Interim Analysis

Effects of Low Winter Flow Releases at Clark Canyon Dam on the Fishery of the Upper Beaverhead River

Montana Department of Fish, Wildlife and Parks
Helena, Montana
June, 1991

Recent drought and associated storage reductions in Clark Canyon Reservoir have resulted in lower than normal stream flows in the Beaverhead River. Although flow reductions have occurred throughout the entire 79.5 miles of river, this summary focuses on the impacts of low flows on the trout populations in the 12.5-mile -long "Blue Ribbon" stretch of river between Clark Canyon Dam and Grasshopper Creek. This "Blue Ribbon" stretch, in addition to sustaining the highest standing crops of brown and rainbow trout on the river, also supports Montana's finest trophy trout fishery. Here, anglers frequently take trout in excess of four pounds. Trout as large as 15 pounds have been captured during the Department of Fish, Wildlife and Parks' annual electrofishing surveys.

As stated earlier, only those effects on the trout populations in the "Blue Ribbon" section are addressed. In-depth discussions of the impacts of low flows on trout in all river stretches are found in Vincent et al. (1990). The bulk of the summary information presented in this discussion was collected and supplied by Dick Oswald (Fishery Biologist for MDFWP, Dillon), whose work is discussed in the above referenced progress report.

FLOWS

Flows in the "Blue Ribbon" stretch are mainly regulated at Clark Canyon Dam. Annually, flows are lowest during the non-irrigation season (roughly mid-October to mid-April) when water for the upcoming irrigation season is stored in the reservoir and releases into the Beaverhead River are reduced. (For the remainder of this discussion, the non-irrigation season will be referred to as winter.) Springs, minor tributaries and seepage at the dam augment winter flows in the upper portion of the "Blue Ribbon" stretch by approximately 25-50 cfs.

Since Clark Canyon Dam was completed in 1964, winter flow releases have averaged about 225 cfs. In response to continuing drought, dam releases were reduced to about 50 cfs over the 1988-1989 winter period and further reduced to about 35 cfs over the winters of 1989-90 and 1990-91 (Table 1). During 1988-89 and 1989-90, low flow releases extended from early September to the end of April, a period of about eight months.

Table 1. Approximate mean winter flow releases at Clark Canyon Dam, Beaverhead River.

Winter	Approximate Mean Flow Release (cfs)
1980-81	205[a]
1981-82	195[a]
1982-83	370[b]
1983-84	400[b]
1984-85	325[b]
1985-86	100[b]
1986-87	220[b]
1987-88	140[b]
1988-89	50[b]
1989-90	35[b]
1990-91	35[b]

[a] Data obtained from USGS.
[b] Data obtained from Jay Chamberlain, Manager, East Bench Irrigation District.

STUDY SECTIONS

Long-term mark-recapture population estimates are available for two study sections within the "Blue Ribbon" stretch:

Hildreth Section

The Hildreth Section begins 1.7 miles below Clark Canyon Dam and extends 1.18 miles downstream. The narrow river channel is characterized by an abundance of undercut banks, root masses, and submerged and overhanging willows, all of which provide highly secure habitat for trout, even at low flows. The Hildreth Section represents the fish community and habitat quality in about 50% of the 12.5-mile-long "Blue Ribbon" stretch.

Pipe Organ Section

The Pipe Organ Section begins about eight miles below Clark Canyon Dam and extends 2.49 miles downstream. Unlike the Hildreth Section, secure habitat for trout is scarce in the Pipe Organ Section, a deficiency that is particularly evident at low flows. About 35% of the "Blue Ribbon" stretch is represented by the Pipe Organ section.

FISH POPULATIONS

Trout standing crop estimates were made in the spring and fall. Fall estimates of brown trout and spring estimates of rainbow trout were generally inflated due to the movement of spawners into the study sections. Therefore, only spring estimates of brown trout and fall estimates of rainbow trout are presented.

Hildreth Section - Total Trout

Estimated standing crops (number and pounds per mile) of brown and rainbow trout, along with mean winter flow releases, are shown in Figures 1 and 2.

Standing crops of age II and older brown trout appear unaffected by the low winter flows of 1988-89 and 1989-90 (Figure 1). In fact, brown trout density increased to record highs in 1989 and 1990 despite low flows. Biomass (pounds) of brown trout was also elevated following these drought flows.

Unlike brown trout, standing crops of rainbow trout declined (Figure 2). Number (586 per mile) and biomass (1,151 pounds per mile) in 1989, following the 50 cfs winter release, were the lowest recorded for 1983-89. Because the rainbow trout estimate in Fall 1988 was made about a month after flow releases were reduced to 50 cfs, the decline in 1988 may also, in part, reflect low flows. Later estimates (in 1990 and 1991) are needed to further evaluate drought impacts on rainbow trout. The necessary data were collected in these years but has not yet been analyzed.

Hildreth Section - Larger Trout

Because the upper portion of the "Blue Ribbon" stretch, where the Hildreth Section is located, is nationally recognized for its trophy trout fishery, changes in numbers of larger brown and rainbow trout were examined.

Numbers of 18 inch and longer and 20 inch and longer brown trout peaked, for the period investigated, in Spring 1988, just prior to severe winter flow reductions, at 521 and 306 per mile, respectively (Figure 3). By Spring 1990, following winter releases of 50 and 35 cfs, their numbers declined to 303 and 104 per mile, respectively.

Following winter flow releases of 50 cfs, numbers of larger rainbow trout also declined to decade lows of 155 (18 inch and longer) and 49 (20 inch and longer) per mile (Figure 4). Again, the reduction in numbers of larger rainbows in Fall 1988 may also, in part, reflect the 50 cfs release, which began about a month before the 1988 estimate was completed. The larger rainbows may have out-migrated due to a reduction in habitat availability associated with decreased flows.

Pipe Organ Section - Total Trout

Estimated standing crops of brown and rainbow trout, along with mean winter flow releases, are shown in Figures 5 and 6.

Number and pounds of age II and older brown trout declined from 1,425 and 1,304, respectively, in 1988 to 853 and 763, respectively, in 1990 -- reductions of about 40% (Figure 5). The biomass estimate of 763 pounds in 1990 was the low for 1981-90. However, low standing crops in 1990 were similar to those in 1986 and 1987, when preceding winter flows averaged 100 and 220 cfs, respectively. While brown trout standing crops have declined during the drought, the magnitude of the reduction cannot be judged severe when compared to previous years.

Unlike brown trout, rainbow trout standing crops markedly declined in 1989 and 1990 following mean winter flows of 50 cfs and 35 cfs, respectively (Figure 6). Number (94 per mile) and biomass (116 pounds per mile) in 1990 were the decade lows for 1981-90. Estimates in 1989 were the second lowest for the same period.

Pipe Organ Section - Larger Trout

Changes in number of larger (18 inch and longer) trout were also examined for the Pipe Organ Section.

Eighteen inch and longer brown trout declined from 107 per mile in 1988, to 66 in 1989, and to 37 in 1990, which is the low for 1981-90 (Figure 7). However, this low is similar in magnitude to the numbers in 1981 (39) and 1983 (41). The latter of these estimates was preceded by a mean winter flow of about 370 cfs, which is about ten times the winter flow of 35 cfs that preceded the 1990 estimate.

Larger rainbow trout appear to have suffered greatly under recent low flows (Figure 8). Numbers of 18 inch and longer declined from 91 per mile in 1987, to 47 in 1988, to 17 in 1989, and to three in 1990. Larger rainbow trout virtually disappeared by 1990 following winter flow releases of 50 and 35 cfs.

SUMMARY AND CONCLUSIONS

1. Effects of recent low winter flows in the upper Beaverhead River were most pronounced on rainbow trout, particularly the Pipe Organ Section.

2. Total trout standing crops have been, in general, less affected by low winter flows. These effects have varied by study section and by trout species.

   In the Hildreth Section, rainbow trout standing crops declined following the 50 cfs flow release and this decline cannot be judged severe. In contrast, standing crops of brown trout increased under low flows.

In the Pipe Organ Section, adverse impacts on total standing crops were more pronounced, particularly for rainbow trout, whose number and biomass declined following winter flows of 50 and 35 cfs.

Un-analyzed estimates completed in 1990 and Spring 1991, and estimates to be conducted in Fall 1991 and later will aid in further evaluating the effects of long-term flow reductions on trout populations in the study sections.

3. Predicting the impacts of incremental flow increases (above the present 35 cfs release) on the trout standing crops in the upper Beaverhead River is not possible from the existing population data. This stems from the fact that many uncontrolled and unmeasured variables (fishing pressure, angling regulations, food supply and productivity, for example) are operating in conjunction with flows to regulate standing crops. In some years, these other variables can be more limiting than are flows. Therefore, observed standing crop variations throughout the study period do not solely reflect winter flow fluctuations.

One important variable to consider is the annual variation in year class strengths. A series of weak yearling crops will lead to the poor recruitment of older fish in later years. The consequence is particularly visible in populations of fast growing trout (the Hildreth Section, for example) where a few year classes comprise the bulk of the older fish. The population may initially fail to respond to higher flows because recruitment is inadequate to seed the newly created living space with fish, causing a longer than anticipated lag between the initiation of higher flows and the expansion of the population. Variable year class strengths over the study period have influenced the response of the populations to varying winter flow releases. An earlier study by Nelson (1986) demonstrated the influence of year class strengths in controlling standing crops of brown trout in the Hildreth study section.

An abundance of secure habitat appears to partially buffer the ill effects of winter flow reductions in the upper river. The population data for the Hildreth and Pipe Organ sections demonstrate the influence of good and poor quality habitat on standing crop losses following severe flow reductions. As a result, low flow impacts vary throughout the 12.5-mile-long "Blue Ribbon" stretch, depending on the quality of the fishes' habitat.

Impacts also appear to be species related, with rainbow trout, in general, more vulnerable to prolonged flow reductions than are brown trout.

4. Although trout populations in the upper Beaverhead River have been significantly affected by recent winter flow reductions, surviving stocks are more than sufficient to rebuild the sport fishery to its former trophy status. The high productivity of the upper half of the "Blue Ribbon" section, coupled with the secure habitat, will aid the rapid recovery of the trophy fishery once winter releases return to normal.

   Although the trophy rainbow fishery appears to have declined with the low winter flows, particularly in the Pipe Organ Section, the trout population that presently exists in the upper river is still capable of sustaining a viable sport fishery. However, if reduced winter flows persist into the near future, further impacts could occur, potentially delaying the eventual recovery of the trophy fishery once flows increase.

RECOMMENDATION OF THE DEPARTMENT OF FISH, WILDLIFE AND PARKS

Based on present storage in Clark Canyon Reservoir, the Department of Fish, Wildlife and Parks does not recommend increasing winter flow releases into the Beaverhead River. This recommendation reflects USBR's operating curve data, which suggest that increased water releases will result in the further depletion of the much reduced storage pool, further jeopardizing year-round flow regimes in the river, as well as the reservoir fishery, in future years. The Department of Fish, Wildlife and Parks prefers a plan that would expeditiously increase storage to the normal range of operation. This will result in greater water supplies for the river and reservoir fisheries as well as for irrigation. Such a plan will depend on continued water conservation until a normal storage pool is achieved. If irrigation restrictions are relaxed with percent gains in the storage pool, then similar increases in winter flow releases should be implemented. This would allow for some recovery of the river fishery as irrigated agriculture experiences recovery. We believe that both agriculture and the fishery would best profit from a program that expeditiously regained the normal storage pool while meeting minimal fisheries and irrigation needs.

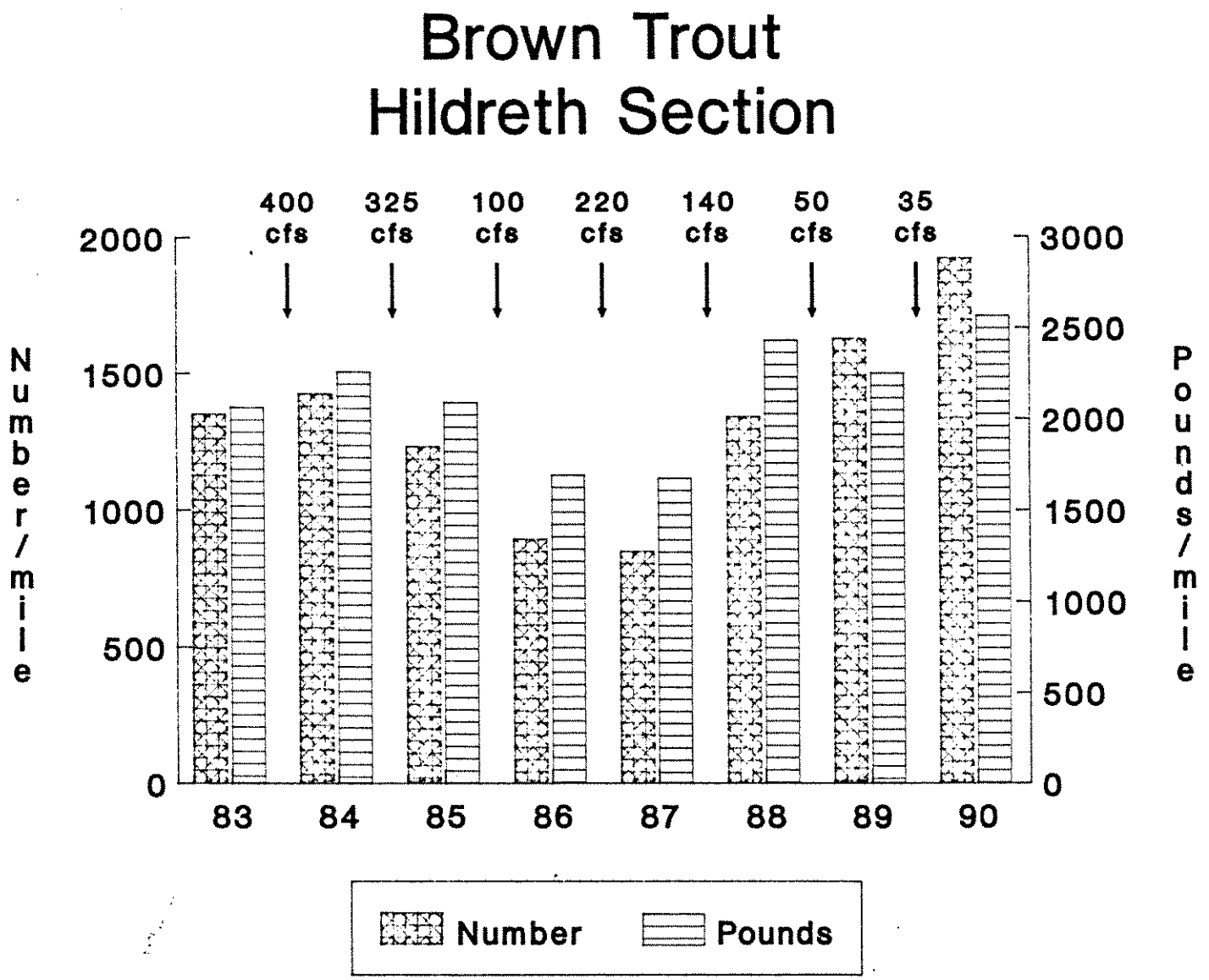

Figure 1. Estimated spring standing crops (per mile) of age II and older brown trout in the Hildreth Section of the Beaverhead River, 1983-90. The approximate mean winter flow release between spring estimates is designated by arrows.

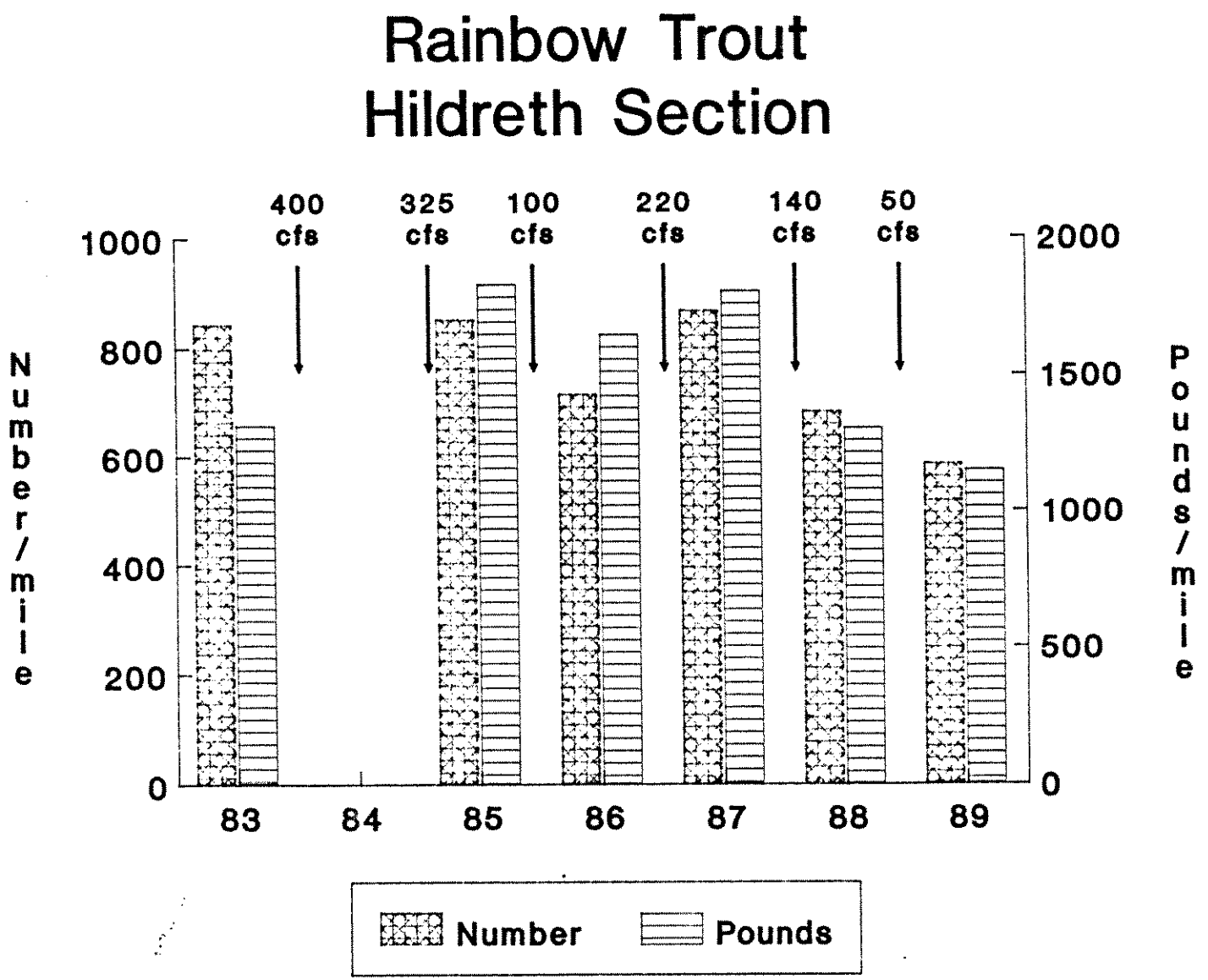

Figure 2. Estimated fall standing crops (per mile) of age I+ and older rainbow trout in the Hildreth Section of the Beaverhead River, 1983-89. The approximate mean winter flow release between fall estimates is designated by arrows.

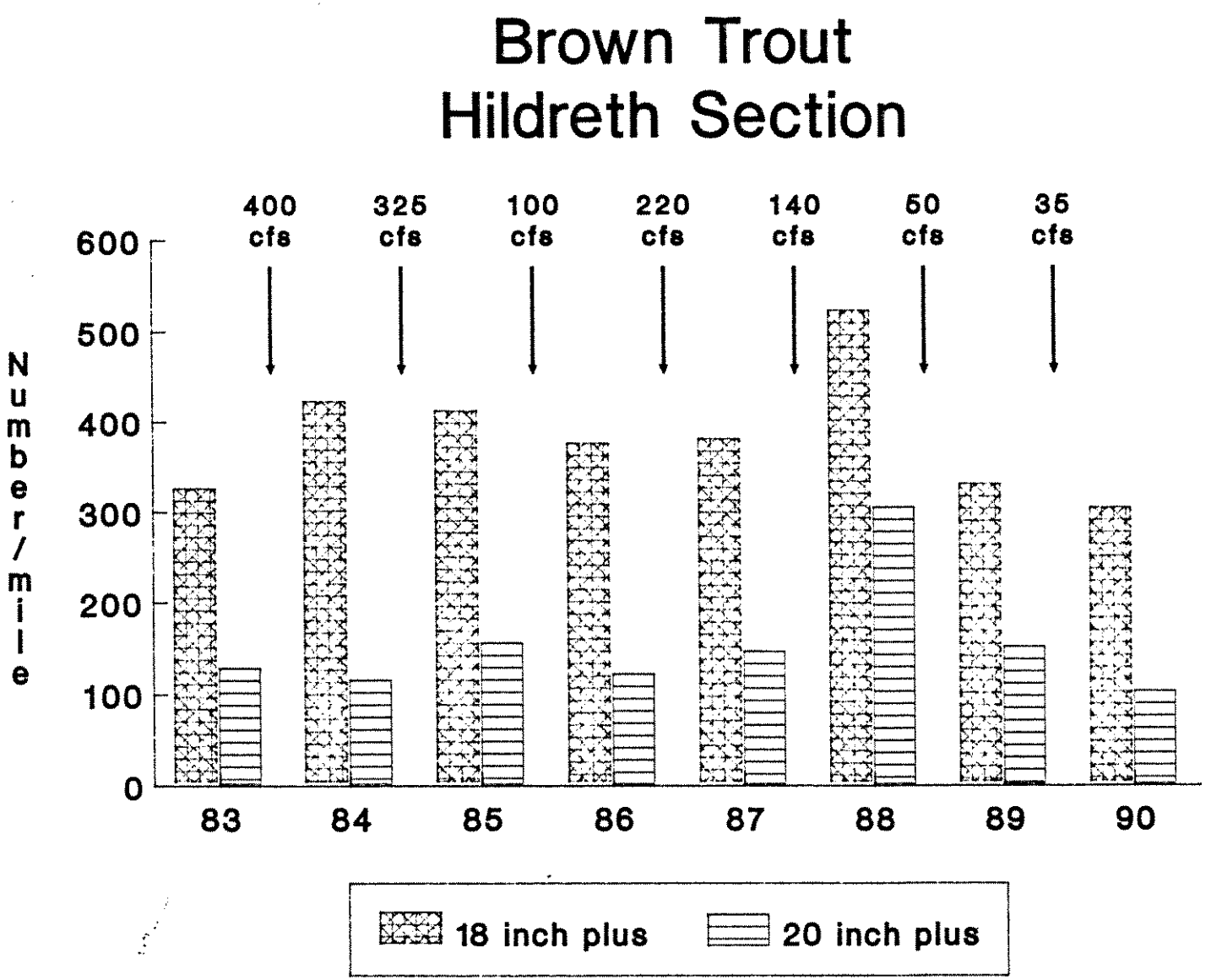

Figure 3. Estimated spring numbers (per mile) of 18 inch and longer and 20 inch and longer brown trout in the Hildreth Section of the Beaverhead River, 1983-90. The approximate mean winter flow release between spring estimates is designated by arrows.

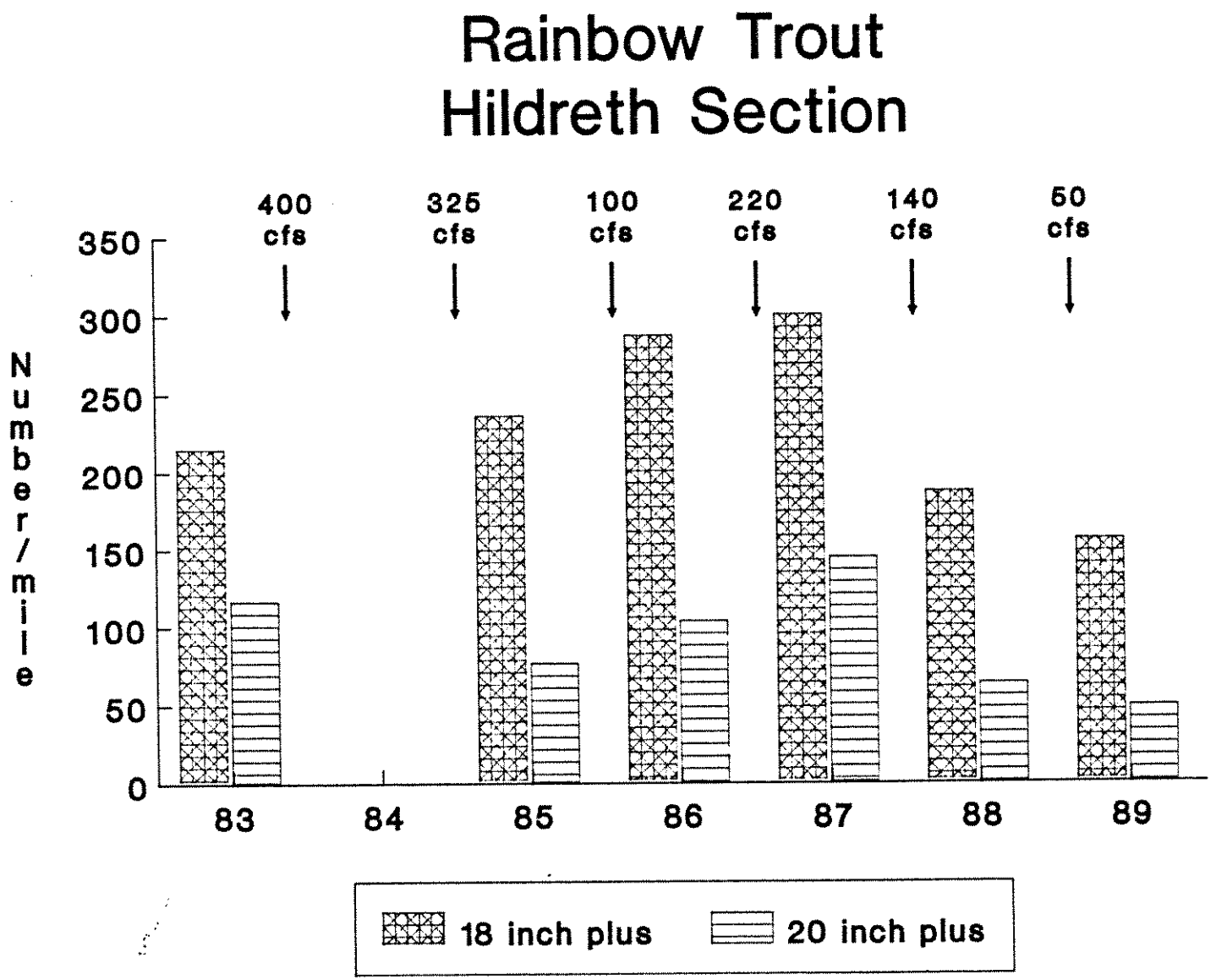

Figure 4. Estimated fall numbers (per mile) of 18 inch and longer and 20 inch and longer rainbow trout in the Hildreth Section of the Beaverhead River, 1983-89. The approximate mean winter flow release between fall estimates is designated by arrows.

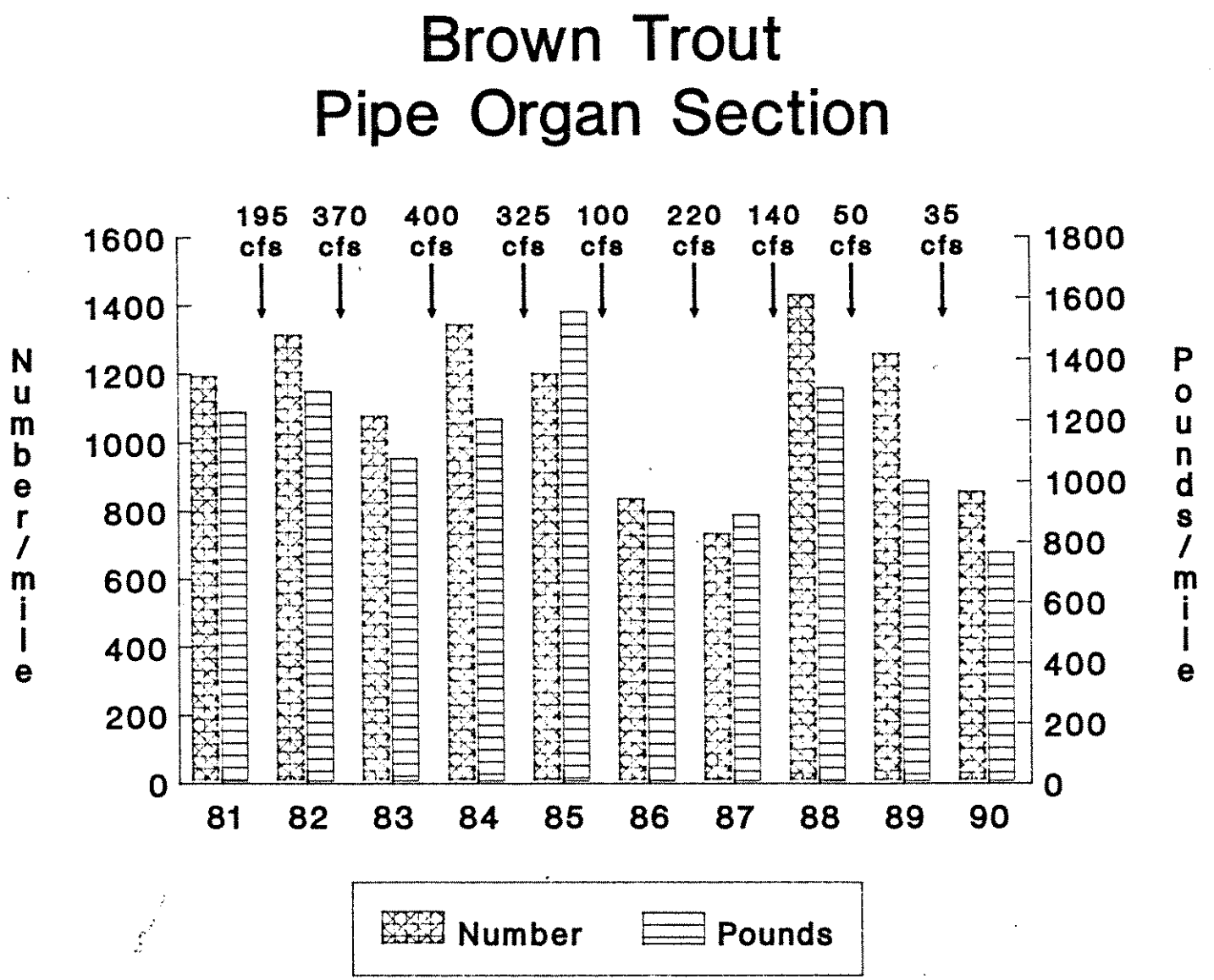

Figure 5. Estimated spring standing crops (per mile) of age II and older brown trout in the Pipe Organ Section of the Beaverhead River, 1981-90. The approximate mean winter flow release between spring estimates is designated by arrows.

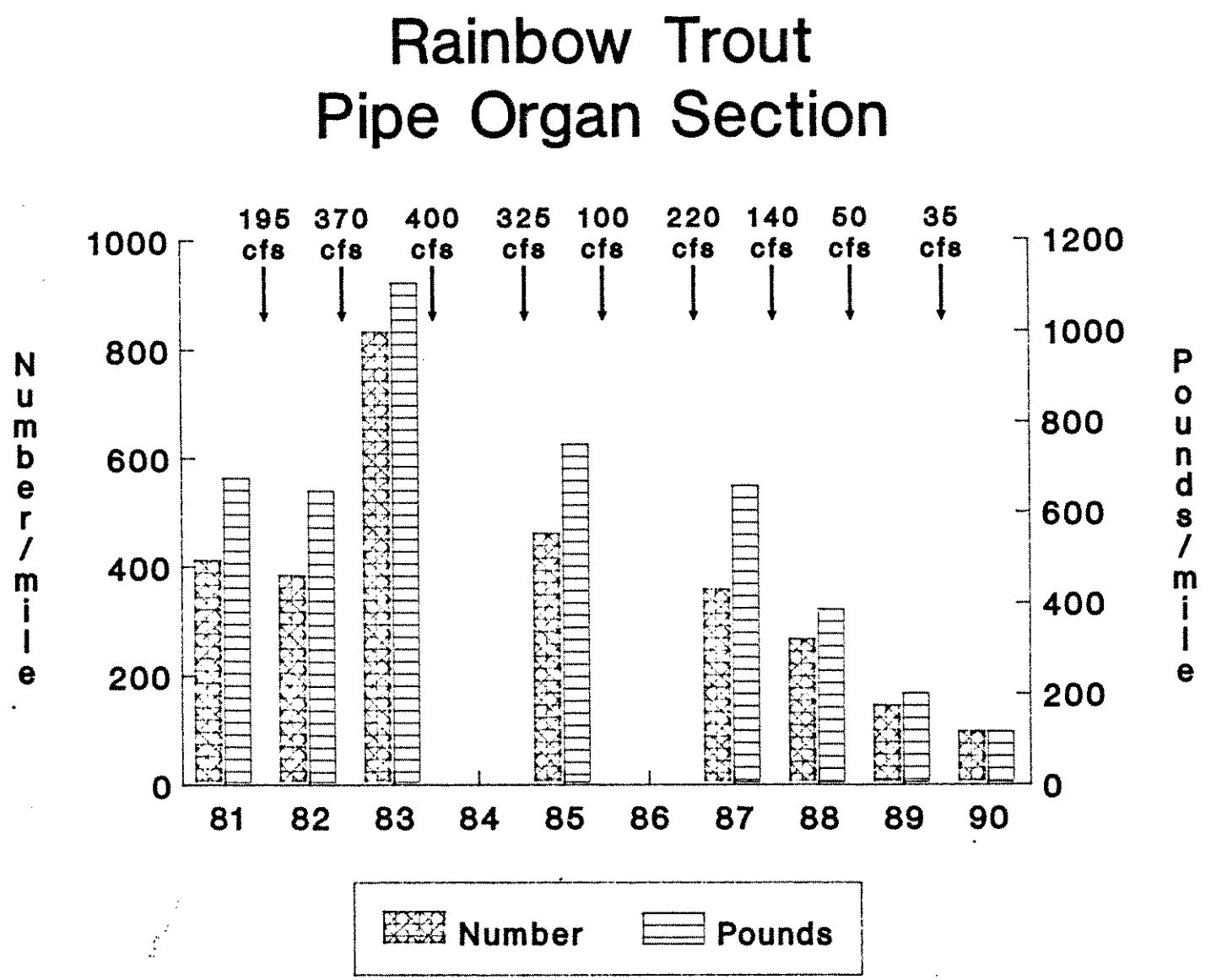

Figure 6. Estimated fall standing crops (per mile) of age I+ and older rainbow trout in the Pipe Organ Section of the Beaverhead River, 1981-90. The approximate mean winter flow release between fall estimates is designated by arrows.

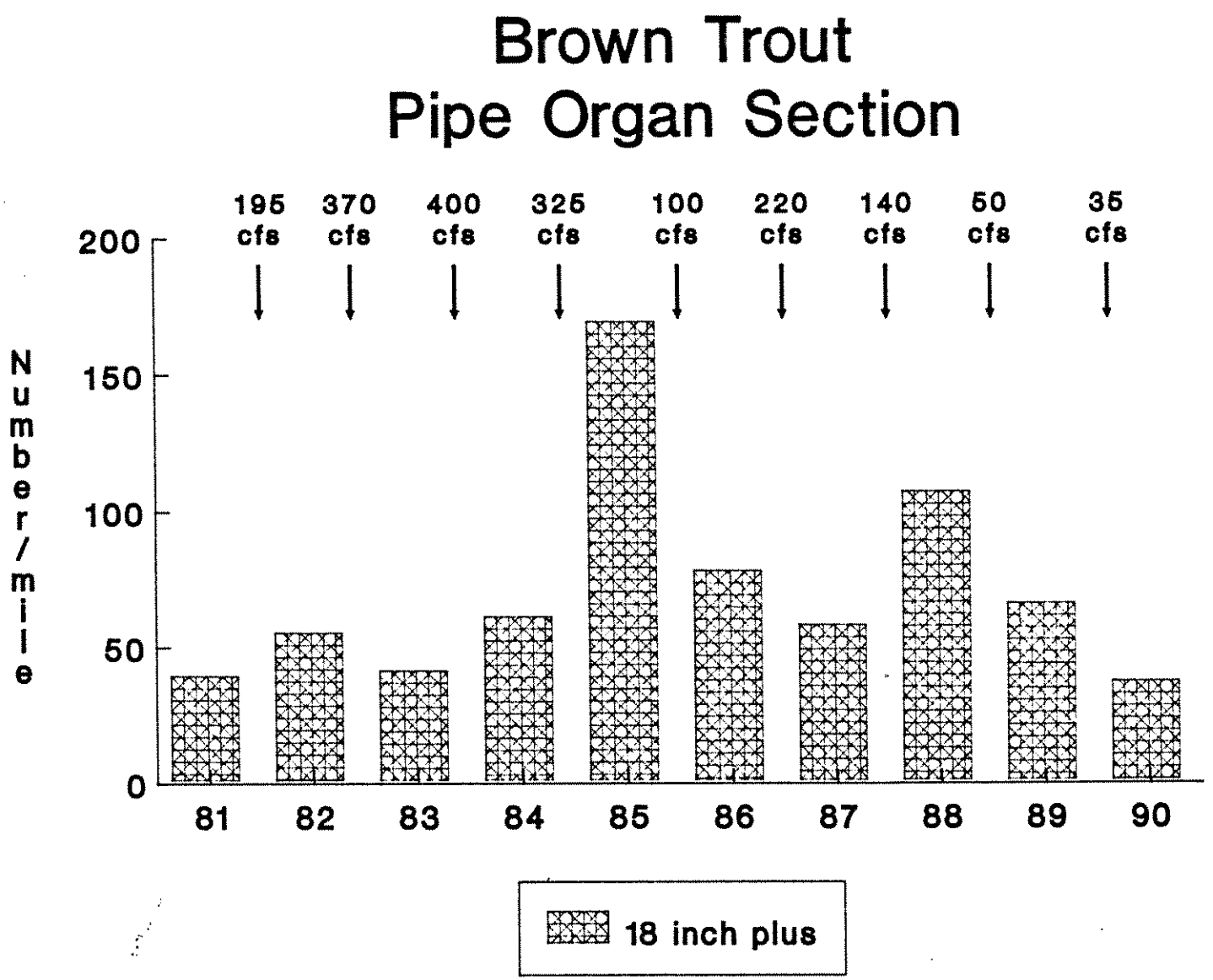

Figure 7. Estimated spring numbers (per mile) of 18 inch and longer brown trout in the Pipe Organ Section of the Beaverhead River, 1981-90. The approximate mean winter flow release between spring estimates is designated by arrows.

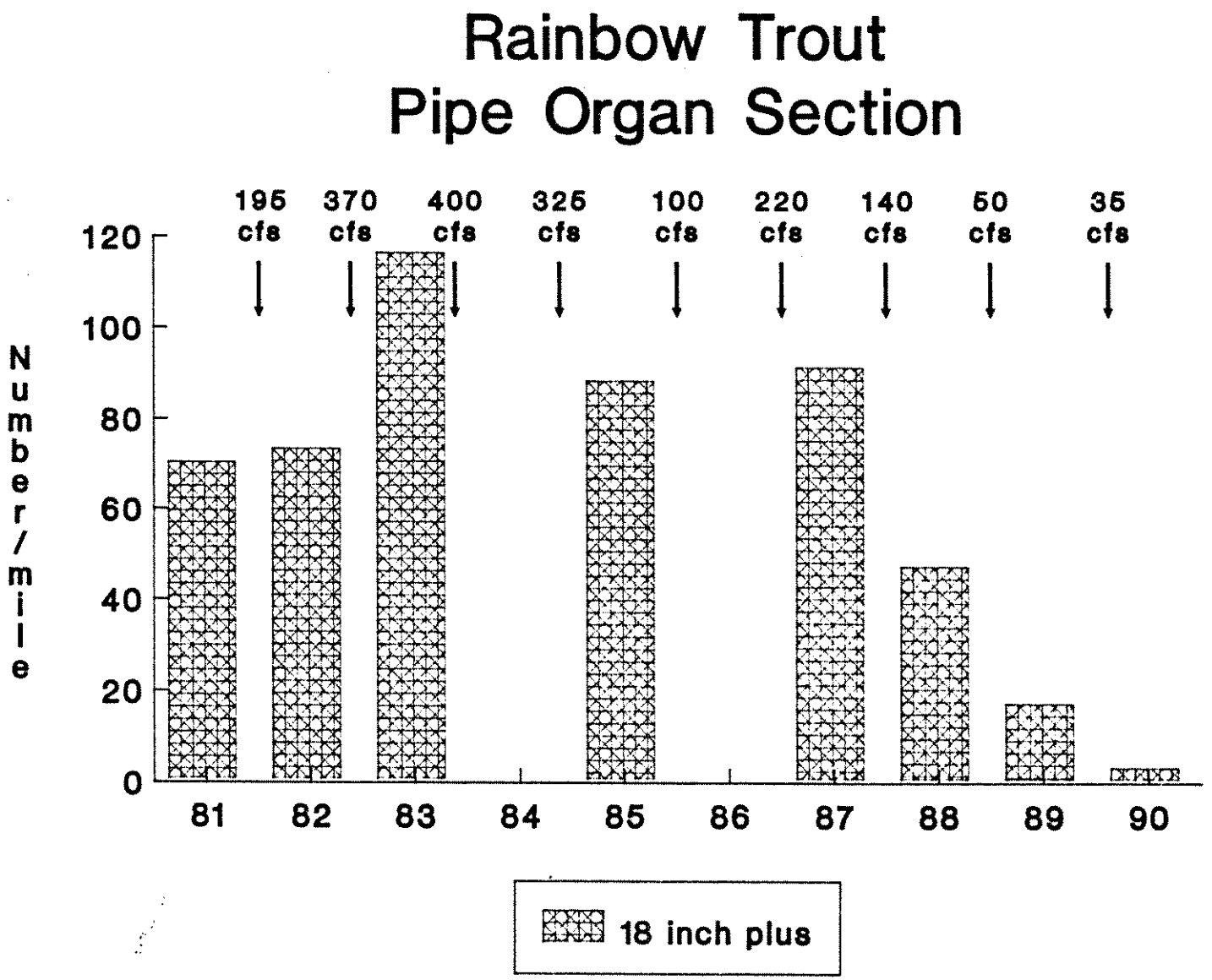

Figure 8. Estimated fall numbers (per mile) of 18 inch and longer rainbow trout in the Pipe Organ Section of the Beaverhead River, 1981-90. The approximate mean winter flow release between fall estimates is designated by arrows.

LITERATURE CITED

Nelson, F. 1986. Effect of flow fluctuations on brown trout in the Beaverhead River, Montana North American Journal of Fisheries Management 6:551-559.

Vincent, E.R., B. Shepard, W. Fredenberg and R. Oswald. 1990. Statewide Fisheries Investigations. Job Prog. Report, Fed. Aid in Fish and Wildlife Restoration Acts, Montana Proj. No. F-46-R-3. Job No. I-f. 56 pp.