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# Standing Stocks of Fish in Some Iowa Streams, with a Comparison of Channelized and Natural Stream Reaches in the Southern Iowa Drift Plain

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# Standing Stocks of Fish in Some Iowa Streams, with a Comparison of Channelized and Natural Stream Reaches in the Southern Iowa Drift Plain.[1]

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Comparisons were made of fish populations inhabiting 11 channelized and natural stream reaches in the Southern Iowa Drift Plain and two drainage ditches in the Des Moines Lobe. Fish were sampled with rotenone, identified, enumerated, and weighed. Total densities of fish ranged from 483/ha at Cylinder Creek to 51,941/ha at Walnut Creek. Total standing stocks of fish ranged from 14 kg/ha at a channelized site on the Chariton River to 1,344 kg/ha at an unchannelized site on the same river. Number of fish species ranged from six sampled at Silver Creek to 16 sampled at Jack Creek. Channelized sites contained fewer fish and substantially lower standing stocks of fish than natural reaches; however the number of species sampled was often similar. The abundance of sport fish was significantly higher in the natural stream reaches, particularly channel catfish (*Ictalurus punctatus*), flathead catfish (*Pylodictis olivaris*), bullhead (I. *melas* and *natalis*), and carp (*Cyprinus carpio*). The Index of Biotic Integrity average was higher at the natural stream reaches ($\bar{x} = 36$) than channelized sites ($\bar{x} = 29.7$). The major differences in fish populations were due to habitat quality and diversity found in the natural sites as compared to the homogeneous habitat of channelized reaches. Iowa streams have insufficient protection from the inroads of man.
INDEX DESCRIPTORS: Channelized streams, Iowa fish distribution, Iowa river basins Southern Iowa Drift Plain.

Interior Iowa streams are an important resource. These waters provide numerous recreational opportunities including fishing, boating, swimming, hunting and trapping as well as a water source for municipal, industrial, and agricultural needs. The contribution of these fisheries is illustrated by the fact the state contains over 30,500 km of streams, and they support one-fourth of the total days of fishing effort by Iowa anglers each year (anonymous 1982). Historically, stream fisheries throughout Iowa have been subjected to a variety of physical and chemical alterations which are the results of channelization, degradation due to poor land use, and point and nonpoint pollution.

In the past, assessment of the overall consequences of these changes to Iowa streams was not possible due to the lack of sufficient data. A systematic study was designed by the Research Division of the Fisheries Bureau to investigate fish populations in streams of the six major river basins in Iowa (Paragamian 1986). The objective of this report is to provide comparative findings of species composition, density, and standing stocks of fish in channelized and natural stream reaches in addition to biological integrity. Data are presented for fish populations in 13 of 69 stream reaches investigated. These stream reaches were selected to provide a comparison of channelized vs. unchannelized waters and sampling for these streams was conducted from 1984 through 1985.

## METHODS AND PROCEDURES

Each sampling site contained 90-150 m of stream and was delineated by an upstream and a downstream block net of 25 mm bar mesh, spanning the width and depth of the stream. Riffles were often used at the upper and lower boundaries of the sampling sites. Two nets constructed of 6 mm bar mesh web and a frame 1 m square, were randomly positioned immediately downstream of the lower net to obtain a subsample of small fish killed in the sample area.

Rotenone, a fish toxicant, was used at each sample site and applied at a rate of 5 ppm. Discharge, measured in cubic meters per second with a Gurley No. 622-F flow meter, was used to determine the amount of 5 percent rotenone to be applied. Application was usually made for a 20-minute period. Rotenone was sprayed immediately above the upper block net and pumped in at the substrate through a perforated hose. Rotenone was also applied to brush piles and backwater areas within the sample site. Mixing of rotenone could also be accomplished when a natural riffle was present at the upper end of the site. Rotenone was used because it is generally nonselective to species, size of fish, or habitat.

Potassium permanganate ($KMnO_4$) was used to detoxify the rotenone below the lower block net. Two or three perforated jugs containing crystaline $KMnO_4$ were evenly spaced and suspended in the water column from the float line of the downstream block net. The chemical was also manually applied along the margin of the net. Potassium permanganate was applied at a ratio of 37.4 kg/1 kg of rotenone or 10 ppm.

As many stressed fish as possible were collected during and after the treatment process. The majority of stressed and dead fish were carried by stream currents into the lower block net. Collections were limited to those fish large enough to be entrapped by the 25-mm bar mesh block net.

Large fish were identified, enumerated, and weighed. Fish collected in subsample nets, small fish, were weighed and preserved in 3.8-liter jars of 10 percent formalin for later identification, enumeration, and wet weighing in the laboratory. Subsamples were subsequently expanded by the comparison of the total width of the lower segment of the sample site in proportion to that covered by the subsample nets. Each treatment site was measured to construct a field-quality map from which surface area was calculated. Statistical comparisons were made with the Student-t test and were limited to only those streams within the Southern Iowa Drift Plain.

The Index of Biotic Integrity (IBI) was used to measure the biotic well-being of each site (Karr 1981). The index incorporates 12 factors such as: species numbers, density, proportion of green sunfish, proportions of various fish guilds (omnivores, piscivors, and insectivors), intolerant species, proportions of hybrids, proportion of tolerant species, number of sucker species, and number of sunfish species. The only measurement of Karr (1981) that was not used was the proportion of diseased fish. Each factor is subdivided into three ranges and each range is given a value of 1, 3 or 5. Values were totaled to provide an index for each site. High index values, possible maximum of 55, are indicative of high biotic integrity while low values, possible low of 11, indicate the opposite.

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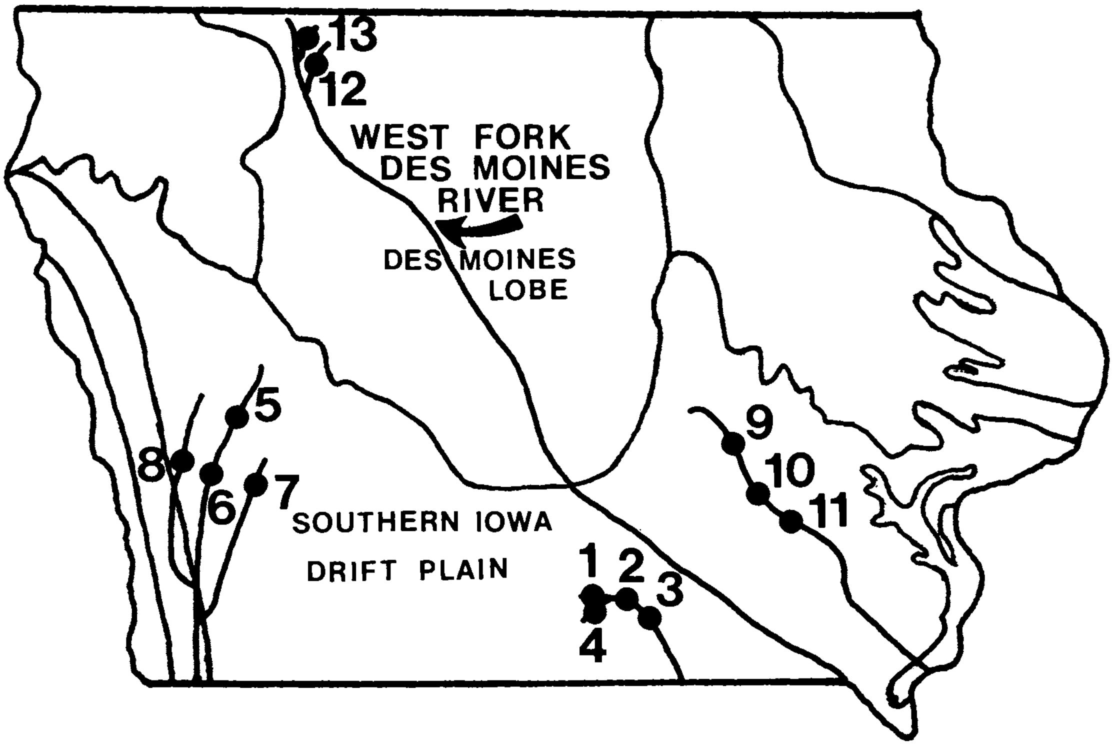


**Fig. 1. Location of thirteen sampling sites on the Chariton River (1-3), Wolf Creek (4), West Fork Nishnabotna River (5-6), Walnut Creek (7), Silver Creek (8), North Skunk River (9-11), Cylinder Creek (12), and Jack Creek (13).**

## SAMPLE SITES

Three sample sites were located on the Chariton River and identified as 1, 2, and 3 (Table 1 and Fig. 1). Site 1 was channelized in 1940 and was void of any in-stream cover, had no meandering, and had a clay substrate. Sites 2 and 3 were unchannelized and contained windfalls and exposed root masses for cover. Sites 2 and 3 also had some meandering and had a combination substrate of primarily silt with sand, and some clay. Wolf Creek (Site 4) was a representative of a headwater tributary of the Chariton River, was unaltered at the sample site, contained brush piles, and silt and sand substrate.

Two channelized sites were sampled on the West Fork of the Nishnabotna River, Sites 5 and 6. Walnut and Silver Creeks are channelized tributaries to the West Fork of the Nishnabotna River, Sites 7 and 8. These streams are characterized by steeply sloped banks (due to grading) and sand and silt substrate. The major difference between the two tributaries in regard to habitat was a former county road bridge on Walnut Creek. The bridge on Walnut Creek was in an advanced stage of deterioration and had formed a pool with concrete and rock habitat. The sample site on Silver Creek contained a brush pile as its only source of in-stream cover.

The three sites on the North Skunk River were identified as 9, 10, and 11 (Fig. 1). Site 9 (Fig. 2) was a channelized reach immediately below a state highway. Sites 10 and 11 were located downstream and were unaltered. Site 9 contained no in-stream cover, and sand substrate. Sites 10 and 11 (Fig. 2) had pools and riffles, silt and sand substrate, windfalls, and exposed root masses for in-stream cover. Cover at Site 11 had been enhanced by a tornado in 1984 that had pushed several trees over and into the river.

Cylinder and Jack Creeks are channelized drainage ditches tributary to the West Fork of the Des Moines River and are within the Des Moines Lobe, Sites 12 and 13 (Table 1 and Fig. 1). Neither stream contained any in-stream cover, and substrate was comprised primarily of sand. The site on Jack Creek was about .5 kilometer upstream from its confluence with the West Fork Des Moines River.

## FINDINGS

Total densities of large and small fish when added ranged from 483/ha at Cylinder Creek to 51,941/ha at Walnut Creek (Tables 2 and 3). Total standing stocks of large and small fish ranged from 14 kg/ha at Site 1 of the Chariton River to 1,344 kg/ha at Site 2 at the same river (Tables 3 and 4). Total number of species ranged from six at Silver Creek to 16 at Jack Creek. Carp dominated the biomass at 70 percent of the sites, ranging from none at Site 9 at North Skunk River and Silver Creek (Site 8) to 1,167 kg/ha at Site 2 on the Chariton River. Channel catfish were second in abundance with standing stocks, ranging from 1 kg/ha at Site 1 of the Chariton River to 341 kg/ha at Site 3 of the Chariton River. Yellow and black bullhead also were important and found at 50 percent of the sites. Flathead catfish, however, were recorded only on the North Skunk at the unchannelized Sites 10 and 11. Sand and red shiners were the most abundant species of small fish.

Index of Biotic Integrity for streams within the Southern Iowa Drift Plain ranged from 25 at Silver Creek to 42 for Wolf Creek (Table 3). The mean IBI for natural stream reaches was 36.0 (S.D. = 3.5), that of the channelized sites was 29.7 (S.D. = 4.8). IBI of Cylinder and Jack Creeks, both in the Des Moines Lobe, were 23 and 31, respectively.

## DISCUSSION

The Chariton and North Skunk River sites in the Southern Iowa Drift Plain provided excellent comparisons of the fish communities

**Table 1. A summary of stream sites sampled for fish.**

| Stream | County | Locations | ha | Date Sampled |
|---|---|---|---|---|
| *Southern Iowa Drift Plain:* | | | | |
| 1. Chariton River | Lucas | T71N-R21W-Sec 5 | .06 | 28 June 1984 |
| 2. | Lucas | T71N-R20W-Sec 19 | .10 | 28 June 1984 |
| 3. | Lucas | T71N-R20W-Sec 29 | .22 | 27 June 1984 |
| 4. Wolf Creek | Lucas | T71N-R21W-Sec 30 | .04 | 26 June 1984 |
| 5. West Fork Nishnabotna River | Shelby | T79-R38W-Sec 19 | .25 | 11 July 1984 |
| 6. | Pottawattamie | T78N-R39-Sec 32 | .28 | 11 July 1984 |
| 7. Walnut Creek | Pottawattamie | T75N-R38W-Sec 15/16 | .09 | 05 Sept 1984 |
| 8. Silver Creek | Pottawattamie | T75N-R41W-Sec 34 | .06 | 05 Sept 1984 |
| 9. North Skunk River | Jasper | T80W-R17W-Sec 31 | .06 | 06 Aug 1985 |
| 10. | Mahaska | T76W-R14W-Sec 22 | .17 | 19 June 1985 |
| 11. | Keokuk | T75N-R13W-Sec 8 | .18 | 22 May 1985 |
| *Des Moines Lobe:* | | | | |
| 12. Cylinder Creek | Palo Alto | T95N-R32W-Sec 24 | .13 | 31 May 1985 |
| 13. Jack Creek | Palo Alto | T95N-R33W-Sec 22 | .10 | 31 May 1985 |

inhabiting channelized and natural stream reaches. Site 1 of the Chariton River was channelized whereas Sites 2 and 3 were unaltered and provided the best fish habitat as described earlier in this report.

Total standing stocks of large and small fish were estimated to be 14 kg/ha at Site 1 while those of Sites 2 and 3 were 1,344 and 1,135 kg/ha, respectively. Variations in densities and standing stocks of channel catfish, the species most desired by anglers in Iowa (Anonymous 1982), were also affected by channelization. Density and standing stock of channel catfish at Site 1 were 52/ha and 1.2 kg/ha, respectively, while the average densities for Site 2 and 3 were 552/ha and about 195 kg/ha, (excluding small channel catfish). The channelized site of the Chariton River was even very dissimilar to Wolf Creek, total standing stock of 763 kg/ha which included 209 kg/ha of channel catfish. Congdon (1971) believed channelization of the Chariton River, in Missouri, has caused as much as an 87 percent reduction in the total fish population.

The findings at the North Skunk River paralleled those of the Chariton. Site 9 of the North Skunk River had no fish other than small cyprinids and a few green sunfish. Sites 10 and 11 of the North Skunk River provided about 400 kg/ha of small and large fish, including an average of 157 kg/ha of channel catfish over 150 mm in length, 14 kg/ha of flathead catfish, 2 kg/ha of walleye, and 193 kg/ha of carp.

Habitat diversity was important in determining species composition, abundance, and total biomass of fish inhabiting a stream reach. The presence of the deteriorated county bridge at the channelized site on Walnut Creek made approximately a 30-fold difference in the standing stock of fish when compared to Silver Creek. Channelization

**Fig. 2. Photo on left is Site 11 on the North Skunk River and on right is Site 9 on the North Skunk River, a channelized reach.**

**Table 2. Species of large fish, and density (N/ha), at 13 sites of streams in Iowa. Estimates were determined by rotenone samples with 25-mm bar nets.**

| | CHARITON RIVER | | | WOLF CREEK | NORTH SKUNK RIVER | | | WALNUT CREEK | SILVER CREEK | WEST FORK NISHNABOTNA RIVER | | CYLINDER CREEK | JACK CREEK |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
| Slender Madtom | | | | | | | 10 | | | | | | |
| *Noturus exilis* | | | | | | | | | | | | | |
| Black Bullhead | 52 | 1,269 | 528 | 802 | | | | | | | | | 79 |
| Yellow Bullhead | | 400 | 642 | 2,817 | | 7 | | | | | | | |
| Stone Catfish | 17 | 104 | | 109 | | 47 | | | | | | | |
| *Noturus flavus* | | | | | | | | | | | | | |
| Channel Catfish | 52 | 331 | 716 | 328 | | 1,378 | 477 | 751 | | 54 | 230 | | |
| Flathead Catfish | | | | | | 40 | 30 | | | | 7 | | |
| Carp | 17 | 3,002 | 1,719 | 548 | | 148 | 205 | 188 | | 30 | 15 | 52 | 22 |
| Creek Chub | | | | 220 | | | | 170 | 37 | | | | |
| *Semotilus atromaculatus* | | | | | | | | | | | | | |
| Flathead Chub | | | | | | | | 1,074 | 294 | 17 | 7 | | |
| *Hybopsis gracilis* | | | | | | | | | | | | | |
| Golden shiner | | 17 | | | | | | | | | | | |
| *Notemigonus chrysoleucus* | | | | | | | | | | | | | |
| Bigmouth Buffalo | | | 12 | | | | 10 | | | | 10 | | |
| *Ictiobus cyprinellus* | | | | | | | | | | | | | |
| River Carpsucker | 35 | 35 | | | | 12 | 20 | | | 47 | 37 | | |
| *Carpiodes carpio* | | | | | | | | | | | | | |
| Quillback Carpsucker | | 17 | | | | 20 | 10 | | | | | 35 | 12 |
| C. *cyprinus* | | | | | | | | | | | | | |
| Shorthead Redhorse | | | | | | 7 | 10 | | | | | | |
| *Moxostoma macrolepidotum* | | | | | | | | | | | | | |
| White Sucker | | | 17 | 81 | | | | | | | | 52 | 170 |
| *Catostomus commersoni* | | | | | | | | | | | | | |
| Goldeye | | | | | | | | | | | 7 | | |
| *Hiodon alosoides* | | | | | | | | | | | | | |
| Gizzard Shad | | 161 | 447 | | | | | | | 210 | 7 | | |
| *Dorosoma cepedianum* | | | | | | | | | | | | | |
| Green Sunfish | 17 | | 35 | 183 | | 35 | | | 37 | 5 | | 27 | |
| *Lepomis cyanellus* | | | | | | | | | | | | | |
| Bluegill | 17 | | 22 | | | | | | | | | | |
| L. *macrochirus* | | | | | | | | | | | | | |
| White Crappie | | 383 | 528 | 54 | | | | | | | 7 | | |
| *Pomoxis annularis* | | | | | | | | | | | | | |
| Black Crappie | | | | | | | | | | | | | |
| P. *nigromaculatus* | | | | | | | | | | | | | |
| Largemouth Bass | 35 | | | 37 | | | | | | | | | |
| *Micropterus salmoides* | | | | | | | | | | | | | |
| Yellow Perch | | | | | | | | | | | | | 12 |
| *Perca flavescens* | | | | | | | | | | | | | |
| Walleye | 35 | | | | | 12 | 10 | | | 5 | | | |
| *Stizostedion vitreum* | | | | | | | | | | | | | |
| Freshwater Drum | 17 | 156 | 415 | 183 | | | | | | | 7 | | |
| *Aplodinotus grunniens* | | | | | | | | | | | | | |
| Total N/ha | 294 | 5,875 | 5,081 | 5,362 | 0 | 1,706 | 782 | 2,183 | 368 | 368 | 334 | 166 | 295 |

**Table 3. Species of small fish, total density (N/ha), and total standing stock (kg/ha). Estimates from subsample nets at 13 sites 1984 and 1985. Also included are Index of Biotic Integrity (IBI) values.**

| | CHARITON RIVER | | | WOLF CREEK | NORTH SKUNK RIVER | | | WALNUT CREEK | SILVER CREEK | WEST FORK NISH-NABOTNA RIVER | | CYLINDER CREEK | JACK CREEK |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
| Banded Killifish *Fundulus diaphanus* | | | | | | | | | | | | | 52 |
| Gizzard Shad | | 57 | | | | | | | | | | | |
| Spotfin Shiner *Notropis spilopterus* | | | | | | | | | | | | 106 | 259 |
| Brassy Minnow *Hybognathus hankinsoni* | | | | | | 42 | | | | | | | 52 |
| Fathead Minnow *Pimephales promelas* | 133 | | | 301 | | | | 10,099 | 4,593 | 86 | | | 360 |
| Sand Shiner *Notropis stramineus* | 1,523 | | | 3,111 | 412 | 247 | 101 | 28,801 | | 610 | 435 | | 166 |
| Red Shiner N. *lutrensis* | 400 | 57 | 32 | 5,921 | | 1,190 | 501 | 4,040 | 3,707 | 173 | 674 | | |
| Golden Shiner | | | | | | | | | | | | | 52 |
| Emerald Shiner N. *atherinoides* | | | | | | | | | | | 99 | | |
| Bigmouth Shiner N. *dorsalis* | 133 | | | | 7,573 | 165 | 101 | 2,462 | 247 | | | | |
| Creek Chub | | | | 301 | 10,289 | | | 632 | 477 | 44 | | | 52 |
| Silver Chub *Hybopsis storeriana* | | | | | | | | | | | 49 | | |
| Bluntnose Minnow *Pimephales notatus* | | | | | 741 | | 49 | | | | | 35 | 104 |
| Flathead Chub | | | | | | | | 3,156 | 607 | 86 | 49 | | |
| Speckled Chub H. *aestivalis* | | | | | | | | | | 131 | 49 | | |
| Suckermouth Minnow *Phenacobius mirabilus* | | | | | 1,482 | 42 | | 442 | | | | | |
| White Sucker | | | | 200 | 1,647 | | | | | | | | |
| Golden Redhorse *Moxostoma erythrurum* | | | | | | 42 | | | | | | | |
| Tadpole Madtom *Noturus gyrinus* | | | 32 | 402 | | | | | | | | 141 | 52 |
| Black Bullhead | | 222 | 32 | 2,109 | | | | | | 173 | 49 | | 360 |
| Yellow Bullhead | | 57 | 32 | 704 | | | | | | | | | |
| Channel Catfish | | 57 | | | | 328 | 600 | 126 | | | 146 | | |
| Stone Catfish | | | | | | 286 | 452 | | | | | | |
| White Crappie | | | 32 | | | | | | | | | | |
| Green Sunfish | 200 | | | | | 42 | | | | 346 | 146 | | |
| Bluegill | | | | | | | 49 | | | | | | 52 |
| Johnny Darter *Etheostoma nigrum* | | | | | | | | | | | | 35 | 52 |
| Total N/ha | 2,389 | 450 | 160 | 13,049 | 22,144 | 2,384 | 1,853 | 49,758 | 9,631 | 1,649 | 1,696 | 317 | 1,613 |
| Total Kg/ha | 3.93 | 15.46 | 3.07 | 96.33 | 33.17 | 16.16 | 11.98 | 135.51 | 46.18 | 10.13 | 12.05 | 2.76 | 8.05 |
| IBI | 38 | 35 | 35 | 42 | 27 | 35 | 33 | 31 | 25 | 26 | 31 | 23 | 31 |

**Table 4. Estimated standing stock (Kg/ha) of large fish at 13 sites of streams in Iowa. Estimates were determined by rotenone samples with 25-mm bar nets.**

| | CHARITON RIVER | | | WOLF CREEK | NORTH SKUNK RIVER | | | WALNUT CREEK | SILVER CREEK | WEST FORK NISHNABOTNA RIVER | | CYLINDER CREEK | JACK CREEK |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
| Slender Madtom | | | | | | | .1 | | | | | | |
| Black Bullhead | .3 | 37.9 | 14.6 | 44.7 | | | | | | | | | 5.8 |
| Yellow Bullhead | | 17.4 | 42.1 | 88.0 | | .2 | | | | | | | |
| Stone Catfish | .8 | .7 | | .8 | | .7 | | | | | | | |
| Channel Catfish | 1.2 | 48.9 | 340.7 | 208.6 | | 182.3 | 131.0 | 224.3 | | 16.8 | 89.6 | | |
| Flathead Catfish | | | | | | 4.3 | 23.1 | | | | 3.9 | | |
| Carp | 1.9 | 1,166.8 | 641.2 | 291.4 | | 105.1 | 281.5 | 322.8 | | 14.3 | 5.9 | 75.3 | 19.3 |
| Creek Chub | | | | 5.5 | | | | 4.8 | .5 | | | | |
| Flathead Chub | | | | | | | | 37.5 | 18.6 | 1.1 | .8 | | |
| Golden Shiner | | .2 | | | | | | | | | | | |
| Bigmouth Buffalo | | | 14.7 | | | | 9.3 | | | | 4.9 | | |
| River Carpsucker | 1.6 | 20.4 | | | | 2.3 | 5.1 | | | 21.3 | 12.9 | | |
| Quillback Carpsucker | | 1.7 | | | | 8.0 | 1.9 | | | | | .8 | .3 |
| Shorthead Redhorse | | | | | | 2.5 | 3.9 | | | | | | |
| White Sucker | | | .8 | 3.6 | | | | | | | | 23.6 | 103.2 |
| Goldeye | | | | | | | | | | | 3.3 | | |
| Gizzard Shad | | 8.0 | 6.7 | | | | | | | 29.9 | 1.3 | | |
| Mooneye | | | | | | | | | | .8 | | | |
| Green Sunfish | .3 | | .5 | 4.1 | | .5 | | | .7 | .1 | | .1 | |
| Bluegill | .2 | | .7 | | | | | | | | | | |
| White Crappie | | 17.3 | 31.7 | 14.1 | | | | | | | .5 | | |
| Largemouth Bass | .8 | | | .4 | | | | | | | | | |
| Yellow Perch | | | | | | | | | | | | | .2 |
| Walleye | 1.5 | | | | | 2.5 | 2.3 | | | .7 | | | |
| Freshwater Drum | 1.4 | 9.4 | 38.6 | 5.3 | | | | | | | .2 | | |
| Total Kg/ha | 10.0 | 1,328.7 | 1,132.3 | 666.5 | 0 | 308.4 | 458.1 | 589.4 | 19.8 | 85.0 | 123.3 | 99.8 | 128.8 |

of Walnut and Silver Creeks, both tributaries of the West Nishnabotna River, occurred about the same time. These streams are very similar in water chemistry, location, and physical characteristics (Paragamian 1986). At this site there was a total fish standing stock of about 725 kg/ha; at least 225 kg/ha were channel catfish, and 323 kg/ha were carp. Sampling at Silver Creek, a stream nearly void of good fish habitat, revealed a total fish standing stock of about 66 kg/ha of which none were channel catfish or carp.

Cylinder and Jack Creeks were also nearly valueless environments for fish. Although 16 species of fish were captured in Jack Creek, this may have been due to its proximity to the West Fork Des Moines River. The two drainage ditches did not have the biomass diversity or presence of sport fish when compared to other tributary streams in the same basin (Paragamian 1986).

The biotic well-being of streams of this investigation was low in comparison to standards prepared by Karr (et. al. 1986). Karr (et. al. 1986) classified IBI ranges of 58-60 as excellent, 48-55 good, 40-44 fair, 28-34 poor, and 12-22 as very poor. Only Wolf Creek rated good with an IBI of 42. The remaining natural stream reaches ranged between poor and good with a mean of 36.0. All channelized stream reaches ranged between very poor and poor with a mean of 29.7. Paragamian (1986) found channelized stream reaches, in the Southern Iowa Drift Plain, had a significantly lower IBI ($P<0.05$) than natural reaches, in a Students-t test. The statistical comparison included streams of this investigation. Channelized waterways were unusually lower in numbers of intolerant species, piscivors, sucker species, and total species. But total numbers or densities varied within each of the two stream conditions. My calculations of IBI did not include diseased fish, thus my values could possibly be a value of 5 less than those developed by Karr (et. al. 1986).

Natural stream reaches provided significantly higher ($P<0.05$) standing stocks than channelized segments. The mean total standing stock of natural stream sites of the Southern Iowa Drift Plain was about 807 kg/ha $\pm 431$ while that of the channelized reaches was 178 kg/ha $\pm 271$. Numbers of species on the other hand were similar ($P>0.05$), a mean of 14.6 $\pm 2.1$ for natural reaches and 11.1 $\pm 4.6$ for the altered sites.

Standing stocks of fish sought after by anglers were significantly higher ($P<0.05$) in natural stream reaches of the Southern Iowa Drift Plain than altered sites. Total standing stocks of channel catfish, other than small fish, averaged 182 kg/ha $\pm 107$ in natural sites while the mean was 22 kg/ha $\pm 39$ in the channelized reaches. Bullhead (*Ictalurus* sp.) averaged 47 kg/ha $\pm 54$ in natural reaches while they were nearly nonexistent in the channelized sites. Carp were substantially more abundant ($P<0.05$) in the natural sites, 497 kg/ha $\pm 422$, while the average in the channelized sites was 57 kg/ha $\pm 130$.

Hansen (1971) studied the effects of stream channelizaton on fishes and benthic invertebrates in the Little Sioux River, Iowa. He found greater daily temperature fluctuations and higher turbidities during low runoff during summer in channelized sections. Invertebrates were similar, but drift was higher in channelized sections whereas numbers of fish species were higher in the unchannelized sites.

Channelized streams lack numerous physical characteristics that provide habitat diversity. These stream channels characteristically lack in-stream cover in the form of windfalls, root wads, and pools (Paragamian 1986). Grading of channelized stream reaches is an additional detrimental feature that creates steep eroding banks. These attributes make it difficult for many fish species to survive during any life stage.

Other investigations in Iowa have documented the environmental consequences of stream channelization. Bulkley (et. al. 1976) summarized several subprojects involving studies of natural and channelized stream reaches. They found channelization reduced habitat diversity by creating uniform water depth and current velocity. Sinuous streams provided greater concentrations of drifting organisms and more species. Zimmer and Bachmann (1978) found drift density in biomass and numbers was positively correlated to sinuosity. But Bulkley (et. al. 1976) felt it was difficult to compare catches from channelized and unchannelized reaches because of varying rates of catch efficiency due to stream depths, cover and turbidities.

Channelization of interior Iowa streams is an active land management practice. Present state regulation (900-71.2(455B) Iowa Administrative Code) allows private landowners to alter stream channels with under 26 square kilometers of watershed without a permit. Landowners with larger watersheds may reduce channel lengths up to 25 percent, within property boundaries, through application to the Department of Environmental Protection. Numerous channel changes are made without permits, and often exceed permissible lengths (Department of Natural Resources).

Channelization of over 4,800 km of streams (Bulkley 1976) in Iowa equates to losses of millions of kilos of fish for food and recreation, in addition to the losses of native flora and fauna because of associated land use changes (Best et. al. 1981). Iowa laws need to be improved and upheld in order to protect these resources.

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