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VOGTLE ELECTRIC GENERATING PLANT
SURVEY OF THE DRIFTING MACROINVERTEBRATES OF THE SAVANNAH RIVER, BURKE COUNTY, GEORGIA, FROM SEPTEMBER, 1980, THROUGH AUGUST, 1981
OPERATING LICENSE STAGE ENVIRONMENTAL REPORT
TECHNICAL DOCUMENT

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VEGP - OLSER

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INTRODUCTION

The Vogtle Electric Generating Plant (VEGP) site is approximately 3169 acres located in Burke County on the southwest side of the Savannah River. The site is at river mile 150.9, approximately 26 miles south-southeast of Augusta, Georgia. The construction site is directly across the river from the Savannah River Plant, a U.S. Department of Energy facility operated by E. I. DuPont DeNemours and Company. The site is located in the coastal plain and is characterized by sandy or sandy loam soil with rolling hills and mixed pine-hardwood vegetation. Construction of VEGP began in June, 1974, and was discontinued in September, 1974, because of unfavorable economic conditions. Construction resumed in January, 1977. Approximately 1391 acres of the site have been cleared for plant construction.

The original plans proposed a generating plant consisting of four units, but construction of two units has been cancelled. The plant will employ two pressurized water reactors producing 1160 MW each. Unit 1 is scheduled to go into service in March, 1987, and Unit 2 in September, 1988. The exhaust steam will be cooled by a closed-cycle cooling system employing natural draft cooling towers using make-up water from the Savannah River. Low volume waste and blowdown from both cooling towers will ultimately be discharged back into the river.

The Savannah River below Augusta, Georgia, and above the VEGP site receives wastewater discharges from municipalities and industries that add organic wastes, nutrients, metals, and other trace contaminants. Stream classification near VEGP is listed as "Fishing".[1] The river near the plant site is typical of large southeastern coastal plain rivers except that a dredged channel is maintained by the Corps of Engineers for barge traffic. The biological community of the river is similar to that of other large southeastern rivers, but has been affected by man's influence on the river. The impoundment of the river above Augusta, Georgia, has reduced the transport of sediments and allochthonous particulate organic material, and the dredging of the channel has reduced the natural shallow areas and backwaters that would normally support a diverse benthic fauna. Studies on the Savannah River flora and fauna have been conducted periodically since 1951 and are detailed in Patrick, et al.[2] Academy of Natural Sciences of Philadelphia,[3] [4] and Matthews.[5]

Georgia Power Company is required by the Plant Vogtle Final Environmental Statement, issued by the United States Atomic Energy Commission,[6] to sample drifting macroinvertebrates in the Savannah River in the vicinity of Vogtle Electric Generating Plant.

A study of drifting organisms began September, 1973, and continued through August, 1974. This study was repeated beginning in September, 1980, and continued through August, 1981. This report summarizes data

on planktonic macroinvertebrate numbers in the Savannah River between river miles 150.6 and 151.2 from September, 1980, through August, 1981. Additional data are being collected and will be summarized in a subsequent report.

METHODS

Savannah River drift surveys were conducted monthly from September, 1980, through August, 1981 (table 1). During each survey, drift samples were collected during the day and at night from two stations located on three transects. The transects are located at: river mile 151.2, approximately 0.3 mile upstream from the proposed site of the intake structure; river mile 150.9, the proposed site of the intake structure; and river mile 150.6, approximately 0.3 mile downstream from the proposed site of the intake structure.

Station 1 of each transect is on the Georgia side of the river, and Station 3 is on the South Carolina side (figure 1). A single 15-minute sample was obtained at each station on a transect. Drifting organisms were collected with paired ½-meter diameter 760 μ mesh nylon plankton nets set 6 to 12 inches off the river bottom. The volume of water filtered was estimated using a flow meter mounted in the mouth of one net. Sample material caught in the nets was transferred to labeled containers and preserved in ten percent formalin. Macroinvertebrates were identified to the lowest practical level and counted at the Georgia Power Company Environmental Affairs Laboratory in Decatur, Georgia.

The elapsed sampling time, river elevation, water temperature, and dissolved oxygen concentration were recorded for each sample. Discharge of the Savannah River was obtained from U.S.G.S. gaging station number 02197320 near Jackson, South Carolina (river mile 156.8). Drift density (number/1000 m^3) was estimated by dividing the number of individuals in a sample by the volume of water filtered.

RESULTS AND DISCUSSION

Flow of the Savannah River is regulated by Hartwell and Clark Hill Reservoirs. Daily discharge of the Savannah River at Jackson, South Carolina, ranged from a minimum of 5190 ft^3/s (147 m^3/s) on July 31, 1981, to a maximum of 17,300 ft^3/s (490 m^3/s) on February 13, 1981. During the sampling period, the average water temperature was 17.6 °C with a range from 6.0 °C on January 14, 1980, to 25.0 °C on August 5, 1981. Dissolved oxygen concentrations averaged 8.1 mg/l and ranged from 6.0 mg/l on July 1, 1980, to 12.4 mg/l on January 14, 1981.

Drift densities had a negative binominal distribution and were transformed for statistical analysis using Log_{10} (density). The transformed

densities have a normal distribution. Analysis of variance of the log transformed densities for differences among months, transects, or between surveys during the day and night suggests that significant differences exist among the main effects. Duncan's Multiple Range Test indicates that surveys conducted during the night show greater densities than those conducted during the day and that the density estimated for the transect at 151.2 are significantly different from those estimated for the transects at 150.9 and 150.6. In addition, the average monthly densities are grouped as follows: February > March, April, May > December, January, June, November ≥ October, September, August, and July (table 2). The average drift density for each month ranged from 924/1000 m^3 in August, 1981, to 17,297/1000 m^3 in February, 1980 (table 3). Approximately 86 percent of the drifting organisms consisted of four major taxa: Annelida (41 percent), Diptera (26 percent), Mollusca (11 percent), and Trichoptera (8 percent). The proportion of these taxa varied through the year.

Drift densities ranged from 1143 to 1489 individuals/1000 m^3 during September, October, and November, 1981. Drifting invertebrates were predominantly Trichoptera (17 to 36 percent), Diptera (26 to 53 percent), and Ephemeroptera (2 to 22 percent).

Drift densities increased from December, 1980 (2027/1000 m^3) through February, 1981 (17,297/1000 m^3). Samples taken in December were dominated by Diptera (42 percent) and Annelida (37 percent). Large numbers of Annelida (28 percent), Crustacea (27 percent), Diptera (18 percent), and Trichoptera (8 percent) were found in February.

The drift density declined in March (9189/1000 m^3), April (7882/1000 m^3), and May, 1981 (5949/1000 m^3). In this three-month period, 81 to 91 percent of the drift consisted of Diptera and Annelida.

Drift densities continued to decline in June (1590/1000 m^3), July (983/1000 m^3), and August, 1981 (924/1000 m^3). Diptera (32 to 43 percent), Trichoptera (14 to 33 percent), and Annelida (7 to 27 percent) comprised the bulk of the drift in these three months, with Diptera and Annelida gradually decreasing in number.

A comparison of average drift densities for surveys completed at night versus surveys completed during the day shows that drift densities are greater at night (tables 4 and 5). All 12 monthly surveys resulted in greater drift densities at night, with the greatest difference occurring in January and February. In January, the average daytime drift rate was 2290/1000 m^3 and consisted primarily of Annelida (46 percent) and Diptera (28 percent). The average nighttime drift rate increased to 8057/1000 m^3 and consisted of Annelida (35 percent) and Diptera (46 percent). The average daytime drift rate in February was 11,740/1000 m^3, consisting of Crustacea (33 percent), Annelida (31 percent), and Diptera (18 percent). The average nighttime drift rate in February was 22,847/1000 m^3, consisting of Diptera (18 percent), Ephemeroptera (15 percent), Annelida (27 percent), Crustacea (24 percent), and Trichoptera (9 percent).

The changes noted in drift densities and composition are typical of those found in rivers. Changes in drift density and composition are known to occur with season and discharge[7, 8]. In addition, drift densities typically show a diurnal variation. In most cases, peak drift densities are found just after sunset[9, 10, 11, 12]. Although continuous surveys were not conducted, it is evident that some orders were present in the drift at noticeably higher densities at night than in the day.

CONCLUSIONS

A survey of drifting macroinvertebrates in the Savannah River at the VEGP construction site was conducted from September, 1980, through August, 1981. The average drift density for this period ranged from 924/1000 m^3 to 17,297/1000 m^3 and was dominated by Diptera, Annelida, and Crustacea. There were detectable differences in drift density among the transects and between day and night surveys. There was a noticeable diel periodicity to both drift densities and composition, with average drift densities for night samples greater than the densities for day samples. The following taxa showed noticeable increases in densities at night: Diptera, Trichoptera, Ephemeroptera, Annelida, and Crustacea.

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TABLE 1

SAMPLING DATES FOR MACROINVERTEBRATE DRIFT IN THE SAVANNAH RIVER IN THE VICINITY OF VOGTLE ELECTRIC GENERATING PLANT. DISCHARGE MEASURED AT JACKSON, SOUTH CAROLINA, USGS GAGING STATION (GAGING STATION 02197320)

Date	Time of Sampling	Discharge m^3/s	Discharge ft^3/s
09-10-80	Night	212	7490
09-11-80	Day	194	6840
10-09-80	Night	176	6200
10-10-80	Day	183	6450
11-06-80	Night	198	7000
11-07-80	Day	197	6960
12-09-80	Night	182	6430
12-10-80	Day	201	7100
01-13-81	Night	216	7610
01-14-81	Day	213	7530
02-12-81	Night	442	15600
02-13-81	Day	396	14000
03-18-81	Night	197	6940
03-19-81	Day	204	7210
04-14-81	Night	171	6030
04-15-81	Day	168	5920
05-12-81	Night	156	5500
05-12-81	Day	156	5500
06-09-81	Night	209	7390
06-09-81	Day	209	7390
07-01-81	Night	147	5200
07-01-81	Day	147	5200
08-05-81	Night	153	5410
08-05-81	Day	153	5410

TABLE 2

ANALYSIS OF VARIANCE AND DUNCAN'S MULTIPLE RANGE TEST FOR DIFFERENCES IN LOG_{10}(DENSITY) OF SAVANNAH RIVER DRIFT. UNDERLINED VALUES IN DUNCAN'S MULTIPLE RANGE TEST DO NOT DIFFER SIGNIFICANTLY FOR $\alpha = 0.05$

Analysis of Variance

Source	df	ss	ms	f	P > f
Month	11	52.05	4.73	37.91	0.0001
Transect	2	0.61	0.31	0.61	0.0897
Day-Night	1	1.70	1.70	13.6	0.0003
Month*Transect	22	1.96	0.09	1.96	0.8224
Day-Night* Month	11	1.70	0.16	1.24	0.2616
Day-Night* Transect * Month	2	0.44	0.22	2.41	0.624
Error	213	26.59	0.124		
Total	284	86.5			

Duncan's Multiple Range Test

Months:

Feb. Apr. Mar. May Dec. Jan. June Nov. Oct. Sep. Aug. July

Transects:

151.2 150.9 150.6

Day-Night:

Night Day

TABLE 3

AVERAGE DAILY MACROINVERTEBRATE DRIFT DENSITIES IN THE SAVANNAH RIVER FROM SEPTEMBER, 1980, THROUGH AUGUST, 1981. DRIFT DENSITIES ARE THE ESTIMATED NUMBER PER 1000 CUBIC METERS

Month	DIPTERA	TRICHOPTERA	EPHEMEROPTERA	COLEOPTERA	ODONATA	PLECOPTERA	HEMIPTERA	MEGALOPTERA	ANNELIDA	MOLLUSCA	CRUSTACEA	MISCELLANEOUS	Total
9	294	414	254	30	19	a	6	5	36	27	12	46	1143
10	574	288	128	31	14	a	a	a	100	27	16	56	1234
11	786	254	37	20	13	5	6	a	238	32	22	76	1489
12	851	195	58	13	32	18	6	a	477	21	224	132	2027
1	2173	122	63	12	36	55	72	a	1937	68	120	518	5176
2	3142	1443	1766	107	116	82	35	14	4892	81	4616	1003	17297
3	2205	367	95	22	20	56	18	6	5300	36	504	560	9189
4	1202	187	74	24	9	117	4	11	5955	21	50	228	7882
5	1560	318	76	36	12	125	11	6	3287	75	180	263	5949
6	618	228	116	66	8	18	10	4	426	25	24	47	1590
7	424	182	110	26	16	a	5	7	110	33	30	40	983
8	298	301	104	30	25	a	17	15	66	16	14	38	924

a- No species collected.

TABLE 4

AVERAGE MACROINVERTEBRATE DRIFT DENSITIES FOR NIGHT SAMPLES IN THE SAVANNAH RIVER FROM SEPTEMBER, 1980, THROUGH AUGUST, 1981, DRIFT DENSITIES ARE THE ESTIMATED NUMBER PER 1000 CUBIC METERS

Month	DIPTERA	TRICHOPTERA	EPHEMEROPTERA	COLEOPTERA	ODONATA	PLECOPTERA	HEMIPTERA	MEGALOPTERA	ANNELIDA	MOLLUSCA	CRUSTACEA	MISCELLANEOUS	Total
9	438	670	442	35	23	a	12	a	46	37	15	54	1772
10	565	331	161	33	13	a	a	a	77	18	11	47	1256
11	894	339	78	18	15	10	12	a	316	36	27	69	1814
12	756	241	69	13	12	18	11	a	493	21	367	98	2099
1	3706	188	96	11	59	81	143	a	2814	95	142	722	8057
2	4172	1945	3442	139	173	101	34	a	6181	93	5372	1195	22847
3	2230	499	125	24	27	74	21	13	5054	43	574	588	9272
4	1434	292	91	30	9	182	8	11	6448	23	49	189	8766
5	1903	466	97	49	11	194	10	a	3778	130	227	396	7261
6	634	299	151	108	7	15	14	7	493	21	33	62	1844
7	579	229	133	26	12	a	9	(a)	98	54	31	27	1198
8	350	398	154	39	32	a	17	19	74	23	17	50	1173

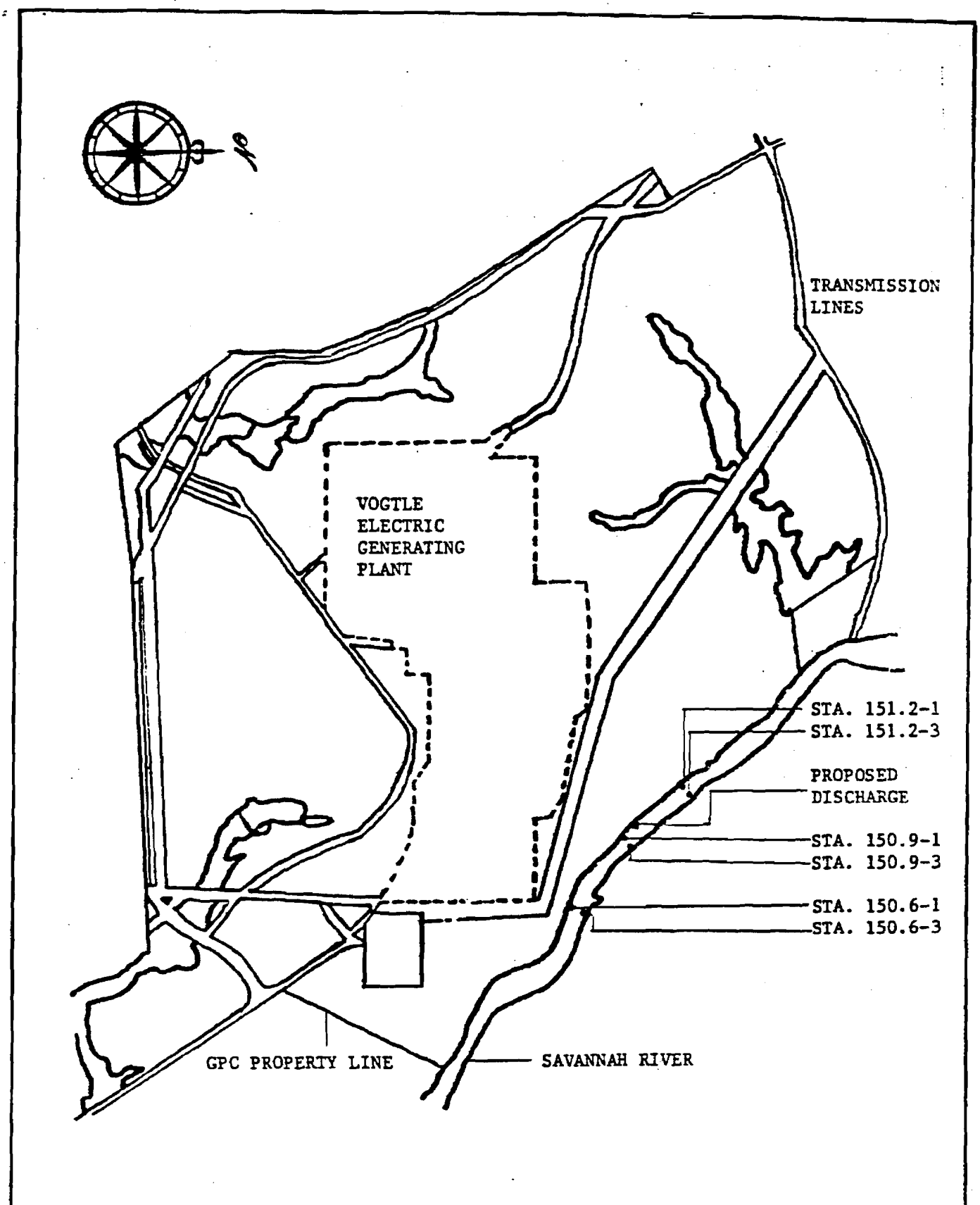
a - No species collected

TABLE 5

AVERAGE MACROINVERTEBRATE DRIFT DENSITIES FOR DAY SAMPLES IN THE SAVANNAH RIVER FROM SEPTEMBER, 1980, THROUGH AUGUST, 1981. DRIFT DENSITIES ARE THE ESTIMATED NUMBER PER 1000 CUBIC METERS

Month	DIPTERA	TRICHOPTERA	EPHEMEROPTERA	COLEOPTERA	ODONATA	PLECOPTERA	HEMIPTERA	MEGALOPTERA	ANNELIDA	MOLLUSCA	CRUSTACEA	MISCELLANEOUS	Total
9	151	158	65	26	15	a	a	9	25	17	9	39	514
10	584	244	95	29	16	a	a	a	125	36	20	66	1214
11	677	168	56	21	11	a	a	a	161	27	17	82	1220
12	946	148	47	13	51	17	a	a	461	21	81	165	1950
1	640	55	30	12	14	28	a	a	1060	40	97	314	2290
2	2111	941	89	75	58	62	35	27	2602	69	3860	811	11740
3	2180	174	65	19	14	37	16	a	5546	29	435	531	9046
4	969	82	57	19	9	52	a	10	5462	19	51	266	6756
5	1216	169	55	22	13	56	11	11	2796	20	134	130	4633
6	601	156	81	25	10	20	6	a	358	29	16	32	1334
7	268	135	86	25	19	a	a	14	122	11	30	53	763
8	246	204	53	21	18	a	17	11	58	10	11	25	674

a - No species collected



Georgia Power

VOGTLE
ELECTRIC GENERATING PLANT
UNIT 1 AND UNIT 2

LOCATION OF VEGP DRIFT SURVEY STATIONS

FIGURE 1

433-9