Bull. Inst. Zool., Academia Sinica **17**(1): 43-59 (1976)

ECOLOGICAL STUDIES OF FISHPONDS IN CHUPEI

YAO-SUNG LIN
Dept. of Zoology, National Taiwan University
Taipei, Taiwan, R. O. C.

Received for publication, June 26, 1978

ABSTRACT

Yao-Sung Lin (1978). *Ecological studies of fishponds in Chupei.* Bull. Inst. Zool., Academia Sinica, **17**(1): 43-59. Ten fishponds were chosen from Chupei Fishery Institute to study the relationship among the amount of chlorophyll, zooplankton, gross production and environmental factors. In July these ponds were stocked with fry of silver carp, common carp, grass carp, bighead and crucian carp. Except two control ponds, the other eight ponds were treated with different fertilizers. From July through October, water samples were taken biweekly for the measurements of various variables. The seasonal variation of chlorophyll, gross production, zooplankton abundance, pH and water transparency were presented. All the variables studied showed no consistent seasonal pattern among the ten fishponds. The variations existed even between adjacent ponds with similar treatment. Whereas the variation of gross production, zooplankton abundance, pH and water transparency were all closely related to the amount of chlorophyll concentration. The mean coefficient of determination suggest that 70% of the variation of transparency in the fishponds could be explained by the chlorophyll concentration. However, the present study failed to show the close relationship of the production of various species of fish on the gross production, chlorophyll concentration and zooplankton abundance.

It is generally believed that fertilization of ponds will increase phytoplankton productivity and subsequent increment in fish production. Increment of fish yield in responses to inorganic fertilizers has a great deal to do with the food production concerned. To increase the fish production in a polyculture pond, a logic procedure would be to increase both phytoplankton and zooplankton. While zooplankton production is dependent on the production of phytoplankton, both of them serve as the food resources for various species of fish. Extensive research in fertilization of ponds have been conducted to secure this sort of information with the hope to increase fish production. Reviews in the literature of artificial fertization of lakes and ponds have been provided by Maciolek[14] and Mortimer and Hickling[17].

Weatherly and Nicolls[24] and Smith[22] found that the addition of nutrients to trout lakes increased phytoplankton and zooplankton populations; and that trout productivity also increased. Goodyear *et al.*[3] demonstrated that the yield of mosquito fish was closely related to gross phytosynthesis. Sreenivasan[23] also showed the same for a series of trophic fisheries.

In Taiwan, Lin and Chen[12] demonstrated the effectiveness of superphospha in increasing the harvest in ponds and reservoirs. From 1969 to 1970, a joint research project was conducted by the Fishery Institute in Chupei and National

Taiwan University to study the pond ecology and effect of fertilizers on fish production. Several papers dealing with various fields have been published by several authors (Lin,[9] Chu *et al.*[2] and Ong[19]). However, the correlation between environment factors and various tropic levels have not been intensively investigated. With phytoplankton-zooplankton-fish interaction in mind, I undertook the present analysis to deal with the relationships among phytoplankton, zooplankton and fish production and the environmental factors in Chupei fishponds.

MATERIALS AND METHODS

The present study was conducted from July to December 1970 in ten fishponds at the Chupei Fishery Institute. The surface areas of these ponds varies from 388 to 1,115 m^2, and mean depths of the pond water ranged from 68 to 84 cm (Table 1). In July these ponds were flooded with well water and then stocked with fry of silver carp, common carp, grass carp, bighead and crucian carp after being drained in June for harvesting the fish crop from the first half of the year.

TABLE 1

Physical characteristics of the ten fish ponds and the total amount of fertilizers applied to each pond.

Ponds No.	Areas (m^2)	Depth of water (cm)	Kind of fertilizer N-P-K	Amount of fertilizer (kg/ha)
A1	485	71	0-18-0	720
A2	1115	83	4-14-2	480
A3	970	84	4- 8-2	480
A4	1067	81	0-18-0	480
A5	611	79	0	0
B1	582	71	0-18-0	720
B2	485	69	4-14-2	720
B3	679	68	0-18-0	480
B4	385	68	4- 8-2	720
B5	388	71	0	0

From July through November, except in control ponds A5 and B5, the other eight ponds were treated with different kind of fertilizers in various doses (Table 1). Fertilizer was applied between 7:00 and 8:00 a. m. on Mondays and Thursdays every week. The rate of application at each time was about one fortieth the total amount listed in Table 1. The fertilizer was completely dissolved in water, then dispersed to the surface of water.

The pH, water transparancy, phosphorus concentration and biological changes in the pond water were monitored by various methods at bi-weekly intervals from July to Oct. 1970. On each date, starting from 10 a. m., water sample was taken at the center of each pond by a cylinder 100 cm in height and 35 cm in diameter; transparancy was measured in situ with a 20 cm Secchi disc. The following variables were measured within 3 hours after the samples were taken: pH of water was measured with a Darmark pH meter; phosphorous was determined by the modified single solution method (Murph and Riley[18]); chlorophyll a, b and c were measured by the method described by Richard and Thompson[20], and the summation of chlorophyll concentration. Zooplanktons were collected by filtering the water samples taken by cylinder through a No. 20 mesh net. They were resuspended in water in a graduated test tube, and the volume of zooplankton precipetated at the bottom of tube will be measured. Oxygen content at consecutive sunrises and the intervening sunset were measured at depths 10 cm below the surface and 10 cm above the bottom for calculation of gross production (McConnell[15]). Fishes were harvested in December and the total fish production recorded.

The various tropic productions and environmental variables measured in this study were commonly assumed to be interrelated. Although the number of observation available from the ten fish ponds is too small for investigation of the aggregate effects of many factors, it is still worthwhile to evaluate the data on hand from the standpoint of correlation and simple regression analysis. Regression and correlation coefficients among zooplankton, chlorophyll, gross production, pH and water transparancy were calculated and their significance were tested for each sampling date of the variables in the ten fish ponds.

To examine the relationship of fish yields with the various production variables, the mean values of the chlorophyll concentration, primary production and zooplankton density from July through October were calculated as the independent variables. The production of silver carp, grass carp, crucian carp, common carp and bighead were dependent variables.

RESULTS

Environment factors

The mean phosphorus concentration from July to October are shown in Table 2. The highest phosphorus concentration was 0.31 ppm in pond B4 and the lowest of 0.05 ppm was in pond B3. The phosphorus concentration in the other eight ponds varied slightly with a ranged from 0.07 to 0.14 ppm. Lin (1970)[10] indicated that there was a significant correlation between phosphorus concentration and the amount of superphosphate added to these ponds in 1969. However similar relationships was not observed in the second half of the year of 1970. One of the reason was that the variation in the amount of superphosphante enrichments in 1970 was much less than that of 1969. The maximum amount of superphosphate added to the fishponds was 10,240 kg/ha in 1969, while that of 1970 was only 720 kg/ha.

The pH values of the ten fishponds indicated that the pond water was strongly alkalinic, mean pH values ranged from 8.7 to 10.1 (Table 2). In ponds with low pH values throughout the sampling period, e. g. A1, B1 and B3, the pH values varied only slightly during the season. However, in the other ponds that had higher mean pH values, obvious seasonal fluctuation was observed (Fig. 1). Liaw[7] reported that the pH fluctuation was great in fertilized

TABLE 2

The mean values of chlorophyll concentration (Chl.), gross production (G. P.), zooplankton density (Zoop.), pH, phosphorous concentration, water transpancy and production of various species of fish in the ten fishponds.

Pond No.	Chlorophyll (mg/m^3)	G. P. (O_2 $mg/m^3/day$)	Zoop. (ml/m^3)	Fish production (kg/ha)						Environment factors		
				Silver carp	Bighead	Grass carp	Common carp	Crucian carp	Total	pH	PO_4-P (ppm)	water trans. (cm)
A1	10.8	10.4	24.9	204	36	46	97	69	452	8.7	0.15	60
A2	170.2	19.9	57.0	315	26	47	46	51	485	9.7	0.10	27
A3	209.1	24.5	60.5	241	42	29	37	52	401	9.8	0.12	21
A4	206.3	26.2	39.5	261	38	20	25	63	362	10.1	0.14	20
A5	177.7	23.0	95.5	50	54	35	23	21	183	9.9	0.14	30
B1	14.4	9.1	9.1	216	27	41	89	246	619	8.7	0.09	32
B2	104.8	17.5	36.2	563	85	38	85	99	870	9.2	0.12	46
B3	26.0	8.0	9.6	237	4	47	46	99	433	8.8	0.05	50
B4	73.9	18.3	34.8	217	77	24	71	82	471	9.4	0.31	28
B5	127.9	19.6	52.4	343	74	43	26	79	565	9.7	0.07	27

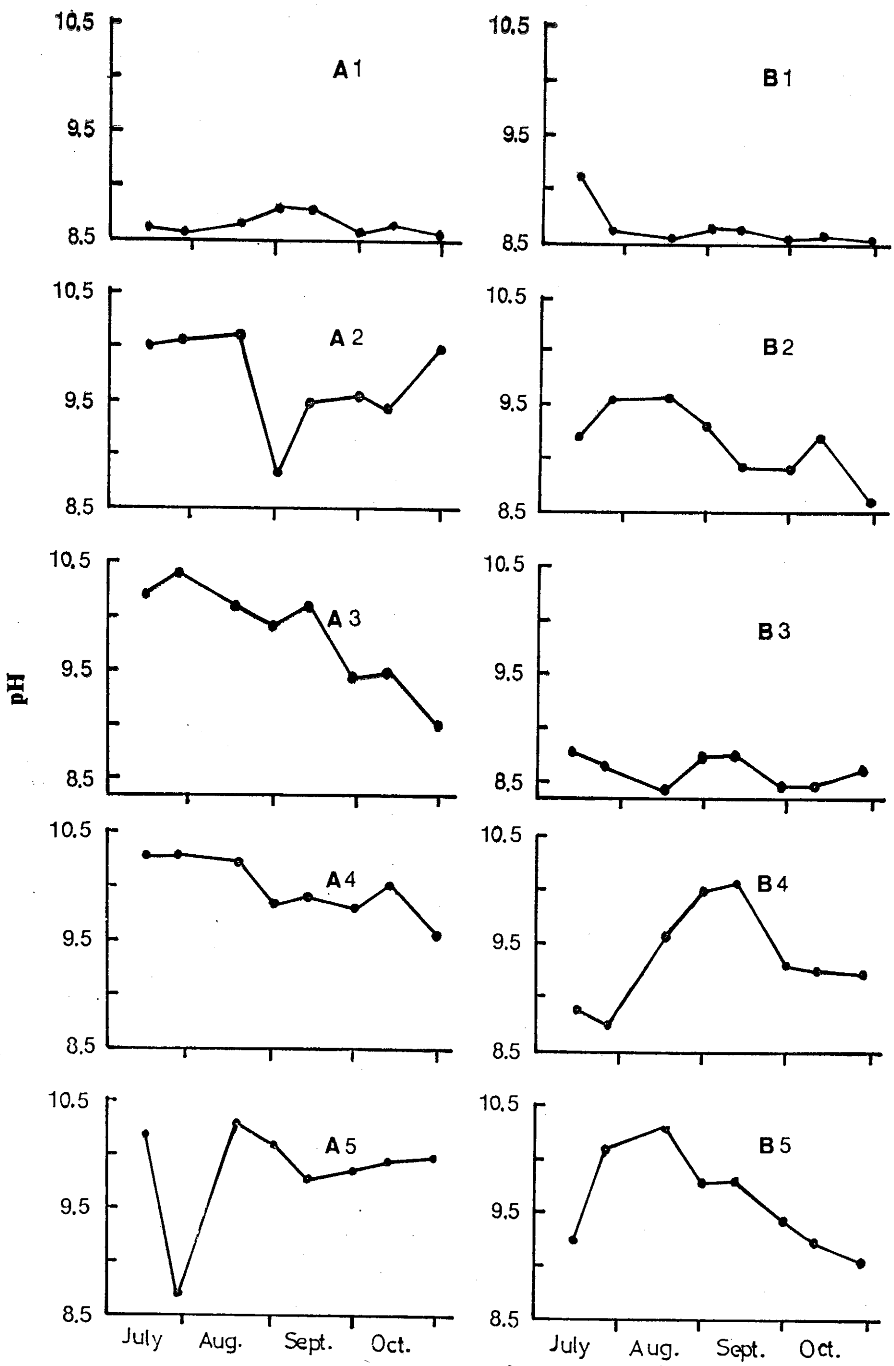

Fig. 1. pH values in the Chupei fishponds from July to October.

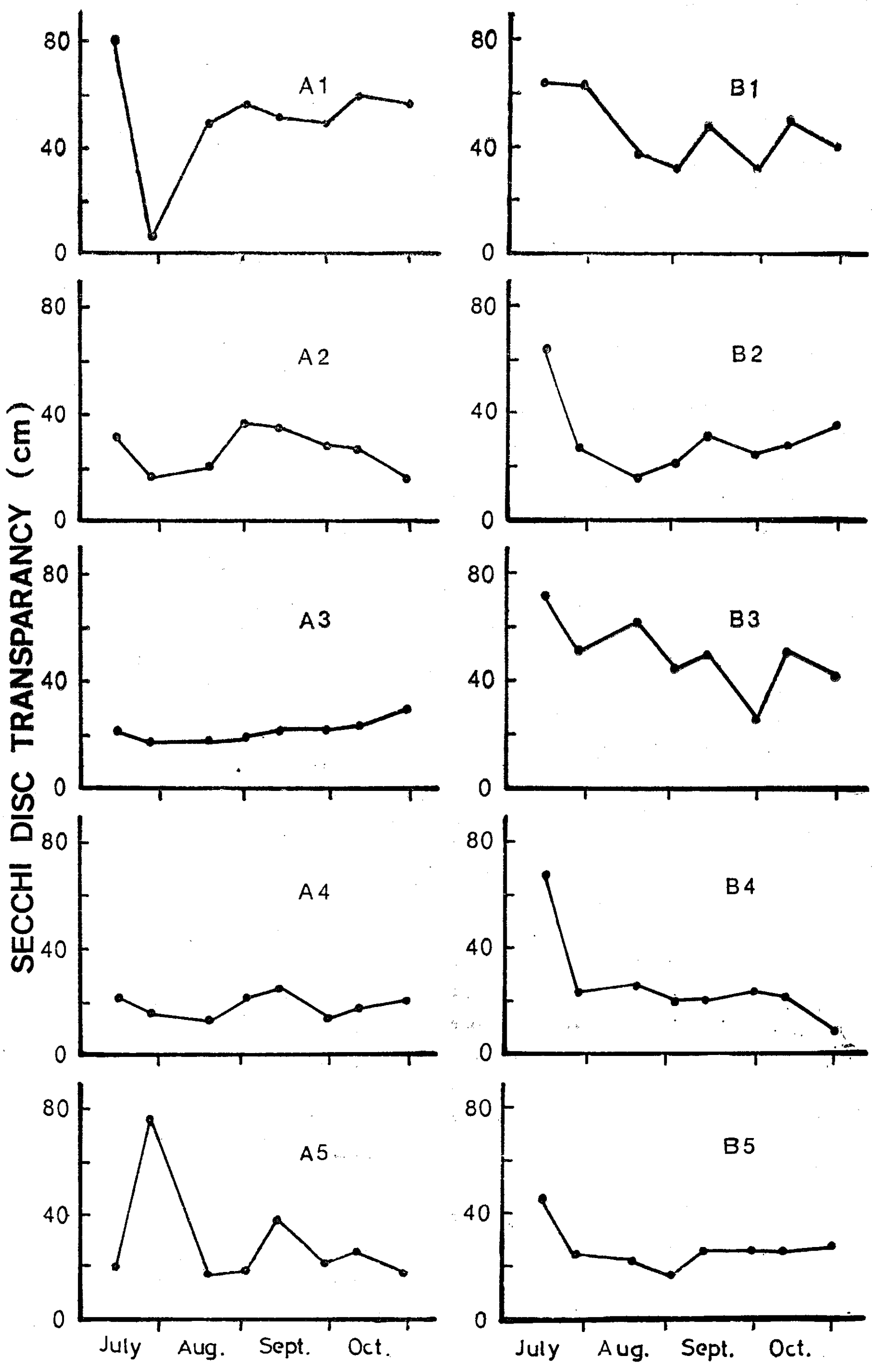

Fig. 2. Secchi disc transparancy in the Chupei fishponds.

ponds. But the data obtained from pond A1 and B1 contradicted Liaw's observation. These two ponds received 720 kg/ha fertilizers yet only slight fluctuation in pH was detected. On the other hand, the fluctuation of pH was great in the two control ponds A5 and B5.

Water transparency reading from Secchi disc was quite low in Chupei fishponds. It ranged from 14 to 80 cm during the experiment period (Fig. 2). Lin[9] suggested that a 25 to 50 cm visibility indicating adequate concentration of phytoplankton and should be maintained by addition of inorganic fertilizers from time to time. Yet the water transparency in the two control ponds ranged from 17 to 76 cm without the addition of fertilizers. This suggested that an adequate phytoplankton concentration can be maintained solely by rich soil fertility.

Biological factors

Chlorophyll

The chlorophyll concentration varied greatly in the ten fish ponds, with the lowest mean value of 10.8 mg/m^3 in pond A1 and the highest of 209.1 mg/m^3 in pond A3 (Table 2). It was also noticed that the chlorophyll concentrations in most of the A-series ponds was higher than that of the B-series ponds. Although Lin[8] demonstrated that enrichment by fertilizers increased the chlorophyll concentration in the fish ponds, such relationship was not obtained in the present study. The chlorophyll in the control ponds (A5 and B5) were much higher than that of ponds A1 and B1 that received superphosphate of 720 kg/ha during the culture period.

No consistent seasonal pattern in chlorophyll concentration was observed among the ponds except between ponds A1 and B1 (Fig. 3). The latter two ponds both happened to have very low chlorophyll concentrations throughout the sampling period. Unexpectedly considerable differences in seasonal variation of chlorophyll concentration was also observed between those ponds that received similar amount of fertilizers or without fertilization (i. e. A1 and B1; A4 and B4; A5 and B5). This may suggest that some factors other than phosphate fertilizers may exert great influence on the phytoplankton population and the consequent chlorophyll concentration.

Gross Production

Gross production varied greatly from pond to ponds, with a mean ranged from 8.0 to 26.2 O_2 mg/m^2/day in these ten fishponds (Fig. 4, Table 2). The mean gross production in the two control ponds A5 and B5 were 23.0 and 19.6 respectively. These values were about two-fold that of pond A1 and B1, which received 720 kg/ha of superphosphate.

Similar seasonal variation patterns were observed between the pairs of A1 and B1, A3 and A4, and A2 and B5 (Fig. 4). However, similarity in gross production pattern was not related to the kind or amount of fertilizers added to the fishponds. For example, ponds A3 and A4 had a similar seasonal pattern although the former received 720 kg/ha of superphosphate enrichment while the latter received 480 kg/ha of mixed fertilizers 4-8-2. Excluding the above mentioned pairs of ponds, the variation of gross production among the remaining ponds were rather great.

Zooplankton

Comparison of the mean abundance of zooplankton among the ten fishponds showed that the highest density occured in A5 while the lowest in B1 (Table 2). The seasonal variation in zooplankton abundance was not consistent among the ten fish ponds (Fig. 5). In ponds A1, B2 and B3, with density of zooplankton less than 5 ml/m^3, the variation of abundance was small throughout the experiment period. Whereas in the ponds A4, B4 and A5, with the mean desity ranging from 7.4 to 8.6 ml/m^3, the fluctuation in abundance varied greatly. In the remaining four ponds, there was a consistent seasonal trend with the highest abundance in late July and decreasing in abundance continua-

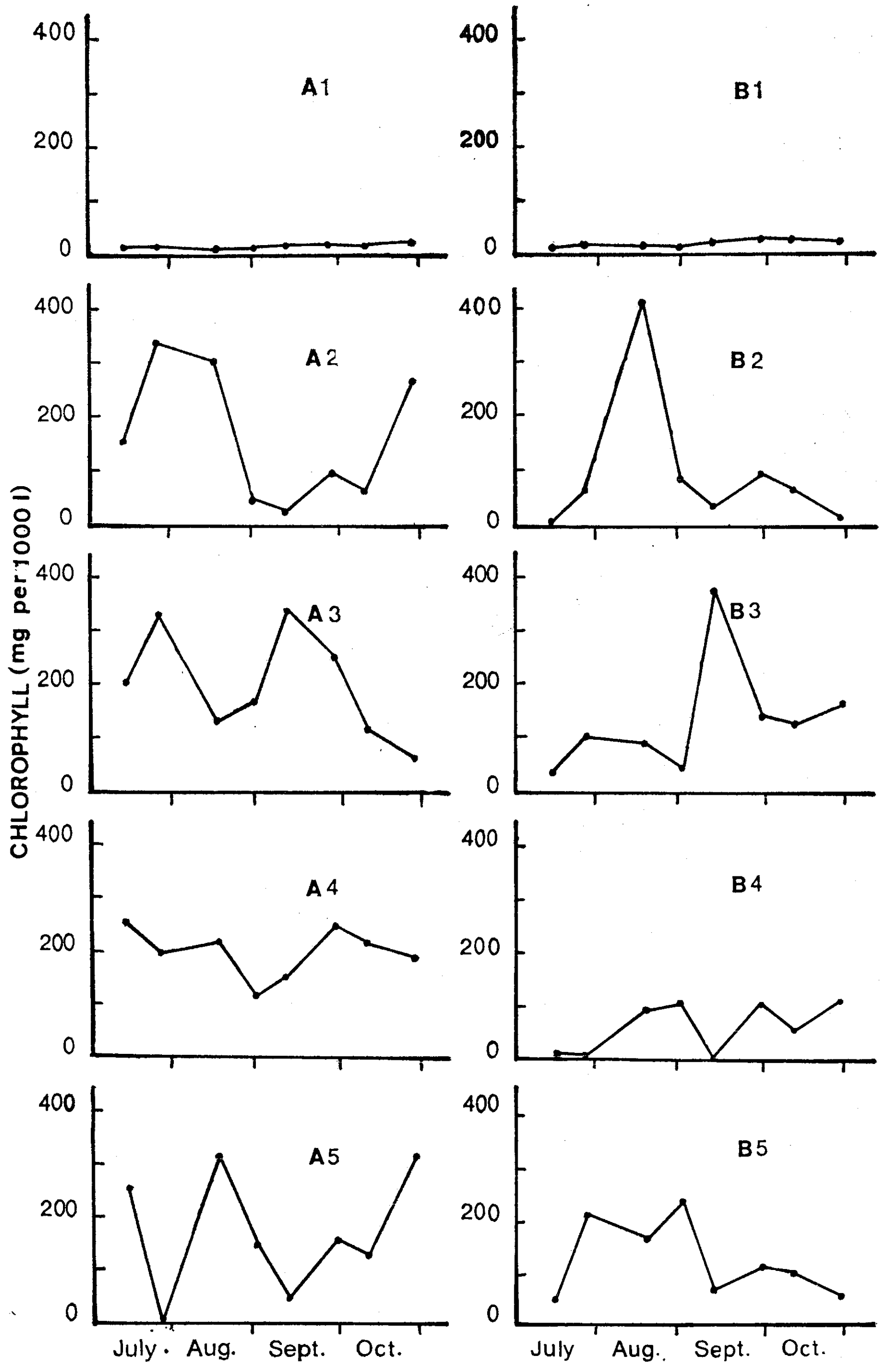

Fig. 3. Changes in chlorophyll concentration in the Chupei fishponds.

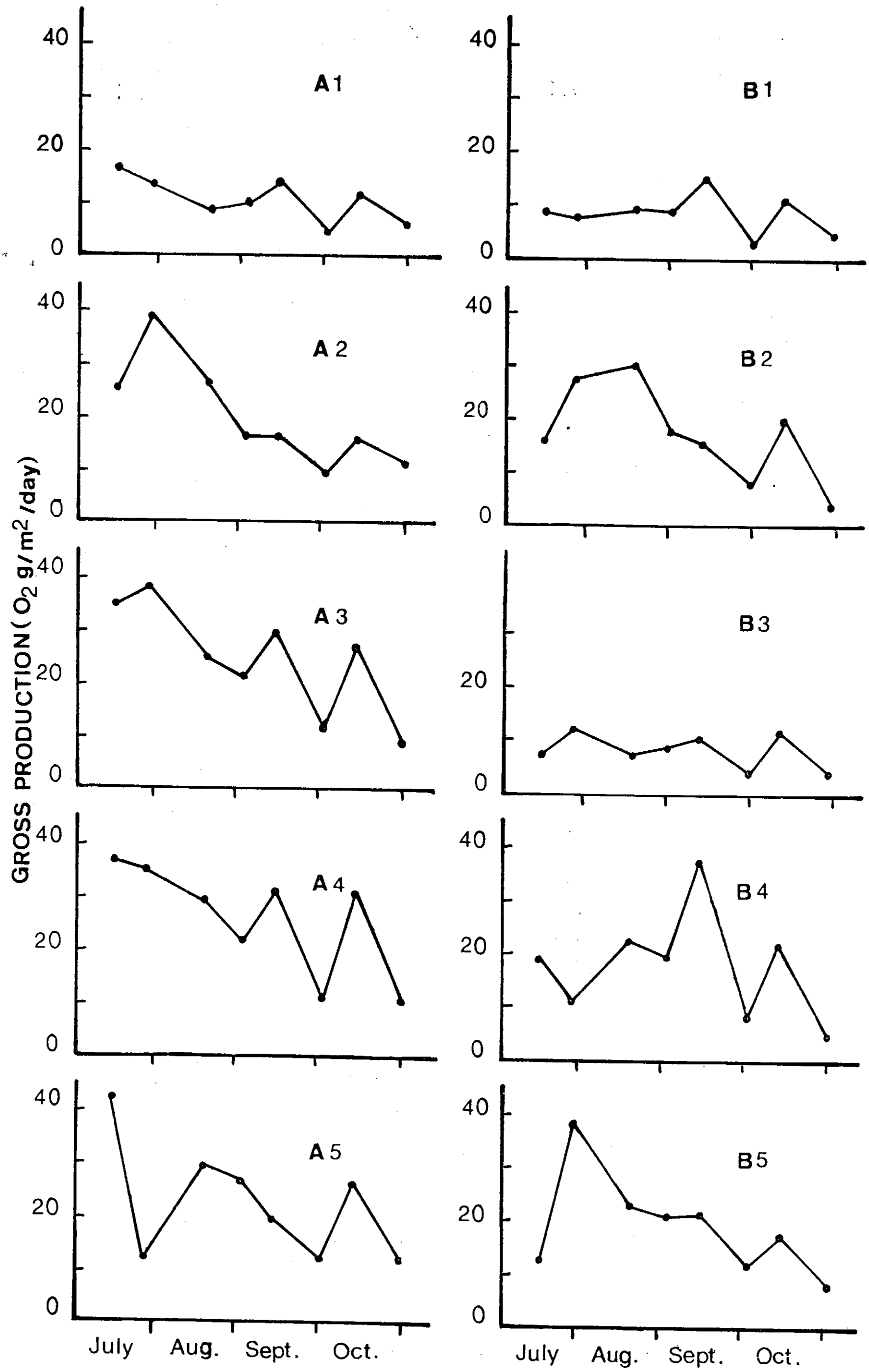

Fig. 4. Changes in gross production in the Chupei fishponds.

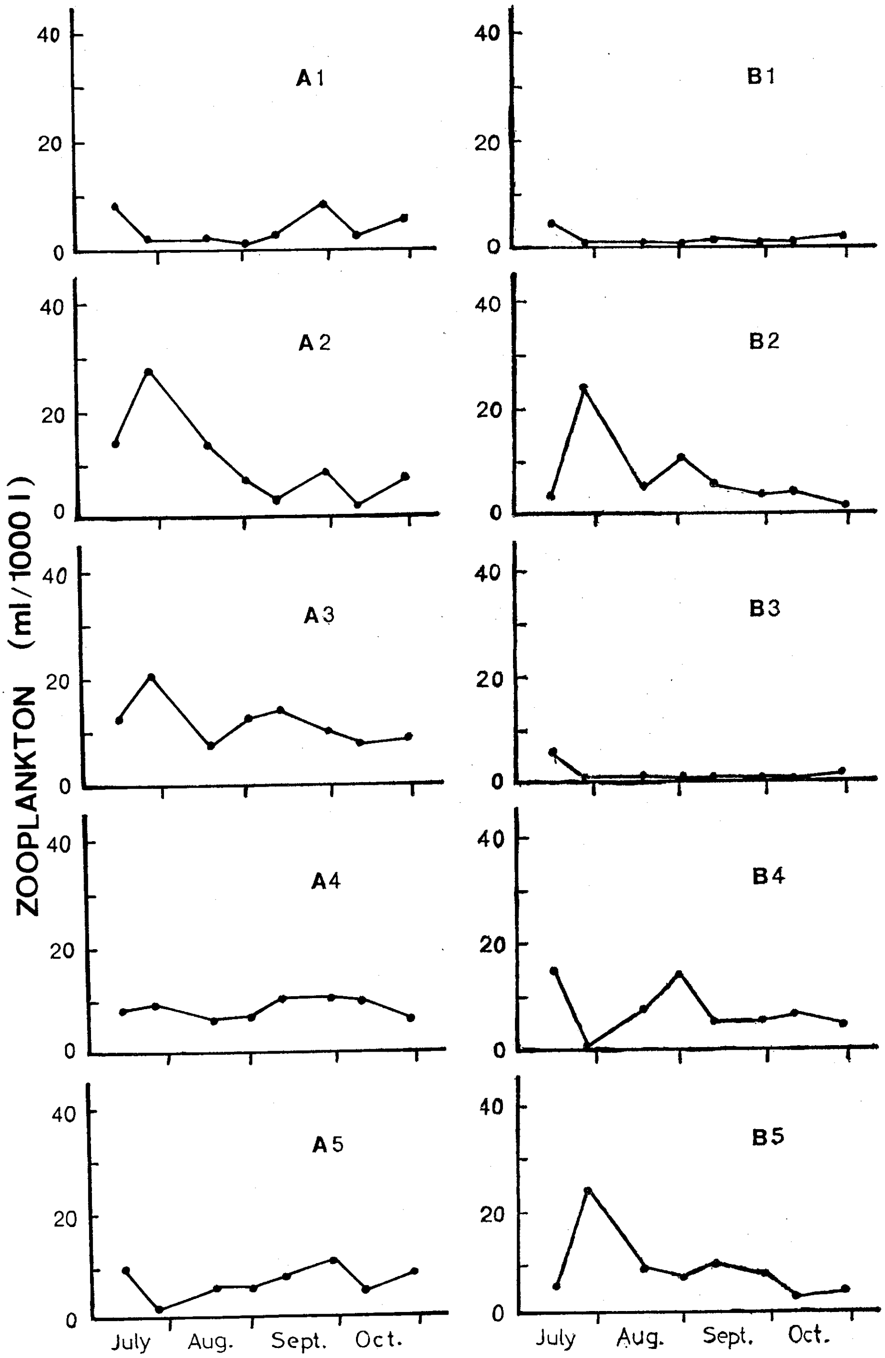

Fig. 5. Changes in zooplankton abundance in the Chupei fishponds.

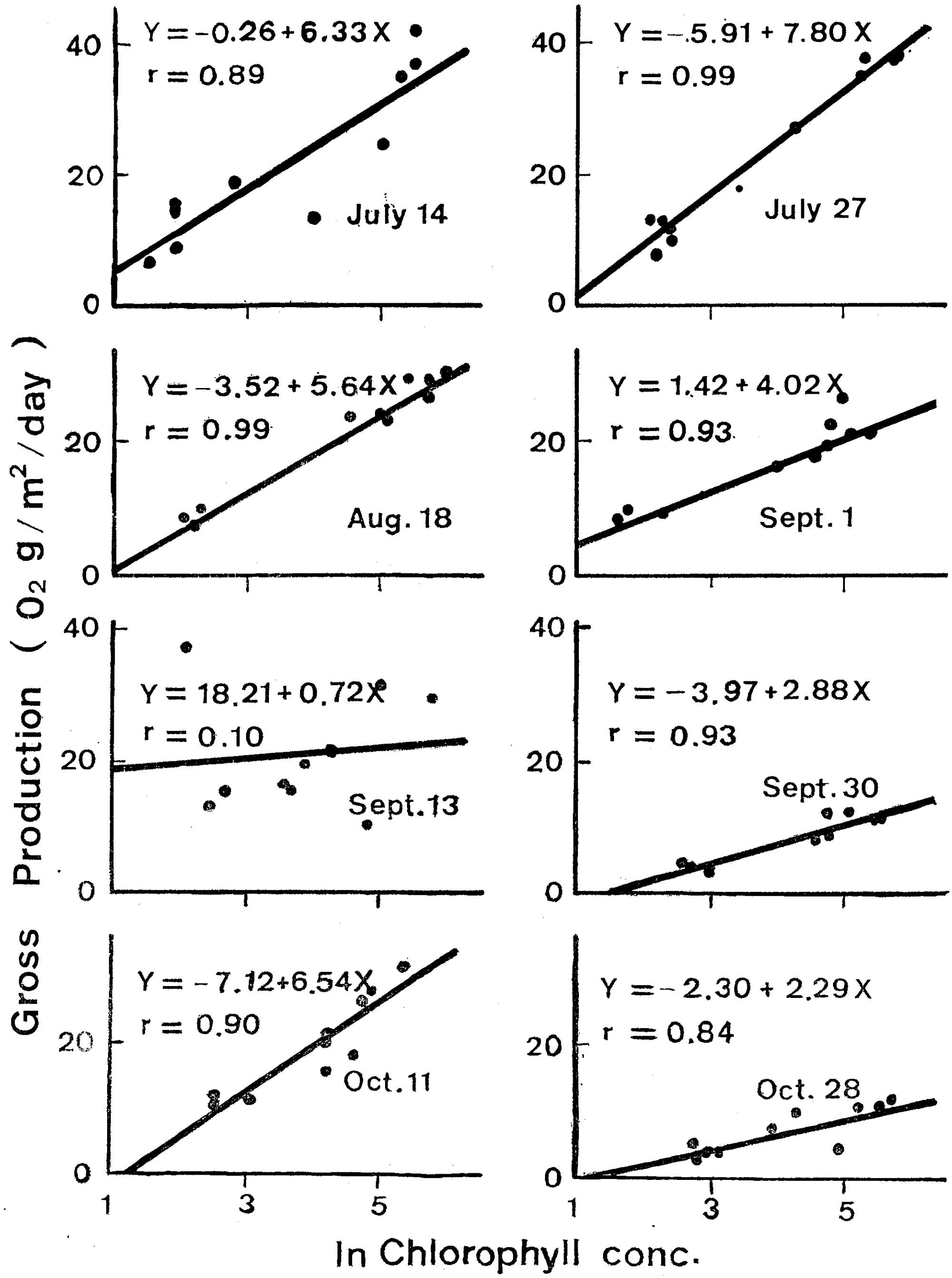

Fig. 6. Regression of the gross production on logarithm of chlorophyll concentration.

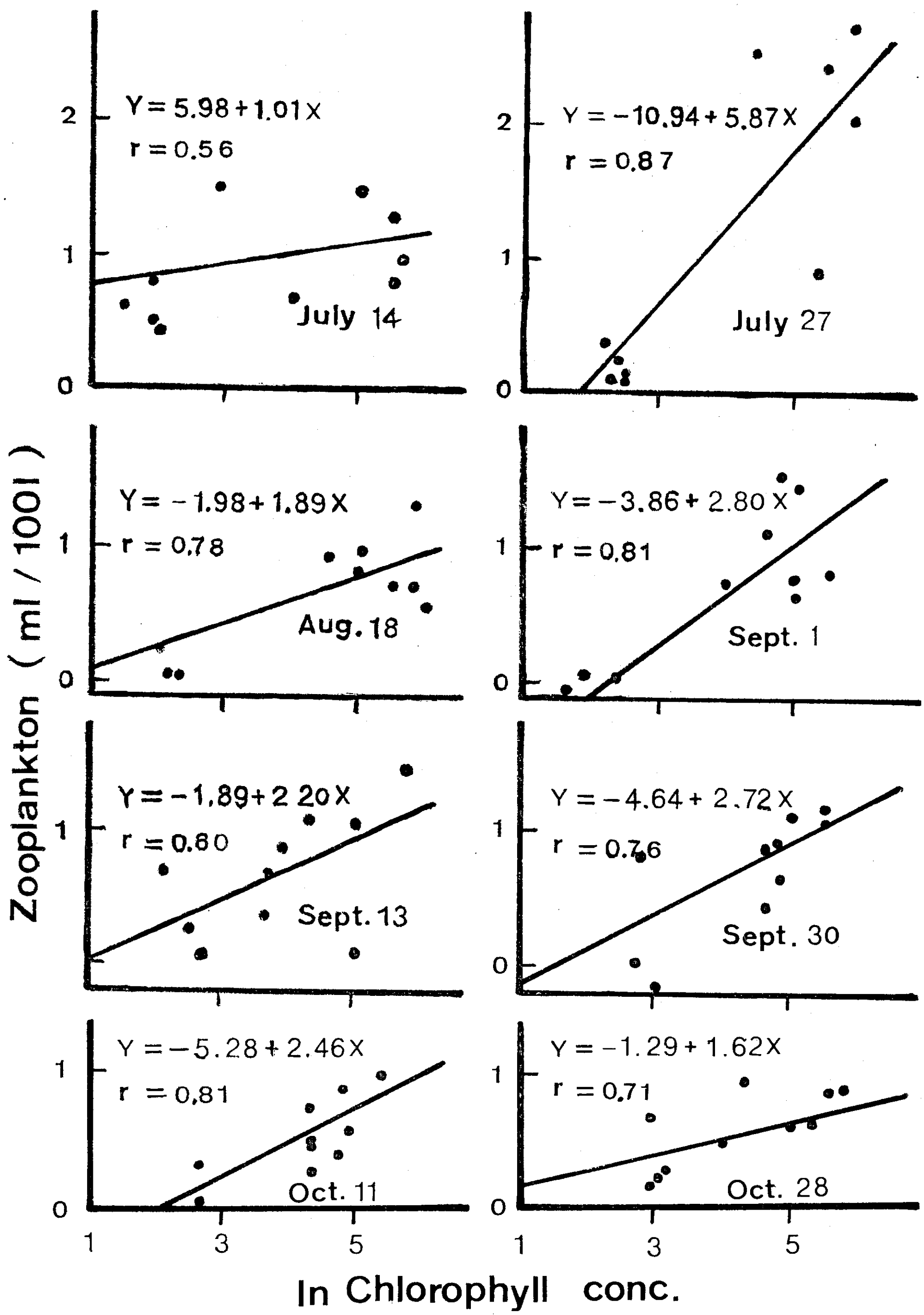

Fig. 7. Regression of the zooplankton abundance on logarithm of chlorophyll concentration.

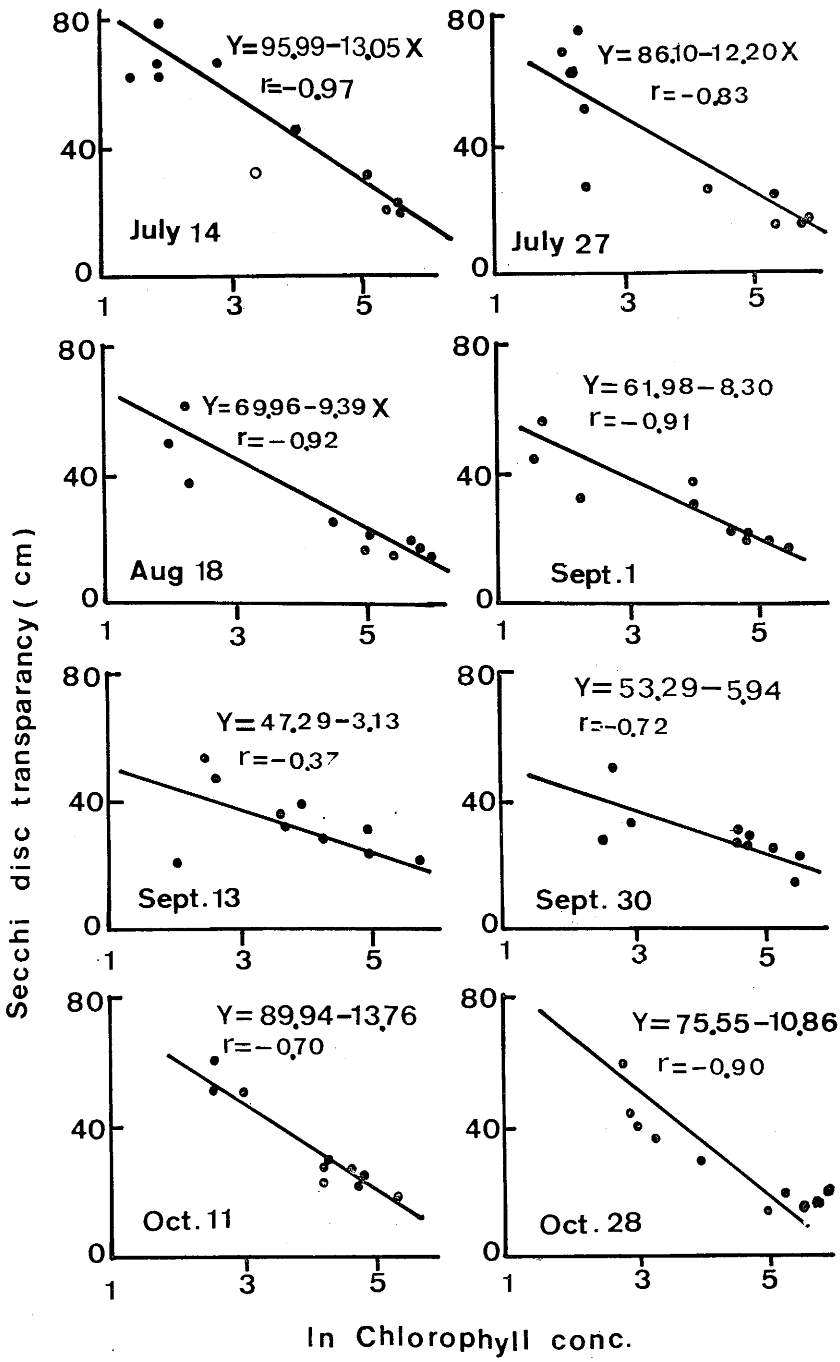

Fig. 8. Regression of the Secchi disc transparency on logarithm of chlorophyll concentration.

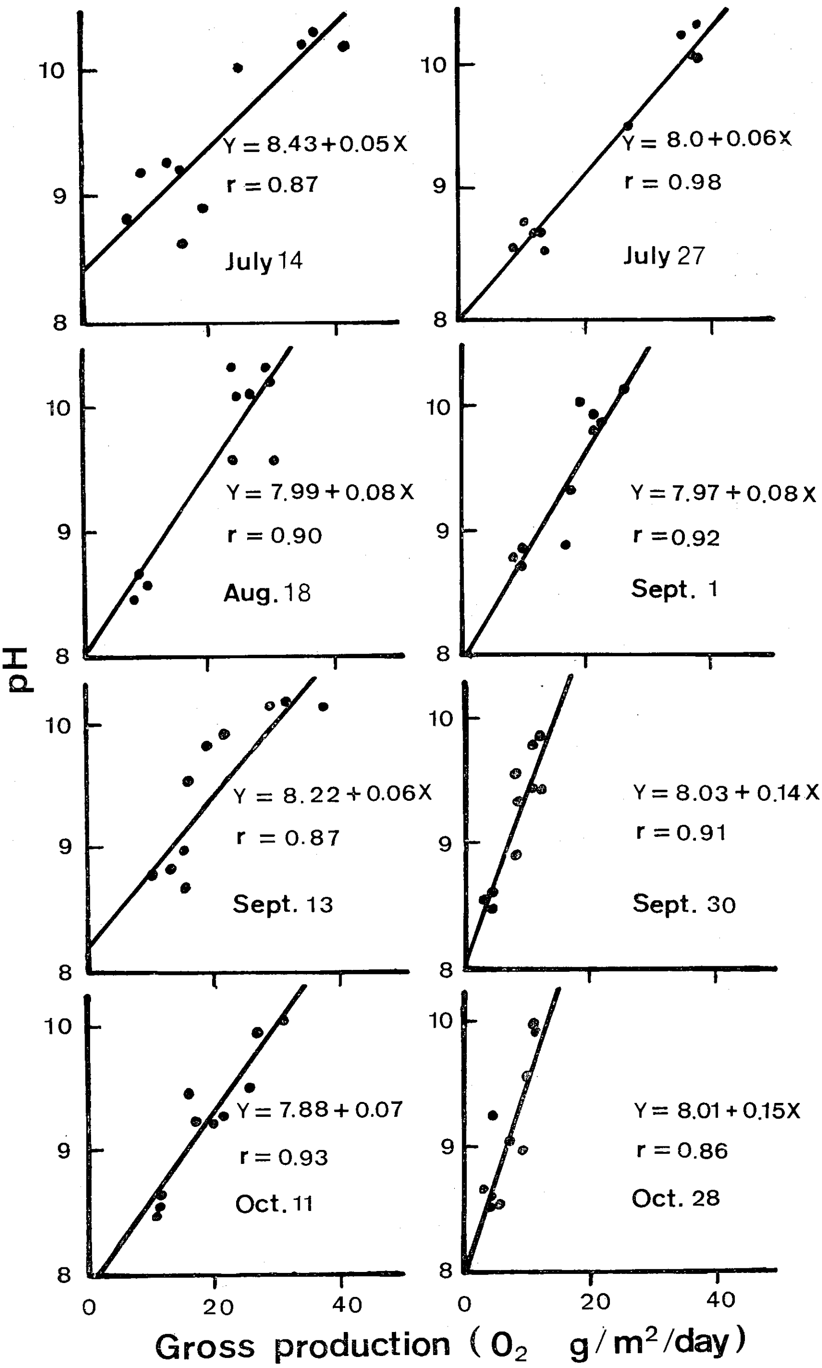

Fig. 9. Regression of the pH on logrithm of chlorophyll concentration.

lly throughout the rest of the sampling period.

Fish Production

The harvest of various species of fish are listed in Table 2. The fish yield varied greatly from pond to pond, with a minmum yield of 183 kg/ha and a maximum of 870 kg/ha. Mean fish yield was 374 kg/ha in the two control ponds, 467 kg/ha in the four superphosphate treatment ponds and 557 kg/ha in the four ponds with mixed fertilizers treatment. Although there is no doubt on the effectiveness of fertilizer treatment in increasing the fish yields, it is impossible to evaluate the most effective kinds and amount of fertilizers that will give the highest fish yields. One of the reasons is the small number of replication in each treatment and the uncontrollable natural systems.

Furthermore the ten fishponds varied in size, mean depth of water and soil fertility. As Lin[11] demonstrated that the soil fertility varied greatly among the ten fishponds. It is difficult to find the true relationship between the fish production and the fertilizers applied in these fishponds.

Regression Analysis

In the Chupei fishponds, the rate of gross production was related to chlorophyll concentration. The regression equations of gross production on total chlorophyll concentration in the ten ponds were calculated for each sampling date as shown in Fig. 6. All the eight correlation coefficients were statistically significant at least at 5% level. The coefficient of determination suggest that at least 75% of the variability of gross production in these ponds could explained by the chlorophyll concentration alone. Similar results were reported by Glooschenko[4] who demonstrated that the distribution of primary production was correlated with the distribution of chlorophyll concentrations.

Zooplankton abundance was also related to chlorophyll concentration. The plot of zooplankton abundance against the logarithm of chlorophyll concentration in these ten ponds for each sampling date were shown in Fig. 7. In general, higher zooplankton density tended to be associated with higher chlorophyll concentration. The regression coefficients calculated from these two variables (Fig. 7) indicated that six out of eight equations were significant at either 5% or 1% level. However, the mean coefficient of determination calculated from eight regression equation was only 55%. The rather low values suggested that some other factors may also have important influence on the abundance of zooplankton.

The linear regression suggested that Secchi disc transparancy was highly correlated with the chlorophyll concentration in the fishponds (Fig. 8). Except on September 13, the correlation coefficients of Secchi disc transparency and chlorophyll concentration were all significant statistically. Overall the mean coefficient of determination of the eight equations suggest that 70% of the variation of transparency in the fishponds could simply be explained by the chlorophyll concentration. Wu[26] demonstrated that the functional relationship between Secchi disc transparency and the abundance of phytoplankton, in general, can be fitted into a hyperbolic equation. While Ito *et al.*,[6] was able to express the relationship between these two variables by logarithmic curve. However, in the present data, simple linear regression equation was probably best fit for the plot of Secchi disc transparency on the logarithm of chlorophyll concentration.

Variation in pH values was related to the gross production in fishpond. Regression of pH on gross production in the ten fishponds on each sampling date were shown in Figure 9. The lowest coefficient of determination ($r^2 \times 100$) ranged from 74% to 96%. All of the correlation coefficients were significant at 1% level. The results may implied that pH values can be used as an index of the gross production of fishponds.

The correlation coefficients of total fish production with the chlorophyll concentration, gross production and zooplankton density in the ten fishponds were −0.36, −0.34 and −0.49 respectively. None of the above correlation was significant at 5% level. This suggest that the fish production in the Chupei fishponds could not be explained solely by any single factor such as chlorophyll concentration, gross production, or zooplankton abundance.

DISCUSSION

In this study, both of the control ponds, A5 and B5, were rich in phosphorus fertility, high in chlorophyll concentration, gross production and zooplankton abundance than that of other treatments ponds. On the other hand, the chlorophyll concentration, gross production and zooplankton density were quite low in the two treatments ponds, with 720 kg/ha of fertilizers, A1 and B1. This was probably due to the residual effect of heavy fertilization in the two control ponds while ponds A5 and B5 received a total of 10,240 kg/ha/year of superphosphate which was substantially higher than the common practive of the fish farmer. Hepher[5] demonstrated that much of the phosphorus added to fishponds by fertilization precipitated as calcium phosphate into the bottom soil. Lin[11] also reported that all the four group of phosphorus, sol-p, Ca-p, Al-p and Fe-p of the bottom soil in ponds A5 and B5 was much higher than that of A1 and B1. Thus it is possible that the amount of phosphorus derived from the bottom soil in ponds A5 and B5 was high enough to support a high production of phytoplankton and zooplankton.

It is apparent that pH, water transparancy, gross production and zooplankton abundance are all highly correlated to chlorophyll concentration. There is sound biological reason for such relationships, because chlorophyll is the essential element in photosynthesis. Ryther and Yentch[21] found functional relationship between gross production and chlorophyll concentration as well as light intensity. Since the intensity of light scattered upon the ten fishponds was similar on any particular sampling date, gross production in each pond was then maily influenced by the chlorophyll concentration. At the same time, CO_2 and HCO_3^- are absorbed by photoplanktons during photosynthesis. Therefore, when large number of phytoplanktons are engaged in photosynthesis, more CO_2 is utilized which resulted in elevating pH value of the water. Hence there exist a close relationship among chlorophyll concentration, gross production and pH values. Phytoplankton is the major food source for zooplankton. Thus increase in phytoplankton population (expressed by chlorophyll concentration) means more abundant food supply, and consequently a higher zooplankton density.

Goodyear *et al.*[3] observed a close relationship between primary productivity and mosquitofish in large microscosms. The failure to show similar result in the Chupei fishponds was probably due to the more diverse fish population and the non-uniformity in physical characteristics among the ten fishponds. Whereas in Goodyear *et al.* experiments all the fish were raised in a 244 cm diameter pool. McConnell[16] suggested that fisheries for species having widely different food habits should probably be considerably separately in the development of gross production-fish yield regression. Then it is unlikely to develop a universal regression of fish yield on primary production or chlorophyll concentration in a polyculture ecosystem. Since the complex interrelationship among the diverse fish population may take the regression of gross production-fish yield for any single species of fish.

It is evident that the patterns of the seasonal variation of chlorophyll concentration, gross production, zooplankton abundance as well as the environmental factors varied greatly among the ten fishpond. These difference were significant even between the ponds with similar treatment. Wohlfarth and Moav[25] suggested that great variation in fish production between similar ponds that were treated like was due to random variation in the organic development within the waters of individual ponds. Buck[1] suggested that whether the fish production of an individual pond was high or low in a particular year was largely a matter of chance. He further suggested that the chance factors may include (1) differences in the timing of degree of colornization of the different ponds by plants and animals, (2) differences in rates which availables nutrients were cycled through the system. Chances factors may also probably influence the chlorophyll from the phytoplankton population in the fishponds. Whereas the close relationships between chlorophyll concentation and both gross production as well as zooplankton abundance suggest that the variation of the latter two variables could be explained by the amount of chlorophyll in the fishponds.

Acknowledgements: This study was finished by the Joint Commission on Rural Reconstruction and The Rockefeller Foundation in 1970. The author wishes to thank Dr. T. P. Chen, former chief of Fisheries division of JCRR, and the late Professor S. Y. Lin for their support of this project. Thanks are also due to Misses Wan Chiang, Y. P. Le, C. Y. Jaw and Mr. C. C. Yu for collecting the data; to Mr. C. J. Hsu and Miss Y. L. Lee for punching the computer card and running the computer program, and to Miss S. H. Wan for her assistance in drawing valuable graphs and typing the manuscript. Finally, I wish to thank my wife Kua-eyce for reviewing the manuscript and making many welcome suggestions.

REFERENCES

1. Buck, D. H., C. F. Thoits., III and C. R. Rose. (1970) Variation in carp production in replicate ponds. *Trans. Am. Fish. Soc.* **1**: 74-79.
2. Chu, C. J., H. K, Po and S. F. Wu. (1970). The effect of phosphorus and nitrogen fertilizers on fish production in freshwater pond (1) (in chinese). *China Fisheries.* No. 212. p.2-12.
3. Goodyear, C. P., C. E. Boyd, and R. J. Beyers. (1972). Relationships between primary productivity and mosquitofish (Gambusia affinis) production in large microcosms. *Limnol. Oceanogr.* **17**(3): 445-450.
4. Glooschenko, W. A., J. E. Moore, M. Munawar, and R. A. Vollenweider. (1974). Primary production in lakes Ontario and Erie; a comparative study. *J. Fish. Res. Board. Can.* **31**: 253-263.
5. Hepher. B. (1958). On the dynamics of phosphorus added to fishponds in Israel. *Limnol. and Oceanogr.* **3**(1): 89-100.
6. Ito, Tokio., J. Toi and M. Shimadate. (1966). Studies on increasing fish production by fertilization in factor ponds-I Biological effects of inorganic fertilizer on food organisms. *Bull. Freshwater. Fish. Res. Lab.* **16**(1): 11-57.
7. Liaw, W. K. (1969). Chemical and biological studies of fish ponds reservoirs in Taiwan. *JCRR Fisheries Series,* **No. 7**: 1-43.
8. Lin, C. N. (1969). Phosphorus dynamics and primary primary production in fertilized ponds. *JCRR Fisheries Series,* **No. 7**: 44-53.
9. Lin, S. Y. (1968). Pond fish culture and the economy of inorganic fertilizer application. *JCRR Fisheries Series,* **No. 6**: 37.
10. Lin, Y. S. (1970). The effect of phosphorus and nitrogen fertilizers on fish production in freshwater ponds. *JCRR Fisheries Series,* **No. 9**: 54-57.
11. Lin, Y. S. (1971). Phosphorus dynamics in Chupei fish ponds. *JCRR Fisheries Series,* **No. 11**: 36-59.
12. Lin, S. Y. and Chen, T. P., (1966). Increase of production in freshwater fish ponds by use of inorganic fertilizers. Proceedings of the World Symposium on Warm-Water pond fish culture. *FAO Fisheries Report* No. **44**(3): 210-225. Rome.
13. Lin, Y. S., W. Chiang, Y. P. Li and C. Y. Jaw. (1971). Phosphorus dyhamics in Chupei fish ponds. *JCRR Fisheries Series,* **No. 11**: 36-59.
14. Maciolek, J. A. (1954). Artificial fertilization of lakes and ponds. U. S. Dept. Inter. Fish and Wildl. Ser. Special Scient. Report. Fisheries No. 113. 40 pp.
15. McConnel, W. J. (1962) Productivity relations in Carboy microcosms. *Limnol. Oceanogr.* **7**: 353-343.
16. McConnell, W. J. (1977). Gross photosynthesis as an estimatator of potential fish production. *Trans. Am. Fish. Soc.,* **106**(5): 417-423.
17. Mortimer, C. H. and C. F. Hickling. (1954). Fertilizers in fishponds. A review of Bibliography Colonial Office, Fishery publications **No. 5**, 155 pp.

18. Murphy, J. and J. P. Riley. (1968). A modified single solution method for the determination of phosphate in natural waters. *Analytic Chemical Acta.* **27**(1962): 31-36.
19. Ong. H. S. (1971). Fertilizer experiments in freshwater fish ponds-relation of phosphorus and nitrogen to plankton and fish production. *JCRR.*
20. Richards, F. A. and T. G. Thompson. (1952). The estimation and characterization of plankton populations by pigments analysis. II. A spectrophotometric method for the estimation of plankton pigments. *Jour. Mar. Res.*, **No. 11**: 156-172.
21. Ryther, J. H. and C. S. Yentch. (1957): The estimation of phytoplankton production in the ocean from chlorophyll and light data. *Limnol. Oceanogr.* **2**: 281-286.
22. Smith, M. W. (1960). Changes in the environment and biota of a natural lake after fertilization. *J. Fish. Res. Bd. Canada.* **26**: 3101-3131.
23. Sreenivasan, A. (1968). The Limnology of and fish production in two ponds in Chingleput (Madrash). *Hydrobiologia* **32**: 131-144.
24. Weatherly, A., and A. G. Nicholls. (1955). The effects of artificial enrichment of a lake. *Aust. J. Marine Freshwater Resources* **6**: 443-468.
25. Wohlfarth, G. W. and Rom. Moav. (1968). The relative efficiency of experiments conducted in undivided ponds and in ponds divided by nets. *FAO Fisheries Reports.* **1**(44): 487-492.
26. Wu. J. F. (1970). The distribution of chlorophyll in the lake and fish pond of Taiwan. *Life Science.* **No. 2**, p. 68-79.

竹北魚池生態研究

林曜松

自竹北水產試驗所選用10個魚池，以爲研究葉綠素，動物性浮游生物，毛基礎生產量和環境因子間關係之用。七月開始放養鰱魚、鯉魚、草魚、鱅、鯽魚之幼苗，其中2個魚池不施肥，8個魚池施用各種不同量的肥料，自7月至10月間，每兩個星期採一次水測量各變數，記錄下葉綠素，毛基礎生產量，動物性浮游生物量，酸鹼度及水中透明度等之月變化。實驗結果顯示各變數之月變化遷勢，在十個魚池間均不相同，甚至於相鄰的兩個魚池，給與相同的處理時，結果也不一樣。然而却發現，毛基礎生產量，動物性浮游生物量，酸鹼度，水中透明度四者均與葉綠素含量有密切相關，自葉綠素的變化可解釋70%水中透明度的變化。至於各種魚產量與毛基礎生產量，葉綠素含量，動物性浮游生物量間之關係，本實驗則無法顯示出其密切相關。