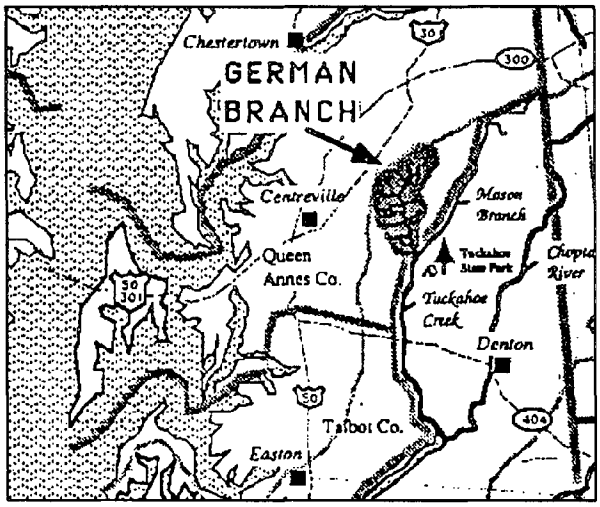

MARYLAND'S TARGETED WATERSHED PROJECT: TRACKING PROGRESS AND MEASURING SUCCESS IN GERMAN BRANCH

STATE OF MARYLAND
COOPERATIVE PROJECT

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WATERSHED TARGETING PROJECT

MARYLAND'S TARGETED WATERSHED PROJECT: TRACKING PROGRESS AND MEASURING SUCCESS IN GERMAN BRANCH

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Maryland's Targeted Watershed Project: Tracking Progress and Measuring Success in German Branch.

John L. McCoy [1], Stuart Lehman[2], Jeffery Opel[3], and Niles Primrose[1].

INTRODUCTION

The Targeted Watershed Project is a multi-agency, state initiative to improve water quality, restore living resources and provide a detailed assessment of the water quality and assessment impacts of these efforts in several tributaries to the Chesapeake Bay. The project is using water quality and living resources monitoring programs to characterize water quality and living resources in the streams, guide restoration activities, and to monitor the effectiveness of these restoration activities.

The project is set up in four phases. The first phase involved planning, initiating the project, and recruiting the cooperators. The second phase involved selecting the basins to be targeted. The third phase is the implementation of the control measures and the assessment of the project. The final phase of the project will involve reporting and disseminating the results.

The project is currently in the assessment and implementation phase. Water quality and living resource assessment and monitoring plans and implementation plans have been developed in each of the watersheds. Restoration activities are focused on water quality problems identified by water quality data collected prior to the project or through the project's water quality assessment program.

The data being generated by the Targeted Watershed Project's implementation tracking program is being used to document progress towards implementation and restoration goals set by the restoration plans. The results of the water quality and living resource monitoring program are being used for several purposes; 1.) to establish baseline water quality and biotic conditions in the watersheds, 2.) to estimate pollutant loads for each watershed, 3.) to evaluate water quality trends in each watershed over time, 4.) to detect any changes in biotic conditions in each watershed during the project. Improvements in water quality and/or biotic conditions within each watershed relative to baseline conditions or as measured with a trend analysis are the measures of success for this project.

German Branch is one of four watersheds selected by this project for restoration activities. The watershed is a 12,100 acre sub-basin of the Choptank River, in Maryland's coastal plain. The primary landuse in the watershed is row crop agriculture. The stream suffers from excessive nutrient and sediment loads. This paper will focus on the methods and results of the project's implementation, water quality, and living resource evaluation programs in German Branch.

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METHODS

Implementation Tracking

USDA and MDE are the lead implementation agencies in the German Branch watershed. The USDA German Branch Hydrologic Unit Project and a Chesapeake Bay Implementation Grant to MDE are the primary implementation funding mechanisms.

The Hydrologic Unit Project uses cost share funds as an incentive to encourage farmers to adopt water quality oriented BMP's. Through accelerated technical and financial assistance and a concentrated information and education program, the project expects to treat 80 percent of the 8,800 acres of cropland in the watershed and develop plans for all of the agricultural land in the watershed. The major systems and practices projected to be implemented are:

Conservation Farm Plans	7,000 acres
Integrated Crop Management	7,000 acres
Riparian Vegetation, Stream Protection and Cropland Conversion	250 acres
Sediment Control Structures	50 acres
Timber Stand Improvement	500 acres
Cover Crop	1,000 acres

The Chesapeake Bay Implementation Grant is an EPA grant to assist in the ~~in the~~ restoration of water quality in the Chesapeake Bay and its tributaries. EPA, MDE and DNR have committed approximately $88,000 towards developing a wetland restoration projects in the German Branch watershed as part of the Targeted Watershed Project. One project to restore a 1.5 acre wetland has been constructed.

Progress in BMP implementation is tracked through cost share accounting and Soil Conservation and Water Quality Plan (SCWQ plans) completion and implementation verification. The cost-share program reports payments to farmers upon completion of practice installation. This data is used to track BMP practice implementation. Acres covered within completed SCWQP's are tallied and used to track conservation planning progress. Spot checks and surveys are used to determine the extent of implementation of completed farm plans.

Water Quality Monitoring Program

The goal of the monitoring program is to be able to characterize water quality, habitat value and productivity and detect changes in water quality that result from various implementation activities in the German Branch watershed.

The water quality assessment and monitoring plans have four components; finfish sampling, macroinvertebrate sampling, water quality sampling, and hydrologic characterization. The water quality sampling and hydrologic characterization can be

further subdivided into two categories, water quality samples collected manually during predominately baseflow conditions and water quality samples collected by automated water quality sampling stations during stormflow conditions. Flow data can be similarly subdivided into two categories, flow data collected manually or read from a staff gauge and flow data collected continuously by automated stations. An automated water quality sampling and discharge monitoring station was established at the outlet of German Branch (Figure 1).

Water Chemistry

Water quality samples and flow measurements are collected monthly at each monitoring station in the German Branch watershed. Water quality samples were collected manually using standard sample handling techniques (Marshall et al. 1992).

The Smithsonian Environmental Research Center was contracted to conduct the storm event based water quality monitoring at the outlet of German Branch. The storm event water quality data collected at the outlet of the German Branch watershed was collected as weekly grab samples and flow weighted weekly composites. The sample collection and preservation techniques used by the Smithsonian are described by Correll (1981).

Citizen monitors were recruited to conduct monitoring weekly at each station in the watershed. Citizen monitors used colorimetric test kits to test for dissolved oxygen, pH and turbidity. The monitors also collected data on air temperature, water temperature, rainfall and stage height.

Benthic Macroinvertebrates

Benthic macroinvertebrate sampling was conducted at each station in the watershed in the spring and fall according to EPA Protocol II Rapid Bioassessment Protocols (Plafkin et al., 1989). The procedure was modified as described by Marshall et al. (1992). The data was used to calculate an index of biological integrity (IBI).

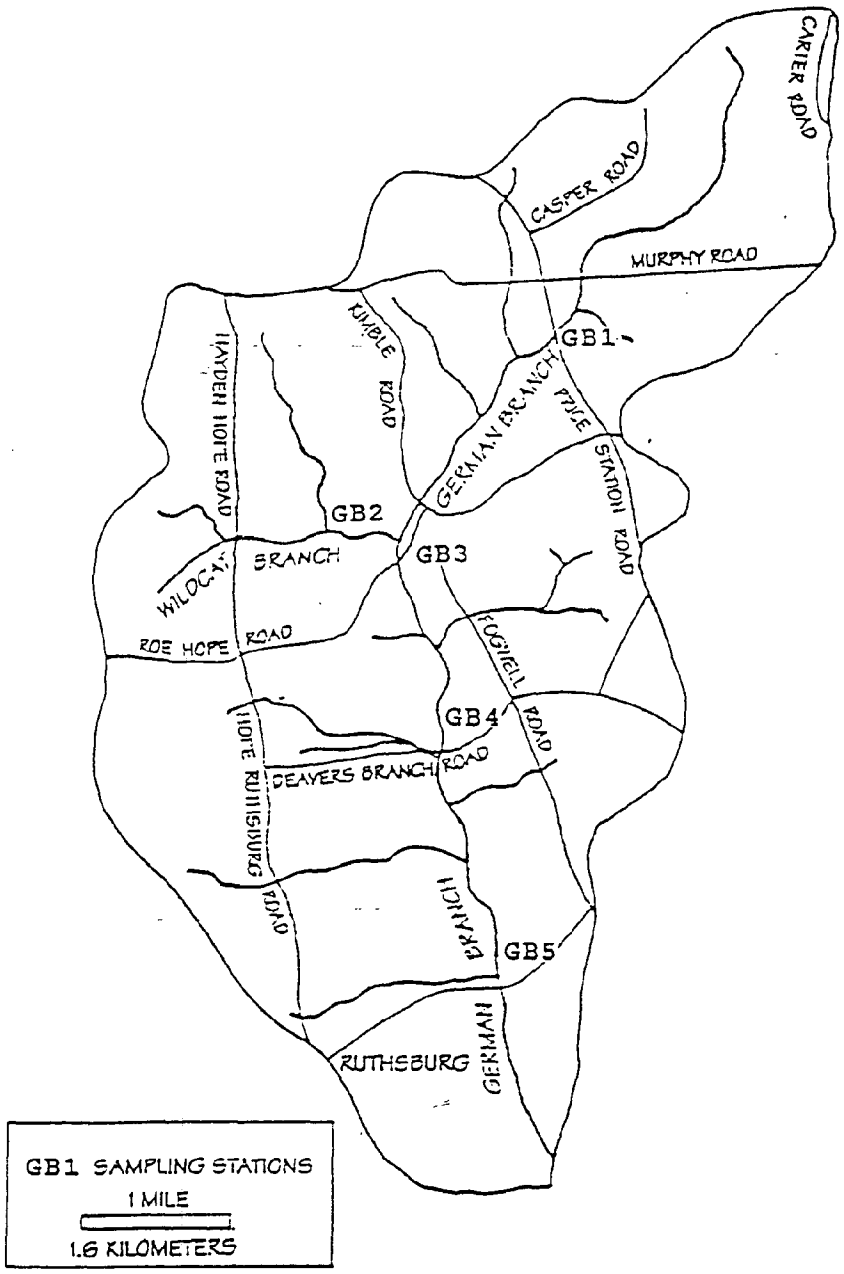
In conjunction with the macroinvertebrate sampling, a habitat assessment was made. Various physical features of the adjacent watershed, riparian zone, banks, and channel, visible from the sampling site were scored (Plafkin et al. 1989). The scores were used to develop a habitat assessment index (HAI). The HAI was used with the ICI to develop a relationship between habitat and the benthic community structure in the stream.

Finfish

Fish were collected at each station in the watershed during the spring and fall. The finfish sampling procedures are described by Marshall et al. (1992)

The finfish data was used to calculate an IBI modified for use in Maryland's coastal plain streams (Fischer et al. 1992). The index was developed to assess biological quality in streams by measuring species composition, trophic composition, fish abundance, and

Figure 1:



Watershed map of German Branch showing monitoring stations

health. In the piedmont streams species richness, trophic structure, and feeding strategies were used to evaluate conditions.

RESULTS

Implementation

The implementation of BMP's in the German Branch watershed has exceeded most of the goals set by the project. SCWQ plans have been written covering a total of 11,700 acres in the watershed (Figure 2). Integrated crop management has been implemented on 7,994 acres. Sediment control practices, including grade stabilization structures, grass waterways, and critical area plantings, have been implemented to serve 8,594 acres in the watershed. Of all the practices, cover crop plantings and timber stand management, lag behind the goals set for the project.

Water Chemistry

Weekly mean nutrient concentrations and weekly mean flow data from 7/90 through 10/93 are presented in Figure 3. In order to separate the effects of natural variations in flow from the changes in pollution control, a log-linear regression was used to adjust the concentration data to remove the effects of changes in flow and season. Residuals of the flow v.s. concentration model were analyzed for time trends to identify trends in the data due to effects other than flow variability. The results of the analysis indicate that phosphorus and nitrogen concentrations have increased over the last three years (Table 1).

Table 1.
Time Trends in Flow and Season Adjusted Data

CONSTITUENT	TIME TREND
TKN	+
NO2+NO3-N	+
NH4-N	+
TOTAL N	+
TOTAL P	+
PO4	+
SEDIMENT	NONE

Annual and weekly loads have been computed using the concentration and flow data at the automated site. Total annual loads are presented in Table 2. Nitrogen and sediment loads have risen over the last three years with total flow.

Table 2.

Annual Loads Discharged By German Branch (Metric Tons/yr.)

Parameter	June 1990 - 1991	June 1991 - 1992	June 1992 - 1993
Total Flow (m^3/yr)	17061733	17481956	22946363
Total P	3.36	4.57	4.28
PO4	1.89	2.64	2.49
Organic Carbon	151.68	166.55	223.96
NO3	59.17	58.52	79.36
NH4	2.68	2.91	3.60
TKN	16.33	19.21	22.24
Sediment	470.77	513.67	574.76
* Total N	75.50	77.73	100.56

* Total N = (TKN + NO3)

Benthic Macroinvertebrates

The calculation of a biological score using the RBP methods requires the use of a reference for comparison. Rather than use a single sample from one year as a reference for all samples, or have different references for each year, a composite reference sample was constructed. The best station from each sampling period (total of 9), as determined from the biotic index, was combined to create a composite reference macroinvertebrate community. The reference RBP metrics were calculated from this reference community. The RBP metrics from all stations from 1989 through 1993 were compared to the reference values to produce biological scores. The annual average biological score metrics are presented in Figure 4. The metrics show a tendency towards improvement over the past four years.

The habitat quality was a little harder to quantify. The exclusion of livestock from the riparian zone at one site in the watershed during the summer of 1993 has allowed a considerable amount of revegetation to occur in the riparian zone and improved habitat conditions along the stream bank adjacent to this site. A stream blockage at one site in the watershed has pooled water in stream segment that was previously dominated by shallow water and gravel bars. Both of these changes positively impacted habitat scores in the watershed. Overall the RBP scores suggest an improvement in water quality within the watershed.

FIGURE 2

CUMMULATIVE ACRES UNDER CONSERVATION FARM PLANS IN THE GERMAN BRANCH WATERSHED 1991 -1994

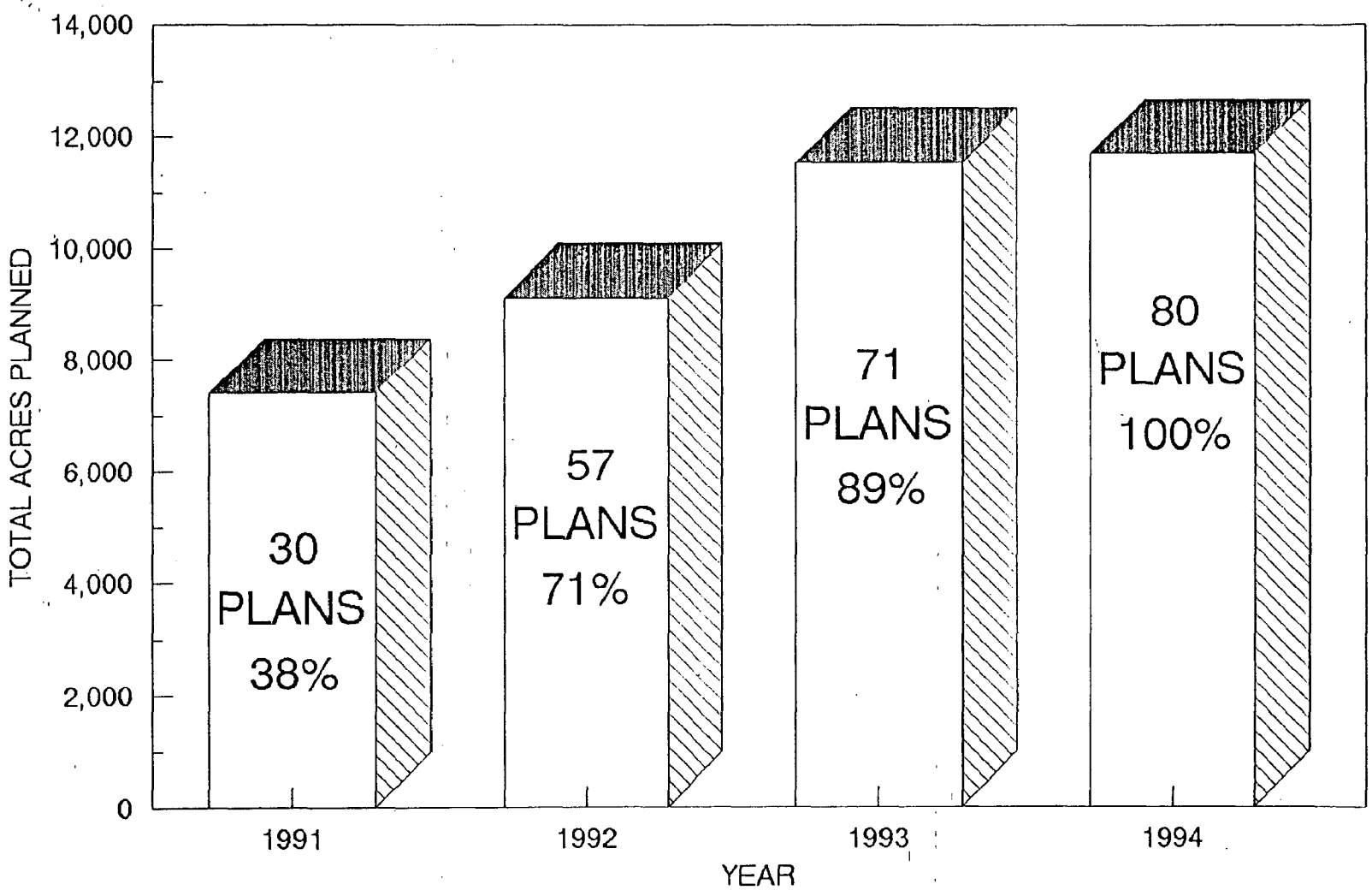


FIGURE 3

WEEKLY MEAN CONCENTRATION AND FLOW IN THE GERMAN BRANCH WATERSHED 1990-1993

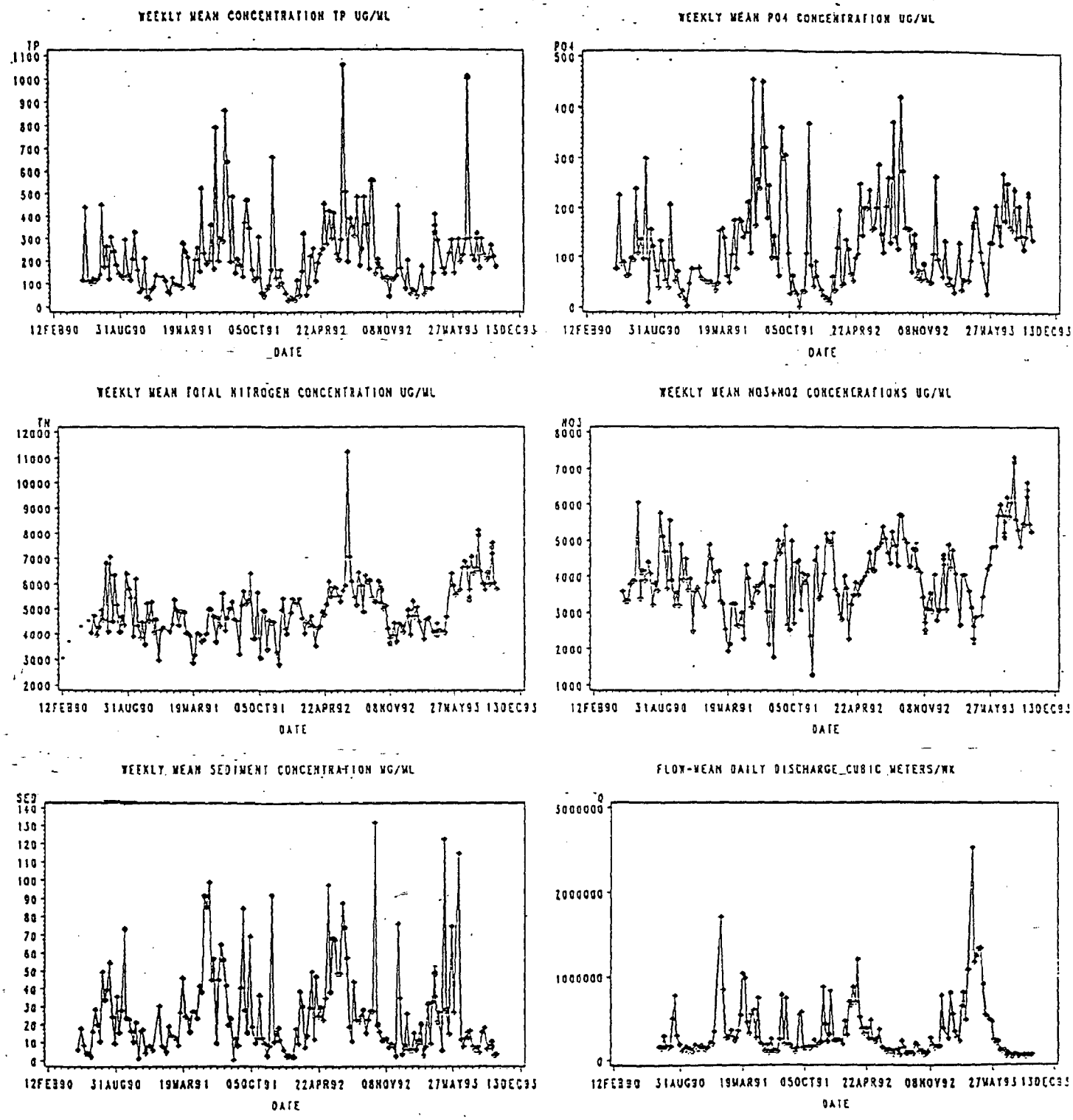
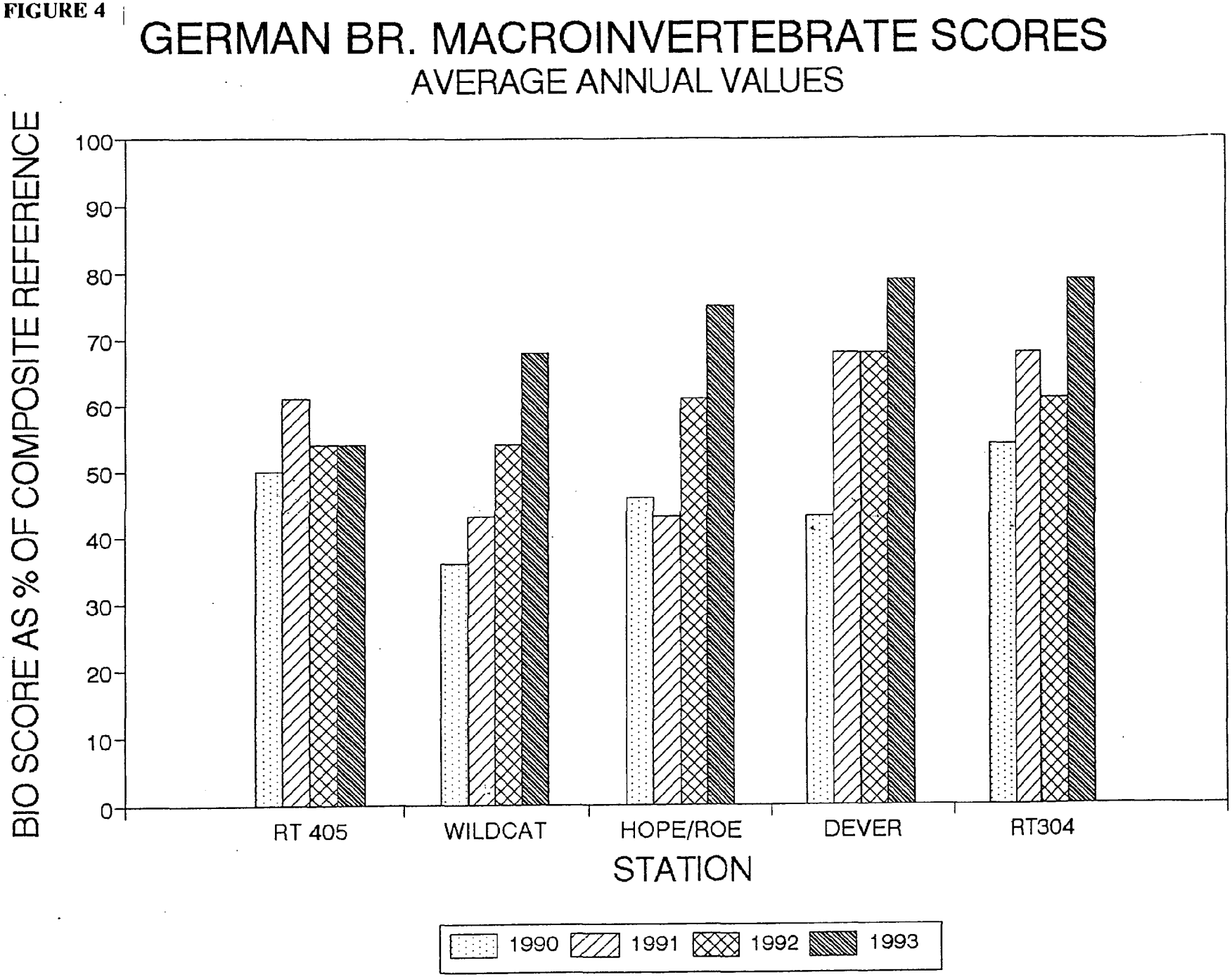


FIGURE 4


GERMAN BR. MACROINVERTEBRATE SCORES
AVERAGE ANNUAL VALUES
BIO SCORE AS % OF COMPOSITE REFERENCE
100
90
80
70
60
50
40
30
20
10
0
RT 405
WILDCAT
HOPE/ROE
DEVER
RT304
STATION
1990
1991
1992
1993

Finfish

The number of species collected in German Branch ranged from a minimum of 4 species at station 2 in the fall 1989, to 17 species at station 5 in the fall of 1990. Species composition varied spatially and temporally in German Branch with the exception of station 1 which remained fairly stable. Samples collected at station 2 indicated some improvement in species composition through the period of study. The fall 1990 sample at station 2 was exceptional with an additional 10 species. The increase in species may be related to elevated flows which began in spring 1989 and continued into 1990. Relatively good recruitment and/or habitat availability may have resulted from these flow conditions. Species composition also increased at stations 3-5 in fall 1990, but was subsequently variable.

Of the various trophic guilds represented at the German Branch stations, in each sampling period, insectivorous individuals were dominant, followed in decreasing order by generalists, omnivores, piscivores, and filter feeders. Proportions were 74%, 20%, 3%, 2% and 1% respectively. The macroinvertebrate community appears to be the major food source supporting the fish community dominated by insectivores. The proportion of insectivores collected at station 1 decreased in fall 1992. Discharge was deficient overall during 1992 and may have impacted macroinvertebrate abundance at this headwater station. A gradual increase in proportion of generalists and a decrease in proportion of insectivores occurred at station 5 for unknown reasons.

The proportion of pollution tolerance classifications for species in German Branch stations and all years combined included intermediate, intolerant, and tolerant individuals at 72%, 15%, and 13% respectively. Species of intermediate tolerance represent a large proportion of finfish populations in German Branch. Proportions of individuals classified as intolerant in German Branch is dependent upon abundance of rosyside dace (C. funduloides). This species was collected at all stations. Species in classified as pollution tolerant were slightly more abundant than intolerant individuals in German Branch.

DISCUSSION

The Targeted Watershed Program was designed to demonstrate the impact of coordinated management activities on water quality and living resources. The various segments of the assessment and implementation phase of the program have been set up to track implementation and changes in water quality.

The results of the implementation tracking program indicate that the majority of the implementation goals set in the program have been met. This is a function of the interest in the project among farmers in the watershed and a very visible Soil Conservation District. SCWQ plans have been developed for all of the farms in the watershed. The implementation of the plans is about 80% for structural practices and 50% for agronomic practices. Through SCWQ plans and integrated crop management SCS and the District estimate that 15,779 tons of soil have been prevented from leaving the farm and 225,793 lbs of nitrogen and 144,194 lbs of phosphorus have been saved over the last three years.

The water quality monitoring program was designed to measure the result of these savings instream as either changes in concentration, loading reductions or as changes in the biological community. To date the program has begun to detect changes only in the biological community. The benthic macroinvertebrate and finfish communities appear to be responding to changes in either habitat or water quality. The water quality results indicate that nutrient concentrations are still increasing. This eliminates nutrients as a cause for the response. The habitat monitoring results indicate that there have been improvements in instream and riparian habitat that would affect the benthic community in German Branch. The water quality data also indicates that flows have increased. The results of the finfish monitoring suggest that the elevated flows have had a positive influence on the finfish community. The benthic community maybe responding to the same changes in habitat that the finfish appear to be responding to. Unlike the chemistry data where we can factor out flow effects from anthropogenic effects on nutrient concentrations we still lack the method for doing this with the biological data.

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