Missouri Department of Natural Resources

Biological Stream Assessment Report

Spring Creek
Adair and Sullivan Counties

September 1994 through March 2001

Prepared for:

Missouri Department of Natural Resources
Water Protection and Soil Conservation Division
Water Pollution Control Program

Prepared by:

Missouri Department of Natural Resources
Air and Land Protection Division
Environmental Services Program

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1.0 Introduction

The Missouri Department of Natural Resources' (MDNR) Environmental Services Program (ESP) conducted a biological assessment of Spring Creek in Adair and Sullivan counties at the request of the Water Pollution Control Program (WPCP). The sampling was conducted from September 1994 through March 2001 to provide data to the WPCP for use in evaluating the biological integrity of this watershed. Cecilia Campbell, Dave Michaelson, Randy Sarver, and others of the Environmental Services Program conducted the sampling.

2.0 Study Area

Spring Creek originates near the town of Lemons, in north central Missouri. The study area includes reaches of class "P" and class "C" stream with beneficial use designations of "warm water aquatic life protection, human health/fish consumption, and livestock and wildlife watering." Permanent flow of this stream is designated to begin at the Highway 129 bridge in Section 26, Township 64 North and Range 18 West (per the Water Quality Standards). During the summer months portions of the class "C" segment do not normally have visible flow and become pooled.

Spring Creek is located within the Plains/Grand/Chariton Ecological Drainage Unit (EDU). An EDU is a region in which biological communities and habitat conditions can be expected to be similar. See Appendix A for a map of the EDU and sampling locations. Table 1 lists the land cover percentages from the Plains/Grand/Chariton EDU, the 14 digit Hydrologic Unit (HU) #10280202010002, and the area within a one-half mile radius around each study location on Spring Creek. Land cover data were derived from Thematic Mapper satellite data from 1991-1993 and interpreted by the Missouri Resource Assessment Partnership (MoRAP).

Table 1
Percent Land Use Within the EDU, the 14-Digit HU,
and a One-Half Mile Radius of Sample Station

Location	Legal	Urban	Crop	Grass	Forest	Swamp
EDU		1.1	43.5	35.9	17.1	0.2
14-Digit HU		.4	9.7	45.6	43.9	<0.1
SLVN	Sec. 25, T. 64 N. R. 18 W.	0	67	28.7	4.1	<0.1
URCA	E 1/2 Sec. 31, T. 64 N. R. 17 W.	0	21.2	60.2	16.8	1.6
GRDN	N 1/2 Sec. 10, T. 63 N. R. 17 W.	0	17.6	26.5	53.6	2.1
EITL	W 1/2 Sec. 24, T. 63 N. R. 17 W.	0	49.1	35.3	15.4	<0.1
DFTH	NE 1/4 Sec. 30, T. 63 N. R. 16 W.	0	36.2	42.9	18.6	2.1
NVGR	NE 1/4 Sec. 32, T. 63 N. R. 16 W.	0	57	36.5	6.2	<0.1

3.0 Station Descriptions

Station SLVN [(sec. 25, T. 64 N., R. 18 W.) (lat. 40.31663132, long. -92.86523438)] is farthest upstream on Spring Creek and located in Sullivan County. It is found below the Route D bridge in the Union Ridge Conservation Area. Samples were collected at this station in the fall of 1994 and the spring of 1995. At the time of sample collection, the stream had isolated pools and was considered a "Class C water" as defined in the state's Water Quality Standards; Class C waters are those that cease to flow during dry periods, but maintain permanent pools that support aquatic life. Land use at the SLVN station was predominately forest and old, overgrown grasslands, with a healthy riparian corridors on both sides of the stream.

Station URCA [(E 1/2 sec. 31, T. 64 N., R. 17 W.) (lat. 40.31211090, long. -92.84008026)] is approximately one mile downstream of the SLVN station and the Union Ridge Conservation Area in Adair County. The samples were collected downstream of the county road bridge south of Route D in the fall of 1994, spring of 1995, and the fall of 2000. During the 2000 sampling event the station was pooled and did not have permanent flow in the upper portion of the sample reach; the low flow was attributed to the drought conditions experienced in that region. The land use at this station was largely grassland with a healthy riparian corridor.

Station GRDN [(N 1/2 sec. 10, T. 63 N., R. 17 W.) (lat. 40.28394318, long. -92.7919461)] is located approximately four miles downstream from the URCA station in Adair County. Samples were collected south of the community of Stahl and upstream of the county road bridge on the Gordon property. The samples were taken in the fall of 2000 and the spring of 2001. Beaver activity above and below the sample station altered flow and affected macroinvertebrate habitat availability at the time those samples were collected. At this station, land use on the north side of the stream was row crop and the south side was largely forested. The riparian corridor was healthy and wide (greater than 18 meters in width).

Station EITL [(W 1/2 sec. 24, T. 63 N., R. 17 W.) (lat. 40.25286102, long. -92.75708008)] is located approximately three miles downstream of the GRDN station in Adair County. Samples were collected on the Eitel property, above and below the concrete county road bridge just off Route O and north of the community of Danforth. Sample collection at this station occurred in the spring and fall of 2000 and the spring of 2001. Beaver activity also occurred up and downstream of the sample station and affected flow and habitat. Land use at this station was predominately row crop on both sides of the stream. There were breaks in the riparian vegetation and areas where the stream banks were unprotected.

Station DFTH [(sec. 30, T. 63 N., R. 16 W.) (lat. 40.25281906, long. -92.75718689)] is located approximately one mile downstream of Station EITL in Adair County. Water and macroinvertebrate samples were collected just off Route O and south of the community of Danforth, upstream of the county road bridge. Samples were collected here in the fall of 1994, spring of 1995, and the fall and spring of 1999. At this station, land use in the watershed was a mix of grass and row crops. The riparian corridor was healthy and wide in a few locations, but there were an increased number of bare areas where bank vegetation had been removed.

Station NVGR [(NE 1/4 sec. 32, T. 63 N., R. 16 W.) (lat. 40.22791672, long. -92.71583557)] is located approximately three-fourths of a mile downstream of the DFTH station in Adair County. The samples were collected downstream of the Highway 6 bridge, just west of the town of Novinger. This station was sampled in the fall of 2000 and the spring of 2001. A drought in 2000 and flood events in early 2001 destroyed macroinvertebrate habitat and reduced riparian cover along the sample reach. The City of Novinger's waste treatment lagoon discharged into the sample reach during both sample collection events. Land use at the NVGR site was largely row crops. This site had good riparian vegetative cover in the fall of 2000. By the spring sampling period in 2001, less than 40 percent of the banks within this sample reach had established vegetative cover and the riparian corridor was less than six meters wide.

4.0 Methods

4.1 Macroinvertebrate Collection

A standardized sample collection procedure was followed as described in the Semi-quantitative Macroinvertebrate Stream Bioassessment Project Procedure (SMSBPP). Spring Creek was sampled as a Glide/Pool stream type.

4.2 Surface Water Samples

Grab samples were collected from each station and preserved in accordance with Standard Operating Procedure MDNR-FSS-001 (Required/Recommended Containers, Volumes, Preservatives, Holding Times, and Special Sampling Considerations). MDNR personnel determined the alkalinity, hardness, specific conductance, pH, dissolved oxygen, and temperature of all water grab samples at the time of collection. Alkalinity and hardness measurements were determined by the use of Hach test kits. Specific conductance, pH, dissolved oxygen, and temperature were determined using Standard Operating Procedures MDNR-FSS-102 (Field Analysis for Specific Conductance), MDNR-FSS-100 (Field Analysis for pH), MDNR-FSS-103 (Sample Collection and Field Analysis for Dissolved Oxygen Using a Membrane Electrode Meter), and MDNR-FSS-101 (Field Measurement of Water Temperature).

4.3 Discharge Measurements

Stream velocity was measured using a Marsh-McBirney Flo-Mate Model 2000. Discharge was calculated using the methods in the Standard Operating Procedure MDNR-WQMS-113 (Flow Measurements in Open Channels).

4.4 Habitat Assessment

Assessments of stream and riparian habitat were conducted using the MDNR Stream Habitat Assessment Project Procedure (SHAPP). The assessment provided additional information to

interpret the macroinvertebrate survey results collected on the reaches of Spring Creek. The assessment results were also compared to reference stream stations in the same EDU to determine whether the habitat supports the aquatic biological community.

4.5 Chain-of-Custody

All macroinvertebrate samples received a numbered label affixed to the sampling jar and an internal label after preservation with formalin. The corresponding label number was entered onto a chain-of-custody form indicating the date, time, and location of collection and parameters to be analyzed per MDNR-FSS-002 (Field Sheet and Chain-of-Custody Record Standard Operating Procedure).

Water samples received a numbered label which was affixed externally to each sample container. The corresponding label number was entered onto a chain-of-custody form (separate from the macroinvertebrate samples). This form also indicated the date, time, and location of collection and the parameters to be analyzed by the MDNR laboratory (per MDNR-FSS-002).

4.6 Macroinvertebrate Analyses

A standardized sample analysis procedure was used following the SMSBPP.

4.7 Water Chemistry Analyses

Water samples were submitted to the MDNR Environmental Services Program for ammonia-nitrogen, nitrite + nitrate-nitrogen, total Kjeldahl Nitrogen, total phosphorus, chloride, and turbidity analyses.

4.8 Quality Assurance/Quality Control (QA/QC)

QA/QC procedures were used in the macroinvertebrate sample collection following the SMSBPP. QA/QC procedures were used in the surface water sample collection following standard operating procedures.

5.0 Observations

Stream stage appeared to be at base flow at the time of sample collection. In the spring of 2001 there was evidence of recent high water events at the NVGR sample station.

6.0 Results

6.1 Biological

Data were evaluated as described in the SMSBPP. The following four metrics were used in the evaluation: 1) Taxa Richness (TR); 2) Ephemeroptera/Plecoptera/Trichoptera Taxa (EPTT); 3) Biotic Index (BI); and, 4) Shannon Index (SI). Stream Condition Index (SCI) scores were determined by calculating metric values and scoring those values against glide/pool biological criteria for the Plains/Grand/Chariton EDU. Those criteria are listed in Table 2 for spring and in Table 3 for fall. Three categories of impairment were determined during the development of these biological criteria. Stream reaches that score from 16-20 are considered fully biologically sustaining, scores from 10 – 14 are considered as partially biologically sustaining, and scores of 4 – 8 are considered non-biologically sustaining.

Table 2
Glide/Pool Biological Criteria for Spring/Warm Water Streams
in the Plains/Grand/Chariton EDU

	Score = 5	Score = 3	Score =1
TR	>48	48-24	<24
EPTT	>7	7-4	<4
BI	<7.24	7.24-8.62	>8.62
SI	>2.44	2.44-1.22	<1.22

Table 3
Glide/Pool Biological Criteria for Fall/Warm Water Streams
in the Plains/Grand/Chariton EDU

	Score = 5	Score = 3	Score = 1
TR	>47	47-24	<24
EPTT	>8	8-4	<4
BI	<7.24	7.24-8.62	>8.62
SI	>2.66	2.66-1.33	<1.33

Individual metric scores were summed to produce the stream condition index (SCI). The seasonal metric scores and SCI for Spring Creek study stations are listed in Table 4. Also listed in the table are the seasonal metric scores for seven reference streams located in the same EDU

as Spring Creek, with the exception of Grindstone Creek (sampled in the spring only). Average scores of each metric were used if the stations were sampled over multiple years. The value for each metric was scored against the criteria in their respective tables.

Table 4
The Four Metrics
and SCI for Spring Creek Stations

Waterbody	Taxa Richness	EPT Taxa	Biotic Index	Shannon Index	SCI
Spring Creek (SLVN)-Fall 1994	3	3	5	3	14
Spring Creek (SLVN)-Spring 1995	3	3	5	5	16
Spring Creek (SLVN) Average					15
Spring Creek (URCA)-Fall 1994	5	5	5	3	18
Spring Creek (URCA)-Spring 1995	3	3	5	5	16
Spring Creek (URCA)-Fall 2000	5	5	5	5	20
Spring Creek (URCA) Average					18
Spring Creek (GRDN)-Fall 2000	3	5	3	3	14
Spring Creek (GRDN)-Spring 2001	5	3	3	3	14
Spring Creek (GRDN) Average					14
Spring Creek (EITL)-Spring 2000	5	5	5	5	20
Spring Creek (EITL)-Fall 2000	5	5	5	5	20
Spring Creek (EITL)-Spring 2001	3	5	3	3	14
Spring Creek (EITL) Average					18
Spring Creek (DFTH)-Fall 1994	5	5	3	3	16
Spring Creek (DFTH)-Spring 1995	3	3	5	5	16
Spring Creek (DFTH)-Spring 1999	5	5	5	5	20
Spring Creek (DFTH)-Fall 1999	5	5	5	3	18
Spring Creek (DFTH) Average					17.5
Spring Creek (NVGR)-Fall 2000	5	5	5	5	20
Spring Creek (NVGR)-Spring 2001	5	5	3	3	16
Spring Creek (NVGR) Average					18

Table 5
The Four Metrics
and SCI for Reference Streams in the
Plains/Grand/Chariton EDU

Waterbody	Taxa Richness	EPT Taxa	Biotic Index	Shannon Index	SCI
East Fork Grand River-Spring 1999	5	5	5	5	20
East Fork Grand River-Fall 1999	5	5	5	5	20
East Fork Grand River-Spring 2000	3	3	5	5	16
East Fork Grand River-Fall 2000	5	5	5	5	20
East Fork Grand River Average					19
Grindstone Creek-Spring 2001	5	5	3	5	18
Locust Creek Station 1-Fall 1994	3	3	3	3	12
Locust Creek Station 2-Fall 1994	3	5	5	5	18
Locust Creek Station 1-Spring 1995	3	3	3	3	12
Locust Creek Station 2-Spring 1995	3	5	5	3	16
Locust Creek-Spring 1999	5	5	5	5	20
Locust Creek-Fall 1999	5	3	5	5	18
Locust Creek-Spring 2000	5	5	5	5	20
Locust Creek-Fall 2000	5	5	5	5	20
Locust Creek Average					17
West Fork Locust Creek-Fall 1994	3	5	5	5	18
West Fork Locust Creek-Spring 1999	5	5	5	5	20
West Fork Locust Creek Average					19
Marrowbone Creek-Fall 2000	5	5	5	5	20
Marrowbone Creek-Spring 2000	5	5	5	5	20
Marrowbone Creek Average					20
No Creek-Spring 2000	5	3	5	5	18
No Creek-Fall 2000	5	3	3	5	16
No Creek-Spring 2001	3	3	3	3	12
No Creek Average					15
West Fork Big Creek-Spring 1999	5	5	5	5	20
West Fork Big Creek-Fall 1999	5	5	5	5	20
West Fork Big Creek-Spring 2000	5	5	5	5	20
West Fork Big Creek-Fall 2000	5	5	3	3	16
West Fork Big Creek Average					19

6.2 Surface Water Samples

Water chemistry results are listed in Appendix B. There were no exceptional concentrations measured at any of the stations during the study but additional data would be needed to provide any significant insight to any land use/stream water chemistry relations. Turbidity was extremely high at the GRDN, EITL, and NVGR stations in the spring of 2001, however, the samples were collected under high flow conditions and the high turbidity readings reflected the effect of an increased suspended sediment load in the water.

6.3 Habitat Assessments

Habitat assessment scores were calculated from data collected in spring of 2001 (see Table 6). Three stations on Spring Creek were assessed as well as two other reference streams in the same EDU. When compared to the two reference streams in the same EDU (No Creek and Grindstone Creek), all three of the Spring Creek stations' scores were within 75% of the reference station scores and, therefore, are considered to potentially support a similar biological community.

Table 6
Habitat Assessment Scores

Waterbody	Station	Year	Season	Habitat Score
Spring Creek	GRDN	2001	S	94
Spring Creek	EITL	2001	S	106
Spring Creek	NVGR	2001	S	79
Grindstone Creek	1	2001	S	87
No Creek	1	2001	S	90

7.0 Discussion

Four of sixteen samples collected on Spring Creek during the study produced SCI scores of 14, or partially biological sustaining. Seventy-five percent of the samples collected during the study produced SCIs that reflected Spring Creek would sustain macroinvertebrate populations. Average SCI scores for each of the sample stations revealed that two of the six Spring Creek stations (SLVN and GRDN) were below 16, the lower limit of fully biological sustaining. The scores inferred that conditions at each station may have had an impact on macroinvertebrate populations.

The SLVN station on Spring Creek was in the headwaters of the creek and was comprised of isolated pools at the time of sample collection in 1994. The low flow regime caused the number of sampled habitats to be considerably lower than at other stations. Land use at this station may

also have had an impact upon the macroinvertebrate samples collected there, although there are several spatial scales of regional land use that must be examined to determine the extent of its effect upon the stream. The predominant land use within the EDU was row crop (43.5%), a common finding in northern Missouri. However, the Spring Creek watershed was in a 14-digit HU in which only 9.7% of the area was in row crops, different from many other HUs and watersheds in that portion of the state. Row cropping is largely confined to the flood plain areas of the HUs. A closer examination of the watershed around the SLVN station revealed that within a one-half mile radius of the sample station, 67% of the land use was in row crops, the largest amount of row crops in the watershed of any sample station. Therefore, the effects of land use may have contributed to the low metric scores at this station, but the effects were masked by intermittent stream conditions and the low flow regime.

Samples collected at the GRDN station also produced average SCI scores below the reference biological criteria for streams in good condition. This station was greatly impacted by beaver activity at the time the samples were collected in 2000 and 2001. The upstream boundary of the reach was a beaver dam and pond and the downstream boundary of the reach was a long pool. The beaver dam greatly reduced flow through the reach and macroinvertebrate habitat was sparse. Over one-half of the land use in the watershed was forested. Any effect on the creek by land use was masked by the impact caused by beaver activity upstream and downstream of the sample station.

The four remaining Spring Creek stations did not exhibit any outstanding trends that could be attributed to land use. Both the URCA and NVGR stations produced lower total habitat scores but were still greater than 75% of the reference stream scores. The habitat scores reflected specific station conditions at the time of sample collection. Low flow and isolated pools at the URCA station and flood events followed by low flow at the NVGR station likely produced lower total scores. The low metric and SCI scores at the EITL station in the Spring of 2001 also reflected the impact of the dry conditions in the region in the fall of 2000 and the subsequent high flow conditions in Spring Creek in the winter and spring of 2001.

In summary, the biological assessment of Spring Creek produced stream condition index values below 16 in 25% of the samples (4 out of 17 samples). Low water levels due to the intermittent flow regimes or as a result of beaver activity affected the samples.

Submitted by: _____

Cecilia Campbell
Environmental Specialist
Water Quality Monitoring Section
Environmental Services Program

Date: _____

Approved by: _____

Earl Pabst
Director
Environmental Services Program

CC:th

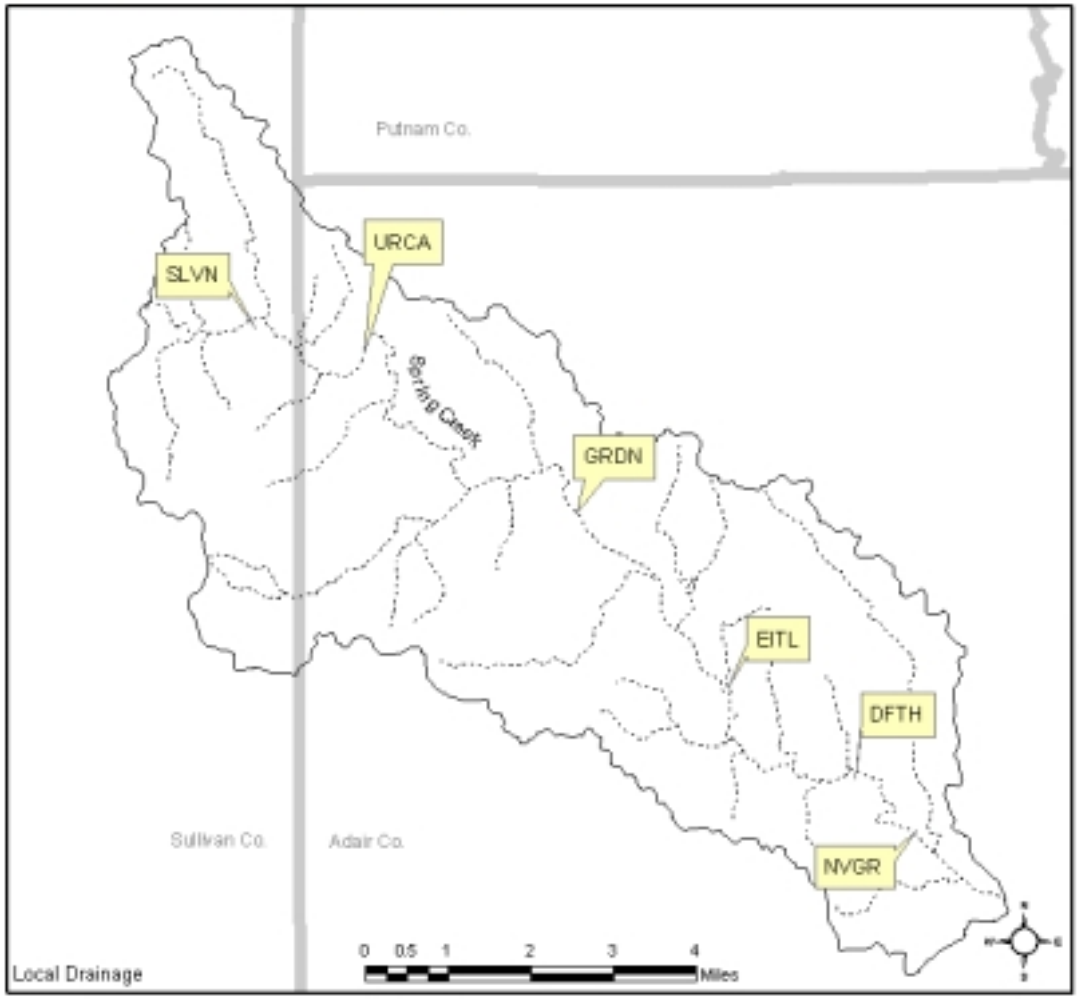
c: Irene Crawford, Regional Director, NERO
John Ford, QAPP Project Manager, WPCP

Appendix A

Maps

Spring Creek &
Plains/Grand/Chariton EDU

Spring Creek Study Sites



Sampling Location

County Boundary

Local Drainage

Stream/River

Local Drainage and Biologic Sampling Site Location

Ecolocial Drainage Unit (EDU) - An EDU is an area that contains a unique combination of habitats and organisms. Missouri is divided into 19 EDUs as shown in the inset map below. This site is located in the highlighted EDU.

Local Drainage - The local drainage area, also known as a 14 Digit Hydrologic Unit, is shown in the main map at left. This area is a portion of the local watershed. Missouri is split into over 1500 such units.

Ecological Drainage Unit

Appendix B

Water Chemistry Data

Station	Sta #	Chemistry #	Seas	Year	Flow	Cond	DO	PH	Temp	TKN	NH_3	NO_2+NO_3	TP	Cl	Turb	Alkalinity	Hardness
					(ft^3/sec)	(µs/cm)	(mg/l)		(°C)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(NTU)	(mg/l)	(mg/l)
SLVN	6		F	1994		665	6.6	7.5	22.4		0.01					200	272
SLVN	6		Spr	1995	4.4	532	10.6	8	12							120	255
URCA	5		F	1994		478	6.6	7.8	22.8		0.02					180	221
URCA	5		Spr	1995	5	543	9.8	7.9	11.5							120	255
GRDN	4	00-7169	F	2000	0.1	345	6.9	7.8	18	1	<0.05	<0.05	0.09	<5.0	19.7		
GRDN	4	01-16910	Spr	2001	169	251	9.8	7.04	12	0.79	<0.05	0.45	0.39	7.04	305		
EITL	3	00-7106	Spr	2000	1.8	432	11.8	8.4	9	2	<0.05	<0.05	0.02	6.42	6.72		
EITL	3	00-7168	F	2000	0.1	369	6.3	7.3	16	1	0.06	0.07	0.08	5.33	33.1		
EITL	3	01-16909	Spr	2001	191	240	9.7	6.8	12	1.02	0.37	0.37	0.53	7.11	427		
DFTH	2		F	1994		464	9.2	8	15.8		0.03					160	221
DFTH	2		Spr	1995	8.3	553	12	8	9							140	272
DFTH	2	99-5123	F	1999	0.1	412	8.8	8.2	22		<0.05		0.01			220	260
NVGR	1	00-7167	F	2000	0.1	661	6.1	7.7	18	<1.0	<0.05	<0.05	0.07	24.2	19		
NVGR	1	01-16908	Spr	2001	147	280	9.4	7.29	15	1.01	<0.05	0.44	0.34	8.64	254		