

PA FISH AND BOAT COMMISSION
COMMENTS AND RECOMMENDATIONS
June 8, 1992

WATER: Hay Creek (603C) Berks County

EXAMINED: July 1991 Code: 01772

BY: Kaufmann, Soldo, Wnuk, and Chandler

Bureau Director Action: Approved - Delano R. Graff Date: 9-11-95
Division Chief Action: Richard A. Snyder Date: 9-11-95
WW Unit Leader Action: _____ Date: _____
CW Unit Leader Action: R. Thomas Heine Date: 9/11/95

AREA COMMENTS:

Hay Creek (Ck.) is a 20.5 km long stream located in sub-subbasin 3C, Robeson and Union townships, Berks County. Hay Ck. was examined in July of 1991 to document the current status of fish populations in the stream and, particularly, to determine the density and distribution of the stream's wild trout population.

Section 01 of Hay Ck., from the headwaters downstream to the SR 82 bridge near Geigertown, supported a Class A wild brown trout population with an acceptable number of legal size and larger fish present. Wild brown trout populations in the section were probably limited by moderate sedimentation of the spawning substrate and somewhat restricted habitat for larger fish.

Section 02 of Hay Ck., from the SR 82 bridge near Geigertown downstream to the Birdsboro property line, supported very few wild trout. This was due to warmer water temperatures and increased sedimentation. Section 02 had less shading and a lower gradient than Section 01. Section 02 provided a valuable stocked trout fishery.

Section 03 of Hay Ck., from the Birdsboro property line downstream to the mouth, supported a better wild brown trout population than Section 02. This was due to increased shading, the confluence of several cooling spring seeps and tributaries and increased gradient, which contributed to less sedimentation. Nevertheless, sedimentation, in combination with poor physical habitat and moderately low gradient, was great enough to seriously limit wild trout populations in Section 03. Poor physical habitat in the section was the result of substrate scouring and partial relocation of the stream channel caused by a 1987 flood. Section 03 supported a very valuable, scenic, walk-in only stocked trout fishery.

AREA RECOMMENDATIONS:

1. The Pennsylvania Department of Environmental Resources should upgrade the Chapter 93 water quality classification of Section 01 of Hay Ck. from

Coldwater Fishery to High-Quality Coldwater Fishery due to the excellent (Class A) wild brown trout population that this section supports. Beaver Run, a tributary to Hay Ck., should also be upgraded to High-Quality Coldwater Fishery for the same reason.

2. The Pennsylvania Department of Environmental Resources should affix the additional designation of migratory fishes to the Hay Ck. basin due to the presence of American eels.
3. The Pennsylvania Fish and Boat Commission should continue to manage the wild brown trout population in Section 01 of Hay Ck. under conventional, statewide angling regulations.
4. The Pennsylvania Fish and Boat Commission should continue to manage Sections 02 and 03 of Hay Ck. for stocked trout under the current stocking rates and statewide angling regulations.
5. The Pennsylvania Fish and Boat Commission should add a special stocking instruction to Hay Ck. which prohibits the substitution of brook trout due to the presence of wild brook trout populations in tributaries to Section 03.
6. Habitat improvement devices should be constructed in Section 03 of Hay Ck. if mitigation for environmental damage is required by the construction and realignment of SR 82.
7. Stormwater retention basins should be required of all future developments in the Hay Ck. basin to prevent exacerbation of future flooding.

CW UNIT COMMENTS

Hay Ck. (603C), Sections 01-03, were examined during July 1991 as part of a routine reinventory of the coldwater resource in Fishers Management Area 6.

Section 01

Section 01 can be characterized as a small headwater stream. The 1991 inventory documented the presence of an excellent wild brown trout population estimated in excess of 47 kg/ha.

Section 02

This segment can be characterized as a small stream supporting a fishery indicative of habitat in transition between a cold and warmwater fishery. The 1991 inventory documented the presence of 11 fish species including a sparse brown trout population.

Section 03

Section 03 can be characterized as a moderate size freestone stream. The 1991 inventory documented the presence of 24 fish species including a naturally reproducing brown trout fishery estimated in excess of 10 kg/ha.

CW UNIT RECOMMENDATIONS

1. Hay Ck. (603C), Section 01, should continue to be managed as a Class A wild trout fishery. Conventional statewide regulations should apply with no stocking.

2. Hay Ck., (603C), Sections 02 and 03, should continue to be managed with the planting of PFBC catchable trout. Stocking rates and frequencies should be determined by classification according to program guidelines.
3. Due to the excellent wild brown trout fishery present in Section 01, the DEP water quality protection classification should be upgraded to HQ-CWF. The upgraded protection status should apply from the headwaters downstream to the SR 0082 bridge near Geigertown. A copy of this report should be forwarded to DEP via Environmental Services.

PENNSYLVANIA FISH AND BOAT COMMISSION
BUREAU OF FISHERIES
FISHERIES MANAGEMENT DIVISION

Hay Creek (603C)
Fisheries Management Report

Prepared by
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Date Sampled: July 1991

Date Prepared: March 1993

INTRODUCTION

Hay Creek (Ck.) is a 20.5 km (12.7 mi.) long stream located in sub-subbasin 3C, Robeson and Union townships, Berks County (Co.). The stream originates just west of US 176 and flows generally southeast to Geigertown. At Geigertown, Hay Ck. bends and flows generally northeast to its confluence with the Schuylkill River at River Mile (RM) 63.1, 40°16'13" Latitude and 75°48'04" Longitude. Hay Ck. can be located on the Morgantown, Elverson and Birdsboro, PA, USGS 7.5 minute quadrangles (Fig. 1).

Hay Ck. has a 57 km² (22 mi.²) drainage basin. The underlying geology of the drainage basin is a combination of diabase, the Hammer Creek Formation and Hammer Creek Conglomerate, all of which date from the Triassic Age. Diabase, also known as "trap rock," consists of quartzite and various pyroxenes which, in past years, had been quarried from the Hay Ck. basin and used for road material and railroad track ballast. The Hammer Creek Formation consists of quartzite sandstone with a few red shale interbeds, while Hammer Creek Conglomerate is a cobble and pebble quartz conglomerate interbedded with red sandstone.

Land use in the Hay Ck. drainage basin is primarily a mixture of undeveloped woodlots, old fields and single family residences. The headwaters were heavily forested until recent years, when large tracts were timbered for the development of New Morgan Borough. The largest town in the basin is Birdsboro, located near the mouth of the stream. Birdsboro had a population of 4,222 people during the 1990 census. There are numerous farm ponds and small tributaries in the basin, and many of the tributaries contain wild trout populations. One of these tributaries is Beaver Run, which enters Hay Ck. near Scarlets Mill. Soldo et al. (1991) estimated that Beaver Run supported a mixed population of wild brook trout *Salvelinus fontinalis* and brown trout *Salmo trutta* totalling 41.12 kg/ha (Class A).

The entire Hay Ck. basin is classified as a coldwater fishery (CWF) under the Pennsylvania Department of Environmental Resources (DER) Chapter 93 water quality standards. The CWF designation requires that permitted discharges to Hay Ck. meet water quality criteria designed to protect and maintain reproducing populations of trout and associated coldwater flora and fauna. Currently, there are two permitted discharges in the Hay Ck. basin. These originate from the Birdsboro sewage treatment plant (STP) and the Bethlehem Mines Grace Mine tailings pond. The Birdsboro STP discharges to Hay Ck. just upstream from the mouth. The Bethlehem Mines Grace Mine

tailings pond discharges to an unnamed tributary which enters Hay Ck. near Joanna Furnace. This tributary was formerly part of the Conestoga Ck. drainage but was diverted by the Grace Mine. The mine is no longer in operation, but the tailings pond still discharges. In addition to the permitted discharges, the Birdsboro Municipal Authority has a water intake on Hay Ck. near Trap Rock.

B and M Incorporated, of Chestnut Hill, has an application pending with DER for a landfill permit at the site of the former Trap Rock diabase quarry adjacent to Hay Ck. and SR 82 near Birdsboro. The proposed landfill would have an active life of 30 years, after which the site will be filled and used as a Christmas tree farm. This landfill is opposed by many local residents and a variety of conservation organizations, including Birdsboro, Robeson, Union Taskforce Against Landfill (BRUTAL), the Berks Co. Federation of Sportsmen, and the Pennsylvania Fish and Boat Commission (PFBC). The reasons these groups oppose the landfill are the potential for leachate contamination of Birdsboro's public water supply, the potential for organic water quality degradation of Hay Ck. due to leachate contamination, and the potential for increased sedimentation in Hay Ck.

There has been one documented fish kill in Hay Ck. and one documented fish kill in an unnamed tributary to Hay Ck. The fish kill in Hay Ck. occurred on August 31, 1971, and was caused by an acid spill from a railroad car. The aquatic macroinvertebrate community was damaged but not completely destroyed, and approximately 10,000 fish were killed. Follow-up surveys by the United States Environmental Protection Agency (Griffith 1973) concluded that the aquatic macroinvertebrate community had almost completely recovered by October, 1972, but that the fish community was probably still depressed.

The fish kill in the unnamed tributary to Hay Ck. occurred on July 22, 1983, in the vicinity of Buck Hollow Road. This kill was caused by bridge repair operations which spilled a small amount of concrete into the stream. Approximately 4 trout, 100 minnows and 10 suckers were killed (Ziegenfus 1983).

The DER has conducted several surveys of Hay Ck. in response to pollution events which did not result in immediate fish kills. Frey (1974) sampled aquatic macroinvertebrate and fish populations in the Birdsboro area to determine the effects of an oil spill which took place on January 30, 1974. The oil spill occurred when a diesel fuel tank on a Reading Railroad locomotive ruptured during a train wreck. Survey data indicated that the spill caused no damage to aquatic life, probably because most of the fuel was trapped in a wetland before it reached Hay Ck.

Frey (1975) measured total dissolved solids concentrations in Hay Ck. and the tributary which carried the outflow from the Grace Mine tailings pond between May 15 and November 20, 1975. Total dissolved solids concentrations were 342 mg/l in Hay Ck. and ranged from 910 to 1,806 mg/l in the tributary. Frey (1978) again surveyed Hay Ck. and the tailings pond tributary in July 1978, to assess the biological impacts of the Grace Mine discharge. At the

time of this survey, the mine was no longer operational. Total dissolved solids and manganese concentrations were elevated in both Hay Ck. and the tributary, but no adverse biological impacts were detected.

Boyer (1988) conducted the most recent DER survey of Hay Ck. in December of 1987. The primary purpose of this investigation was to assess the impacts of logging operations in the Hay Ck. headwaters on the brown trout population in the stream. The logging was done to clear land for the development of New Morgan Borough. Boyer concluded that the wild brown trout population in Hay Ck. was being depressed by the effects of heavy sedimentation and stormwater runoff resulting from the extensive headwater clear cuts. The effects of the headwater clear cuts were exacerbated by poor logging practices and improper sedimentation and erosion controls. Additionally, the logging was presumed to have contributed to the September 8, 1987, Hay Ck. flood, which washed out four bridges, destroyed portions of SR 82, and partially inundated Birdsboro Borough.

The PFBC has conducted three general investigations of Hay Ck. The first was performed by Bielo and Sickles (1956) in August of 1956. Physical-chemical and biological characteristics were documented at five sampling stations. Water temperatures ranged from 19.4 to 21.7°C, pH values ranged from 7.0 to 7.2, and total hardness values ranged from 50 to 61 mg/l. Mayflies were the most abundant aquatic macroinvertebrate taxa, while stoneflies were rated "present." The aquatic macroinvertebrate community was considered somewhat limited by the abundance of sand in the substrate. Minnows, suckers and trout were observed at the various stations. Eroded soil was the most serious source of pollution.

Marshall et al. (1977) conducted the next PFBC survey of Hay Ck. as part of the statewide inventory of trout stocked streams in June of 1977. Physical-chemical and biological characteristics were documented at four sampling stations from River Mile 7.54 downstream to River Mile 0.88. Water temperatures ranged from 17.0 to 21.5°C, pH values ranged from 7.0 to 7.2, specific conductance values ranged from 80 to 700 umhos, total alkalinity values ranged from 18 to 21 mg/l, and total hardness values ranged from 34 to 290 mg/l. The high values for specific conductance and total hardness were the result of discharges from the Grace Mine. Aquatic macroinvertebrate diversity was generally good at all four sites as collections ranged between 18 and 26 taxa. Additionally, some pollution sensitive taxa were collected at each site.

Fish community diversity during the 1977 PFBC survey ranged from 9 to 17 species per site. Brown trout were captured at all four sites but were most abundant at the two upstream sites. The investigators did not note whether these fish were wild or stocked but, based on the length-frequency distribution, the majority of the fish at River Mile 7.54 were wild. Brown trout biomass at this site was estimated at 30.82 kg/ha. Population estimates were not

conducted at the other three sites. The PFBC discontinued trout stocking in Hay Ck. upstream from Geigertown following this survey due to posting problems and the significant wild brown trout population. Additionally, the investigators noted siltation problems in the downstream portions of the stream.

Emery and Neiswinter (1982) conducted the next PFBC survey of Hay Ck. in November of 1982. The two sampling sites in this survey were located upstream and downstream from a proposed quarry/landfill site. There was little difference in physical-chemical parameters and biological characteristics between the two sites. Water temperature was 9.0°C, pH was 7.2 and total hardness was 60 mg/l at both sampling sites. Specific conductance was 121 umhos at the upstream site and 125 umhos at the downstream site, while total alkalinity was 25 mg/l at the upstream site and 26 mg/l at the downstream site. Aquatic macroinvertebrate diversity was good, as 23 taxa were collected at the upstream site and 20 taxa were collected at the downstream site. Additionally, several pollution sensitive taxa were present at both sites. The fish community was composed of 13 species at the upstream site and 10 species at the downstream site. A few brown trout, some of which were probably wild fish, were captured at both sites.

The PFBC has historically managed Hay Ck. as a stocked trout fishery. The year trout were first stocked in Hay Ck. is unknown, but records date to at least 1956. Brown, brook and rainbow (*Oncorhynchus mykiss*) trout have all been stocked in past years. The current PFBC stocking program is conducted on two sections of stream. The upstream section, which is 100% privately owned, receives 350 brown trout, 145 rainbow trout and 5 trophy palomino trout during the preseason plant, and a total of 420 brown trout and 280 rainbow trout spread over two inseason plants. The downstream section, which is 100% publicly owned, receives 1,890 brown trout, 790 rainbow trout and 20 trophy palomino trout during the preseason plant, and a total of 2590 brown trout and 1110 rainbow trout spread over four inseason plants.

In addition to the PFBC stockings, the Birdsboro Sportsmen's Club and the South Birdsboro Archery, Rod and Gun Club both stock trout in Hay Ck. for annual children's fishing rodeos in the community park at the edge of town. Other local organizations involved with fisheries management issues on Hay Ck. have included the Berks Co. Chapter of Trout Unlimited and the Birdsboro Jaycees, both of which have conducted habitat improvement projects on the stream.

The objectives of the present PFBC investigation were to document the current status of fish populations in Hay Ck., and, particularly, to determine the density and distribution of the stream's wild trout population.

METHODS

The biological survey of Hay Ck. was conducted between July 23 and July 29, 1991. All procedures of the survey were carried out according to those outlined by Marcinko et al. (1986).

Hay Ck. was divided into three sections for fisheries management purposes. This sectioning strategy was based on the distribution of wild trout in the headwaters and the extent of public land near the mouth. Section 01 extended from the headwaters downstream to the SR 82 bridge near Geigertown and was 10.3 km long. Section 02 extended from the SR 82 bridge near Geigertown downstream to the Birdsboro property line, located 800 m downstream from the SR 2031 bridge, and was 3.8 km long. Section 03 extended from the Birdsboro property line downstream to the mouth and was 6.4 km long. Most section social data collected by Marshall et al. (1977) were still applicable. New and updated social characteristics recorded in the 1991 survey were parking counts and access in Section 01, the percentage of private land open to public fishing in Section 02, and human population densities for all three sections.

Three representative sampling stations were chosen in Section 01. Station 0101 (RM 10.72) was located 63 m downstream from the SR 10 bridge and was 90 m long. Station 0102 (RM 9.32) was located 8 m downstream from the SR 2015 bridge and was 304 m long. Station 0103 (RM 7.54) was located 450 m downstream from the SR 2035 bridge and was 360 m long. Station 0103 was a repeat of the station sampled by Marshall et al. (1977).

One representative sampling station was chosen in Section 02. Station 0201 (5.66) was located at a bridge on a private farm lane south of the junction of SR 82 and T-341 and was 330 m long. Station 0201 was a repeat of the station sampled by Marshall et al. (1977) except that the 1977 station was 485 m long.

Four representative sampling stations were chosen in Section 03. Station 0301 (RM 3.68) was located 50 m downstream from a private road bridge at White Bear and was 360 m long. Station 0301 was a repeat of the station sampled by Marshall et al. (1977). Station 0302 (RM 2.65) was located 205 m upstream from the SR 82 bridge and was 302 m long. Station 0302 was a repeat of the station sampled by Emery and Neiswenter (1982). Station 0303 (RM 1.74) was located 30 m upstream from the first SR 82 bridge upstream from Birdsboro and was 320 m long. Station 0303 was a repeat of the station sampled by Emery and Neiswenter (1982). Station 0304 (RM 0.37) was located 248 m downstream from the SR 724 bridge and was 240 m long.

At all of the above stations, physical-chemical parameters were field measured and fish communities were sampled by backpack electrofishing using from 100 to 200 volts of alternating current. A Chapman modified Petersen population estimate (Ricker 1975) was performed at Stations 0102, 0103 and 0301 to quantify the brown trout populations. Too few trout were captured at the other stations to calculate a population estimate.

Aquatic macroinvertebrates were collected by kick screens and hand picking rocks at Stations 0103, 0302 and 0303. Aquatic macroinvertebrates were generally identified to the familial level and were assigned pollution tolerance index values based on a combination of those developed by RMC Environmental Services Inc.

(1991), EA Mid-Atlantic Regional Operations Engineering, Science and Technology Inc. (1990), Klemm et al. (1990), Illinois EPA (1989), and PFBC field experience. Aquatic macroinvertebrate data collected by the DER (Boyer 1988) were described by family rather than by genus, as in the original report, to facilitate comparisons with PFBC aquatic macroinvertebrate data.

RESULTS

Section 01

Physical and social characteristics of Section 01 are described below and presented in Table 1. Section 01 was 10.3 km long, averaged 3.1 m in width, and had a gradient of 20.3 m/km. The section was 100% privately owned, with 80% of its length open to public fishing and 20% closed. Road access was good, as 54% of the section was within 100 m of a road, 94% of the section was within 300 m of a road and 100% of the section was within 500 m of a road. Parking, however, was poor, as there were only 3 parking spaces/km. The human population density for the townships surrounding Section 01 was 61 persons/km² (suburban) based on the 1990 census.

Station 0101 (RM 10.72)

Station 0101 was located in an unshaded pasture, but the stream channel at the upstream end of the station was heavily shaded by impenetrable brush. Bank erosion was moderate and the bottom substrate consisted of silt, sand and rubble. The station was primarily composed of short, shallow pools and short riffles. Overhanging grasses provided the only fish cover.

Physical-chemical parameters and their associated values measured at Station 0101 on July 24, 1991, were as follows: air temperature 26.0°C, water temperature 22.0°C, specific conductance 80 umhos, pH 7.0, total alkalinity 15 mg/l, and total hardness 29 mg/l (Table 2). Values of physical-chemical parameters at Station 0101 in 1991 were generally comparable to those measured at the station by Boyer (1988) when seasonally adjusted.

The aquatic macroinvertebrate community was not sampled at Station 0101 in 1991. Boyer (1988) documented 15 taxa at Station 0101, including three mayfly families, four stonefly families and two caddisfly families.

The fish community at Station 0101 consisted of 5 species (Table 4), and was dominated by fishes common in streams that are transitional between a coldwater and a warmwater environment. Blacknose dace (*Rhinichthys atratulus*) and creek chubs (*Semotilus atromaculatus*) were the only species rated abundant. Brown trout and bluegills (*Lepomis macrochirus*), both rated present, were the sportfish species captured.

In eight minutes of electrofishing at the 90 m long station, the sampling crew captured seven brown trout and three bluegills.

The brown trout ranged from 50 to 224 mm in total length (Fig. 2), and all were wild fish. Of the seven brown trout captured, one (14.3%) was ≥ 150 mm in total length. The bluegills ranged from 50 to 124 mm in total length, and had probably originated from one of the farm ponds in the drainage.

Station 0102 (RM 9.32)

Station 0102 was located in a partially shaded area of stream. Bank erosion was light and the bottom substrate consisted of silt, rubble and boulders. The station was primarily composed of long, shallow riffles. Fish cover was provided by overhanging brush, instream boulders, a few instream logs, and a few deeper pools.

Physical-chemical parameters and their associated values measured at Station 0102 on July 24, 1991, were as follows: air temperature 38.0°C, water temperature 22.5°C, specific conductance 99 umhos, pH 8.6, total alkalinity 25 mg/l, and total hardness 38 mg/l (Table 2). Values of physical-chemical parameters at Station 0102 in 1991 were generally comparable to those measured at the station by Boyer in 1987 when seasonally adjusted.

The aquatic macroinvertebrate community was not sampled at Station 0102 in 1991. Boyer (1988) documented 20 taxa at Station 0102, including four mayfly families, five stonefly families and five caddisfly families.

The fish community at Station 0102 consisted of 12 species (Table 4), and was dominated by coldwater fishes and species common in streams that are transitional between a coldwater and a warmwater environment. Brown trout, creek chubs, white suckers (*Catostomus commersoni*), and tessellated darters (*Etheostoma olmstedi*) were the species rated abundant. Brown trout, rated abundant, and bluegills, rated present, were the sportfish species captured. Brown trout biomass and brown trout number per hectare were 65.46 kg/ha (Class A) and 2,726 fish/ha, respectively (Table 5). The brown trout ranged from 50 to 424 mm in total length (Fig. 2), and all were wild fish. Of the 233 brown trout captured, 61 (26.2%) measured ≥ 150 mm in total length.

In 49 minutes of electrofishing during the marking run at the 304 m long station, the sampling crew also captured 11 bluegills. The bluegills ranged from 25 to 149 mm in total length and had probably originated from one of the farm ponds in the drainage.

Boyer (1988) electrofished a 200 m long stretch of stream located between Stations 0101 and 0102. Only two sublegal size wild brown trout were captured even though salmonid habitat was considered suitable.

Station 0103 (RM 7.54)

Station 0103 was located in a densely shaded area of stream. Bank erosion was light and the bottom substrate consisted of silt,

sand and gravel. The station was primarily composed of long pools and short riffles. Fish cover was provided by brush piles, instream logs, water depth in the pools, overhanging vegetation, and a few large boulders.

Physical-chemical parameters and their associated values measured at Station 0103 on July 25, 1991, were as follows: air temperature 24.0°C, water temperature 20.9°C, specific conductance 102 umhos, pH 7.2, total alkalinity 28 mg/l, and total hardness 42 mg/l (Table 2). Values of physical-chemical parameters at Station 0103 in 1991 were generally comparable to those measured at the station by Boyer (1988) and Marshall et al. (1977) when seasonally adjusted.

Aquatic macroinvertebrate diversity at Station 0103 was fair, as 15 taxa were collected (Table 3). The collection included two mayfly families, two stonefly families and three caddisfly families. One of the taxa collected, Capniidae (a stonefly family), had a pollution tolerance index value less than three. None of the taxa collected were rated abundant.

Aquatic macroinvertebrate diversity at Station 0103 has steadily declined since 1977. Marshall et al. (1977) documented 25 taxa, Boyer (1988) documented 20 taxa and the present survey documented 15 taxa. The number of mayfly families present declined from five in 1977 to two in both 1987 and 1991. The number of stonefly families present increased from four in 1977 to five in 1987, but declined to two in 1991. The number of caddisfly families present declined from seven in 1977 to five in 1987 and three in 1991.

The fish community at Station 0103 consisted of 16 species (Table 4), and was dominated by coldwater fishes and species common in streams that are transitional between a coldwater and a warmwater environment. Brown trout, cutlips minnows (*Exoglossum maxillingua*), common shiners (*Luxilus cornutus*), blacknose dace, creek chubs, and tessellated darters were the species rated abundant, while migratory American eels (*Anguilla rostrata*) were rated rare. Brown trout, rated abundant, bluegills, rated rare, and largemouth bass (*Micropterus salmoides*), rated present, were the sportfish species captured. Brown trout biomass and brown trout number per hectare were 63.60 kg/ha (Class A) and 1,018 fish/ha, respectively (Table 5). The brown trout ranged from 50 to 374 mm in total length (Fig. 2), and all were wild fish. Of the 123 brown trout captured, 46 (37.4%) measured ≥ 150 mm in total length.

In 57 minutes of electrofishing during the marking run at the 360 m long station, the sampling crew also captured two bluegills and five largemouth bass. Both the bluegills and the largemouth bass ranged from 25 to 74 mm in total length, and both had probably originated from farm ponds in the drainage.

The fish community documented at Station 0103 in 1991 was similar to that documented by Marshall et al. (1977), except that wild brown trout biomass had more than doubled between 1977 and 1991. Boyer (1988) electrofished two 200 m long stretches of stream

in the vicinity of Station 0103. Eight brown trout were captured in each stretch, most of which were judged to be wild fish.

Section 02

Physical and social characteristics of Section 02 are described below and presented in Table 1. Section 02 was 3.8 km long, averaged 5.4 m in width, and had a gradient of 4.0 m/km. The section was 100% privately owned, with 92% of its length open to public fishing and 8% closed. Road access was excellent, as 60% of the section was within 100 m of a road and 100% of the section was within 300 m of a road. Parking was adequate, as there were 24 parking spaces/km. The human population density for the townships surrounding Section 01 was 61 persons/km² (suburban) based on the 1990 census.

Station 0201 (RM 5.66)

Station 0201 was located in a partially shaded area of stream. Bank erosion was moderate and the bottom substrate consisted of silt and sand with a few rocky and gravelly areas. The station was primarily composed of a single long, slow moving pool that was impounded by a small rock dam at the downstream end as well as numerous other instream obstructions. A very thick overgrowth of shrubs was present throughout most of the station. Fish cover was provided by the overhanging brush, log jams and other instream debris.

Physical-chemical parameters and their associated values measured at Station 0201 on July 25, 1991, were as follows: air temperature 26.0°C, water temperature 22.0°C, specific conductance 192 umhos, pH 7.4, total alkalinity 32 mg/l, and total hardness 74 mg/l (Table 2). Values of physical-chemical parameters at Station 0201 in 1991 were generally comparable to those measured at the station by Boyer (1988) when seasonally adjusted. Data from Marshall et al. (1977), however, were not comparable to the 1987 and 1991 data. Specific conductance and total hardness measured 700 umhos and 290 mg/l, respectively, in 1977. The reason for the decreases in specific conductance and total hardness measurements from the 1977 survey to the 1987 and 1991 surveys was the cessation of operations at the Grace Mine.

The aquatic macroinvertebrate community was not sampled at Station 0201 in 1991. Marshall et al. (1977) documented 18 taxa at Station 0201, while Boyer (1988) documented 20 taxa. The number of mayfly families present declined from four in 1977 to three in 1987, but the number of stonefly families present increased from two in 1977 to three in 1987 and the number of caddisfly families present increased from four in 1977 to five in 1987.

The fish community at Station 0201 consisted of 11 species (Table 4), and was dominated by fishes common in streams that are transitional between a coldwater and a warmwater environment. Blacknose dace and white suckers were the only species rated

abundant, while migratory American eels were rated present. Brown trout, rated present, and bluegills, rated rare, were the sportfish species captured.

In 35 minutes of electrofishing at the 330 m long station, the sampling crew captured nine brown trout and two bluegills. Of the nine brown trout captured, seven (77.8%) were judged to be of wild origin and two (22.2%) were judged to be stocked fish. The wild trout ranged from 175 to 399 mm in total length, while the stocked trout ranged from 250 to 349 mm in total length (Fig. 3). The two bluegills measured between 50 and 74 mm in total length. The bluegills had probably originated from farm ponds in the drainage, but may also have been spawned in the pool created by the small rock dam at Station 0201.

The fish community documented at Station 0201 in 1991 was similar to that documented by Marshall et al. (1977), except that 66 brown trout were captured in two electrofishing runs of 485 m each in 1977. Boyer (1988) did not electrofish at Station 0201 due to the station's poor salmonid habitat.

Section 03

Physical and social characteristics of Section 03 are described below and presented in Table 1. Section 03 was 6.4 km long, averaged 7.2 m in width, and had a gradient of 8.2 m/km. The section was 100% publicly owned and open to public fishing. Road access was excellent, as 85% of the section was within 100 m of a road, 96% of the section was within 300 m of a road, and 100% of the section was within 500 m of a road. Parking was also excellent, as there were 74 parking spaces/km. The human population density for the townships surrounding Section 01 was 104 persons/km² (suburban) based on the 1990 census.

Station 0301 (RM 3.68)

Station 0301 was located in a partially shaded area of stream. Bank erosion was moderate and the bottom substrate consisted of sand, gravel and rubble in combination with a few beds of *Elodea* spp. The station was primarily composed of long pools, long runs and short riffles. Fish cover was provided by undercut banks, instream boulders, overhanging shrubs, and water depth in the deeper pools.

Physical-chemical parameters and their associated values measured at Station 0301 on July 29, 1991, were as follows: air temperature 21.0°C, water temperature 21.0°C, specific conductance 130 umhos, pH 7.1, total alkalinity 26 mg/l, and total hardness 57 mg/l (Table 2). Values of physical-chemical parameters at Station 0301 in 1991 were generally comparable to those measured at the station by Boyer in 1987 when seasonally adjusted. Data from Marshall et al. (1977), however, were not comparable to the 1987 and 1991 data. Specific conductance and total hardness measured 410 umhos and 188 mg/l, respectively, in 1977. The reason for the

decreases in specific conductance and total hardness measurements from the 1977 survey to the 1987 and 1991 surveys was the cessation of operations at the Grace Mine.

The aquatic macroinvertebrate community was not sampled at Station 0301 in 1991. Marshall et al. (1977) documented 26 taxa at Station 0301, while Boyer (1988) documented only 17 taxa. The number of mayfly families present declined from four in 1977 to two in 1987, but the number of stonefly and caddisfly families present remained constant at two and five, respectively.

The fish community at Station 0301 consisted of 15 species (Table 3), and was dominated by fishes common in streams that are transitional between a coldwater and a warmwater environment. Blacknose dace and white suckers were the only species rated abundant, while migratory American eels were rated present. Brown trout, rated common, brook trout, rated rare, and brown bullheads (*Ameiurus nebulosus*), rated rare, were the sportfish species captured. Total brown trout biomass and total number of brown trout per hectare were 43.81 and 434 fish/ha, respectively (Table 5). Of the 85 brown trout captured, 76 (89.4%) were judged to be of wild origin and 9 (10.6%) were judged to be stocked fish. Wild brown trout biomass and number of wild brown trout per hectare were 27.36 kg/ha (Class B) and 387 fish/ha, respectively (Table 5). The wild brown trout ranged from 50 to 449 mm in total length (Fig. 4), with 37 (48.7%) of the fish measuring ≥ 150 mm. The stocked brown trout ranged from 250 to 424 mm in total length (Fig. 4).

In 48 minutes of electrofishing during the marking run at the 360 m long station, the sampling crew also captured one brook trout and one brown bullhead. The brook trout measured between 200 and 224 mm in total length, and was judged to be of wild origin. The brown bullhead measured between 175 and 199 mm in total length, and had probably originated from one of the farm ponds in the drainage.

The fish community documented at Station 0301 in 1991 was similar to that documented by Marshall et al. (1977), although the 1977 survey documented only nine fish species. Additionally, the 1977 survey captured only 14 brown trout. Boyer (1988) captured only one brown trout while electrofishing in a 200 m stretch of stream at Station 0301, even though salmonid habitat was judged to be good to excellent.

Station 0302 (RM 2.65)

Station 0302 was located in an open area of stream. Bank erosion was light and the bottom substrate consisted of silt, rubble and boulders. Siltation was heavy in the pools and slower moving riffles, and a light coating of algae covered the rubble and boulders. The station was primarily composed of long, open pools with little fish cover except for the scattered instream boulders.

Physical-chemical parameters and their associated values measured at Station 0302 on July 23, 1991, were as follows: air temperature 37.0°C, water temperature 25.0°C, specific conductance 150 umhos, pH 8.4, total alkalinity 26 mg/l, and total hardness 55

mg/l (Table 2). Values of physical-chemical parameters at Station 0302 in 1991 were generally comparable to those measured at the station by Boyer (1988) and Emery and Neiswinter (1982) when seasonally adjusted.

Aquatic macroinvertebrate diversity at Station 0302 was fair, as 11 taxa were collected (Table 3). The collection included two mayfly families, three stonefly families and one caddisfly family. Two of the taxa collected, Capniidae and Perlodidae (both stonefly families), had pollution tolerance index values less than three. Two of the taxa collected, Perlidae (a stonefly family) and Hydropsychidae (a caddisfly family), were rated abundant.

Aquatic macroinvertebrate diversity at Station 0302 has steadily declined. Emery and Neiswinter (1982) documented 23 taxa, Boyer (1988) documented 14 taxa and the present survey documented only 11 taxa. The number of mayfly families present declined from four in 1982 to three in 1987 and two in 1991. The number of stonefly families present increased from two in 1982 to three in both 1987 and 1991. The number of caddisfly families present declined from seven in 1982 to three in 1987 and one in 1991.

The fish community at Station 0302 consisted of 14 species (Table 4), and was dominated by fishes common in streams that are transitional between a coldwater and a warmwater environment. Common shiners, blacknose dace, longnose dace (*Rhinichthys cataractae*), and white suckers were the species rated abundant, while migratory American eels were rated present. Brown trout, rated present, brown bullheads, rated present, redbreast sunfish (*Lepomis auritus*), rated rare, bluegills, rated present, and largemouth bass, rated rare, were the sportfish species captured.

In 33 minutes of electrofishing at the 302 m long station, the sampling crew captured 24 brown trout, four brown bullheads, one redbreast sunfish, five bluegills, and one largemouth bass. Of the 24 brown trout captured, 17 (70.8%) were judged to be of wild origin and 7 (29.2%) were judged to be stocked fish. The wild brown trout ranged from 75 to 349 mm in total length (Fig. 5), with 9 (52.9%) of the fish measuring ≥ 150 mm. The stocked brown trout ranged from 200 to 324 mm in total length (Fig. 5). The redbreast sunfish and largemouth bass measured between 175 and 199 mm in total length, the bluegills ranged from 50 to 174 mm in total length, and the brown bullheads ranged from 175 to 224 mm in total length. The largemouth bass, bluegills and brown bullheads had probably originated from the farm ponds in the drainage. The redbreast sunfish had probably migrated into Hay Ck. from the Schuylkill River.

The fish community documented at Station 0302 in 1991 was similar to that documented by Emery and Neiswinter (1982), although only four brown trout were captured in 1982. Boyer (1988) did not capture any brown trout while electrofishing a 250 m long stretch of stream in the vicinity of Station 0302.

Station 0303 (RM 1.74)

Station 0303 was located in a partially shaded area of stream. Bank erosion was light and the bottom substrate consisted of silt, rubble and boulders. The station was primarily composed of long riffles and a few deep pools. Fish cover was provided by the deeper pools and some undercut banks.

Physical-chemical parameters and their associated values measured at Station 0303 on July 23, 1991, were as follows: air temperature 31.0°C, water temperature 24.0°C, specific conductance 152 umhos, pH 7.3, total alkalinity 31 mg/l, and total hardness 63 mg/l (Table 2). Values of physical-chemical parameters at Station 0303 in 1991 were generally comparable to those measured at the station by Emery and Neiswinter (1982).

Aquatic macroinvertebrate diversity at Station 0303 was poor to fair, as 10 taxa were collected (Table 3). The collection included two mayfly families, one stonefly family and two caddisfly families. None of the taxa collected had a pollution tolerance index value less than three. Two of the taxa collected, Perlidae (a stonefly family) and Hydropsychidae (a caddisfly family), were rated abundant. Except for Perlidae and Hydropsychidae, aquatic macroinvertebrates were sparse at Station 0303.

Aquatic macroinvertebrate diversity at Station 0303 declined between 1982 and 1991. Emery and Neiswinter (1982) documented 20 taxa, while the present survey documented only 10 taxa. The number of mayfly families present declined from three in 1982 to two in 1991, the number of stonefly families present remained constant at one, and the number of caddisfly families present declined from seven in 1982 to two in 1991.

The fish community at Station 0303 consisted of 10 species (Table 4), and was dominated by fishes common in streams that are transitional between a coldwater and a warmwater environment. Cutlips minnows, common shiners, blacknose dace, and white suckers were the species rated abundant, while migratory American eels were rated rare. Brown trout, rated present, and rainbow trout, rated rare, were the sportfish species captured.

In 40 minutes of electrofishing at the 320 m long station, the sampling crew captured 24 brown trout and one rainbow trout. Of the 24 brown trout captured, 18 (75.0%) were judged to be of wild origin and six (25.0%) were judged to be stocked fish. The wild brown trout ranged from 75 to 299 mm in total length (Fig. 6), with seven (38.9%) of the fish measuring ≥ 150 mm. The stocked brown trout ranged from 225 to 374 mm in total length (Fig. 6), while the rainbow trout measured between 250 and 274 mm in total length. The rainbow was judged to be a stocked fish.

The fish community documented at Station 0303 in 1991 was similar to that documented by Emery and Neiswinter (1982), although the 1982 survey captured only seven brown trout and no rainbow trout.

Station 0304 (RM 0.37)

Station 0304 was located in a partially shaded area of stream. Bank erosion was light and the bottom substrate consisted of silt, sand and rubble. Sedimentation was heavy in the pools and slower moving runs, and there was a coating of algae on top of the rubble. The station was primarily composed of long pools, short riffles and a few runs. Little fish cover was present except for water depth in the pools and a single undercut tree.

Physical-chemical parameters and their associated values measured at Station 0304 on July 24, 1991, were as follows: air temperature 31.0°C, water temperature 23.0°C, specific conductance 155 umhos, pH 7.8, total alkalinity 38 mg/l, and total hardness 64 mg/l (Table 2).

The aquatic macroinvertebrate community was not sampled at Station 0304 in 1991. Boyer (1988) documented 14 taxa in the vicinity of Station 0304, including two mayfly families, three stonefly families and three caddisfly families.

The fish community at Station 0304 consisted of 19 species (Table 4), and was dominated by fishes common in streams that are transitional between a coldwater and a warmwater environment. Common shiners, blacknose dace, longnose dace, fallfish (*Semotilus corporalis*), and white suckers were the species rated abundant, while migratory American eels were rated rare. Brown trout, yellow bullheads (*Ameiurus natalis*), rock bass (*Ambloplites rupestris*), bluegills, and smallmouth bass (*Micropterus dolomieu*), all of which were rated present, and redbreast sunfish, rated rare, were the sportfish species captured.

In 24 minutes of electrofishing at the 240 m long station, the sampling crew captured two brown trout, two yellow bullheads, six rock bass, three bluegills, five smallmouth bass, and one redbreast sunfish. The brown trout ranged from 175 to 349 mm in total length, and both were wild fish. The yellow bullheads measured between 200 and 224 mm in total length, the rock bass ranged from 75 to 224 mm in total length, the bluegills ranged from 50 to 99 mm in total length, the smallmouth bass ranged from 125 to 374 mm in total length, and the redbreast sunfish measured between 150 and 174 mm in total length. The warmwater sportfish species captured at Station 0303 may have been native to Hay Ck. or could have migrated into the stream from the Schuylkill River or from the farm ponds in the drainage.

DISCUSSION

Section 01 of Hay Ck. supported a Class A (≥ 40 kg/ha) wild brown trout population with an acceptable number of legal size and larger fish present, including fish as large as 400 to 424 mm in total length (Fig. 2). Wild brown trout populations in Section 01 were probably limited by moderate sedimentation of the spawning gravels and somewhat restricted physical habitat for larger fish. Sedimentation problems in the section were the result of past logging and residential development activities in the headwaters in

combination with a limited amount of agriculture. Because of the abundance of legal size trout and because of the presumably low angling pressure due to restricted access (significant posting and little parking), there is no need for special angling regulations to manage the wild trout fishery in Section 01.

Section 01 of Hay Ck. exhibited higher wild brown trout densities during the present survey than those documented by any previous survey. Wild brown trout biomass at Station 0103 increased from 30.82 kg/ha in 1977 (Marshall et al. 1977) to 63.60 kg/ha in 1991 (Table 5). This biomass increase was probably attributable in part to the cessation of adult trout stocking and the resulting decrease in angling mortality in this portion of the section since 1977.

In his 1987 survey, Boyer (1988) documented the lowest wild brown trout densities found during any previous survey of Hay Ck. Boyer concluded that the wild trout populations of Hay Ck. in 1987 were depressed due to reproductive failure caused by excessive stormwater runoff and sedimentation of the stream bed. These conditions were the result of the 1987 flood, which was exacerbated by headwater logging activities. Boyer (1988) further stated that the substrate in Hay Ck. would become stabilized, allowing the brown trout population to recover, if proper erosion, sedimentation and stormwater runoff controls were implemented in the basin.

Compared to Section 01, Section 02 of Hay Ck. supported very few wild brown trout. This was due to increased water temperatures and increased sedimentation in Section 02. Water temperatures and sedimentation increased because Section 02 was less shaded and had a lower gradient than Section 01. Additionally, a portion of Section 02 was impounded. Past logging and residential development activities in the headwaters, in combination with agricultural activities both within and upstream from the section, were the sources of sedimentation problems in Section 02.

The decrease in the number of trout captured at Station 0201 from 1977, when 66 brown trout were captured, to 1991, when 9 brown trout were captured, may have been related to present stocking practices. In 1977, it was not noted whether the trout captured were wild or stocked fish; nevertheless, because no trout ≤ 174 mm were present in the sample, it can be assumed that the majority were holdover stocked fish. Station 0201 was posted against trespass in 1991. If the bridge at the downstream end of the station was not posted in 1977, it may have served as a stocking point, thus contributing to the high number of holdover trout found in 1977.

Although Section 02 is poorly suited for wild trout, it still provides a valuable stocked trout fishery. Section 02 is currently stocked at a rate of 300 trout/acre/year in the optimum yield category. This is based on the section's private ownership, Class D (<10 kg/ha) wild trout biomass, good recreational use potential, suburban (40 to 125 persons/km²) human population

density, and Class 3 (4 to <10 m) width. These characteristics continued to apply to Section 02 during the present survey, although a greater percentage of land was posted against trespass in 1991 than in 1977. The increase in posting, however, was not great enough to affect current stocking rates.

Section 03 of Hay Ck. supported a better wild trout population than Section 02. This was due to lower water temperatures and decreased sedimentation in Section 03. Lower water temperatures probably resulted from increased shading and the addition of small springs which enter the section from the surrounding hillsides. Decreased sedimentation probably resulted from decreased agriculture, a lack of impounded areas and increased gradient. Gradient in Section 03 was slightly more than double that of Section 02.

Although sedimentation in Section 03 was less than in Section 02, sedimentation, in combination with poor physical habitat and moderately low gradient, was still great enough to limit wild trout populations in Section 03. Sedimentation problems in Section 03 resulted from logging, residential development and agricultural practices in upstream areas. Poor physical habitat in Section 03 resulted primarily from the 1987 flood, which caused substrate scouring and partial relocation of the stream channel. As a consequence, much of the stream channel in Section 03 became a series of long, wide, shallow riffles interspersed with a few deep pools (Boyer 1988).

Other factors which may have limited wild brown trout abundance to a lesser degree in Section 03 were angling pressure resulting from the stocked trout fishery and seasonally stressful water temperatures. During most years, however, summer water temperatures in Section 03 are probably suitable for trout survival. Some wild trout were captured at all four stations in the section despite the extreme weather conditions that prevailed in 1991.

Wild brown trout biomass at Station 0301 in 1991 was estimated at 27.36 kg/ha (Table 5), a dramatic increase from the wild trout densities documented at this station by Marshall et al. (1977) and Boyer (1988). No reason for this dramatic increase was readily apparent during the 1991 survey, but it may have been related to this site's generally good habitat and a decrease in angling pressure due to the closure of SR 82 and some other nearby access roads following the 1987 flood. Substantial upstream or downstream expansion of this isolated wild trout population would be limited by poor physical habitat.

Section 03 currently provides a high quality stocked trout fishery. The section is stocked at a rate of 475 trout/acre/year in the high yield category. This is based on the section's public ownership, Class D (<10 kg/ha) wild trout biomass, high recreational use potential and Class 3 (4 to <10 m) width. Some of these characteristics no longer applied to Section 03 during the 1991 survey, although the section was still 100% publicly owned and maintained a suburban human population density and a Class 3 width.

Wild brown trout population estimates were not conducted at three of the four stations in Section 03 because too few wild trout were captured. A minimum estimate, however, was calculated for these stations based on the total number of wild trout caught. These calculations resulted in estimates of 7.5, 7.0 and 2.0 kg/ha of wild trout biomass for Stations 0302, 0303 and 0304, respectively. Including the wild brown trout biomass estimate of 27.36 kg/ha at Station 0301, the average wild trout biomass for Section 03 was 10.96 kg/ha (biomass Class C). This increase in wild trout biomass from Class D to Class C, however, was not great enough to affect current stocking rates.

As with the wild brown trout biomass classification, some of the characteristics which determine the recreational use potential of Section 03 changed in 1991, but the degree of these changes was not great enough to affect current stocking rates. These characteristics, specifically road access and the number of parking spaces, were not quantified during the 1991 survey but had undoubtedly changed from the 1977 data presented in this report because of the closure of SR 82. SR 82 formerly provided the only vehicular access to most of Section 03. This road has been gated since 1987 but stocking trucks are still able to get through, creating a popular walk-in fishery in a scenic setting. Section 03 is still considered to have high recreational use potential even though vehicular access has been greatly diminished because the section remains in public ownership and because the closure of SR 82 enhanced the scenic qualities of the fishery. The Pennsylvania Department of Transportation plans to reopen the Birdsboro portion of SR 82 by the year 2000 but the rebuilt portion of the roadway will be situated east of its present location and out of the Hay Ck. floodplain.

Section 03 of Hay Ck., because of its poor spawning habitat but generally cool summer water temperatures, presents the opportunity for delayed harvest management. Delayed harvest management, however, is not desirable at the present time for several reasons. Hay Ck. is one of the only stocked trout waters in close proximity to Birdsboro, and the current fishery provides vehicle accessible and walk-in trout angling throughout the summer months without utilizing delayed harvest restrictions. Additionally, there are four delayed harvest projects, specifically those on Tulpehocken, Pickering, French, and West Valley Creeks, within a 25 mi. radius of Hay Ck.

Physical-chemical parameters measured throughout the length of Hay Ck. by Boyer (1988) and during the present survey indicated excellent water quality. Water quality parameters varied little from historical data except for decreases in specific conductance and total hardness at some stations. These decreases were directly attributable to the cessation of operations at the Grace Mine.

Aquatic macroinvertebrate community composition reflected the excellent water quality of the Hay Ck. basin, as some pollution intolerant taxa were collected at all of the stations sampled. Aquatic macroinvertebrate community diversity, however, exhibited

a steady decline from historical levels at Stations 0103, 0302 and 0303. At these stations, much of the decline in community diversity was the result of a decline in the number of caddisfly families present. The number of caddisfly families present at Station 0103 declined from seven in 1977 to five in 1988 and three in 1991. Similarly, the number of caddisfly families present at Station 0302 declined from seven in 1982 to three in 1987 and one in 1991, and the number of caddisfly families present at Station 0303 declined from seven in 1982 to two in 1991.

Boyer (1988) detected a subtle change in aquatic macroinvertebrate community composition in Hay Ck. from the headwaters downstream. Few stationary residents, such as case building caddisflies and those free moving forms associated with a coarse substrate, were found in areas where water attained a high velocity during storm events. Boyer attributed this to a combination of bottom scouring and the proliferation of unstable substrates in high velocity areas. The continuing decline in caddisfly family diversity from historical levels through 1991 may also have been attributable to bottom scouring and unstable substrates.

Aquatic macroinvertebrate communities were not sampled at Stations 0201 and 0301 in 1991, but were sampled by Marshall et al. (1977) and Boyer (1988). These stations did not exhibit the decline in familial diversity, particularly caddisfly diversity, that was exhibited by the stations discussed above. Caddisfly family diversity increased at Station 0201 and remained constant at Station 0301 from 1977 to 1987. Stations 0201 and 0301 were located within and downstream from lower gradient reaches than the other three stations, and thus were probably less affected by the 1987 flood and subsequent high water events.

The current DER Chapter 93 use designation of CWF is inadequate to protect the fisheries and aquatic life documented in Hay Ck. by the present survey. Section 01 should be redesignated from CWF to High-Quality Coldwater Fishery (HQ-CWF) due to the presence of a Class A wild brown trout population. Beaver Run, a tributary to Section 02 of Hay Ck., should also be redesignated from CWF to HQ-CWF because this stream supports a Class A wild trout population. Sections 02 and 03 of Hay Ck. should remain CWF due to the presence of wild trout within these sections. Additionally, the DER should adopt the further designation of migratory fishes (MF) for the entire Hay Ck. basin because of the presence of American eels.

MANAGEMENT RECOMMENDATIONS

1. The Pennsylvania Department of Environmental Resources should upgrade the Chapter 93 water quality classification of Section 01 of Hay Ck. from Coldwater Fishery to High-Quality Coldwater fishery due to the excellent (Class A) wild brown trout population that this section supports. Beaver Run, a tributary to Hay Ck., should also be upgraded to High-Quality Coldwater Fishery for the same reason.
2. The Pennsylvania Department of Environmental Resources should affix the additional designation of migratory fishes to the Hay Ck. basin due to the presence of American eels.
3. The Pennsylvania Fish and Boat Commission should continue to manage the wild brown trout population in Section 01 of Hay Ck. under conventional, statewide angling regulations.
4. The Pennsylvania Fish and Boat Commission should continue to manage Sections 02 and 03 of Hay Ck. for stocked trout under the current stocking rates and statewide angling regulations.
5. The Pennsylvania Fish and Boat Commission should add a special stocking instruction to Hay Ck. which prohibits the substitution of brook trout due to the presence of wild brook trout populations in tributaries to Section 03.
6. Habitat improvement devices should be constructed in Section 03 of Hay Ck. if mitigation for environmental damage is required by the construction and realignment of SR 82.
7. Stormwater retention basins should be required of all future developments in the Hay Ck. basin to prevent exacerbation of future flooding.

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Table 1. Physical and social characteristics of Hay Ck. (603C), Berks Co.

Characteristic	Section		
	01	02	03
PHYSICAL			
USGS Quadrangle(s)	Q38 & Q39	Q39	P39 & Q39
Length (km)	10.3	3.8	6.4
Mean width (m)	3.1	5.4	7.2
Area (ha)	3.2	2.0	4.6
Gradient(m/km)	20.3	4.0	8.2
SOCIAL			
Ownership:			
% Public	0	0	100
% Private (open)	80	92	0
% Private (closed)	20	8	0
Road access:			
% Within 100 m	54	60	85
% Within 300 m	94	100	96
% Within 500 m	100	100	100
Parking spaces/km	3	24	74
1990 Human population Density (#/km ²)	61	61	104

Q38 = Morgantown USGS 7.5 minute quadrangle.

Q39 = Elverson USGS 7.5 minute quadrangle.

P39 = Birdsboro USGS 7.5 minute quadrangle.

Table 2. Physical-chemical characteristics of Hay Ck. (603C), Berks Co., measured in July of 1991.

Parameter	Station									
	0101	0102	0103	0201	0301	0302	0303	0304		
Date	7/24	7/24	7/25	7/25	7/29	7/23	7/23	7/24		
Air temperature (°C)	26.0	38.0	24.0	26.0	21.0	37.0	31.0	31.0		
Water temperature (°C)	22.0	22.5	20.9	22.0	21.0	25.0	24.0	23.0		
Specific conductance (umhos)	80	99	102	192	130	150	152	155		
pH (standard units)	7.0	8.6	7.2	7.4	7.1	8.4	7.3	7.8		
Total alkalinity (mg/l)	15	25	28	32	26	26	31	38		
Total hardness (mg/l)	29	38	42	74	57	55	63	64		

Table 3. Aquatic macroinvertebrate taxa collected at Stations 0103, 0302, and 0303 of Hay Ck. (603C), Berks Co., in July of 1991.

Taxon	Station			PTI
	0103	0302	0303	
Ephemeroptera				
Heptageniidae -----	X	X	X	4
Siphonuridae -----	X	X	X	7
Plecoptera				
Capniidae -----	X	X		1
Perlidae -----	X	*	*	3
Perlodidae -----		X		2
Coleoptera				
Dryopidae -----	X			5
Trichoptera				
Hydropsychidae -----	X	*	*	4 to 8
Philopotamidae -----	X		X	6
Polycentropodidae ---	X			6
Odonata				
Aeshnidae -----	X	X		8
Diptera				
Chironomidae -----	X	X	X	0 to 10
Tipulidae -----	X			4
Megaloptera				
Corydalidae -----		X	X	6
Sialidae -----			X	8
Hemiptera				
Gerridae -----	X			NA
Decapoda				
Cambaridae -----	X	X		6
Amphipoda				
Gammaridae -----	X			2 to 8
Plesiopora -----	X			10
Opisthopora -----		X	X	10
Class Gastropoda -----			X	1 to 9
Total Taxa	15	11	10	

PTI = Pollution Tolerance Index. PTI ranges from 0 (very intolerant of pollution) to 10 (very tolerant of pollution).
 X = Present at Station; * = Abundant at Station.

Table 4. Fish species captured by backpack electrofishing in Hay Ck. (603C), Berks Co., in July of 1991.

Scientific name	Station									
	0101	0102	0103	0201	0301	0302	0303	0304		
<i>Salvelinus fontinalis</i>										R
<i>Oncorhynchus mykiss</i>										
<i>Salmo trutta</i>										
<i>Clinostomus funduloides</i>										
<i>Exoglossum maxilllingua</i>										
<i>Luxilus cornutus</i>										
<i>Notropis procerne</i>										
<i>Cyprinella splioptera</i>										
<i>Rhinichthys atratulus</i>										
<i>Rhinichthys cataractae</i>										
<i>Semotilus atromaculatus</i>										
<i>Semotilus corporalis</i>										
<i>Catostomus commersoni</i>										
<i>Hypentelium nigricans</i>										
<i>Amelurus natalis</i>										
<i>Amelurus nebulosus</i>										
<i>Anguilla rostrata</i>										
<i>Ambloplites rupestris</i>										
<i>Lepomis auritus</i>										
<i>Lepomis cyanellus</i>										
<i>Lepomis gibbosus</i>										
<i>Lepomis macrochirus</i>										
<i>Micropterus salmoides</i>										
<i>Micropterus dolomieu</i>										
<i>Etheostoma olmstedii</i>										
Brook trout										R
Rainbow trout										
Brown trout	P	A	A	A	P	C	C	P	P	P
Rosyside dace										
Cutlips minnow										
Common shiner										
Swallowtail shiner										
Spotfin shiner										
Blacknose dace	A	R	A	A	A	A	A	A	A	A
Longnose dace	P	R	R	R		C	A			A
Creek chub	A	A	A							
Fallfish										
White sucker		A	P	A	A	A	A	A	A	A
Northern hog sucker		R	P							
Yellow bullhead										
Brown bullhead										
American eel										
Rock bass										
Redbreast sunfish										
Green sunfish		R	R							
Pumpkinseed		R	R	R	R	R	R	P	P	P
Bluegill	P	P	R	R	R					
Largemouth bass										
Smallmouth bass										
Tessellated darter	A	A	A	P	C	C	R	P	P	C

A = Abundant (>100); C = Common (26 - 100); P = Present (3 - 25); R = Rare (1 - 2).

Total species 5 12 16 11 15 14 10 19

Table 5. Brown trout biomass estimates for Hay Ck. (603C), Berks Co., determined in July of 1991.

Length group (mm)	Station							
	0102		0103		0301 (TOTAL)		0301 (WILD)	
	kg/ha	#/ha	kg/ha	#/ha	kg/ha	#/ha	kg/ha	#/ha
50-74	3.75	1,250	0.63	157	0.01	4	0.01	4
75-99	4.75	950	2.89	413	1.10	184	1.10	183
100-124	0.09	7	0.68	57	0.74	26	0.74	25
125-149	0.50	15	0.00	0	0.00	0	0.00	0
150-174	4.47	88	0.71	14	2.63	47	2.63	47
175-199	12.98	183	5.64	86	5.45	64	5.45	64
200-224	9.98	95	10.83	114	1.28	13	1.28	12
225-249	8.29	51	11.44	78	0.60	4	0.60	4
250-274	10.41	58	7.26	36	3.91	21	1.56	8
275-299	3.60	15	5.51	21	8.44	34	4.22	17
300-324	1.17	7	4.83	14	4.42	13	2.95	8
325-349	0.00	0	9.62	21	3.08	8	3.08	8
350-374	0.00	0	3.56	7	2.00	4	0.00	0
375-399	0.00	0	0.00	0	3.21	4	0.00	0
400-424	5.47	7	0.00	0	3.20	4	0.00	0
425-449	0.00	0	0.00	0	3.74	4	3.74	4
Totals	65.46	2,726	63.60	1,018	43.81	434	27.36	387

kg/ha = Kilograms of trout per hectare.
 #/ha = Number of trout per hectare.
 0301 (TOTAL) = Estimates based on all trout captured at Station 0301.
 0301 (WILD) = Estimates based solely on wild trout captured at Station 0301.

Handwritten notes:
 9.09
 14.66
 17.98
 19.53

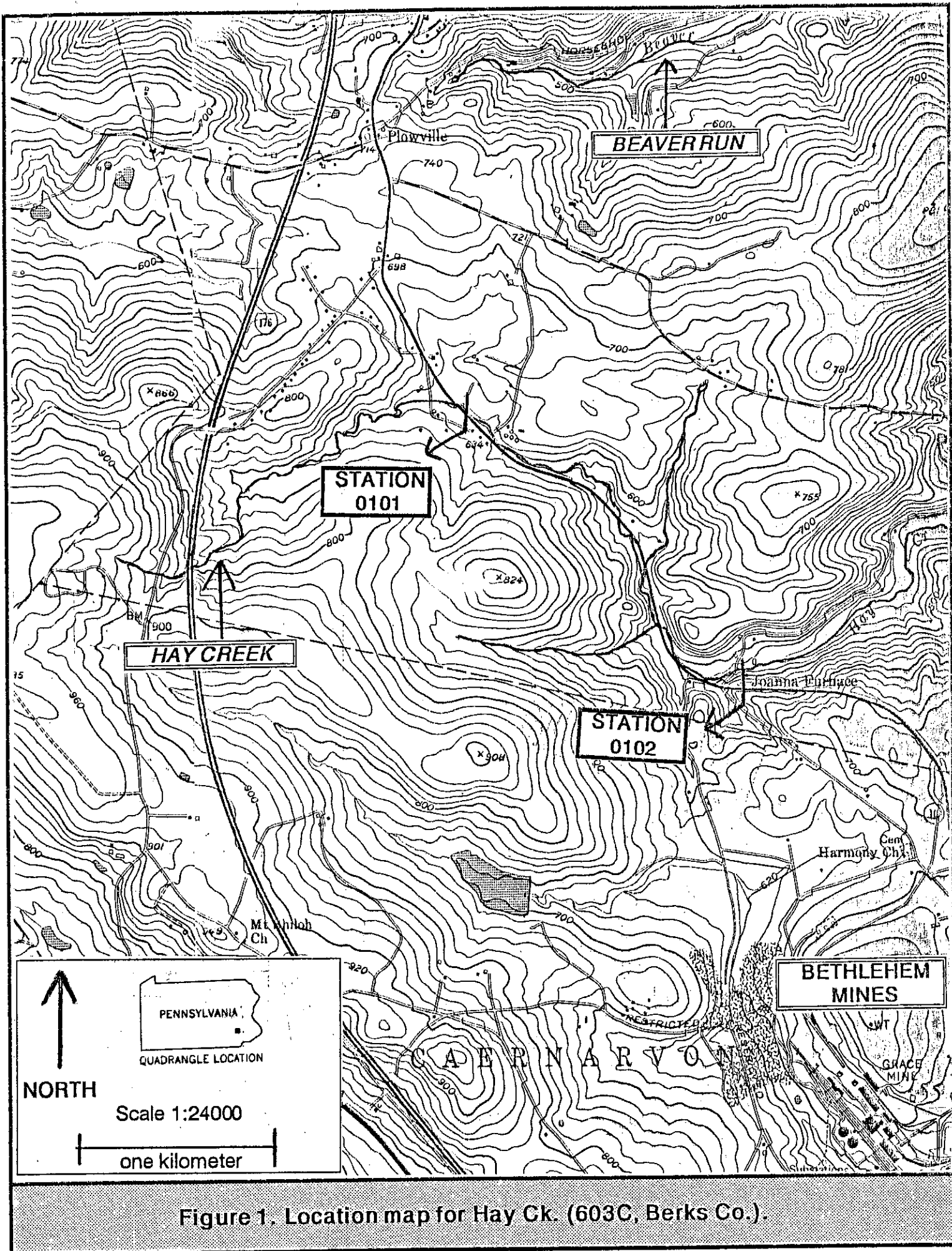


Figure 1. Location map for Hay Ck. (603C, Berks Co.).

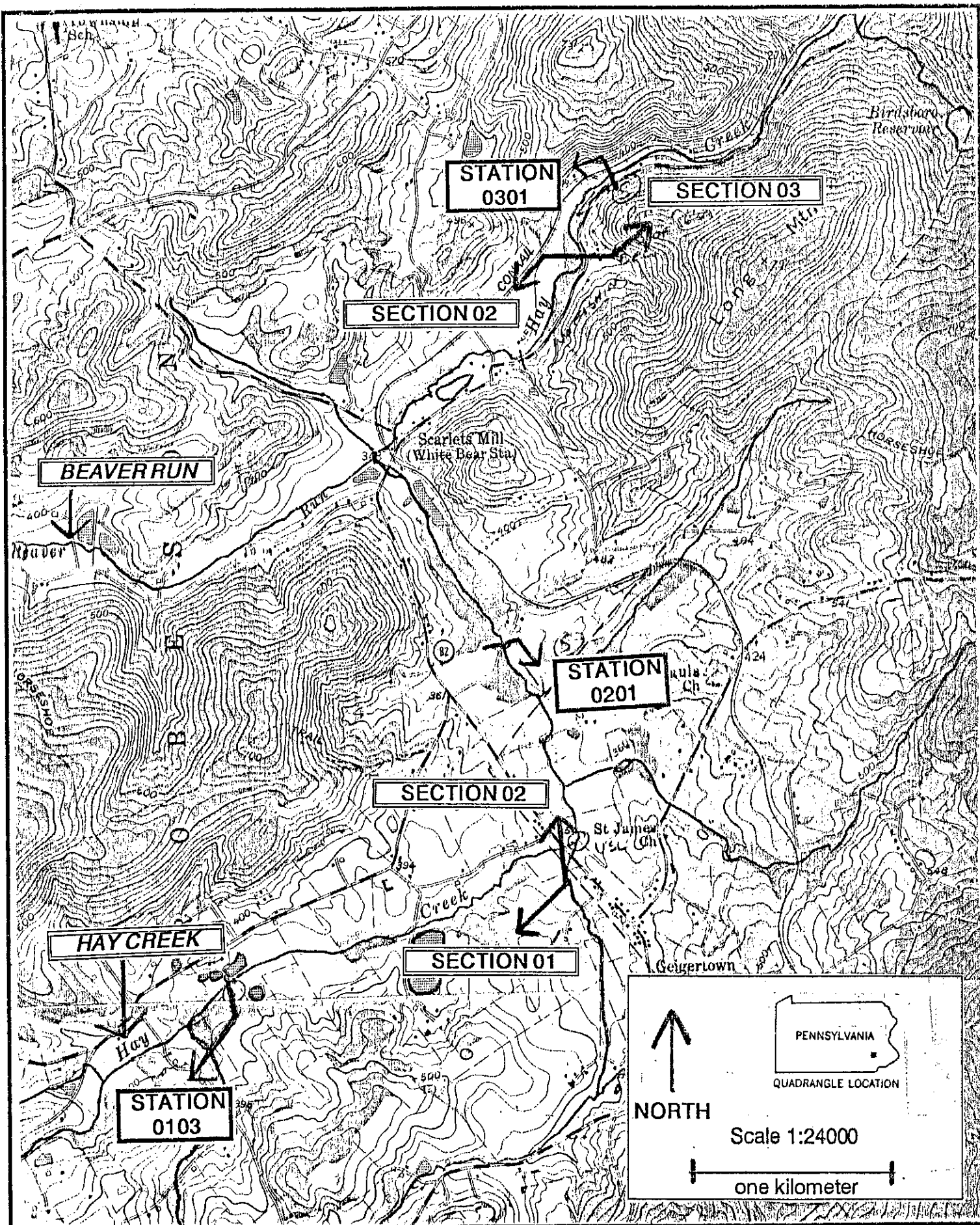


Figure 1. Location map for Hay Ck. (603C, Berks Co.). (CONTINUED)

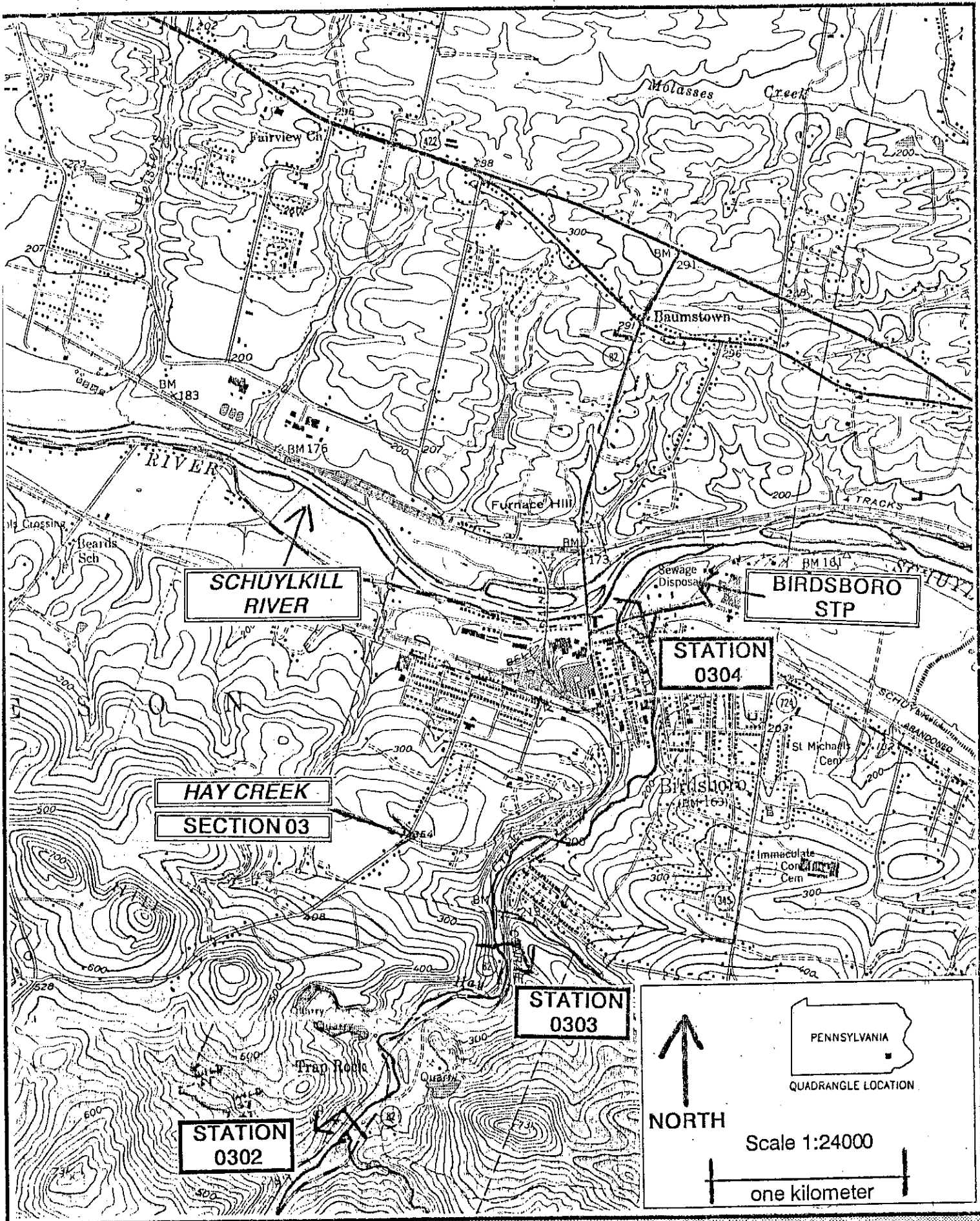
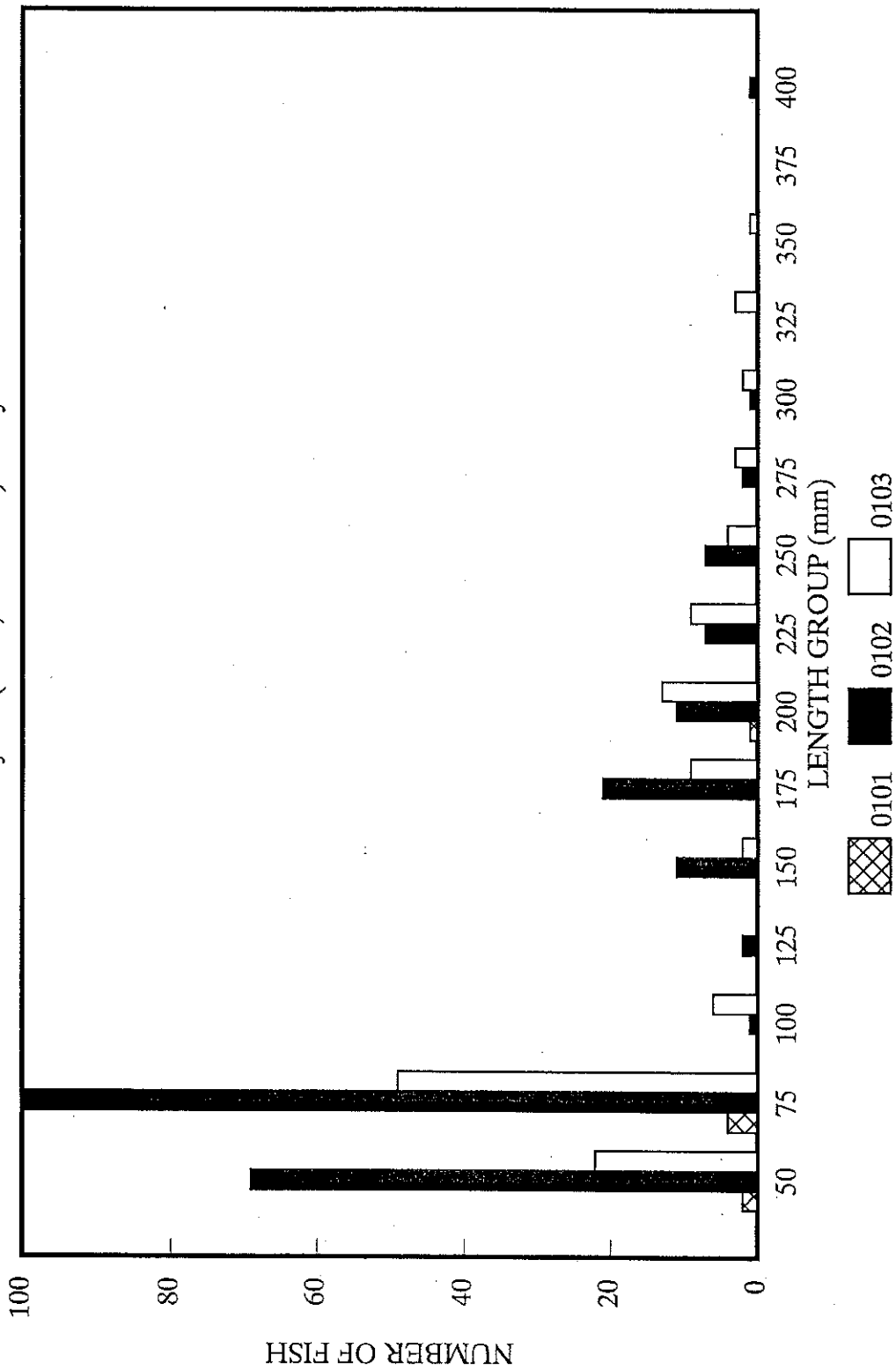


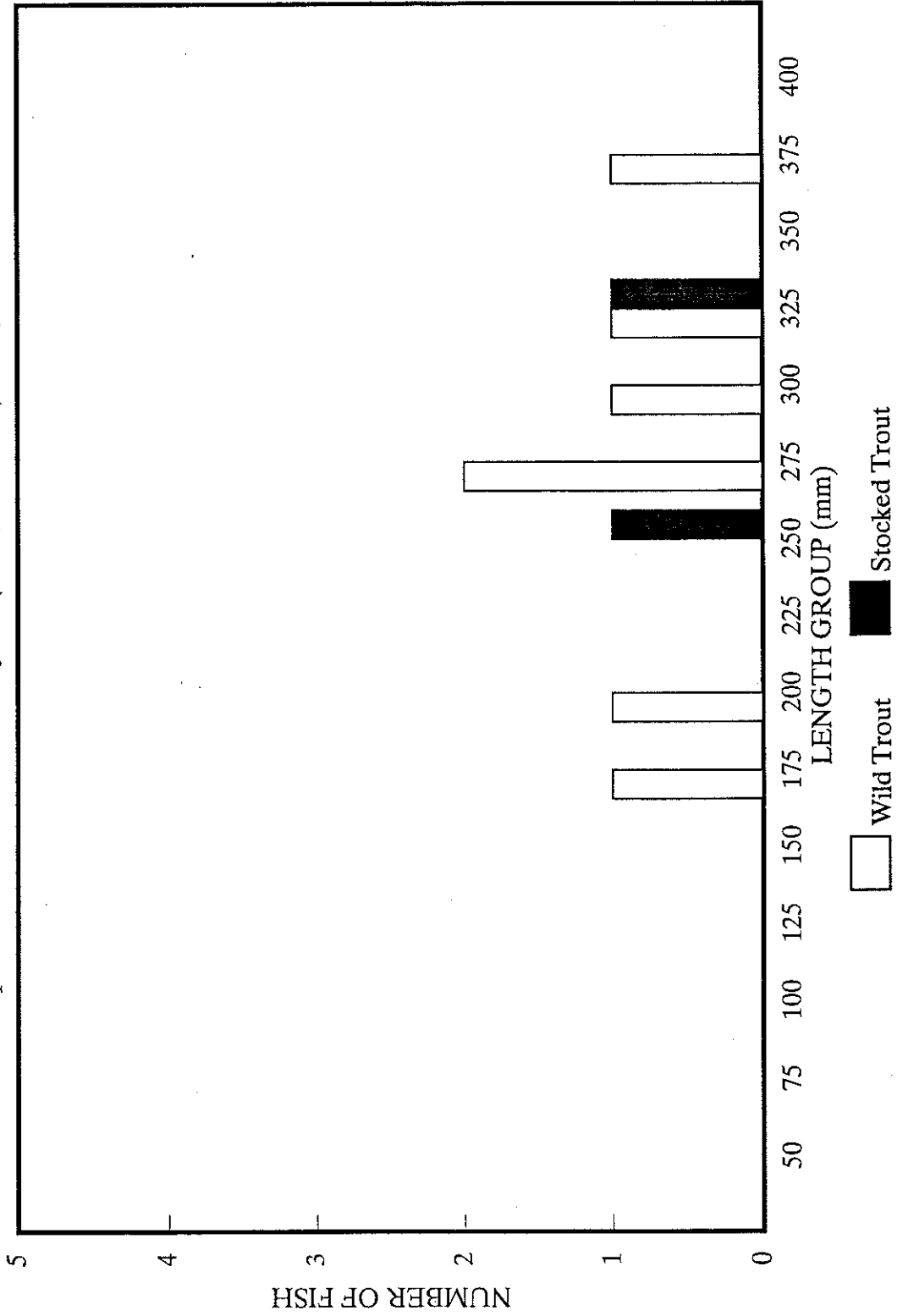
Figure 1. Location map for Hay Ck. (603C, Berks Co.). (CONTINUED)

Figure 2. Length—frequency distribution for brown trout captured in Section 01 of Hay Ck. (603C, Berks Co.) in July of 1991.



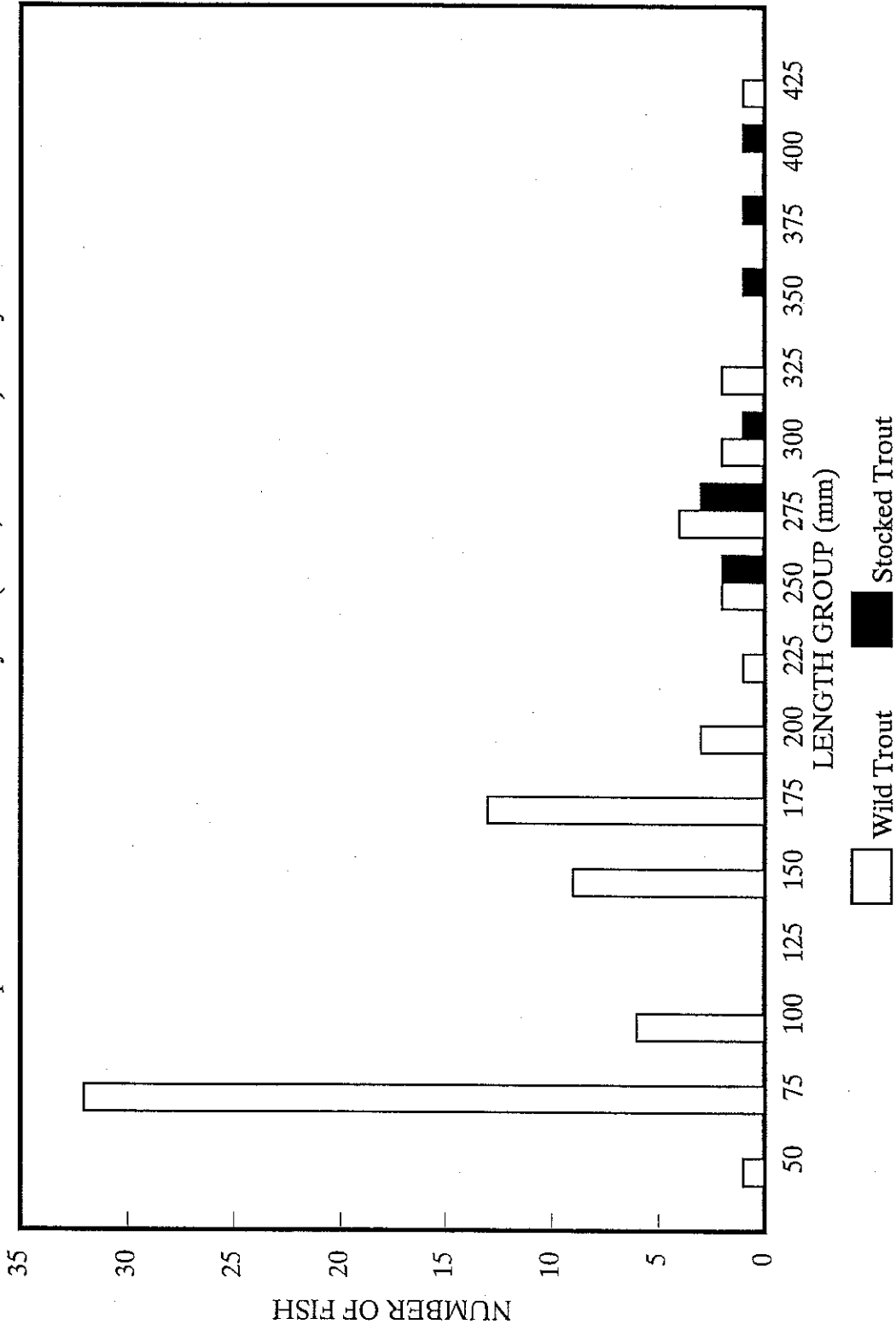
Total catch at Station 0101 = 7; Total catch at Station 0102 = 233; Total catch at Station 0103 = 123.
 All of the brown trout captured in Section 01 were wild fish.

Figure 3. Length—frequency distribution of wild and stocked brown trout captured at Station 0201 of Hay Ck. (603C, Berks Co.) in July of 1991.



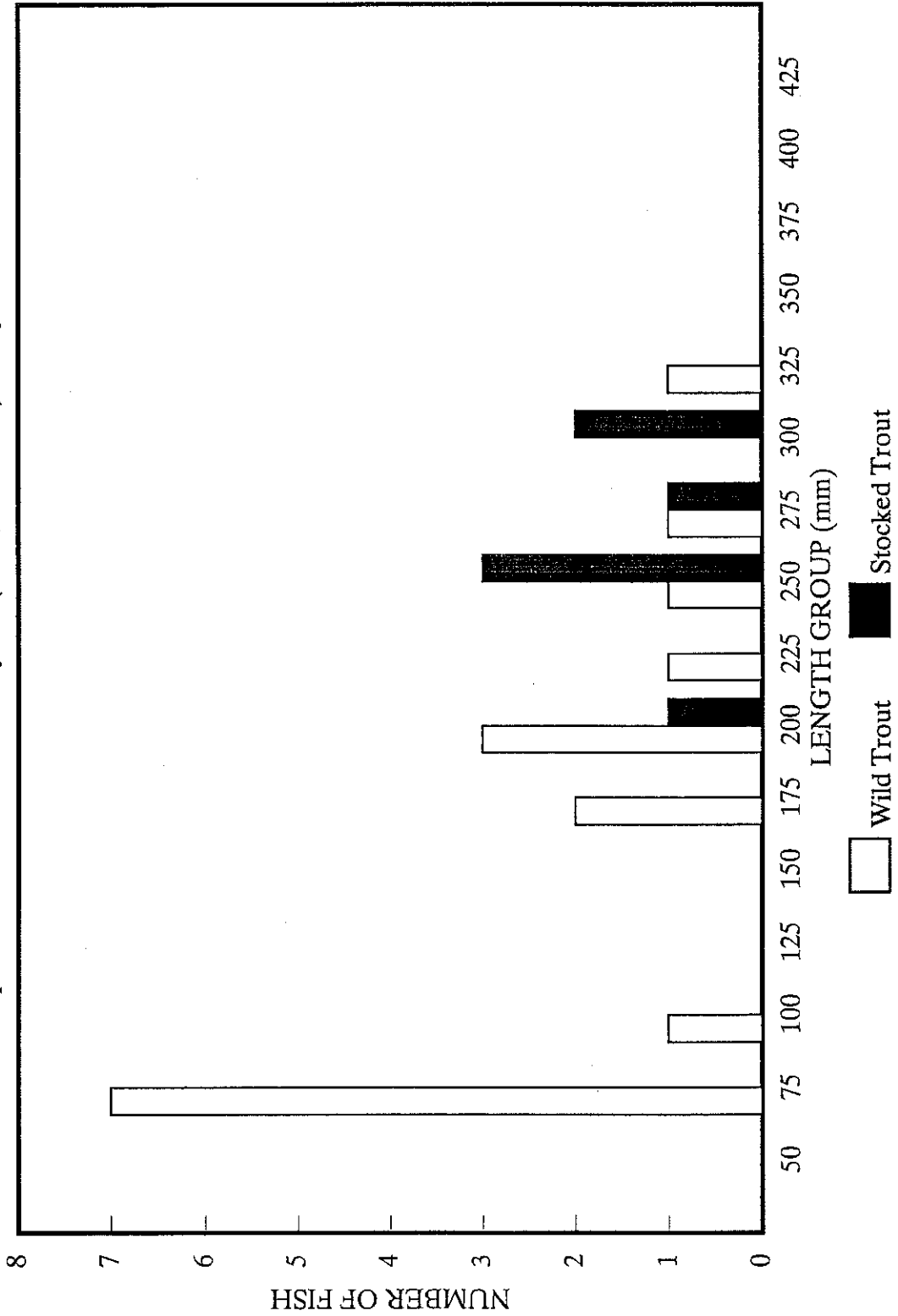
Total Catch: 7 wild brown trout and 2 stocked brown trout.

Figure 4. Length—frequency distribution of wild and stocked brown trout captured at Station 0301 of Hay Ck. (603C, Berks Co.) in July of 1991.



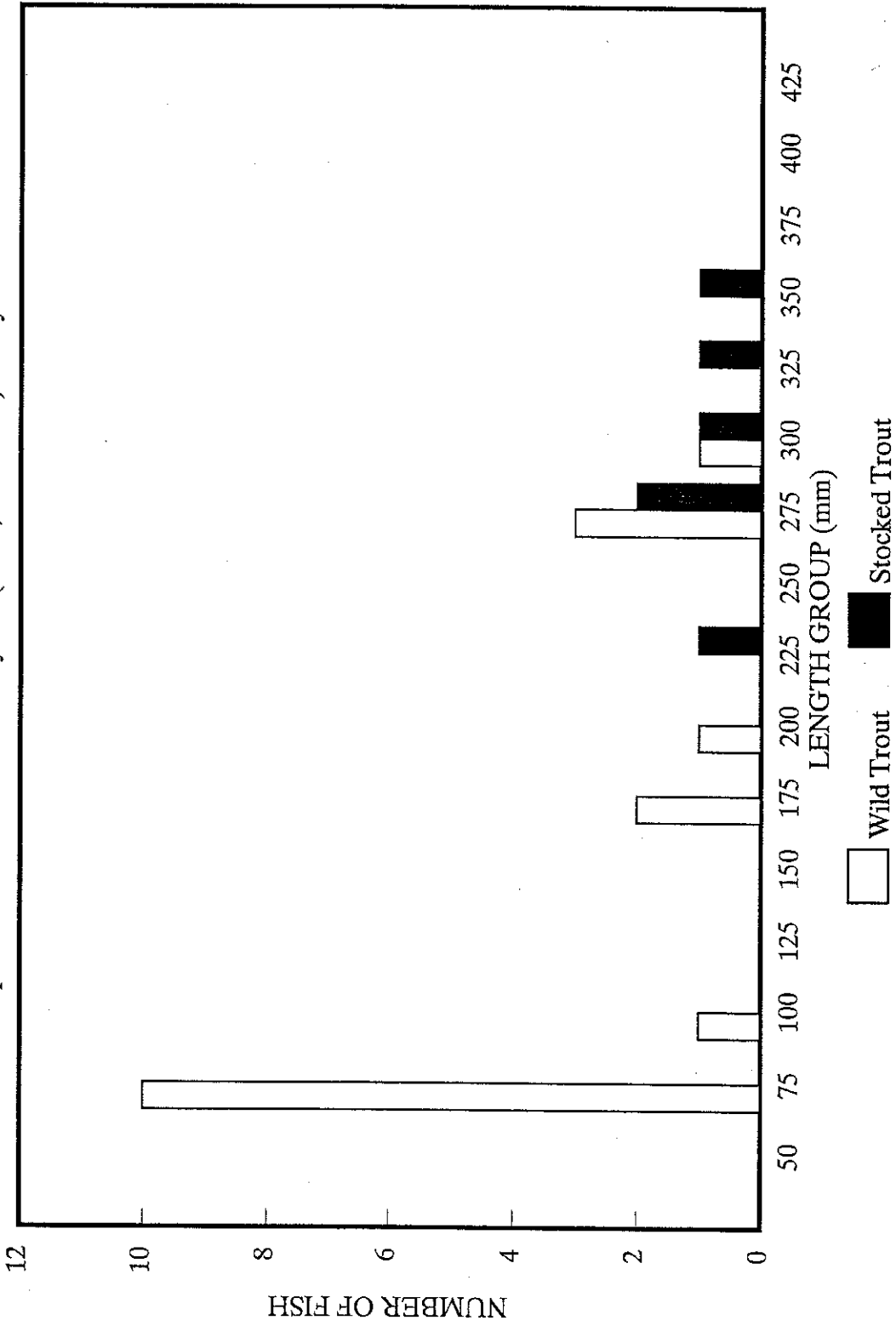
Total Catch: 76 wild brown trout and 9 stocked brown trout.

Figure 5. Length—frequency distribution of wild and stocked brown trout captured at Station 0302 of Hay Ck. (603C, Berks Co.) in July of 1991.



Total Catch: 17 wild brown trout and 7 stocked brown trout.

Figure 6. Length—frequency distribution of wild and stocked brown trout captured at Station 0303 of Hay Ck. (603C, Berks Co.) in July of 1991.



Total Catch: 18 wild brown trout and 6 stocked brown trout.