	11.5°	9.9	10	7.0
Aug.	68	12°	11°	13°	10°	10.8	7	7.1
Sept.	68	15°	10°	11.5°	8.5°	10.9	5	7.0
Oct.	68	15.5°	-.5°	10°	5°	11.5	5	7.0
Nov.	68	3°	1°	5°	4°	12.2	7	7.1
Dec.	68	-1°	-3°	1.5°	1°	--	5	7.1
Jan.	69	--	--	--	--	--	--	--
Feb.	69	6°	2°	3.5°	1°	12.7	5	7.2
Mar.	69	9°	4°	5.5°	4.5°	12.0	5	7.2

* Maximum - minimum readings.

Table 3

Numbers of each Size Class of Representative Cold Blooded Vertebrates

NAME	Size Class (mm)	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Feb.	Mar.
Dicamptodon ensatus	I. (20- 40)	2	5	5	4	1	6	2	0	0	1	0
	II. (41- 70)	14	13	15	16	4	8	1	0	0	0	0
	III. (71-135)	3	2	7	14	4	5	0	0	0	0	0
	TOTAL	19	20	27	34	9	19	3	0	0	1	0
Cottus tenuis	I. (19-40)	2	4	3	1	1	0	1	1	0	0	0
	II. (41-60)	8	1	2	11	1	5	2	0	0	0	1
	III. (61-84)	2	0	4	8	1	1	2	1	0	0	0
	TOTAL	12	5	9	20	3	6	5	2	0	0	1
Salmo gairdneri	I. (28-40)	14	16	3	5	11	3	2	8	1	3	5
	II. (41-60)	0	0	11	3	13	14	9	7	0	3	3
	III. (61-93)	0	1	0	1	3	5	16	0	0	0	0
	TOTAL	14	17	14	9	27	22	27	15	1	6	8

Table 4 Frequency/Density of Bottom Fauna Identified to Family (*Adults; ** Pupa)

FAMILY	Apr.	May	June	July	Sept.	Oct.	Nov.	Dec.	Feb.	Mar.
	F/D	F/D	F/D	F/D	F/D	F/D	F/D	F/D	F/D	F/D
NEMOURIDAE	60/ 1.8	--	20/ .5	--	--	30/ .4	--	60/ 4.4	40/34.3	40/ 5.6
PERLODIDAE	10/ .1	30/ .6	50/1.1	70/1.4	70/ 2.1	30/ .4	70/ 1.2	50/ 1.2	40/ .5	40/ 1.1
PERLIDAE	20/ .2	10/ .1	10/ .1	60/ .2	70/ 2.4	60/ 2	50/ 1.9	60/ 2.2	30/ .5	20/ .3
CHLOROPERLIDAE	10/ .4	60/1.5	50/1	20/ .4	30/ .6	40/ .9	50/ 2.5	60/ 1.6	30/ 1.4	40/ 1.8
PELTOPERLIDAE	--	--	--	10/ .1	--	--	--	--	--	--
UNIDENTIFIED PLECOPTERA	10/ .1	10/ .2	10/ .1	10/ .1	10/ .1	--	--	--	--	--
BAETIDAE	70/18.8	70/10	70/4.6	70/6.2	60/ 3.7	40/ .7	80/ 3.1	50/ 2.3	40/ 4.4	60/ 2.8
EPHEMERELLIDAE	70/ 2.7	80/2.4	70/4.7	60/2.7	40/ 5.1	70/ 3.7	80/ 4.6	70/10.3	40/ 7.8	50/ 2.9
LEPTOPHLEBIIDAE	20/ .3	40/1.5	40/2	50/3.2	--	30/ .3	10/ .1	10/ .6	40/ .9	30/ 2.6
HEPTAGENIIDAE	60/ 8.6	70/8.7	60/4.8	70/1.6	70/14.3	60/14.6	80/18.3	80/18.3	40/19.9	50/11.8
SIPHLONURIDAE	30/ .5	20/1.2	70/6.1	70/3.8	--	10/ .1	--	--	20/ .6	30/ 1.3
UNIDENTIFIED EPHEMEROPTERA	10/ .2	--	--	40/ .7	--	--	--	10/ .1	--	--
PHILOPOTOMIDAE	--	--	--	20/ .3	--	--	--	--	--	--
LEPIDOSTOMIDAE	40/ .5	40/2.9	30/1.2	70/3.8	50/ 1.4	70/ 1.2	30/ 1.3	40/ 1	20/ .5	50/ 1.4
LIMNEPHILIDAE	--	--	10/ .1	90/6.6	40/ 1.7	50/ 2.7	10/ .2	10/ .1	20/ .4	40/ 1.5
RHYACOPHILIDAE	--	10/ .2	30/ .6	40/ .6	--	40/ .5	--	50/ .6	30/ .9	10/ .1
HYDROPSYCHIDAE	50/ .6	40/ .5	--	20/ .2	40/ 6.7	60/ 6.9	50/ 1	60/ 2.3	30/ 1	30/ .3
PHYSCOMYIIDAE	10/ .1	10/ .1	--	--	--	--	--	--	--	--
GLOSSOSOMATIDAE	10/ .1	40/ .4	20/ .3	50/ .7	50/ 5.7	70/15.7	80/ 2.6	80/ 5.8	30/ .8	30/ 1
BRACHYCENTRIDAE	--	10/ .1	--	--	10/ .6	--	10/ .1	--	--	--
ELMIDAE	30/ .4	10/ .5	40/ .8	70/5.6	70/12.2	70/10.1	60/ 1.2	50/ .9	40/ 7	10/ .1
CHRYSOMELIDAE	10/ .1	--	--	--	--	--	--	--	--	--
HALIPLIDAE	10/ .2	--	--	--	--	--	--	--	--	--
CURCULIONIDAE*	--	10/ .1	--	--	--	--	--	--	--	--
STAPHYLINIDAE*	--	--	20/ .3	10/ .1	--	10/ .1	--	--	--	--
OYTISCIDAE	--	--	--	10/ .1	--	--	--	--	--	--
NOTERIDAE	--	--	--	10/ .1	--	--	--	--	--	--
PTILODACTYLIDAE	--	--	--	--	--	--	20/ .2	--	--	--
UNIDENTIFIED COLEOPTERA*	--	--	10/ .2	50/1.4	40/ .5	20/ .4	--	--	--	--
BLEPHAROCERIDAE**	10/ .1	10/ .3	--	--	--	--		--	--	--
TIPULIDAE	20/ .2	40/1	60/1.3	90/7.1	50/ 1.5	70/ 1.4	40/ .6	30/ .6	30/ 2.3	10/ .2
DOLOCOPHODIDAE	20/ .2	20/ .3	10/ .1	20/ .2	10/ .1	--	--	--	--	20/ .2
CHIRONOMIDAE	--	10/ .1	30/ .5	60/1.6	--	--	--	20/ .6	40/ .6	20/ .2
SIMULIIDAE	--	--	10/ .2	10/ .1	--	10/ .1	40/ 1.6	50/10.9	40/ .6	20/ .3
SCIARIDAE	--	--	--	--	--	10/ .1	--	--	--	--
RHAGIONIDAE	--	--	--	20/ .2	10/ .1	20/ .2	--	--	--	--
UNIDENTIFIED DIPTERA	10/ .1	--	--	10/ .1	--	10/ .1	--	--	--	10/ .1
ENTOMOBRYIDAE*	--	--	--	10/ .1	--	--	--	--	--	10/ .1
SMINTHURIDAE*	--	--	10/ .1	--	--	--	--	--	--	--
CHALCIDOIDEA*	--	--	10/ .1	--	--	--	--	--	--	--
FORMICIDAE*	--	--	--	--	--	--	--	--	--	10/ .1
UNIDENTIFIED HEMIPTERA*	--	--	--	--	--	--	--	10/ .2	--	--
OLIGOCHAETES	20/ .2	20/ .7	20/ .8	60/3.6	40/ 6.2	70/24.9	80/26.9	90/17.3	40/ 3.8	40/ 4.7
NEMATOMORPHA	--	10/ .1	20/ .3	20/ .3	10/ .1	--	--	--	--	--
NEMATODES	--	--	--	--	10/ .1	--	10/ .1	--	--	--
TURBELLARIANS	30/ .5	--	--	30/ .8	10/ .3	20/ .3	20/ .2	--	--	--
PELYCEPODS	--	--	--	--	--	--	--	--	--	--
GASTROPODS	--	--	--	--	--	--	--	--	--	--
SPIDER	--	--	10/ .1	--	--	--	--	--	--	--
MITE	--	--	--	--	--	--	--	--	--	--
EGGS	--	--	20/ .2	20/ .2	--	--	--	10/ .1	10/ .1	--
A. truei	--	10/ .1	--	--	--	--	--	10/ .1	--	--
S. gairdneri	--	--	20/ .3	--	--	--	--	--	--	10/ .1
C. tenuis	--	--	20/ .3	--	--	--	--	--	--	--

Table 5 Frequency/Density of Food Organisms found in the Three Size Classes of D. ensatus

I

FOOD ITEM	Apr.	May	June	July	Aug.	Sept.	Oct.
	F/D	F/D	F/D	F/D	F/D	F/D	F/D
SIPHLONURIDAE	100/1.5	20/ .4	--	75/2.0	--	--	50/1.0
EPHEMERELLIDAE	100/2	--	--	50/1.25	--	17/ .17	--
HEPTAGENIIDAE	100/1.5	--	--	50/2.0	--	--	50/ .5
LEPTOPHLEBIIDAE	50/2.5	60/1.8	20/ .2	100/4.25	--	66/1.17	50/ .5
BAETIDAE	--	20/ .4	--	100/2.25	--	--	--
PERLODIDAE	--	20/ .2	--	50/ .75	--	--	--
PERLIDAE	--	--	--	--	--	--	--
CHLOROPERLIDAE	50/1	20/ .2	--	50/ .75	--	17/ .17	--
NEMOURIDAE	50/ .5	--	--	25/ .25	--	--	--
RHYACOPHILIDAE	--	20/1.4	--	--	--	--	--
LEPIDOSTOMIDAE	--	--	--	--	--	33/ .66	--
HYDROPSYCHIDAE	--	--	--	--	--	--	--
LIMNEPHILIDAE	--	--	--	25/ .75	--	17/ .17	--
PHILOPOTOMIDAE	--	--	--	--	--	--	--
GLOSSOSOMATIDAE	--	--	--	25/ .25	--	--	--
CHIRONOMIDAE	50/ .5	40/ .6	20/ .2	50/ .5	100/1.0	50/ .66	--
TIPULIDAE	--	20/ .4	--	25/ .25	--	--	--
SIMULIIDAE	--	--	--	--	--	--	--
DIPTERA*	--	--	--	--	--	--	--
TABANIDAE	--	--	--	--	--	--	--
FAMILY X	--	--	--	--	--	--	--
ELMIDAE*	--	--	--	50/ .75	--	--	--
ELMIDAE	--	--	--	--	--	--	--
CARABIDAE*	--	--	--	--	--	--	--
CERAMBYCIDAE*	--	--	--	--	--	--	--
DYTISCIDAE	--	--	--	--	--	--	--
HYMENOPTERA*	--	--	--	--	--	--	--
TENTHREDINIDAE	--	--	--	--	--	17/ .17	--
SALMO	--	--	--	--	--	--	--
COTTUS	--	--	--	--	--	--	--
MEMBRACIDAE*	--	--	--	--	--	--	--
GRYLLIDAE*	--	--	--	--	--	--	--
SPIDER*	--	20/ .2	--	--	--	--	--
CERCOPIDAE*	--	--	--	--	--	--	--
MITE	--	--	--	--	--	--	--
PELYCEPODA	20/ .2	--	--	--	--	--	--
GASTROPODA	--	--	--	--	--	--	--
LEPIDOPTERA	--	--	20/ .2	--	--	--	--
DETRITUS	--	20/ .6	--	--	--	17/ .17	--

* Adults

Table 5 (continued)

I (continued)				II				
Nov.	Dec.	Feb.	Mar.	Apr.	May	June	July	Aug.
F/D	F/D	F/D	F/D	F/D	F/D	F/D	F/D	F/D
--	--	--	--	35.8/1.4	69 /2.0	20 / .53	44 / .81	--
--	--	--	--	28.3/ .5	46 /1.0	20 / .6	56 /1.4	--
--	--	--	--	21.2/ .43	70 /1.6	13.3/ .47	6 / .06	--
--	--	--	--	28.3/ .28	85 /2.4	27 /2.2	31 /1.25	--
--	--	--	--	7 / .21	38 / .38	13.3/ .13	31 /2.1	50/1.0
--	--	--	--	14.3/ .14	--	--	19 / .19	--
--	--	--	--	--	--	--	--	--
--	--	--	--	28.3/ .28	31 / .76	6.7/ .53	6.3/ .06	--
--	--	--	--	21.2/ .35	31 / .39	--	19 / .25	--
--	--	--	--	7 / .07	7.8/ .08	--	--	--
--	--	--	--	7 / .07	7.8/ .153	--	12.5/ .41	--
--	--	--	--	7 / .07	--	--	--	--
--	--	--	--	--	--	6.7/ .07	56 /1.7	75/1.25
--	--	--	--	--	--	--	6.3/ .06	--
--	--	--	--	--	--	--	6.3/ .06	--
--	--	--	--	14.3/ .14	15.5/ .23	20 / .27	44 / .81	--
--	--	--	--	--	23 / .46	6.7/ .13	--	25/ .25
--	--	--	--	--	--	--	19 / .19	--
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	25/ .25
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	6.7/ .07	--	25/ .25
--	--	--	--	--	--	6.7/ .07	--	--
--	--	--	--	--	15 / .31	--	--	--
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	25/ .25
--	--	--	--	--	--	--	--	25/ .25
--	--	--	--	7 / .07	--	6.7/ .07	--	--
--	--	--	--	--	--	--	6.3/ .06	--
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	25/ .25
--	--	--	--	7 / .07	--	--	--	--
--	--	--	--	--	15 / .153	--	--	--
--	--	--	--	--	7.8/ .08	--	--	--
--	--	--	--	--	--	--	6.3/ .06	--
--	--	--	--	14 / .28	15 / .153	6.7/ .07	12.5/ .125	25/ .25

Table 5 (continued)

II (continued)						III		
Sept.	Oct.	Nov.	Dec.	Feb.	Mar.	Apr.	May	June
F/D	F/D	F/D	F/D	F/D	F/D	F/D	F/D	F/D
38 / .38	--	--	--	--	--	--	50/1.5	43/ .43
12.5/ .125	--	--	--	--	--	--	50/1.0	14/ .43
21 / .21	--	--	--	--	--	33/ .33	50/1.0	29/ .29
62 /3.6	--	--	--	--	--	33/ .33	50/1.5	29/ .43
--	--	--	--	--	--	33/ .66	--	14/ .14
38 / .38	--	--	--	--	--	--	50/ .5	--
--	--	--	--	--	--	--	--	--
12.5/ .125	--	--	--	--	--	--	--	--
--	--	--	--	--	--	33/1.33	50/ .5	--
25 / .25	--	--	--	--	--	--	--	--
12.5/ .5	--	--	--	--	--	33/ .33	--	--
--	--	--	--	--	--	--	--	--
50 / .88	--	--	--	--	--	--	50/ .5	29/ .29
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--
12.5/ .125	--	--	--	--	--	33/ .33	50/ .5	14/ .14
12.5/ .25	--	--	--	--	--	--	100/2	29/ .29
--	--	--	--	--	--	--	50/ .5	--
--	--	--	--	--	--	--	--	14/ .14
--	--	--	--	--	--	--	--	--
12.5/2.9	--	--	--	--	--	--	--	--
25 / .38	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	33/ .33	--	--
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	29/1.14
--	--	--	--	--	--	--	--	14/ .14
--	--	--	--	--	--	--	--	--
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--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--
12.5/ .125	--	--	--	--	--	33/ .66	--	29/ .43

Table 5 (continued)

III (continued)

July	Aug.	Sept.	Oct.	Nov.	Dec.	Feb.	Mar.
F/D	F/D	F/D	F/D	F/D	F/D	F/D	F/D
21/ .5	50/1.25	--	--	--	--	--	--
36/ .71	50/2.25	--	--	--	--	--	--
29/ .64	50/ .5	--	--	--	--	--	--
14/ .21	25/ .25	20/1.0	--	--	--	--	--
64/2.2	25/ .5	--	--	--	--	--	--
36/ .64	--	20/ .2	--	--	--	--	--
14/ .14	--	--	--	--	--	--	--
14/ .14	--	--	--	--	--	--	--
29/ .36	50/ .5	--	--	--	--	--	--
29/ .64	--	--	--	--	--	--	--
7/ .07	50/1.0	20/ .2	--	--	--	--	--
14/ .14	--	--	--	--	--	--	--
43/2	100/2.5	20/ .4	--	--	--	--	--
--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--
21 / .21	25/ .5	20/ .2	--	--	--	--	--
14 / .14	25/ .5	20/ .4	--	--	--	--	--
21 / .36	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--
--	--	40/2.2	--	--	--	--	--
7.1/ .07	25/ .25	--	--	--	--	--	--
7.1/ .07	--	--	--	--	--	--	--
7.1/ .07	25/ .25	--	--	--	--	--	--
--	--	20/ .2	--	--	--	--	--
--	--	20/ .2	--	--	--	--	--
7.1/ .07	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--
--	25/ .25	20/ .2	--	--	--	--	--
21 / .42	--	--	--	--	--	--	--
--	25/ .25	--	--	--	--	--	--
--	25/ .25	--	--	--	--	--	--
--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--
7.1/ .29	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--
--	--	40/ .4	--	--	--	--	--

Table 6 Frequency/Density of Food Organisms found in the Three Size Classes of S. gairdneri

FOOD ITEM	I						
	Apr.	May	June	July	Aug.	Sept.	Oct.
	F/D	F/D	F/D	F/D	F/D	F/D	F/D
SIPHLONURIDAE	7.1/ .07	12.5/ .125	--	60/ 1.2	9.1/ .09	--	--
BAETIDAE	7.1/ .07	12.5/ .125	66/1.66	100/11.6	27 / .45	--	--
EPHEMERELLIDAE	--	12.5/ .125	33/ .33	20/ .4	--	--	--
HEPTAGENIIDAE	7.1/ .07	12.5/ .125	--	20/ .8	--	--	--
LEPTOPHLEBIIDAE	--	6.3/ .06	--	40/ 1.0	--	--	--
NEMOURIDAE	7.1/ .07	19 / .19	--	60/ 1.2	19.2/ .18	33/ .33	--
NEMOURIDAE*	--	--	--	--	--	--	--
PELTOPERLIDAE	--	--	--	--	--	--	--
CHLOROPERLIDAE	--	12.5/ .19	--	40/ .4	9.1/ .09	33/ .33	--
PERLIDAE	--	--	--	--	--	--	--
PERLODIDAE	--	--	--	40/ .4	--	--	--
RHYACOPHILIDAE	7.1/ .07	--	--	--	9.1/ .09	--	--
LIMNEPHILIDAE	14 / .14	12.5/ .125	--	--	--	--	--
TRICHOPTERA*	--	--	--	--	9.1/ .18	--	--
LEPIDOSTOMIDAE	--	--	33/1.0	40/ .4	18.2/ .18	33/ .33	--
HYDROPSYCHIDAE	--	--	--	--	--	--	--
GLOSSOSOMATIDAE	--	--	--	--	--	--	--
FAMILY X	--	--	--	--	--	--	--
CHIRONOMIDAE	4 / .36	44 /2.7	100/7.33	100/17.4	100 /7.4	66/8.0	--
TIPULIDAE	--	--	--	40/ .4	--	33/ .33	--
TIPULIDAE*	36 /1.14	63 /1.5	66/ .66	40/ 1.0	9.1/ .18	--	50/ .5
CERATOPOGONIDAE	--	--	--	--	--	--	--
SIMULIIDAE	--	12.5/ .125	--	60/ 1.0	27 /1.0	--	--
SIMULIIDAE*	--	--	--	--	--	--	--
SCOLYTIDAE*	--	--	--	--	--	--	--
STAPHYLINIDAE*	--	--	--	--	9.1/ .09	--	--
LAGRIIDAE*	--	--	--	--	--	--	--
MORDELLIDAE*	--	--	--	--	9.1/ .09	--	--
CARABIDAE*	--	--	--	--	--	--	--
HYDROPHILIDAE*	--	--	--	--	--	--	--
SCARABAEIDAE*	--	--	--	--	9.1/ .09	--	--
ELMIDAE	--	--	--	--	--	--	--
ELMIDAE*	--	--	--	--	--	--	--
PSELAPHIDAE*	--	--	--	--	--	--	--
DYTISCIDAE*	--	--	--	--	--	--	--
CHRYSOMELIDAE*	--	--	--	--	9.1/ .09	33/ .33	--
TENEBRIONIDAE*	--	--	--	--	--	--	--
CICADELLIDAE*	--	19 / .25	--	--	18 / .36	--	--
MEMBRACIDAE*	--	--	--	--	--	--	--
MILLIPEDE*	--	--	--	--	--	--	--
CENTIPEDE*	--	--	--	--	--	--	--
GERRIDAE*	--	--	--	--	--	--	--
SCUTELLERIDAE*	--	--	--	--	--	--	--
BRACONIDAE*	--	--	--	--	--	--	--
FORMICIDAE*	--	6.3/ .06	--	--	--	--	--
CYNIPIDAE*	--	--	--	--	9.1/ .09	--	--
CHALCIDOIDEA*	--	--	--	--	--	--	--
SMINTHURIDAE*	--	31 / .37	--	20/ .2	45 /1.27	33/ .66	50/ .5
ENTOMOBRYIDAE*	--	31 / .49	--	--	27 / .27	--	--
SPIDER*	--	6.3/ .06	--	20/ .2	18.2/ .18	--	--
MITE	--	12.5/1.0	--	40/ .4	9.1/ .09	--	--
PELYCEPODA	--	12.5/ .06	--	--	--	--	--
GASTROPODA	--	--	--	--	9.1/ .18	--	--
OLIGOCHAETA	--	--	--	--	--	--	--
NEMATODA	--	--	33/ .33	--	--	--	--
DETRITUS	--	--	--	--	--	--	--

* Adults

Table 6 (continued)

I (continued)				II				
Nov.	Dec.	Feb.	Mar.	Apr.	May	June	July	Aug.
F/D	F/D	F/D	F/D	F/D	F/D	F/D	F/D	F/D
--	--	--	--	--	--	27 / .27	100/2.0	15.4/ .23
--	--	--	20/ .2	--	--	28 / .28	100/5.3	23 / .38
--	--	--	20/ .2	--	--	9.1/ .09	66/1.33	--
12.5/ .125	--	--	--	--	--	18 / .28	33/ .33	7.7/ .08
--	--	--	20/ .2	--	--	--	--	15.4/ .15
12.5/ .25	--	--	--	--	--	--	--	7.7/ .08
--	--	--	20/ .4	--	--	--	--	--
--	--	--	20/ .2	--	--	--	--	--
--	--	--	--	--	--	--	--	7.7/ .08
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	18 / .18	66/3.3	23 / .31
12.5/ .125	--	--	--	--	--	--	33/1.33	7.7/ .15
--	--	--	--	--	--	--	--	7.7/ .08
--	--	--	--	--	--	16.5/ .36	-	23 / .23
12.5/ .125	--	--	--	--	--	9.1/ .91	33/ .33	7.7/ .08
--	--	--	--	--	--	--	--	7.6/ .154
--	--	--	--	--	--	--	--	23 / .31
--	--	--	--	--	--	--	--	--
12.5/ .125	--	66/ .33	60/1.4	--	--	73 /4.2	100/8.0	92 /8.4
--	--	--	--	--	--	--	--	23 / .23
--	--	100/1.0	60/ .8	--	--	36 / .91	33/ .33	23 / .23
--	--	--	20/ .2	--	--	--	--	--
--	--	--	--	--	--	18 / .182	--	23 / .38
--	--	--	40/ .4	--	--	18 / .45	--	--
--	--	--	--	--	--	--	--	7.7/ .08
--	--	--	--	--	--	--	33/ .33	7.7/ .38
--	--	--	--	--	--	9 / .27	--	--
--	--	--	--	--	--	--	--	7.7/ .08
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	7.7/ .08
--	--	--	--	--	--	--	33/ .33	--
--	--	--	--	--	--	27 / .27	--	15.4/ .15
--	--	--	--	--	--	18 / .182	--	15.4/ .154
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	15.4/ .31
--	--	--	--	--	--	--	--	--
12.5/ .125	--	--	--	--	--	--	33/ .33	38 / .46
--	--	--	--	--	--	--	--	7.7/ .08
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	9.1/ .09	--	7.7/ .08
--	--	--	--	--	--	--	--	7.7/ .08
--	--	--	--	--	--	--	--	7.7/ .08
--	--	--	--	--	--	--	--	7.7/ .08
--	--	--	--	--	--	9.1/ .09	--	--
38 / .5	--	33/ .33	60/2.8	--	--	--	--	23 / .62
--	--	--	60/1.6	--	--	18 / .45	--	15.4/ .154
--	--	--	--	--	--	--	--	23 / .23
--	--	--	20/ .2	--	--	45 / .91	--	7.7/ .08
--	--	--	20/ .2	--	--	--	--	--
12.5/ .125	--	33/ .66	--	--	--	--	--	7.7/ .08
12.5/ .125	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	36 / .64	--	7.7/ .08

Table 6 (continued)

II (continued)						III		
Sept.	Oct.	Nov.	Dec.	Feb.	Mar.	Apr.	May	June
F/D	F/D	F/D	F/D	F/D	F/D	F/D	F/D	F/D
14.3/ .14	--	--	--	33/ .33	33/ .66	--	--	--
21 / .57	--	29 / .29	--	--	--	--	100/1.0	--
14.3/ .14	--	--	--	--	33/ .66	--	--	--
7.1/ .07	--	--	--	--	33/ .66	--	--	--
14.3/ .21	--	--	--	--	--	--	--	--
--	--	--	--	--	66/1.0	--	100/3.0	--
14.3/ .14	11/ .11	--	--	--	66/ .66	--	--	--
--	--	--	--	--	--	--	--	--
7.1/ .07	11/ .11	--	--	33/ .33	--	--	--	--
--	--	14 / .143	--	--	--	--	--	--
7.1/ .07	--	--	--	--	--	--	--	--
7.1/ .07	--	--	--	--	--	--	--	--
21 / .29	--	--	--	--	--	--	100/1.0	--
--	--	--	--	--	33/ .33	--	--	--
--	22/ .22	--	--	33/ .33	--	--	--	--
21 / .21	--	14 / .14	--	--	--	--	--	--
--	--	14 / .14	--	--	--	--	--	--
7.1/ .07	--	--	--	--	--	--	--	--
79 /2.1	11/ .11	29 / .29	--	66/1.33	33/6.0	--	--	--
--	11/ .11	--	--	--	--	--	--	--
50 / .92	45/1.1	14 / .14	--	33/ .66	66/4.33	--	--	--
--	--	14 / .14	--	--	--	--	--	--
7.1/ .07	--	--	--	33/ .33	33/ .33	--	--	--
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--
--	11/ .11	--	--	--	--	--	--	--
7.1/ .07	22/ .22	--	--	--	--	--	--	--
14.3/ .14	22/ .22	14 / .14	--	--	--	--	--	--
--	--	--	--	--	33/ .33	--	100/1.0	--
--	--	--	--	33/ .33	--	--	--	--
--	11/ .11	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--
7.1/ .07	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--
7.1/ .07	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--
7.1/ .07	--	--	--	--	33/ .33	--	--	--
14.3/ .14	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--
7.1/ .14	22/ .33	14.3/ .14	--	--	--	--	--	--
14.3/ .14	--	--	--	--	33/ .33	--	--	--
21 / .21	45/ .45	--	--	33/ .33	--	--	--	--
--	--	--	--	--	--	--	--	--
--	--	--	--	33/ .66	--	--	--	--
--	--	--	--	33/2.33	--	--	--	--
--	--	--	--	--	--	--	--	--
--	--	--	--	33/ .33	--	--	--	--
--	--	--	--	--	--	--	--	--

Table 6 (continued)

III (continued)

July	Aug.	Sept.	Oct.	Nov.	Dec.	Feb.	Mar.
F/D	F/D	F/D	F/D	F/D	F/D	F/D	F/D
100/1.0	33/ .33	40/ .6	--	--	--	--	--
100/4.0	--	--	--	--	--	--	--
--	--	20/ .4	--	--	--	--	--
--	--	20/ .2	6.2/ .125	--	--	--	--
--	--	20/ .2	--	--	--	--	--
100/1.0	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--
--	--	--	12 / .12	--	--	--	--
--	--	40/ .4	19 / .19	--	--	--	--
--	--	60/ .6	6.2/ .06	--	--	--	--
--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--
--	--	20/1.0	12 / .25	--	--	--	--
--	--	20/ .2	6.2/ .06	--	--	--	--
--	--	--	--	--	--	--	--
100/8.0	33/ .33	60/1.0	31 / .31	--	--	--	--
--	--	20/ .2	12 / .12	--	--	--	--
--	--	--	56 /1.25	--	--	--	--
--	--	--	--	--	--	--	--
--	--	40/ .4	--	--	--	--	--
--	--	--	19 / .31	--	--	--	--
--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--
--	--	--	6.2/ .06	--	--	--	--
--	--	--	6.2/ .06	--	--	--	--
--	--	--	--	--	--	--	--
--	--	--	19 /1.75	--	--	--	--
100/1.0	--	--	12 / .12	--	--	--	--
--	--	--	6.2/ .06	--	--	--	--
--	--	--	6.2/ .06	--	--	--	--
--	--	--	6.2/ .06	--	--	--	--
--	66/1.0	--	--	--	--	--	--
--	33/ .33	--	--	--	--	--	--
--	100/1.66	--	6.2/ .06	--	--	--	--
--	--	--	--	--	--	--	--
--	--	20/ .2	--	--	--	--	--
--	33/ .33	--	--	--	--	--	--
--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--
--	--	20/ .4	19 / .56	--	--	--	--
--	--	--	6.2/ .06	--	--	--	--
--	--	--	19 / .19	--	--	--	--
--	--	--	6.2/ .06	--	--	--	--
--	--	20/ .2	--	--	--	--	--
--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--
--	33/ .33	--	--	--	--	--	--
--	--	--	--	--	--	--	--

Table 7 Frequency/Density of Food Organisms found in the Three Size Classes of C. tenuis

I

FOOD ITEM	Apr.	May	June	July	Aug.	Sept.	Oct.
	F/D	F/D	F/D	F/D	F/D	F/D	F/D
SIPHLONURIDAE	100/1.0	--	33/ .33	--	100/1.0	--	--
BAETIDAE	--	25/ .25	--	100/1.0	--	--	--
EPHEMERELLIDAE	--	25/ .5	--	--	--	--	--
HEPTAGENIIDAE	--	--	--	--	--	--	--
LEPTOPHLEBIIDAE	--	50/1.75	--	--	--	--	--
PERLODIDAE	--	--	--	--	--	--	--
CHLOROPERLIDAE	--	--	--	--	--	--	--
NEMOURIDAE	--	--	--	--	--	--	--
RHYACOPHILIDAE	--	25/ .25	--	--	--	--	--
LEPIDOSTOMA	--	--	--	--	--	--	--
HYDROPSYCHIDAE	--	--	--	--	--	--	--
LIMNEPHILIDAE	--	--	33/ .33	--	--	--	--
GLOSSOSOMATIDAE	--	--	--	--	--	--	--
TRICHOPT. PUPA	--	--	--	--	--	--	--
CHIRONOMIDAE	--	50/ .5	66/ .66	100/2.0	100/5.0	--	100/3.0
TIPULIDAE	--	--	--	--	--	--	--
FAMILY X	--	--	--	--	--	--	--
ELMIDAE	--	--	--	--	--	--	--
ELMIDAE*	--	--	--	--	--	--	--
DYTISCIDAE	--	--	--	--	--	--	--
MITE	--	--	--	--	100/1.0	--	--
PELYCEPODA	--	50/ .5	--	--	--	--	--
SALMO	--	--	--	--	--	--	--
NEMATODE	50/1.0	--	--	--	--	--	--
DETRITUS	--	25/ .25	33/ .33	--	--	--	--

* Adults

Table 7 (continued)

I (continued)				II				
Nov.	Dec.	Feb.	Mar.	Apr.	May	June	July	Aug.
F/D	F/D	F/D	F/D	F/D	F/D	F/D	F/D	F/D
--	--	--	--	38 / .75	100/1.0	--	55/1.36	--
--	--	--	--	63 / .75	100/2.0	--	9/ .45	--
--	--	--	--	63 /1.5	100/1.0	--	27/ .36	--
--	--	--	--	25 / .5	--	--	--	--
--	--	--	--	--	--	--	9/ .09	--
--	--	--	--	--	--	--	27/ .55	--
--	--	--	--	25 / .38	--	--	--	--
--	--	--	--	25 / .5	--	--	--	--
--	--	--	--	--	--	50/ .5	9/ .09	--
--	--	--	--	--	--	--	--	--
--	--	--	--	12.5/ .125	--	--	--	--
--	--	--	--	--	--	--	27/ .73	--
--	--	--	--	12.5/ .125	--	--	--	--
--	--	--	--	--	--	--	--	--
100/5.0	--	--	--	50 /2.25	100/1.0	100/5.5	55/1.0	100/15
--	--	--	--	--	--	--	9/ .09	--
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	9/ .09	--
--	--	--	--	--	--	--	--	100/ 4.0
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	9/ .09	--
100/1.0	--	--	--	12.5/ .125	--	--	--	--
--	--	--	--	--	--	--	--	--
--	--	--	--	25 / .25	100/2.0	--	--	100/ 1.0
--	--	--	--	12.5/ .125	--	--	--	--

Table 7 (continued)

II (continued)						III		
Sept.	Oct.	Nov.	Dec.	Feb.	Mar.	Apr.	May	June
F/D	F/D	F/D	F/D	F/D	F/D	F/D	F/D	F/D
20/ .4	--	100/1.0	--	--	--	--	--	33/ .33
20/ .2	--	--	--	--	--	50/ .5	--	--
--	--	--	--	--	--	50/1.5	--	--
20/ .2	50/ .5	--	--	--	--	--	--	--
20/ .2	--	--	--	--	--	--	--	--
--	--	--	--	--	--	100/1.0	--	--
--	--	100/1.0	--	--	--	--	--	--
--	--	100/1.0	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	50/1.5	--	--
--	--	100/1.0	--	--	--	--	--	--
40/ .4	50/1.0	--	--	--	--	--	--	33/ .33
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--
80/9.4	--	--	--	--	100/2.0	50/1.0	--	--
--	50/ .5	100/1.0	--	--	100/1.0	--	--	--
20/ .8	--	--	--	--	--	--	--	--
--	100/1.0	--	--	--	--	--	--	--
--	--	--	--	--	100/1.0	--	--	--
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	33/ .66
--	--	--	--	--	--	100/2.5	--	66/1.0
--	--	--	--	--	--	--	--	--

Table 7 (continued)

III (continued

July	Aug.	Sept.	Oct.	Nov.	Dec.	Feb.	Mar.
F/D	F/D	F/D	F/D	F/D	F/D	F/D	F/D
50 / .63	100/1.0	100/1.0	50/ .5	--	--	--	--
12.5/ .125	--	--	--	--	--	--	--
12.5/ .125	--	--	--	--	--	--	--
12.5/ .125	--	--	--	--	--	--	--
38 / .38	--	--	--	--	--	--	--
12.5/ .125	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--
12.5/ .125	--	100/1.0	--	--	--	--	--
--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--
50 /1.75	100/1.0	--	100/7.5	--	--	--	--
--	--	--	100/1.0	--	--	--	--
--	--	--	--	--	--	--	--
38 /1.25	--	100/1.0	--	--	--	--	--
--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--
38 / .5	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--
12.5/ .50	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--
--	100/1.0	--	--	--	--	--	--
12.5/ .125	--	--	--	--	--	--	--
12.5/ .125	--	--	50/ .5	--	--	--	--

Table 8 Ave. Frequency/Density of Food Organisms found in D. ensatus, S. gairdneri, and C. tenuis

D. ensatus

FOOD ITEM	Apr.	May	June	July	Aug.	Sept.	Oct.
	F/D	F/D	F/D	F/D	F/D	F/D	F/D
SIPHLONURIDAE	40/1	55/1.6	18/ .4	35/ .8	22/ .6	16/ .16	30/ .6
BAETIDAE	11/ .11	35/ .35	11/ .11	56/2.3	33/ .6	--	--
EPHEMERELLIDAE	31/ .5	25/ .6	15/ .5	44/1.0	22/1.0	10/ .1	--
HEPTAGENIIDAE	21/ .6	55/1.3	11/ .3	24/ .6	22/ .2	10/ .1	30/ .3
LEPTOPHLEBIIDAE	25/ .5	55/1.7	26/3.3	29/1.1	11/ .11	53/1.8	30/ .3
PERLODIDAE	11/ .11	10/ .1	--	29/ .4	--	21/ .2	--
PELTOPERLIDAE	--	--	--	--	--	--	--
CHLOROPERLIDAE	25/ .3	30/ .7	4/ .03	18/ .21	--	10/ .1	--
PERLIDAE	--	--	--	6/ .06	--	--	--
NEMOURIDAE	25/ .5	--	--	23/ .3	22/ .2	--	--
NEMOURIDAE*	--	--	--	--	--	--	--
RHYACOPHILIDAE	5/ .05	10/ .4	--	12/ .2	--	10/ .1	--
LIMNEPHILIDAE	--	5/ .05	4/ .03	44/1.6	66/1.6	32/ .5	--
LEPIDOSTOMIDAE	5/ .05	5/ .1	--	6/ .2	22/ .5	21/ .2	--
HYDROPSYCHIDAE	5/ .05	--	--	6/ .06	--	--	--
GLOSSOSOMATIDAE	--	--	--	6/ .09	--	--	--
TRICHOPTERA*	--	--	--	--	--	--	--
PHILOPOTOMIDAE	--	--	--	6/ .12	--	--	--
FAMILY X	--	--	--	--	--	16/1.8	--
CHIRONOMIDAE	21/ .2	25/ .4	19/ .22	38/ .6	22/ .3	26/ .3	--
DIPTERA*	--	--	4/ .03	--	--	--	--
TIPULIDAE	--	25/ .4	11/ .19	8/ .08	22/ .2	10/ .2	--
CERATOPOGONIDAE	--	--	--	--	--	--	--
TIPULIDAE*	--	--	--	--	--	--	--
TABANIDAE	--	--	--	--	11/ .1	--	--
SIMULIIDAE	--	5/ .05	--	18/ .24	--	--	--
SIMULIIDAE*	--	--	--	--	--	--	--
SCOLYTIDAE*	--	--	--	--	--	--	--
STAPHYLINIDAE*	--	--	--	--	--	--	--
LAGRIIDAE*	--	--	--	--	--	--	--
MORDELLIDAE*	--	--	--	--	--	--	--
CARABIDAE*	--	10/ .2	--	3/ .03	11/ .1	--	--
HYDROPHILIDAE*	--	--	--	--	--	--	--
SCARABAEIDAE*	--	--	--	--	--	--	--
CERAMBYCIDAE*	--	--	--	--	--	5/ .05	--
ELMIDAE*	--	--	4/ .03	12/ .1	22/ .2	10/ .2	--
ELMIDAE	--	--	4/ .03	3/ .03	--	--	--
PSELAPHIDAE*	--	--	--	--	--	--	--
DYTISCIDAE*	5/ .05	--	--	--	--	5/ .05	--
CHRYSOMELIDAE*	--	--	--	--	--	--	--
TENEBRIONIDAE*	--	--	--	--	--	--	--
CICADELLIDAE*	--	--	--	--	--	--	--
MEMBRACIDAE*	--	--	--	--	11/ .1	--	--
GERRIDAE*	--	--	--	--	--	--	--
CERCOPIDAE*	--	--	--	--	11/ .1	--	--
SCUTELLERIDAE*	--	--	--	--	--	--	--
BRACONIDAE*	--	--	--	--	--	--	--
FORMICIDAE*	--	--	--	--	--	--	--
CYNIPOIDEA*	--	--	--	--	--	--	--
TENTHREDINIDAE*	--	--	--	--	11/ .1	5/ .05	--
CHALCIDOIDEA*	--	--	--	--	--	--	--
SMINTHURIDAE*	--	--	--	--	--	--	--
ENTOMOBRYIDAE*	--	--	--	--	--	--	--
MILLIPEDE*	--	--	--	--	--	--	--
CENTIPEDE*	--	--	--	--	--	--	--
LEPIDOPTERA	--	--	37/ .04	3/ .03	--	--	--
GRYLLIDAE*	--	--	--	--	11/ .1	--	--
PELYCEPODA	--	15/ .15	--	--	--	--	--
GASTROPODA	--	5/ .05	--	3/ .12	--	--	--
OLIGOCHAETE	--	--	--	--	--	--	--
SPIDER*	--	5/ .05	--	--	--	5/ .05	--
MITE	5/ .05	--	--	--	--	--	--
NEMATODE	--	--	--	3/ .03	--	--	--
DETRITUS	16/ .3	5/ .15	11/ .11	12/ .2	11/ .1	21/ .2	--
SALMO	5/ .05	--	11/ .33	9/ .2	11/ .1	5/ .05	--
COTTUS	--	--	4/ .03	3/ .03	--	--	--

* Adult

Table 8 (continued)

D. ensatus (continued)				C. tenuis				
Nov.	Dec.	Feb.	Mar.	Apr.	May	June	July	Aug.
F/D	F/D	F/D	F/D	F/D	F/D	F/D	F/D	F/D
--	--	--	--	42/ .7	20/ .2	22/ .2	50/1.0	66/ .6
--	--	--	--	50/ .6	40/ .6	--	15/ .35	--
--	--	--	--	50/1.3	40/ .6	--	20/ .25	--
--	--	--	--	17/ .3	--	--	5/ .05	--
--	--	--	--	--	40/1.4	--	20/ .2	--
--	--	--	--	17/ .17	--	--	20/ .4	--
--	--	--	--	--	--	--	--	--
--	--	--	--	17/ .3	--	--	--	--
--	--	--	--	--	--	--	--	--
--	--	--	--	17/ .3	--	--	5/ .05	--
--	--	--	--	--	--	--	--	--
--	--	--	--	--	20/ .2	11/ .1	5/ .05	--
--	--	--	--	--	--	22/ .2	40/1.2	33/ .3
--	--	--	--	8/ .25	20/ .2	--	--	--
--	--	--	--	8/ .08	--	--	--	--
--	--	--	--	--	--	--	--	--
--	--	--	--	8/ .08	--	--	--	--
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--
--	--	--	--	42/1.6	60/ .6	56/1.7	50/1.2	66/ .6
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	5/ .05	--
--	--	--	--	--	--	--	--	--
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--	--	--	--	--	--	--	--	33/1.3
--	--	--	--	--	--	--	20/ .3	--
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	5/ .05	--
--	--	--	--	--	--	--	--	--
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--	--	--	--	8/ .08	40/ .4	--	--	--
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	5/ .05	33/ .3
--	--	--	--	42/ .8	20/ .4	22/ .3	5/ .05	33/ .3
--	--	--	--	8/ .08	20/ .2	11/ .1	5/ .05	--
--	--	--	--	--	--	11/ .2	--	33/ .3
--	--	--	--	--	--	--	--	--

Table 8 (continued)

<u>C. tenuis</u> (continued						<u>S.gairdneri</u>		
Sept.	Oct.	Nov.	Dec.	Feb.	Mar.	Apr.	May	June
F/D	F/D	F/D	F/D	F/D	F/D	F/D	F/D	F/D
33/ .5	20/ .2	50/ .5	--	--	--	7/ .07	12/ .12	21/ .2
17/ .2	--	--	--	--	--	7/ .07	18/ .18	36/ .6
--	--	--	--	--	--	--	12/ .12	14/ .14
17/ .2	20/ .2	--	--	--	--	7/ .07	12/ .12	14/ .2
17/ .2	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	14/ .14
--	--	--	--	--	--	--	--	--
--	--	50/ .5	--	--	--	--	12/ .18	--
--	--	--	--	--	--	--	--	--
17/ .2	--	50/ .5	--	--	--	7/ .07	24/ .35	--
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	7/ .07	--	--
33/ .3	60/3.2	--	--	--	--	14/ .14	12/ .12	--
--	--	--	--	--	--	--	--	14/ .9
--	--	50/ .5	--	--	--	--	--	--
--	40/ .4	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	14/ .3
--	--	--	--	--	--	--	--	--
17/ .6	--	--	--	--	--	--	--	--
83/7.8	20/ .6	50/ .5	--	--	100/2.0	14/ .4	41/2.5	71/4.9
--	--	--	--	--	--	--	--	--
--	20/ .2	50/ .5	--	--	100/1.0	--	--	--
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	36/1.1	59/1.4	43/ .86
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	12/ .12	14/ .14
--	--	--	--	--	--	--	--	14/ .14
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	7/ .07
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	21/ .2
--	40/ .4	--	--	--	100/1.0	--	--	--
--	--	--	--	--	--	--	6/ .06	14/ .14
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	18/ .2	--
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	7/ .07
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	6/ .06	--
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	7/ .07
--	--	--	--	--	--	--	29/ .35	--
--	--	--	--	--	--	--	29/ .5	14/ .4
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--
--	--	50/ .5	--	--	--	--	12/ .12	--
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	6/ .06	--
--	--	--	--	--	--	--	12/ .9	36/ .7
--	20/ .2	--	--	--	--	--	--	57/ .4
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--

Table 8 (continued)

S. gairdneri (continued)

July	Aug.	Sept.	Oct.	Nov.	Dec.	Feb.	Mar.
F/D	F/D	F/D	F/D	F/D	F/D	F/D	F/D
66/ 1.0	11/ .15	14/ .18	--	--	--	17/ .17	13/ .25
100/ 8.8	22/ .4	14/ .36	--	13/ .13	--	--	13/ .13
33/ .6	--	14/ .18	--	--	--	--	38/ .4
22/ .6	4/ .04	9/ .09	3/ .07	7/ .07	--	--	13/ .25
22/ .6	7/ .07	14/ .18	--	--	--	--	13/ .13
45/ 1.3	11/ .15	5/ .05	7/ .07	--	--	--	--
--	--	--	--	--	--	--	13/ .13
22/ .2	7/ .07	9/ .09	3/ .03	--	--	17/ .17	--
--	--	--	--	7/ .07	--	--	--
56/ .9	11/ .1	--	--	7/ .13	--	--	25/ .4
--	--	14/ .14	3/ .03	--	--	--	38/ .5
11/ .45	7/ .1	14/ .14	11/ .1	7/ .07	--	--	--
--	4/ .04	27/ .3	3/ .03	--	--	--	--
33/ .3	11/ .11	9/ .27	7/ .07	7/ .07	--	17/ .17	--
--	4/ .07	14/ .14	7/ .15	7/ .07	--	--	--
--	11/ .15	5/ .05	3/ .03	7/ .07	--	--	--
--	15/ .15	--	--	--	--	--	13/ .13
--	--	--	--	--	--	--	--
--	--	5/ .05	--	--	--	--	--
100/13	90/7	68/2.6	22/ .2	20/ .2	--	50/ .8	50/3.1
--	--	--	--	--	--	--	--
22/ .2	11/ .1	9/ .18	11/ .1	--	--	--	--
--	--	9/ .09	--	7/ .07	--	--	13/ .13
33/ .6	15/ .15	32/ .6	48/1.2	7/ .07	--	66/ .8	63/2.1
--	--	--	--	--	--	--	--
33/ .6	22/ .5	14/ .14	--	--	--	17/ .17	--
--	--	--	11/ .18	--	--	--	38/ .4
--	4/ .04	--	--	--	--	--	--
11/ .1	7/ .2	--	--	--	--	--	--
--	--	--	--	--	--	--	--
--	4/ .04	--	--	--	--	--	--
--	--	--	3/ .03	--	--	--	--
--	--	--	3/ .03	--	--	--	--
--	7/ .07	--	3/ .03	--	--	--	--
--	--	--	--	--	--	--	--
11/ .1	7/ .07	9/ .09	15/ .15	7/ .07	--	--	--
11/ .1	--	5/ .05	15/ .9	--	--	--	--
--	7/ .07	--	3/ .03	--	--	--	13/ .13
--	--	--	3/ .03	--	--	17/ .17	--
--	11/ .18	5/ .05	7/ .07	--	--	--	--
--	7/ .1	--	--	--	--	--	--
11/ .1	33/ .2	5/ .05	--	7/ .07	--	--	--
--	15/ .2	--	3/ .03	--	--	--	--
--	4/ .04	--	--	--	--	--	--
--	--	--	--	--	--	--	--
--	4/ .04	--	--	--	--	--	--
--	4/ .04	5/ .05	--	--	--	--	13/ .13
--	4/ .04	9/ .09	--	--	--	--	--
--	7/ .07	--	--	--	--	--	--
--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--
11/ .1	29/ .8	14/ .27	19/ .45	27/ .3	--	17/ .17	38/1.9
--	15/ .18	--	3/ .03	--	--	--	50/1.1
--	--	5/ .05	--	--	--	--	--
--	--	5/ .05	--	--	--	--	--
--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--
--	--	5/ .05	--	--	--	17/ .3	13/ .13
--	7/ .1	--	--	7/ .07	--	33/1.3	--
--	--	--	--	7/ .07	--	--	--
11/ .1	18/ .18	14/ .14	26/ .26	--	--	17/ .17	--
22/ .2	7/ .07	--	3/ .03	--	--	--	13/ .13
--	7/ .07	--	--	--	--	17/ .17	--
--	4/ .04	--	--	--	--	--	--
--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--

Table 9 Frequencies/Densities of Bottom Fauna Identified to Genus and Species (where possible)

IDENTIFICATIONS		Apr.	May	June	July	Sept.	Oct.	Nov.	Dec.	Feb.	Mar.
		F/D	F/D	F/D	F/D	F/D	F/D	F/D	F/D	F/D	F/D
PLECOPTERA											
Nemouridae	Nemoura sp.	50/1	--	20/ .5	--	--	30/ .4	--	60/4.2	40/34.3	50/5.6
	Brachyptera sp.	30/ .8	--	--	--	--	--	--	--	--	--
Perlodidae	Isogenus nonus (?)	10/ .10	40/ .5	40/ .8	80/1.2	70/1.8	30/ .4	60/ 1.1	60/ 1.1	30/ .4	40/ .9
	Arcynopteryx sp.	--	10/ .1	20/ .3	20/ .2	10/ .2	--	10/ .1	10/ .1	10/ .1	--
	Diura knowltoni (?)	--	--	--	--	10/ .1	--	--	--	--	10/ .2
Perlidae	Acroneruia californica	20/ .2	10/ .1	10/ .1	50/ .7	70/2.4	70/2	50/1.9	70/2.2	30/ .5	20/ .3
Chloroperlidae	Alloperla sp.	10/ .4	60/1.2	30/ .8	10/ .2	1o/ .1	40/ .5	50/2.5	60/1.4	30/ 1.3	40/1.8
	Hastoperla sp.	--	10/ .1	--	10/ .1	10/ .3	--	--	10/ .1	--	--
	Paraperla sp.	--	10/ .1	20/ .2	10/ .1	20/ .2	10/ .4	--	--	10/ .1	--
Peltoperlidae	Peltoperla campanula	--	--	--	10/ .1	--	--	--	--	--	--
Unidentified		10/ .1	10/ .2	10/ .1	10/ .1	10/ .1	--	--	--	--	--
EPHEMEROPTERA											
Baetidae	Centroptilum sp. (?)	--	--	10/ .5	--	--	--	--	--	--	--
	Baetis tricaudatus	30/ .6	40/ .4	30/ .5	30/ .5	50/1.5	10/ .1	10/ .1	--	10/ .6	10/ .1
	Baetis intermedius	60/2	60/1.3	50/2.4	70/5.8	50/1.9	30/ .4	60/2.3	40/1.6	40/ 2.5	30/1.3
	Baetis bicaudatum	70/16	70/3.3	30/ .4	40/ .4	30/ .4	10/ .2	30/ .7	40/ .7	40/ 1.3	50/1.5
Ephemerellidae	Ephemerella orestes	--	10/ .1	--	--	--	--	--	20/ .2	--	--
	E. flavilinea	30/1.1	20/ .3	30/ .6	--	--	--	--	--	--	--
	E. infrequens	10/ .1	--	--	--	--	--	--	10/ .1	--	--
	E. inermis	--	20/ .5	--	--	--	--	--	--	--	--
	E. aurivilli	--	10/ .1	10/ .1	--	--	--	--	--	--	--
	E. margarita	10/ .2	20/ .3	--	--	10/ .1	--	--	10/ .6	--	--
	E. spinifera	--	--	--	30/1.2	30/4.1	40/2.2	10/ .1	10/ .1	20/ .7	10/ .3
	E. hystrix	--	--	--	--	--	--	--	10/ .1	--	--
	E. hecuba	--	--	--	30/ .4	--	--	--	--	--	--
	E. tibialis	--	--	10/ .1	10/ .1	--	--	--	--	--	--
	E. heterocaudata	10/ .4	10/ .1	10/ .2	--	--	--	10/ .2	10/ .1	--	--
	E. teresa	--	--	10/ .2	--	--	--	--	--	--	--
	E. doddsi	--	--	10/ .1	--	--	--	20/ .3	20/ .3	--	--
	E. micheneri	--	--	10/ .1	--	--	--	--	--	--	--
	Ephemerella sp.	40/ .9	40/1	50/3.2	50/ .7	20/ .9	60/1.5	80/4	80/8.9	40/ 7.1	50/2.6
Leptophlebiidae	Paraleptophlebia sp.	10/ .2	--	20/ .6	10/ .4	--	10/ .1	10/ .1	--	40/ .9	30/1.6
	P. gregalis	--	--	10/ .1	--	--	--	--	--	--	--
	P. memorialis	10/ .1	40/1.5	10/ .7	10/ .2	--	20/ .2	--	10/ .6	--	--

Table 9 (continued)

IDENTIFICATIONS		Apr. F/D	May F/D	June F/D	July F/D	Sept. F/D	Oct. F/D	Nov. F/D	Dec. F/D	Feb. F/D	Mar. F/D
	P. debilis	--	--	20/ .5	50/2.4	--	--	--	--	--	--
	P. bicornuta	--	--	--	20/ .2	--	--	--	--	--	--
Heptageniidae	Epeorus longimanus	60/7.1	70/6	30/3.4	--	10/ .2	--	60/1.6	80/2.8	30/ 4.6	40/3.1
	E. deceptivus	--	10/ .1	--	--	--	--	--	10/ .4	--	--
	E. flavipennis	--	10/ .1	--	--	10/ .1	--	10/ .1	--	--	--
	E. grandis (?)	--	10/ .1	--	--	--	--	10/ .1	10/ .3	10/ .3	--
	E. nitidus	--	--	--	--	--	--	--	10/1.4	--	--
	E. albertae (?)	--	10/ .1	--	--	--	--	--	--	--	--
	Epeorus sp.	50/1.3	40/1.4	10/ .1	--	10/ .1	20/ .5	50/1.8	20/ .4	20/ 1.3	10/ .6
	Cinygmula sp.	60/4.3	50/1	40/1.1	80/1.6	70/14.3	60/18.9	80/12.2	80/10.2	40/12.7	50/8.0
	Rithrogena hageni	--	--	--	--	40/ .7	40/ .9	70/5.3	50/2.7	30/ .8	10/ .2
Siphlonuridae	Amelitus cooki	10/ .2	20/ .4	20/1	30/ .4	--	--	--	--	--	--
	Amelitus sp.	20/ .5	30/ .8	50/5.1	50/3.4	--	10/ .1	10/ .1	--	20/ .6	30/1.3
Unidentified		--	--	--	40/ .7	--	--	--	10/ .1	--	--
TRICHOPTERA											
Philopotomidae		--	--	--	20/ .3	--	--	--	--	--	--
Lepidostomatidae	Lepidostoma sp.	40/ .5	40/2.9	30/1.2	70/3.8	50/1.4	70/1.2	30/1.3	40/1	20/ .5	50/1.4
Limnephilidae		--	--	10/ .1	90/7.6	40/1.7	50/2.7	20/ .2	10/ .1	20/ .4	40/1.6
Rhyacophilidae	Rhyacophila sp.	--	10/ .2	30/ .6	50/ .6	--	40/ .5	--	50/ .6	30/ .9	10/ .1
Hydropsychidae	Archtosyche sp.	--	--	--	--	--	10/ .1	--	--	--	--
	Hydroscyche sp.	50/ .6	40/ .5	--	20/ .2	40/6.7	60/6.9	50/1	60/2.1	30/ 1	30/ .9
Physcomyiidae	Polycentropus sp.	10/ .1	10/ .1	--	--	--	--	--	--	--	--
Glossosomatidae	Glossosoma sp.	10/ .1	40/ .4	20/ .3	50/ .7	50/5.8	70/16.2	80/2.8	80/5.8	30/ .8	30/1
	Brachycentrus sp.	--	10/ .1	--	--	10/ .6	--	10/ .1	--	--	--
COLEOPTERA											
Elmidae	Heterlimnius sp.	20/ .2	10/ .5	40/ .6	90/6.1	70/11.7	70/9.4	50/1	40/ .7	40/ 3.2	10/ .1
	Lara sp.	10/ .1	--	10/ .2	--	--	10/ .1	--	20/ .2	--	--
	Narpus sp.	10/ .1	--	--	20/ .2	10/ .1	10/ .1	--	--	--	--
	Ampumis sp.	--	--	--	--	10/ .4	--	--	--	20/ .3	--
Chrysomelidae	Donacia sp.	10/ .1	--	--	--	--	--	--	--	--	--
Haliplidae	Haliplus sp.	10/ .2	--	--	--	--	--	--	--	--	--
Curculionidae	Phytobius sp.*	--	10/ .1	--	--	--	--	--	--	--	--
Staphylinidae	Emplenota sp.*	--	--	20/ .3	--	--	10/ .1	--	--	--	--
Dytiscidae	Oreodytes sp.	--	--	--	10/ .1	--	--	--	--	--	--
Noteridae	Notomicrus sp.*	--	--	--	10/ .1	--	--	--	--	--	--
Ptilodactilydae	Anchycteis sp.	--	--	--	--		--	20/ .2	--	--	--
Unidentified adults		--	--	10/ .2	10/ .1	20/ .2	10/ .1	--	--	--	--
DIPTERA											
Blepharoceridae	Bibiocephala sp.**	10/ .1	10/ .3	--	--	--	--	--	--	--	--
Tipulidae	Hexatoma sp.	10/ .1	30/ .7	30/ .4	100/1.8	30/ .8	50/ .6	20/ .4	30/ .4	30/ .9	10/ .2

Table 9 (continued)

IDENTIFICATIONS		Apr. F/D	May F/D	June F/D	July F/D	Sept. F/D	Oct. F/D	Nov. F/D	Dec. F/D	Feb. F/D	Mar. F/D
Tipulidae	<u>Limnophila sp.</u>	10/ .1	--	40/ .6	70/4.3	20/ .3	10/ .1	--	--	--	--
	<u>Dicranata sp.</u>	--	--	10/ .1	50/1	20/ .2	40/ .4	20/ .2	--	30/ .4	--
	<u>Pedicia sp.</u>	--	20/ .2	10/ .2	--	20/ .2	10/ .3	--	10/ .2	30/ 1	--
Dolicophodidae	<u>Aphrosylus sp.</u>	--	20/ .3	10/ .1	20/ .2	10/ .1	--	--	--	--	20/ .2
Chironomidae		10/ .1	10/ .1	30/ .8	70/1.7	--	--	--	20/ .6	40/ .6	20/ .2
Simuliidae		10/ .1	--	10/ .2	10/ .1	--	10/ .1	40/1.6	50/10.4	40/ .6	20/ .3
Sciaridae	<u>Sciara sp.</u>	--	--	--	--	--	10/ .1	--	--	--	--
Rhagionidae	<u>Atherix sp.</u>	--	--	--	20/ .2	10/ .1	20/ .2	--	--	--	--
Unidentified		10/ .1	--	--	10/ .1	--	40/ .6	--	--	--	10/ .1
COLLEMBOLA											
Entomobryidae*	<u>Sinella sp.</u> (?)	--	--	--	10/ .1	--	--	--	--	--	10/ .1
Sminthuridae*	<u>Sminthurinus sp.</u>	--	--	10/ .1	--	--	--	--	--	--	--
HYMENOPTERA											
Chalcidoidea*		--	--	10/ .1	--	--	--	--	--	--	--
Formicidae		--	--	--	--	--	--	--	--	--	10/ .1
HEMIPTERA											
Unidentified		--	--	--	--	--	--	--	10/ .2	--	--
Oligochaetes		20/ .2	20/ .7	30/ .9	80/3.6	50/6.2	80/25	90/27	90/27.1	40/ 3.8	40/4.7
NEMATODES		--	--	--	--	10/ .1	--	10/ .1	--	--	--
TURBELLARIANS		30/ .5	--	--	30/ .8	10/ .3	20/ .3	20/ .2	--	--	--
NEMATOMORPHS		--	10/ .1	20/ .3	20/ .3	10/ .1	--	--	--	--	--
MOLLUSCANS		--	--	--	--	--	--	--	--	--	--
Pelycepods		--	--	--	--	--	--	--	--	--	--
Gastropods		--	--	--	--	--	--	--	--	--	--
ARACHNIDS		--	--	--	--	--	--	--	--	--	--
Spiders		--	--	10/ .1	--	--	--	--	--	--	--
Mites		--	--	--	--	--	--	--	--	--	--
EGGS (masses)		--	--	20/ .2	20/ .2	--	--	--	--	--	--
<u>Salmo</u>		--	--	10/ .1	--	--	--	--	--	10/ .1	--
<u>Cottus</u>		--	--	20/ .2	--	--	--	--	--	--	--
<u>Ascaphus</u>		--	10/ .1	--	--	--	--	--	10/ .1	--	--

* Adults ** Pupa

Table 10

List of Keys used for bottom fauna identifications

Jensen, S. L., 1966. The mayflies of Idaho (Ephemeroptera). Unpublished M. S. Thesis. University of Utah.

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Usinger, R. L., 1963. Aquatic insects of California. University of California Press. 2nd ed.

Ward, H. B. and G. C. Whipple. 1966. Fresh water biology. John Wiley and Sons, Inc. New York. 2nd ed.