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A Reconnaissance of Crayfish Populations

in Western Montana

Prepared for Montana Department of
Fish, Wildlife and Parks

by

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Introduction

Crayfish are large conspicuous members of many aquatic communities. They are important in system energetics and nutrient cycling (Momot et al. 1978), are preyed upon by fish (Lorman and Magnuson 1978) and support recreational, subsistence and commercial fisheries or aquaculture operations in many parts of the world (Holdich and Lowery 1988).

Crayfish also have negative attributes such as damages to dikes and dams by burrowing species (Holdich and Lowery 1988) and reduction of aquatic macrophytes (Lodge and Lorman 1987). Adverse effects on game fish spawning have been imputed (Lorman and Magnuson 1978).

Introductions of crayfish have resulted in replacements of native species (Bouchard 1977, Capelli 1982, Lodge et al. 1986). The introduction of American crayfish into Europe brought a fungal plague (Aphanomyces) which eliminated native crayfish over large areas (Alderman and Polglase 1988) and, coincidentally, enhanced the market for North American crayfish in Europe.

Approximately 330 crayfish species occur in North America (Hobbs 1988) but only five species are native to the portion of the U.S. west of the continental divide. The western species, all in the genus (Pacifastacus, are members of the family Astacidae which also includes the European crayfishes. (Resemblance to native forms has made Pacifastacus especially acceptable in European markets.)

The family Cambaridae is far more diverse and includes specialized forms such as burrowers and cave-dwellers. The largest genera are Cambarus, Orconectes and Procambarus. Cambarid crayfishes have been introduced into the western U.S. (Riegel 1959). The possibility that species from a diverse, highly co-evolved fauna can eliminate Pacifastacus is substantial.

In 1988, commercial fisherman began harvesting crayfish in western Montana. Most of the effort was directed toward Thompson Falls, Noxon and Cabinet Gorge Reservoirs on the lower Clark Fork River but a small fishery developed on the Clark Fork near Frenchtown and exploratory fishing was done in a number of lakes including Lake Mary Ronan.

Strong public response lead to public hearings arranged by MDFWP in midsummer 1988. Issues discussed at the hearings included potential overharvest to the detriment of the fishery and to gamefish populations dependent on crayfish for forage. Other concerns were the potential for the spread of aquatic weeds and of diseases of fish and crayfish on traps and other gear. Several things were apparent. 1. Public feeling, at least that of some individuals, against the fishery was quite strong. Similar conflicts arose earlier in Washington (Comeaux, 1974). 2. The Montana Department of Fish lacked the regulatory machinery to control the fishery at this time. 3. There was almost no information available concerning the distribution and taxonomy of crayfish in western Montana nor on abundance and population structure. A preliminary report (OEA Research, 1988) to MDFWP described size distribution and catch/effort of unidentified "crayfish" in six Montana waters.

This report addresses the third issue. Objectives were to 1. Determine the distribution of the native Pacifastacus and of introduced species in western Montana, especially region 1. 2. Describe the sex, size and, if possible, age structure of crayfish populations with special emphasis on the exploited populations in the Clark Fork reservoir. Evaluate the methods used to obtain such data. 3. Compare the survey results with the extensive literature on crayfish biology in other regions. 4. Make preliminary management recommendations and better define the management and scientific questions concerning crayfish populations.

Methods

Crayfish were collected along shorelines and in streams by handpicking or seining. Rocks were lifted and crayfish sheltering beneath them were grabbed or caught in a seine placed downstream.

Commercially available galvanized screen traps (9 x 18 inches with 2 inch openings in the funnels) were baited with chunks of frozen fish (whitefish, peamouth and squawfish) and set overnight. Catches from these traps may not be entirely comparable to those in the commercial catch. Traps used by commercial fishermen are larger and probably retain more crayfish. They also have larger openings (2 1/2 - 3 inches) and provide easier access for the largest _Pacifastacus_.

Crayfish were sexed and measured and most were released at the capture site. Newly molted or berried (egg-bearing) individuals were noted. Voucher specimens (one of each sex) were kept and identified using Hobbs (1972). All measurements in this report are carapace lengths (C.L.) from the tip of the rostrum to the median posterior margin of the rigid cephalothorax. (Note that some literature values for C.L. are the shorter distance from the margin of the eye socket to the posterior edge of the cephalothorax.) Total lengths measured from rostrum to telson were taken on many animals to verify a widely accepted relationship that

$$TL \approx 2 \times CL$$

Thus, the minimum commercially acceptable crayfish is 45mm C.L. C.L. is a more repeatable measure, especially on preserved animals, since it avoids the telescoping of abdominal segments.

A series of female Pacifastacus was preserved and dissected for determination of maturity and egg counts. I accompanied commercial fishermen and discussed crayfish biology and their operations. Gary Smith and Andy Anderson, Bear Creek Fisheries, Libby and Tom Aichlmayr, Frenchtown were most helpful.

Results

Species and Distribution

Two species, Pacifastacus leniusculus and Orconectes virilis were collected. These will be referred to by their generic names in most of the following discussion.

Pacifastacus leniusculus is native to the Pacific Northwest and occurs in flowing and standing waters. Its range has been extended by introduction (Riegel 1959) and some of the most thoroughly studied populations in California (Abrahamsson and Goldman 1970; Shimizu and Goldman 1983) are the result of introductions. It probably is native to its entire Montana range (Fig. 1, Appendix A). Pacifastacus was collected from the Idaho line upstream to Missoula and in the Bitterroot River. It is known to occur further upstream in the Bitterroot (Tom Jones, pers. comm.). It appears to be absent from the Clark Fork upstream from Milltown Dam (Vicki Watson, pers. comm.). Its status in the Flathead River downstream from Kerr Dam to the Clark Fork confluence is unknown. It occupies large rivers and reservoirs.

Orconectes virilis is a widely distributed species in the northern U.S. and southern Canada whose native range extends into Montana east of the continental divide (Crocker and Barr 1968). It has been introduced to western Montana and deliberately dispersed by MDFWP (Joe Huston, pers. comm.) and probably by anglers. It is found in small (e.g. Loon, Lake Co.) to large (Flathead) lakes (Fig. 1, Appendix) and in some streams (e.g. Owl Creek, the warm, productive outlet of Placid Lake). Orconectes coexists with Pacifastacus in Noxon and Cabinet Gorge reservoirs. Details of this co-occurrence are given below. Orconectes certainly is more widely distributed than my records indicate. In particular, it occurs in Dickey Lake in the Kootenai drainage (Joe Huston, Gary Smith, pers. comm.) Loon L. (Lincoln Co.) is my only Kootenai drainage locality.

Absences can be informative too. I was especially interested in the extent to which Orconectes could disperse between lakes and into the range of Pacifastacus. I also wished to determine if Pacifastacus utilized tributaries of the Clark Fork reservoirs.

Pacifastacus was not collected in the Thompson, Vermillion, and Bull Rivers. Furthermore, I did not collect it in the Kootenai River below the falls nor has Gary Smith (pers. comm.) taken it anywhere in the drainage. It also appears to be absent in the Flathead system above Kerr Dam (Appendix; Jack Stanford, pers. comm.).

Although Orconectes can live in streams, I collected none in the Thompson River below the lakes. Apparently, this species is not presently spreading downstream to Thompson Falls Reservoir. I collected none in the Bull River, including the low-gradient section.

Orconectes was not collected in several lakes (Bull, Tally, Upper Stillwater) which seem to offer excellent habitat.

Coexistence of Pacifastacus and Orconectes was observed in only two waterbodies where they show marked ecological separation (Fig. 2). In Cabinet Gorge and Noxon Reservoirs, good catches of Pacifastacus are made in the upper ends of the reservoirs but catches decrease downstream and a few large <u>Orconectes</u> appear (A. Anderson, pers. comm.).

My collections of <u>Orconectes</u> were made by trapping close to shore and by hand capture in shallow water. <u>Orconectes</u> were readily trapped and YOY were extremely abundant along the shorelines. No <u>Pacifastacus</u>, of any size, were taken at these sites. No <u>Orconectes</u> were taken in apparently suitable habitat in the extensive shoals at Finley Flats in the upper portion of Noxon Rapids Reservoir.

Adult <u>Pacifastacus</u> were trapped in numbers above the Noxon bridge in Cabinet Gorge Reservoir. (See section on population structure.) In general, I relied on the commercial fishermen for information on this component of the population. Young <u>Pacifastacus</u> were collected at the head of Noxon Rapids Reservoir and at two sites in Thompson Falls Reservoir. <u>Pacifastacus</u> YOY were common near the boat launch in Thompson Falls. Unlike the situation in the lower reservoirs, good catches of <u>Pacifastacus</u> are taken throughout Thompson Falls Reservoir (A. Anderson, pers. comm.). The abundance of YOY is strikingly different from the <u>Orconectes</u> - dominated shorelines in the lower impoundments. No <u>Orconectes</u> have occurred in the commercial catch from Thompson Falls Reservoir (A. Anderson, pers. comm.)

<u>Population Structure</u>

<u>Gear selectivity and effectiveness</u>.

Baited traps are considered to be biased sampling devices for crayfish (Brown and Brewis 1978), lobsters (Cooper and Uzmann 1980) and similar animals. In general, larger males predominate in trap catches although the sex ratio varies seasonally with molting period and the presence of ovigerous females which tend to be inactive. Size and sex biases probably reflect both seasonal activity patterns and social dominance.

I did not attempt a rigorous test of these ideas but the limited data are consistent with other studies. Trap catches with more than a few individuals show a significant excess of males (Table 1) whereas the sex ratio in hand caught collections cannot be distinguished from 1:1. Caution is needed here since the hand captured crayfish are smaller than trapped ones. In Table 2, the size distributions of a large hand collection and a small trap collection are significantly different although both were made in the same area. Baited traps do seem to catch crayfish if they are present (Table 3). Only 2/44 and 2/13 traps were empty which implies that the absences of crayfish in Bull Lake (n=5) and Upper Stillwater Lake (n=15) are real.

Size, age and maturity.

The largest *Orconectes* collected (46mm CL, McGregor L., 47mm, Cabinet Gorge Reservoir) are slightly larger than any reported in the literature summarized by Weagle and Ozburn (1972). However, Hazlett et al. 1974, collected larger individuals, including a 69mm female in a Michigan stream and OLA (1988) catches included presumed *Orconectes* of ≈50mm CL. *Orconectes virilis* attains an age of four years (Momot 1988).

Pacifastacus is a much larger animal with males exceeding 70mm CL. Further, most of my trap catch (Fig.3) was > 45mm, the approximate commercial minimum. (On 3 September, 1988 I accompanied A. Anderson tending commercial traps in the same area and estimated that < 1-2% were sub-harvestables.)

Females were smaller than males (Fig. 3) which is typical of this species (Abrahamsson and Goldman, 1970) and crayfish in general (Lowery 1988).

This feature may be exaggerated in Fig. 3 if the largest females were ovigerous and less vulnerable.

One function of minimum size policies is to permit individuals to reproduce at least once before harvest. Of the 49 females (Fig. 3), only the largest (63mm) was berried. She carried 221 pleopodal eggs averaging 2.4mm in diameter. Egg number and size are comparable to those in other populations of <u>Pacifastacus</u> (Abrahamsson and Goldman 1970, Mason 1978, McGriff 1983a) although an adequate sample might detect differences in fecundity and egg size.

The remaining females were dissected. All were immature. Ovarian eggs were small (< .7mm)). None of these females had extruded "glair" (egg cement). Since some <u>Pacifastacus</u> females mature at lengths ≤35mm in Lake Tahoe and the Sacramento River (Abrahamsson and Goldman 1970, McGriff 1983), it is unlikely that the single berried female indicates the minimum size at maturity in the Cabinet Gorge population. In the California populations, 50% are mature at carapace lengths between 40-50mm. The biased sex ratio (Fig. 3) suggests that many females were berried, inactive and unavailable to the gear. However, the data do show that many marketable females are immature indicating delayed maturity or alternate year reproduction.

Collections of YOY (Fig. 4) are limited but adequate to show that males are larger than females by the end of the first growing season and that <u>Pacifastacus</u> YOY are considerably larger than first-year <u>Orconectes</u>.

Unlike fish, crustaceans cannot be aged by marks on bones or scales. All hard parts are shed with each molt. Conventional length-frequency analysis can be used (Flint 1975, Shimizu and Goldman 1983) but sometimes statistical techniques are required to separate modes. Momot (1988) indicates rather frequent mis-assignments of marked crayfish to age classes and in an Orconectes population estimated that ≈20% were incorrectly aged. The following analysis is extremely tentative but comparison with published data lends support to the interpretation. Restricting the analysis to males removes one source of variability in length at age.

The few presumed 0-class male Pacifastacus (24-34mm CL) (Fig. 4) are considerably larger than fall collected YOY in Lake Tahoe (Flint 1975) and approximately the same size as YOY from the Sacramento River (McGriff 1983). It is possible, but unlikely, that the five week difference in collecting time would shift the YOY upward to the 45mm mode in Fig. 3 which I believe to represent I-class individuals. If this is correct, some Pacifastacus are recruited to the fishery late in their second year. Three probable year classes over the 48-60mm range are followed by a tail of larger animals which, extending the approximate annual increment of ≤ 5mm, must represent several more year classes. Pacifastacus and some other astacid species live 6-12 years (Lowery 1988).

I again emphasize the preliminary nature of this analysis which could be much improved by larger collections of small crayfish and sequential collections through the year to determine growth rates. However, it appears that Cabinet Gorge Pacifastacus are fast growing, are fully recruited to the fishery at age II (third growing season) and, under natural mortality rates, may live another four years or more.

Discussion

The presence of two crayfish species in western Montana complicates management. Harvest regulations, the potential for replacement of the large native *Pacifastacus* by smaller exotic *Orconectes*, and the relative utility of the two species as forage for game fishes are all at issue.

Orconectes rarely reaches the 3 5/8 in. (≈46mm CL) minimum for commercial acceptance of *Pacifastacus*. Establishment of a comparable legal minimum for all crayfish would protect virtually all *Orconectes* from exploitation and might tip any competitive balance in favor of the exotic. The two species are readily distinguishable so there is no reason to impose common regulations.

Species replacements in crayfish are common although mechanisms which may include aggressive interactions (Bovbjerg 1970), reproductive interference (Butler and Stein 1985), differential reproductive rates and vulnerability to predators, are not well understood. Bouchard (1977) reported that in the Rogue River, Oregon, introduced *Orconectes neglectus* has restricted *Pacifastacus leniusculus* to the swifter reaches. The distributions of *Orconectes virilis* and *Pacifastacus* in Cabinet Gorge and Noxon reservoirs is consistent with Bouchard's observations. Momot and Leering (1986), on the other hand, reported that *Pacifastacus* dominates *O. virilis* in aggressive encounters. However, their experiments were confounded by size and maturity interactions and must be viewed as preliminary.

The history of *Orconectes* in the Clark Fork reservoirs is unknown. Schrier (1983) identified crayfish from Bull River Bay (Cabinet Gorge Reservoir) as *Pacifastacus*. I did not collect in the embayment but *Orconectes* now occupies the shoreline in nearby parts of the reservoir. Rapid replacements (Capelli 1982) are known and *Orconectes* may still be expanding in these reservoirs. A long history of changes in reservoir operation and fisheries management (Huston 1985) suggests that nothing is in equilibrium in these systems. It also is possible that stabilization of water levels may favor _Orconectes_.

Orconectes has been planted in Montana lakes as forage for game fishes, especially smallmouth bass. This species is smaller than _Pacifastacus_ and may be more available to predators. However, further introductions may rule out the possibility of establishing _Pacifastacus_ if that were considered desireable. The options for waters presently without crayfish are: continue without crayfish, stock _Orconectes_, or stock _Pacifastacus_. Persistence of two-species assemblages in lakes without high flow-through seems unlikely.

Concerns about overfishing of _Pacifastacus_ were the initial stimulus for this research. There is no indication that significant overfishing occurred during 1988. Numerous large crayfish were available after fishing ceased in September. (Fishing terminated with the forest fire closure.)

Crayfish populations appear to be resilient under heavy fishing (Momot and Gowing 1977, Momot 1986, McGriff 1983b, Shimizu and Goldman 1983). Momot (1984, 1986) suggests that crayfish populations are regulated by density-dependent changes in juvenile mortality with adjustments of adult growth, fecundity and age at maturity of lesser importance. Responses in any or all of these parameters would allow crayfish populations to compensate for exploitation.

Some caution is needed, however, in applying the limited comparative data to Montana _Pacifastacus_. I am not certain that my interpretation of population structure is correct. Small _Pacifastacus_ were difficult to collect so growth rates may be overestimated. The age at maturity is unknown.

If YOY are truly scarce, _Pacifastacus_ may depend on reproduction by multiple year classes to "average out" environmental variability. Continued heavy fishing would reduce survival into the older age classes and increase the possibility of recruitment failure.

Some exploited fish populations have sustained high catches right up to the time they collapsed. This can occur if fishing is concentrated in the best habitat or core areas and animals are moving in as others are removed. Thus, the peripheral populations are reduced without giving any signal in the catch. Once the population is fished down to the core, continued exploitation causes quick collapse. Crayfish densities and distributions reflect aggressive interactions (Abrahamsson 1966, Momot 1988) and could behave this way.

Momot (1984, 1986, 1988) comments on the difficulty of detecting both yield and recruitment overfishing of crayfish. He also notes the sensitivity of northern crayfish populations to between-years differences in weather, especially temperature and length of growing season. Population stability and resilience to fishing may be determined more by climate than by harvest policies.

The biggest unknown is the future of Pacifastacus populations even in the absence of exploitation. If the population of Orconectes is still expanding, Pacifastacus may disappear from the Clark Fork reservoirs anyway and harvest probably will take much of the blame. As noted earlier, fishing could hasten competitive exclusion.

In summary, there is no reason to believe that fishing has damaged Pacifastacus populations. However, the data are rudimentary and uncertainties are many concerning the population biology of Pacifastacus and its interactions with Orconectes.

Recommendations

1. Regulate the spread of *Orconectes*.
   a) Prohibit introduction of crayfish and other invertebrates, by private individuals.
   b) Declare a moratorium on introduction by MDFWP until management options and goals are defined.
2. Write harvest regulations which recognize the major biological differences between *Pacifastacus* and *Orconectes*.
3. Establish a workable scheme to monitor the fishery: size, composition, catch/effort and, perhaps, total catch. An alternative procedure would be late season trapping by MDFWP at a limited number of index stations.
4. Monitor the younger age classes of both *Pacifastacus* and *Orconectes* in the Clark Fork reservoirs.

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Table 1. Comparison of sex ratios in hand collected samples and baited trap collections. Probabilities are from Chi-square tests against the hypothesis of 1 male:1 female.

Method	Location	Species	Males	Females	P
Hand	Van Lake	Orconectes	98	84	>.25
	Cabinet Gorge Reservoir	Orconectes	5	6	--
	Noxon Reservoir	Orconectes	14	7	>.10
	Clark Fork River	Pacifastacus	4	7	>.25
	Noxon & Thompson Falls	Pacifastacus	5	6	>.25
Trap	Van Lake	Orconectes	13	4	<.05
	McGregor Lake	Orconectes	29	4	<.005
	Cabinet Gorge Reservoir	Pacifastacus	178	49	<.005

Table 2. Size composition of hand-captured and trapped _Orconectes_ from Van Lake, 15 July, 1988. Data were collected by a University of Montana class from the University of Montana Biological Station.

Total length (mm.)	Hand	Trap
< 15	11	--
15-19	5	--
20-24	39	1
25-29	69	6
30-34	32	1
25-39	19	6
≥ 40	7	3
Aggregated for chi-square test.		
<15-24	55	1
25-34	101	7
≥ 35	26	9

$x^2 = 17.5$, $P < .005$

Table 3. Frequency distribution of catch/trap in Cabinet Gorge Reservoir. (*Pacifastacus*) and McGregor Lake (*Orconectes*).

Number/Trap	Cabinet Gorge	McGregor
0	2	2
1	5	2
2	1	2
3	3	1
4	8	3
5	4	1
6	6	-
7	4	1
8	7	1
9	3	-
10	1	-
	44	13

CAPTIONS FOR FIGURES

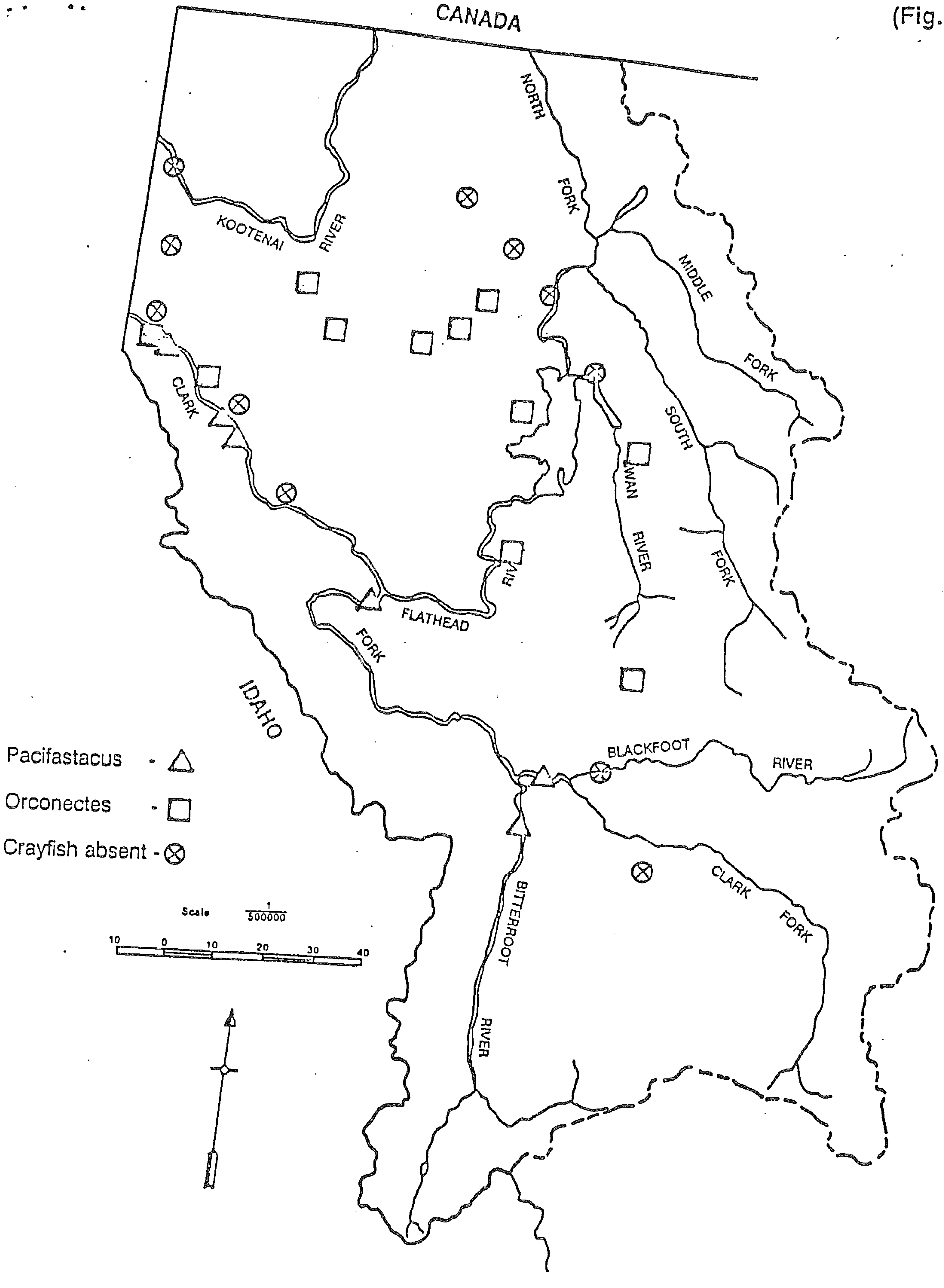
1. Distribution of crayfishes in western Montana. Adjacent localities in the Clark Fork reservoirs are combined.

2. Distribution of crayfishes in Noxon Rapids and Cabinet Gorge reservoirs.

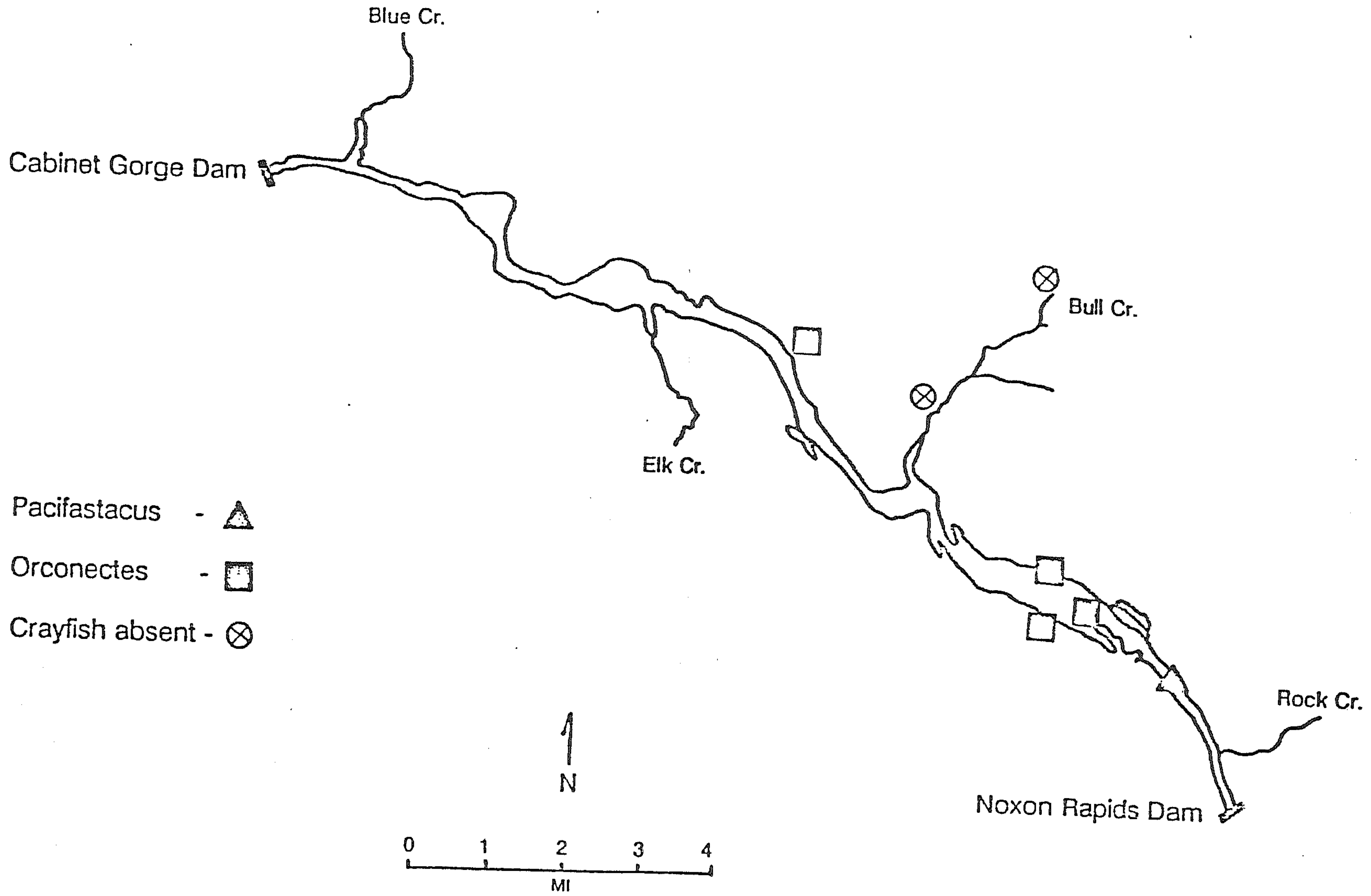
3. Size and sex composition of trap catches from Cabinet Gorge Reservoir, October 15-16, 1988.

4. Size and sex composition of shoreline hand collections from Thompson Falls, Noxon Rapids and Cabinet Gorge reservoirs, September 2-4, 1988.

(Fig. 1)

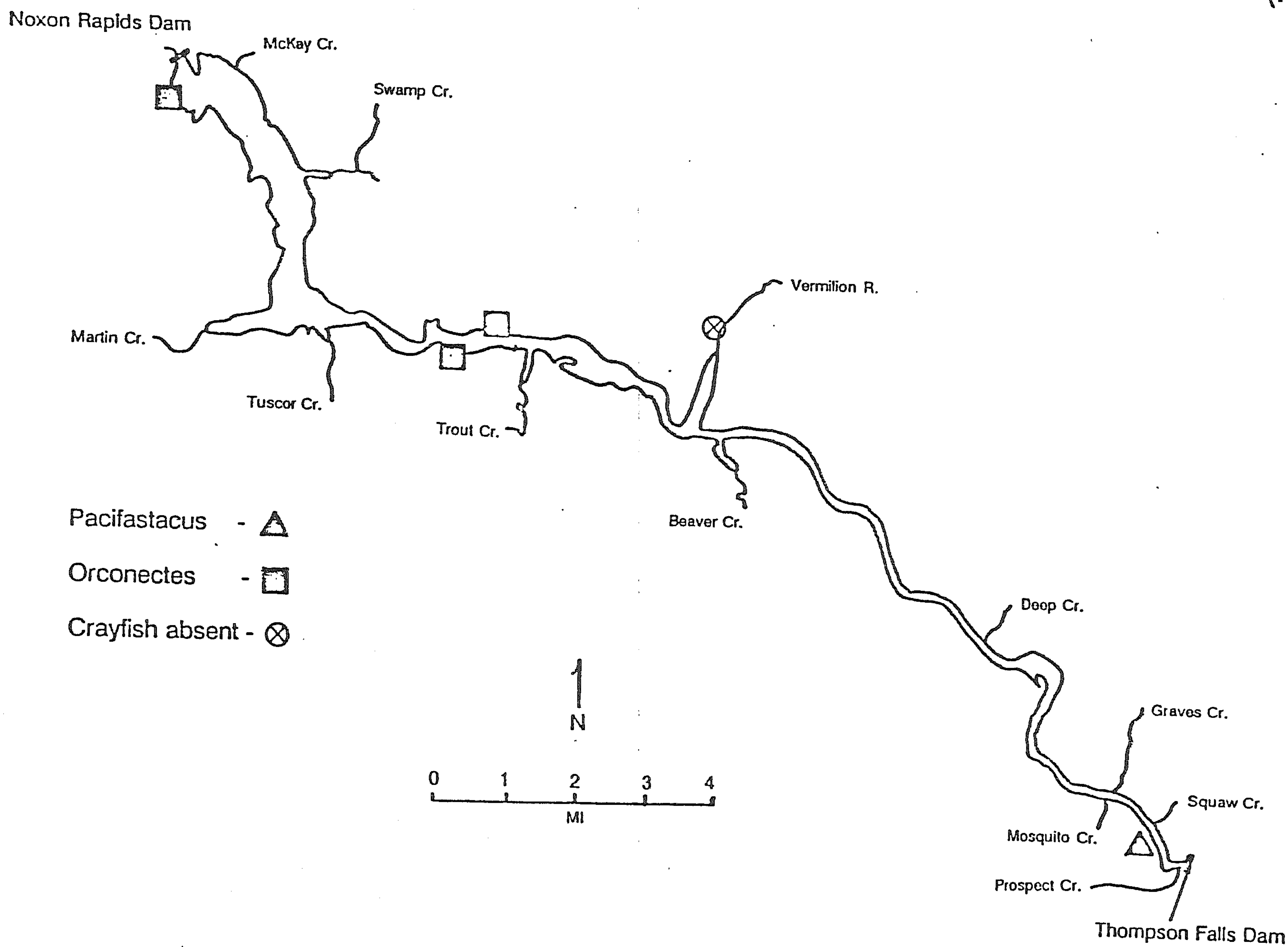

CANADA
NORTH
FORK
KOOTENAI
RIVER
MIDDLE
FORK
SOUTH
FORK
CLARK
SWAN
RIVER
RIV
FLATHEAD
FORK
IDAHO
BLACKFOOT
RIVER
CLARK
FORK
BITTERROOT
RIVER
Pacifastacus -
Orconectes -
Crayfish absent -
Scale 1/500000
10 0 10 20 30 40

(Fig. 2A)



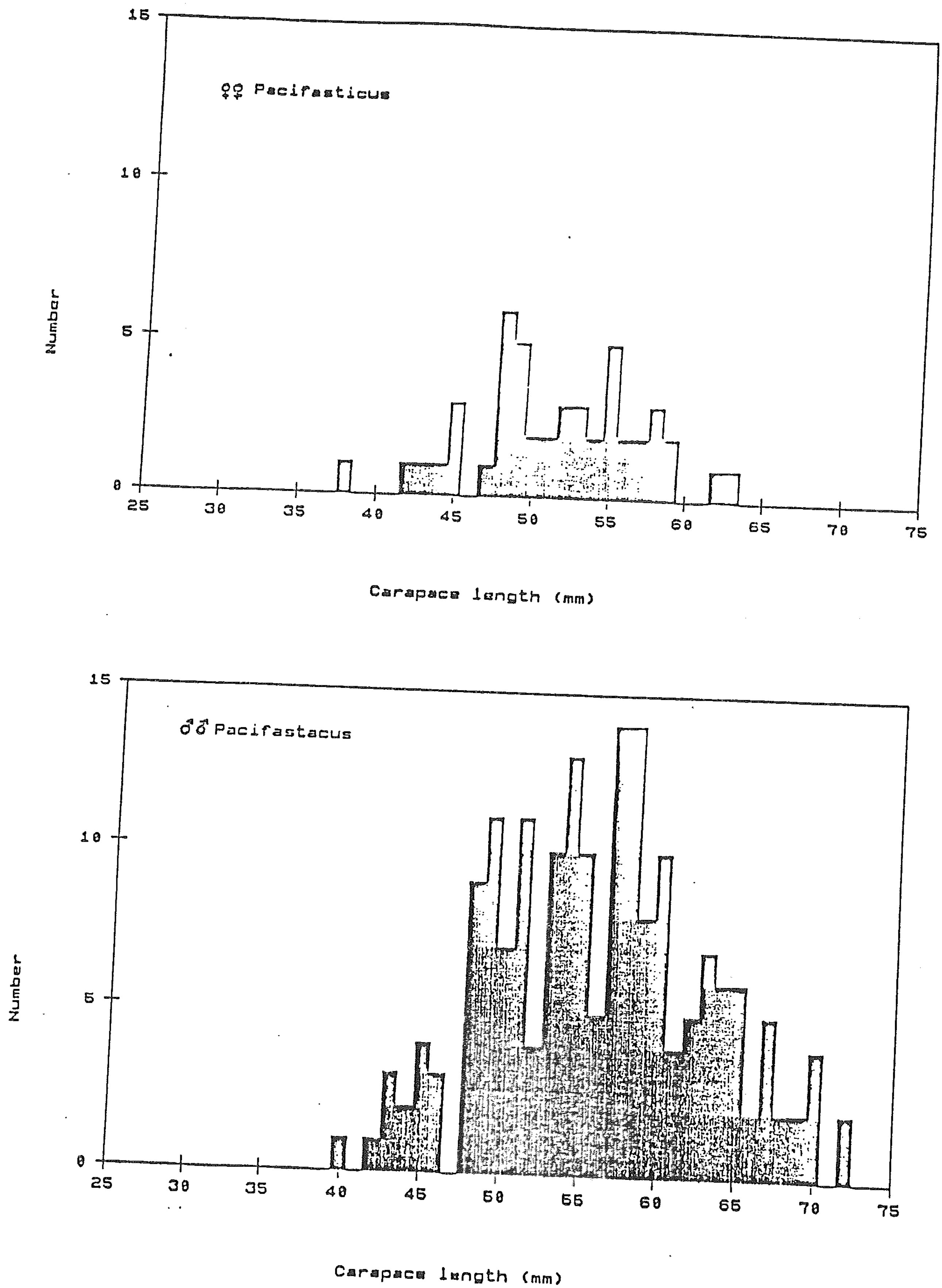
Blue Cr.
Cabinet Gorge Dam
Bull Cr.
Elk Cr.
Pacifastacus -
Orconectes -
Crayfish absent -
Rock Cr.
Noxon Rapids Dam
N
0
1
2
3
4
MI

(Fig. 2B)



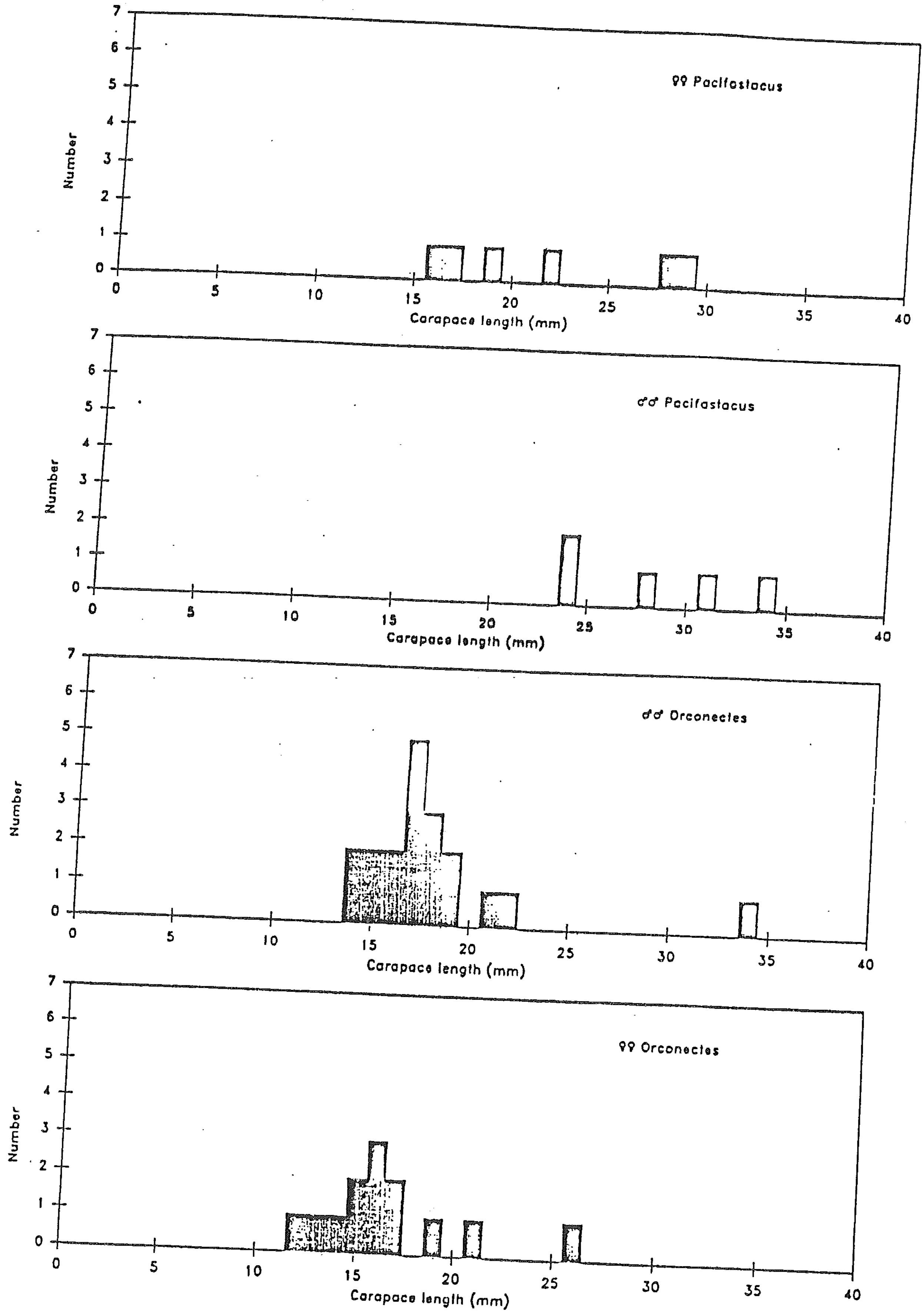
Noxon Rapids Dam
McKay Cr.
Swamp Cr.
Martin Cr.
Tuscor Cr.
Trout Cr.
Vermilion R.
Beaver Cr.
Deep Cr.
Graves Cr.
Squaw Cr.
Mosquito Cr.
Prospect Cr.
Thompson Falls Dam
Pacifastacus -
Orconectes -
Crayfish absent -
N
0
1
2
3
4
MI

(Fig. 3)



♀♀ Pacifasticus
Number
0
5
10
15
25
30
35
40
45
50
55
60
65
70
75
Carapace length (mm)
♂♂ Pacifastacus
Number
0
5
10
15
25
30
35
40
45
50
55
60
65
70
75
Carapace length (mm)

(Fig. 4)


♀♀ Pacifastacus
♂♂ Pacifastacus
♂♂ Orconectes
♀♀ Orconectes
Number
Carapace length (mm)
0
5
10
15
20
25
30
35
40
1
2
3
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6
7

APPENDIX A. COLLECTIONS

1. Van L., Lake Co., VII-15-88. A. Sheldon and class. Orconectes. Hand and traps.

2. Loon L., Lake Co., VIII-5-88. Orconectes. Hand.

3. Clark Fork R., Sanders Co., nr. Quinn's Hot Springs. Pacifastacus. Hand.

4. Thompson R., Sanders Co., VIII-26-88. Approx. .5 mi above mouth. No crayfish. Hand.

5. Vermillion R., Sanders Co., VIII-26-88. Approx. mile 1.25 on road. No crayfish. Hand.

6. Bull R., Sanders Co., VIII-26-88. Approx. 1.5 mi above mouth. No crayfish. Hand.

7. Bull R., Sanders Co., VIII-27-88. First northbound bridge, mile 8.5, Rt. 56. Five traps. No crayfish.

8. Bull L., Lincoln Co., VIII-27-88. Mile 18 on Rt. 56. Five traps. No crayfish.

9. Cabinet Gorge Res., Sanders Co., VIII-27-88. Mile 8 on Rt. 200. Five Traps. Orconectes.

10. Cabinet Gorge Res., Sanders Co., VIII-27-88. Nr. highway maintenance station between Noxon and Bull River. Five Traps. Orconectes.

11. Kootenai R., Lincoln Co., VIII-27-88. Yaak C. G. No crayfish.

12. Loon L., Lincoln Co., VIII-27-88. Turnout on Rt. 2. Hand. Orconectes.

13. Thompson R., Sanders Co., VIII-27-88. Campsite 2-3 mi upstream from Bend R. S. No crayfish.

14. McGregor Cr., Flathead Co., VIII-27-88. At Thompson River Rd. No crayfish.

15. McGregor L., Flathead Co., VIII-28-88. At Forest Service C. G. Traps (13). Orconectes.

16. Little Bitterroot L., Flathead Co., VIII-28-88. Westside Road. Hand. Orconectes.

17. Ashley L., Flathead Co., VIII-28-88. At recreation area. Hand. Orconectes.

18. Tally L., Flathead Co., VIII-28-88. At F. S. campground. Hand. No crayfish.

19. Upper Stillwater L., Flathead Co., VIII-29-88. South side before bend into largest portion of main lake. Traps (15) and hand. No crayfish.

20. Flathead R., Flathead Co., VIII-29-88. Pressentine Bar. Hand. No crayfish.

21. Noxon Rapids Res., Sanders Co., IX-2-88. Northshore Campground. Hand. Orconectes.

22. Cabinet Gorge Res., Sanders Co., IX-3-88. South side 1.1 mi west Noxon Landing. Hand. Orconectes.

23. Noxon Rapids Res., Sanders Co., IX-3-88. Horseshoe Ridge access. Hand. Pacifastacus.

24. Cabinet Gorge Res., Sanders Co., IX-3-88. Between Noxon bridge and R.R. bridge. Commercial catch (Andy Anderson). Orconectes and Pacifastacus.

25. Noxon Rapids Res., Sanders Co., IX-4-88. Finley Flats along shore upstream from landing. Hand, night-lighting and traps (6). No crayfish.

26. Thompson Falls Res., Sanders Co., IX-4-88. Riprap at boat landing. Hand. Pacifastacus.

27. Thompson Falls Res., Sanders Co., IX-4-88. Downstream from mouth of Thompson R. Hand. Pacifastacus.

28. Noxon Rapids Res., Sanders Co., IX-4-88. South side approx. 1/4 mi downstream from R.R. bridge downstream from Trout Creek. Hand. Orconectes.

29. Noxon Rapids Res., Sanders Co., IX-4-88. Southside, approx. 1/4 mi above dam. Hand. Orconectes.

30. Same location as #28. Traps. Orconectes.

31-34. Cabinet Gorge Res., Sanders Co., X-15-16-88. Upstream from Noxon Bridge. Traps. Pacifastacus.

35. Clark Fork R., Missoula Co., IX-22-89. Higgins St. bridge. Hand. Pacifastacus.

36. Bitterroot R., Missoula Co., IX-27-88. Slough at Lolo sewage treatment plant. Hand. Pacifastacus.

37. Blackfoot R., Missoula Co., IX-3-88. Marco Flat. Electrofishing. No crayfish.

38. Rock Cr., Missoula Co., IX-12-88. Valley of the Moon area and Sawmill Gulch. Hand. No crayfish.

39. Crow Cr., Lake Co., I-11-88. Lower creek. Juan Imbert. Orconectes.

40. Owl Cr., Missoula Co., various dates. No specimens kept. A. Sheldon, J. McAuliffe, J. Gore, D. Eaton.

41. Swan R., Lake Co., IX-4-88. Fishing access upstream from Ferndale. Hand. No crayfish.

42. Flathead L., Lake Co., Dr. Alan Covich, pers. comm. No specimens. Orconectes.

43. Lake Mary Ronan, Lake Co., Dr. Alan Covich, pers. comm. No specimens. Orconectes.