1971

Validation Studies at Locomotive Springs, Curlew Valley Validation Study

J. Anne Holman

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1970

PROGRESS REPORT

VALIDATION STUDY

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J. Anne Holman

Utah State University

Logan, Utah

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J. Anne Holman, Utah State University, Logan, Utah

Collection of data from two ponds, Off and Sparks, at the Locomotive Springs site began March, 1970. There were a total of 23 trips made. These were made weekly through May and then were changed to twice a month when stable summer conditions were established. The trips are now monthly during the winter months. The collection and processing of samples is the responsibility of I. Walkiw assisted by M. Brooks.

Starting in June, one trip a month was extended over two days in order to collect primary production data via diurnal oxygen pulse in polyethylene tubes. (Kemmerer and Neuhold, 1969.) These collections have been continued monthly except for August when bad weather made roads impassable. Table 1 gives dates of collection trips and data collected on each trip.

Table 1. Collection Trips Inventory -- Off Spring

	Month Days	Year	Bottom Samples (Ekman)	Invertebrates (Core)	Invertebrates Dry weights (Core)	Chemicals	Temperature	Plankton	Primary Production Tubes	Chlorophyll	Macrophyte Dry Weights (Core)	Planktonic Bacteria	Mud Bacteria	Fish Branding	Comments
	03-10	70	D R Y	R U N								X			
1	03-31	—	X												
2	04-07		X			X	X					X	X		
3	04-14		X			X	X	C-B X							
4	04-21		X			X	X	C-B X		X		X			
5	05-05		X			X	X								
6	05-12				X	X	X	*Measure X		X					
7	05-21		X		X	X	X	X							
8	05-28		X		X	X	X	X		X					
9	06-11		X		X	X	X	X	X	X					
10	06-25		X		X	X	X	X							
11	07-08-10		X		X	X	X	X	X			X	X		
	07-15						--Thermograph Installed--								
12	07-23		X	X		X		Pump & net X		X	X			X	
13	08-05-07		X			X		X		X				X	Mapped Off
14	08-20			X		X		X		X	X	X	X		
15	09-02-04			X		X		X	X	X					
16	09-16			X		X		X		X	X				
	09-17													X	
17	10-13-15			X	X	X		X	X	X	X	X		X	
18	11-13			X				X		X	X	X		X	
19	11-21-23					X		X	X						
20	12-08											X		X	

Solar radiation data will be obtained from equipment set up on terrestrial validation site.
Flow rate data is being obtained from USGS headquarters SLC.
*Measure - measured amount of water dipped into plankton net.
C-B - Clarke-Bompus plankton net.

Validation Studies at Locomotive Springs, Curlew Valley (Continued)

All samples were returned to the laboratory for processing except for the dissolved oxygen determinations for the primary production tubes. These were run in the field. All other dissolved oxygen samples had reagents added in the field and were placed on ice for the return trip, then titrated on arrival at the lab. All samples for chemical test were also transported on ice and processed on arrival at the lab in Logan. Materials and organisms to be dried and weighed were picked from unfixed samples the same day of collection. Plankton samples were fixed in 5% formalin on site and counted later. Ekman dredge and Macan core samples were preserved in 5% formalin with Phloxine B dye added (enough to leave fluid around the sample a definite pink) and picked at least 3 days later in order to insure dye penetration into all animal matter.

From Table 1 it is noticeable that techniques have changed during the year. Each change was necessary in order to meet a specific problem or condition. When it was apparent that very little, if any, change occurred on a weekly basis during the late spring and early summer, the sampling schedule was changed to bimonthly. When the extreme conditions of winter made sampling schedules unpredictable, it was felt advisable to limit trips to once a month.

Three major changes were made in equipment. The traditional Ekman Dredge was discarded for a modified Macan core sampler and the Clarke-Bumpus plankton net for a diaphram suction pump and regular plankton net. Both of these changes were necessitated by the massive growth of the rooted Potamogeton and the filamentous algae Spirogyra. These formed mats from top to bottom throughout the pond, leaving open water directly over the main cones. In our situation, both new apparatus have proved to be far superior to the former equipment. The use of thermister readings for temperature at each visit was necessary because of the late arrival of two science associates, three lead thermographs, and the need to construct locked metal boxes which were buried at pond side in order to provide protection from vandalism for the equipment.

A quick-freeze mud corer was tried once but discarded as impractical for constant use. However, it will be tried again to determine depth of oligocheate penetration into the bottom mud.

Maps were drawn for both Off (Fig. 1) and Sparks (Fig. 2) using plane tables. Attempts were made to map the bottom of each pond by the use of underwater photographs but this was rendered useless by the overgrowth of the vegetation mats. During the spring runoff period four cones were noticed in Off Spring. All but two of these disappeared as the summer progressed.

Dr. Clair Stalnaker is in charge of the fish productivity studies. In November of 1969 Off Spring was poisoned (Rotenone) without our knowledge. All fish were removed. In early June electrofishing techniques revealed no fish in Off. On June 12th, using a backpack shocker, 360 Gila atraria were taken from the channel below the flow meter exit from Off. These were measured and weighed before being released into Off Spring. The mean length was 63.3 mm and mean weight was 3.685 gms. Monthly sampling was started in July using electrofishing techniques. Because of the problems of getting the shocked fish out of the mats of vegetation, traps were used beginning in August along with electrofishing. A total of 200 fish have been marked and released back into the spring.

Length measurements were taken from all fish captured and weights were recorded for those which were branded. Five of the 200 branded fish were later found dead. In September, 35 fish were killed during sampling and were preserved for later examination of gut content, etc. However, lengths and weights were recorded while these fish were fresh. All data has been sent to the central office of the Desert Biome and has been stored on computer tape. A program for population estimation has been written by the modeling group but has not been used to date since only three recaptures have been recorded during the five sampling periods.

Large numbers of tadpoles were seen during fish shocking procedures during the late summer months. A method for sampling these is being worked out. Work has begun in the difficult area of bacterial production and decomposition in the ponds. Dr. Fred Post has come up with interesting preliminary results and is now in the process of developing better techniques for estimation of bacterial biomass and activity, using rates of radioactive substrates uptake correlated to numbers of cells and metabolic rate of the cells. A full description of this work may be found in his proposal, "Nutrient Uptake by Aquatic Bacteria" submitted this fall for review. Results from samples taken from Off may be found in Table 2. It is interesting to note that there are few planktonic bacteria but large numbers are found in clouds around submerged plants and algae. Mud samples yield great numbers of bacteria; many that are difficult to grow. The mud bacteria appear to be metabolically more active than the planktonic bacteria, but this may just indicate the larger numbers present in the bottom ooze.

Dr. Ray Lynn is working in cooperation with Dr. Post on the radioactive substrates techniques since these offer a way of finding out the flow of energy from the plants and algae directly to the bacteria. Dr. Lynn has also submitted a research proposal in this area ("Nutrient Cycling in Selected Freshwater Algae.").

Validation Studies at Locomotive Springs, Curlew Valley (Continued)

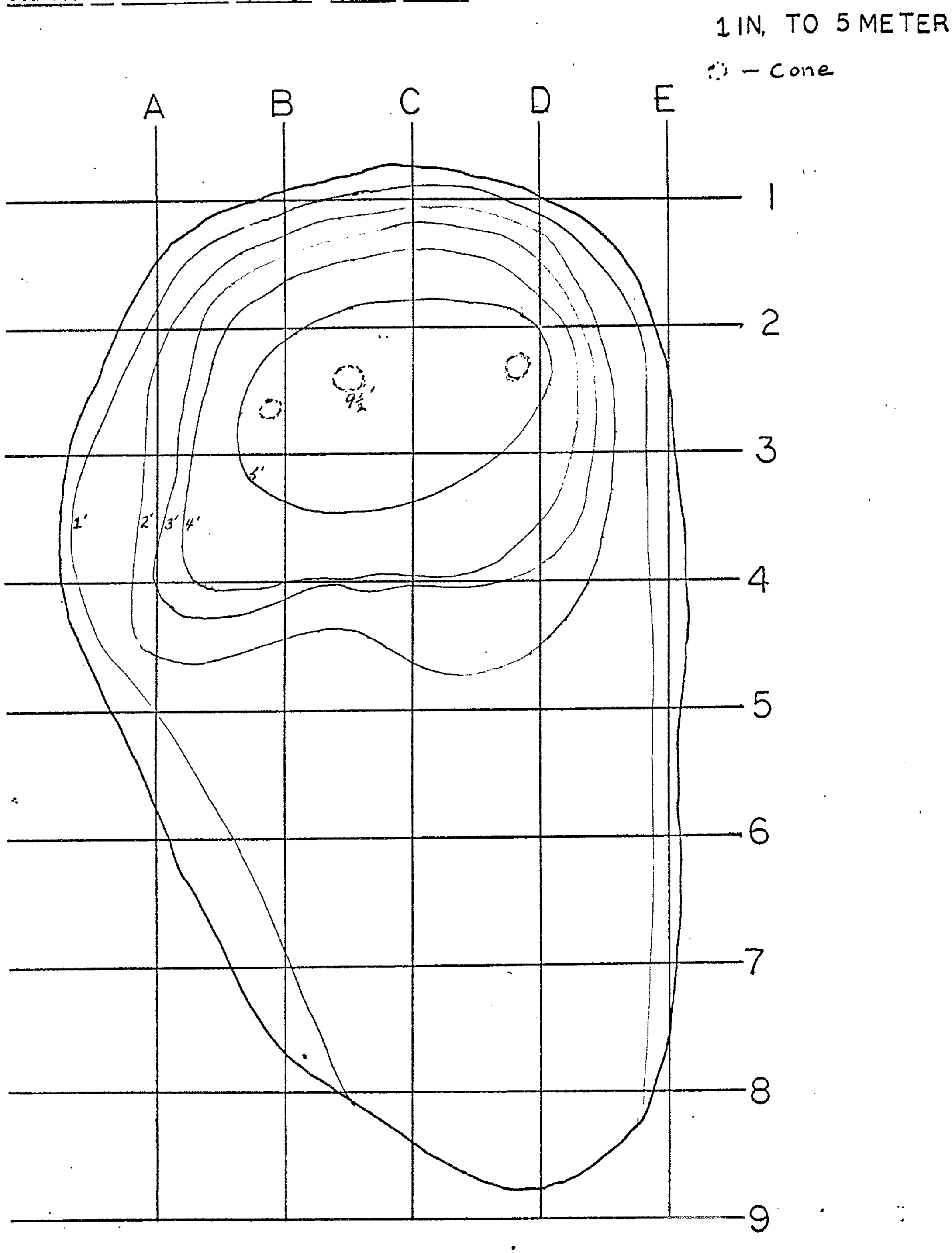

Figure 1. Map of Off Spring using plane tables.

Validation Studies at Locomotive Springs, Curlew Valley (Continued)

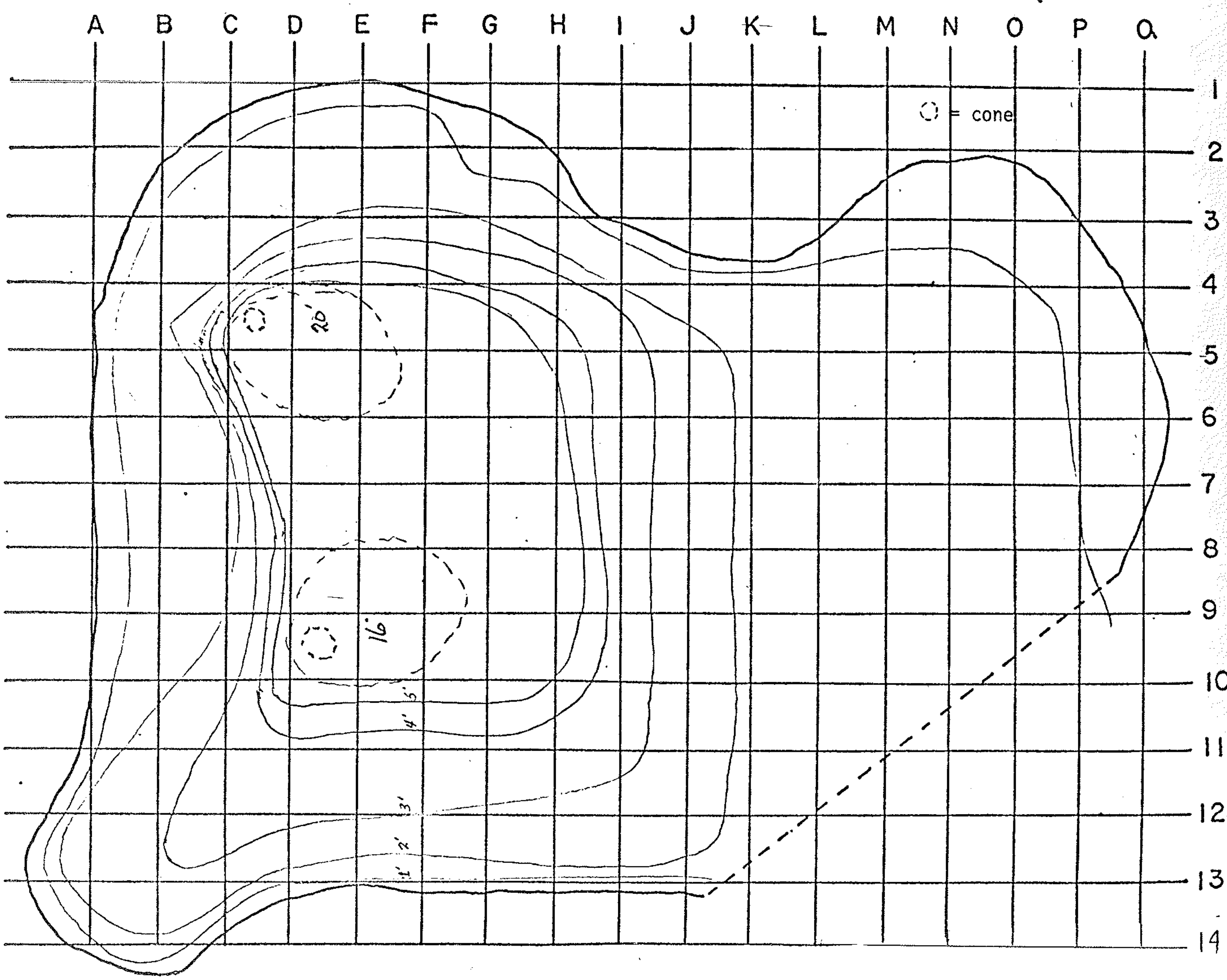

Figure 2. Map of Sparks Spring using plane tables. 1/2 inch to 5 meter.

Validation Studies at Locomotive Springs, Curlew Valley (Continued)

During August and September a short exploratory experiment was run by Michael Brooks (Laboratory Assistant) on the effects of day length on *Spirogyra* growth. Since temperature and chemicals in the water changed very little during the growth period, it was felt that photoperiod might control the appearance of the *Spirogyra* mats.

Conditions of the pond were duplicated as much as possible. One gram wet weight of *Spirogyra* was placed in a 250 ml flask containing 150 ml of fresh water from Off Spring. The flasks were placed in a Sherer controlled environment chamber set at a 15°C night temperature and 18°C day temperature. The light intensity was 200 ft candles approximating that found at 6 feet below the surface of the pond.

Table 2. Bacterial Information -- Off Spring

Date of Sample	PLANKTON Plate Count[1] with algae	PLANKTON Plate Count[1] without algae	MUD Total Plate Count	Total MPN[2]	MPN NO_3 reducers
3-11-70	90,000	1,700		1.5×10^6	3.6×10^5
4-1		3,600			
4-21		29,000			
7-9		1.5×10^5	2.5×10^7		
8-20	60,000	5,000	6.5×10^6		
9-4*		41,000			
10-15		6,300			
11-13		8,000			
12-8		4,000			

*Coliforms 3.5/ml

[1]Surface plating on Plate Count Agar at 20°C

[2]MPN in Nitrate Broth

Four different day lengths of 9, 10, 11, and 12 hours of light were used, each lasting one week. At the end of each week the material was examined microscopically and for chlorophyll content. For the sample period of August 1 through September 20, the average chlorophyll content of pond samples was .869 micrograms chlorophyll per liter. *Spirogyra* would not grow in laboratory conditions that we produced, but it would maintain itself. Under 12 and 11 hours of light there was no change in the *Spirogyra*. With only 10 hours of light there was slight decrease in chlorophyll to .762 mg/l whereas under 9 hours of light chlorophyll dropped to .49 mg/l. Microscopically, this set of *Spriogyra* showed yellow cells which appeared to be dying. This 9-hours-of-light material was then placed under 12 hours of light for one week and an increase in chlorophyll with an improved microscopic appearance resulted. This might suggest that *Spirogyra* requires at least 10 hours of light to maintain itself.

These results may explain the decrease of chlorophyll and the early browning of the *Spirogyra* mats on the west side of Off Spring. The high bank of the west side causes a shadow to fall cutting the sunshine hours by approximately two hours from the amount received by the east side.

Much time has been spent by Irene Walkiw (Research Assistant) in organizing data set coding forms by which raw data is now fed directly to the computer programs. She has also written abstracts of collection techniques used for each data set (see Table 3). Copies of these abstracts and coding forms are available from the Desert Biome Office.

During the past year two literature reviews were undertaken; one by Robert Kramer "A Search of the Literature for Data Pertaining to the Bioenergetics and Population Dynamics of Freshwater Fish," and one by Anne Holman, "A Literature Search for Biological and Physical Parameters for Use in Estimation of Zooplankton Production." These were summarized for the Desert Aquatics Group meeting in Pocatello, Idaho, in September and published by the Desert Biome Office, Utah State University. These will be revised and

Validation Studies at Locomotive Springs, Curlew Valley (Continued)

Table 3. Data Sets for Collection Techniques

Data Set Code			Name of Data Set	Abstract	Coding Form
1.	A3UHQ01 A3UHQ02	(Spa) (Off)	Survey of Benthic Aquatic Invertebrates	X	X
2.	A3UHQ02 A3UHQ12	(Off) (Spa)	Macroinvertebrate Counts (core samples)	No	No
3.	A3UHQ03		Dry Weights of Macroinverte-brates (calibration data)	X	X (but have not returned from printe
4.	A3UHA04 A3UHQ14	(Off) (Spa)	Physical & Chemical data	X	X
5.	A3IIHQ05 A3UHQ15	(Off) (Spa)	Determinations of Phytoplankton and Zooplankton Concentrations	X	X
6.	A3UHQ06 A3UHQ16	(Off) (Spa)	Primary Productivity	X	X
7.	A3UHQ07 A3UHQ17	(Off) (Spa)	Dry Weights of Macrophytes (core samples)	In prep.	In prep.
8.	A3UHQ08 A3UHQ18	(Off) (Spa)	Chlorophyll Determinations	In prep.	In prep.
9.	A3UHQ09 A3UHQ10	(Spa) (Off)	Air and Water Temperature	X	None-Graphs sent dir. to Central Off
10.	A3UNB01 A3UNB02	(Off) (Spa)	Gauge Height and Discharge	X	None-Records sent dir. to Central Off by USGS
	A3UKE01	(Off)	Fish Productivity	X	X

Meetings for all investigators and research assistants involved with the Locomotive Springs study have been held monthly or more frequently when needed. These meetings have provided an opportunity to discuss the overall goals of the Biome and more specifically of the aquatic program. As data has been processed by the computer, attempts are being made to work with the modelers in putting the data into a workable model. This phase of the study has been slowed down considerably by lack of enough people to handle raw data being fed into the programming department of the Biome. This situation has been taken care of so that more rapid progress is hoped for in the future.

A major meeting of aquatic investigators from all research sites in the Desert Biome was held September 9 and 10 at Idaho State University in Pocatello, Idaho. Drs. Holman, Kramer, Lynn, Neuhold, Post, and Stalnaker attended along with Miss Walkiw.

An outcome of our own monthly meetings, the meeting in Pocatello, and the NSF review committee's report is the realization that more work must be done on the interface between the aquatic and terrestrial systems. Work has begun on quantifying nutrients blown or washed by rain or runoff into the ponds. The area of muskrat and waterbird contributions to the ponds and the return of nutrients by these vertebrates back to the land has yet to be tackled.

The data which has been processed is from Off Spring and is presented in Table 4. Major organisms encountered at the Springs are listed below.

Phytoplankton

Closterium

Coccaneis, *Suriella*

Zooplankton or in Mats

Cladocera

Copepods

Validation Studies at Locomotive Springs, Curlew Valley (Continued)

Mats
- Spirogyra
- Cladophora
- Potamogeton
- Ruppia maritima

Hyalella azteca
Corixidar
Rotifera

Benthos
- Oligochaeta
- Chironomidae
- Hyalella
- Nematoda
- Ischnura
- Physa
- Hirudinea
- Callibaetis

Vertebrates
- Utah chub
- Carp
- Rainbow Trout (few stocked previously)
- Rana pipiens
- Muskrat (few)
- Waterbirds

Table 4. Data for Off Spring, March - November 1970

Date	mg/L Chlorophyll	Primary Prod. mid depth only $mg\ O_2/m^2/day$ gross	net	°C Mean Temp.	Mean pH	ppm Mean O_2	ppm Mean NO_3	ppm Mean NO_2	ppm Mean PO_4
3- -70				15	7.8	8.8	0.74	0	0
4-21-70	Top .0606 Bottom .0404			15.4	7.7	6.86	1.16	0	0.21
5-11-70	Top .5633 Bottom .0843								
5-14-70	Top .4924			15.9	7.7	8.4	1.17	0	0.05
5-25-70									
6-11-70	Top .319	1.16	1.61	16.5	7.2	6.9	0.83	0	0.06
6-25-70	Top .233 (7-8-70)	11.85	13.11						
7-23-70	Spiro. .168 Plant .9332			16.5	7.4	5.56	1.16	0.01	0.3
8-7-70	Spior. .193 Plant .869			16.0	7.4	7.4	.105	0.05	0.09
8-21-70	Spiro. .1842 Spiro. .8432								
9-3-70	Sprio. .1710	7.57	7.93	16.0	7.7	12.0	1.02	0.01	0.13
9-17-70	Sprio. .2710								
10-20-70	Spiro. .27 (10-14-70)	9.54	12.49	15.0	7.3	7.43	.106	0	0.09
11-22-70	Spiro.	3.65	6.04	9.0	7.4	9.26	1.1	0	0.03

Sprio. = Spirogyra

Literature Cited

Kemmerer, Andrew J., J. M. Neuhold. 1969. A method for gross primary productivity measurements. Limnol. and Ocean. 14,4:607-610.

Macan, T. T. 1964. The Odonata of a Moorland fishpond. Int. Revue. ges. Hydrobiol. 49:325-360.