CHAPTER III

RESULTS

The calculated discharges and data from laboratory analyses of suspended sediment, dissolved phosphorus, total dissolved phosphorus, particulate phosphorus and reactive silicate concentrations over a tidal cycle were used in computing the material fluxes through the Chao Phraya River. In this study an attempt was made to describe the patterns and trends of the above material transport in the lower basin of the Chao Phraya River during December 1987 to December 1988. The results here could be divided into eight main groups which are as follows:

1. Discharge and Tidal Currents
2. Salinity Distributions
3. Material Concentrations
4. Material Fluxes
5. The Relationships between the Material Concentrations and the Discharges
6. The Relationships between the Concentrations of Total Phosphorus and Suspended Sediment
7. The Laboratory Simulation on Conservative and Non-Conservative Behavior of Phosphorus
8. Adsorption Capacities of Phosphorus

Discharge and Tidal Currents

The tidal currents at the Pak Kret and the Bang Sai Transects were a mixed tidal regime. For example, at the Pak Kret Transect it was a diurnal tide on December 6-7, 1988. On the contrary, had a semidiurnal pattern on April 8-9, 1988. In comparison to the Bang Sai Transect, it had both semidiurnal and diurnal patterns on April 8-9, 1988 and April 22-23, 1988 respectively (Fig. 9).

The data of tidal velocity and water level in Period 1 (December 6, 1987 - January 19, 1988) and Period 2 (March 13, 1988 - May 6, 1988) at the Pak Kret Transect indicated that the flow pattern varied with direction of the tide. During Period 2 the flow pattern was influenced dominantly by flood current, especially on April 8, 1988. Because the tidal velocities during flood were mostly lower than during ebb, thus, the net fluxes were often exported to the lower river except on April 8, 1988 (Fig. 15). In contrast, during the same period (Period 2) at the Bang Sai Transect the strength of tidal velocities tends to be lower than at the Pak Kret Transect. This was clearly seen on April 8-9, 1988 the maximum flood and ebb velocities at the Pak Kret Transect were 0.653 m/sec and 0.847 m/sec and at the Bang Sai Transect were 0.325 m/sec and 0.452 m/sec respectively (Fig. 10).

The water level of the Pak Kret Transect during Period 1 and Period 2 ranged from 1.88-3.66 m and 1.82-3.38 m respectively. At the Bang Sai Transect ranged from 2.14-3.46 m. However, it was found that during flood current the water levels were a little higher than during ebb current. This can be seen on April 8-9, 1988 at Pak Kret

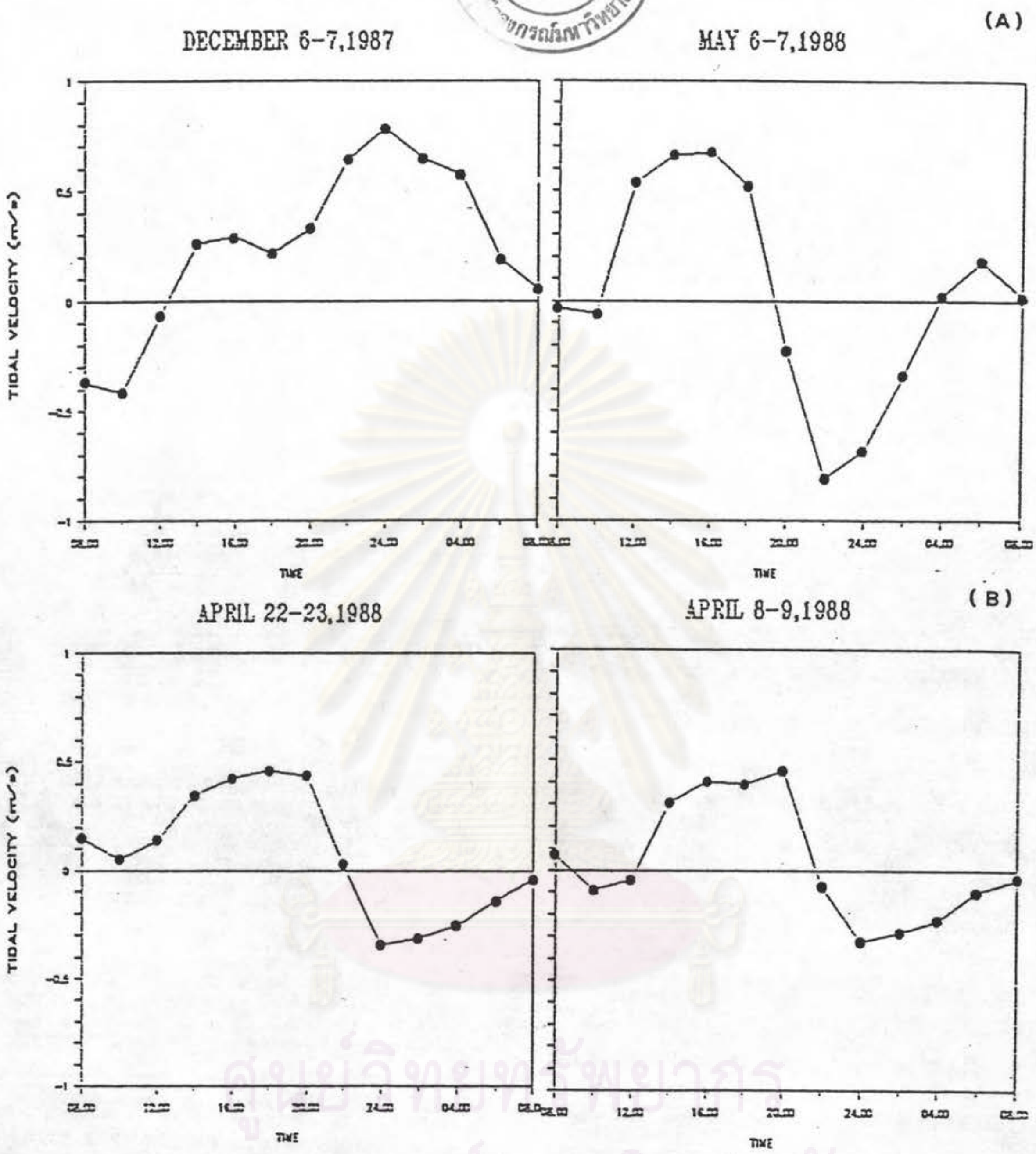


Figure 9 Diurnal and Semidiurnal Patterns occurred at Pak Kret (A) and Bang Sai (B) Transects.

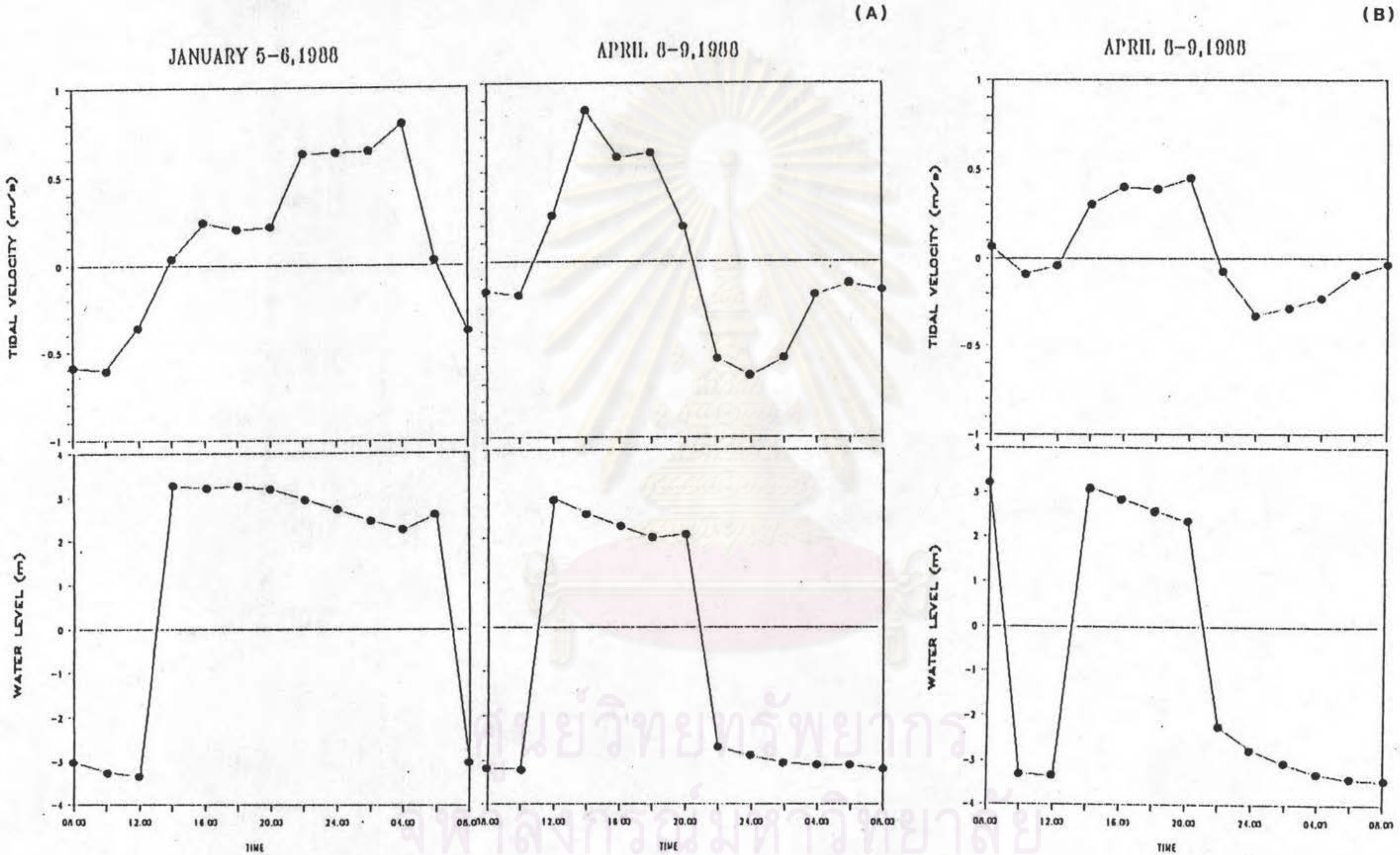


Figure 10 Time series variations of the tidal velocity and water level at the Pak Kret Transect (A) and at the Bang Sai Transect (B).
Positive (+) in ebb direction and negative (-) in flood direction.

Transect, the water level during flood current was in the range of 2.70-3.20 m and in the range of 2.00-2.88 m during ebb current (Fig. 10).

In addition, the range of daily net discharge through the Pak Kret Transect during Period 1 were from 60.87-608.86 m^3/sec and during Period 2 were from 19.95-273.13 m^3/sec (Table 3). This can be considered that Period 1 was high discharge condition (wet season) and Period 2 was low discharge condition (dry season) as shown in Fig. 11. At the Bang Sai Transect during March 13, 1988 - May 6, 1988 (Period 2) the range of daily net discharge were from 38.01-472.80 m^3/sec (Table 3).

The representative tidal cycles used to describe time series variations of tidal velocities and water levels through the Pak Kret Transect of Period 1 on January 5,1988 and of Period 2 on April 8,1988 were selected and shown in Fig. 10 (A) and compared with (B) of Bang Sai Transect on April 8,1988.

Salinity Distributions

Salinity of river water samples collected from the Pak Kret and Bang Sai Stations were accurately measured by using the Beckman Induction Salinometer (Model RS7-C) which was provided by the Oceanographic Division, Hydrographic Department, Bangkok, Thailand. The salinity distribution at surface, middepth and bottom levels of the Pak Kret Station during Period 1 was the same order as during Period 2 and varied in a similar manner. That is, at Pak Kret Station during Period 1 ranged from 0.145-0.162 ‰ and also during Period 2

Table 3 Daily mean data of discharge, suspended sediment (SS.), phosphate-P, total-P, particulate-P, and silicate at the Pak Kret (PK) and Bang Sai (BS) Stations during December 6, 1987 to May 6, 1988.

Date	Discharge (m^3/s)		SS. (mg/l)		PO4-P (μM)		Total-P (μM)		Part.-P (μM)		Silicate (μM)	
	PK	BS	PK	BS	PK	BS	PK	BS	PK	BS	PK	BS
Dec.06,87	608.86	**	26	**	0.92	**	1.23	**	0.31	**	220	**
Dec.20,87	731.08	**	16	**	0.39	**	0.90	**	0.50	**	176	**
Jan.05,88	310.31	**	22	**	0.42	**	1.52	**	1.09	**	169	**
Jan.19,88	60.87	**	26	**	0.38	**	2.42	**	2.05	**	224	**
Mar.13,88	19.95	150.38	79	**	2.13	**	5.18	**	3.10	**	152	**
Mar.25,88	105.17	145.94	85	168	2.05	2.56	4.04	10.14	1.99	7.59	208	171
Apr.08,88	-33.61	38.01	136	121	2.60	1.28	6.16	6.11	3.58	4.82	143	205
Apr.22,88	273.13	107.89	106	70	1.76	1.50	4.97	2.97	3.20	1.47	99	78
May.06.88	63.31	472.80	83	58	1.99	1.31	4.93	3.79	2.93	2.47	134	135

Discharge is positive in ebb direction and is negative in flood direction.

** ..... not determined

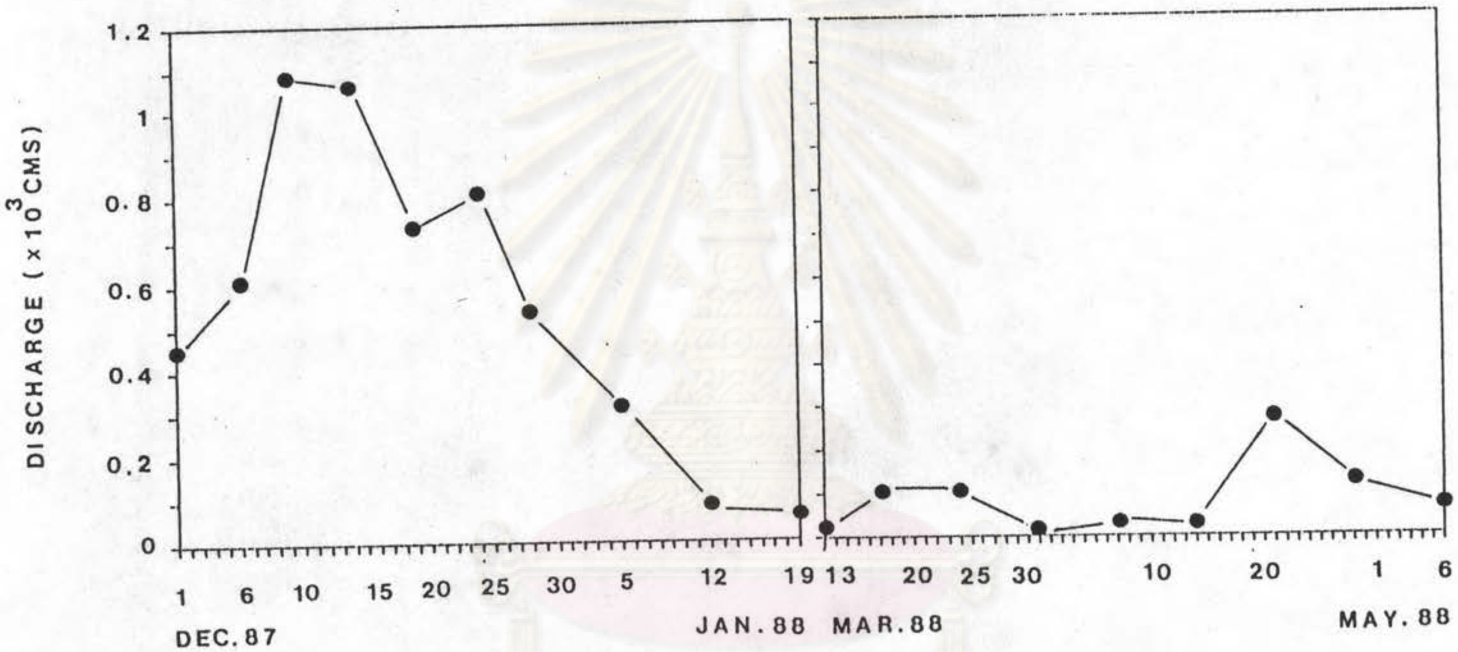


Figure 11 Comparison of daily discharge (m^3/sec) of Pak Kret Transect between Period 1 (December 1, 1987 - January 19, 1988) and Period 2 (March 13, 1988 - May 6, 1988).

ranged from 0.138-0.195 ‰. In comparison to Bang Sai Station, the surface salinity distribution ranged from 0.123-0.162 ‰ (Period 2). Thus, the range of salinity tends to be a little greater at Pak Kret Station than at Bang Sai Station. However, water at Pak Kret Station seemed to be well-mixed vertically due to the lack of salinity stratification (Fig. 12).

Material Concentrations

The daily mean flow weighted concentrations of suspended sediment, phosphate phosphorus, total phosphorus and particulate phosphorus at Pak Kret Station were considerably different between two periods. During high discharge condition (Period 1) the concentrations of all parameters were less than during low discharge condition (Period 2) as can be seen from Table 3. On the contrary, the silicate concentrations were the same order for both seasons .

In order to determine the effect of tidal currents on material concentrations, therefore, the daily mean flow-weighted flood and ebb concentrations were considered. It was found that they varied among sampling dates during two periods (Table 4). On the contrary, observed daily patterns in mean flow-weighted flood and ebb concentrations indicated that they tended to vary in similar fashion, see Fig. 13. Thus, it can be said that the effect of tide (flood vs. ebb) was less than the effect of other daily meteorological factors.

Furthermore, the annual regimes of monthly mean content of materials at the Pak Kret Station during December 1987 to December 1988 were observed. It was revealed that these patterns also show

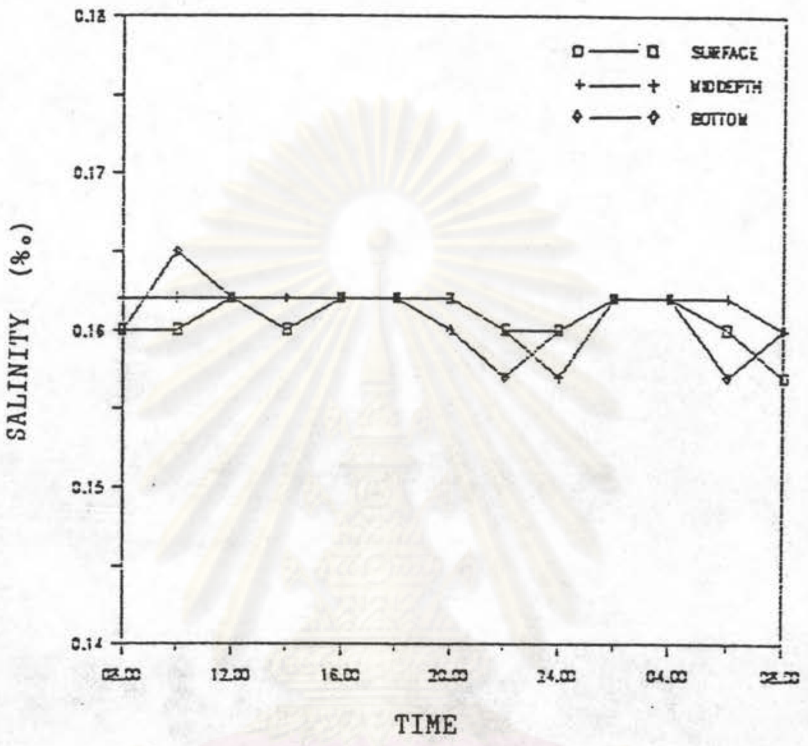
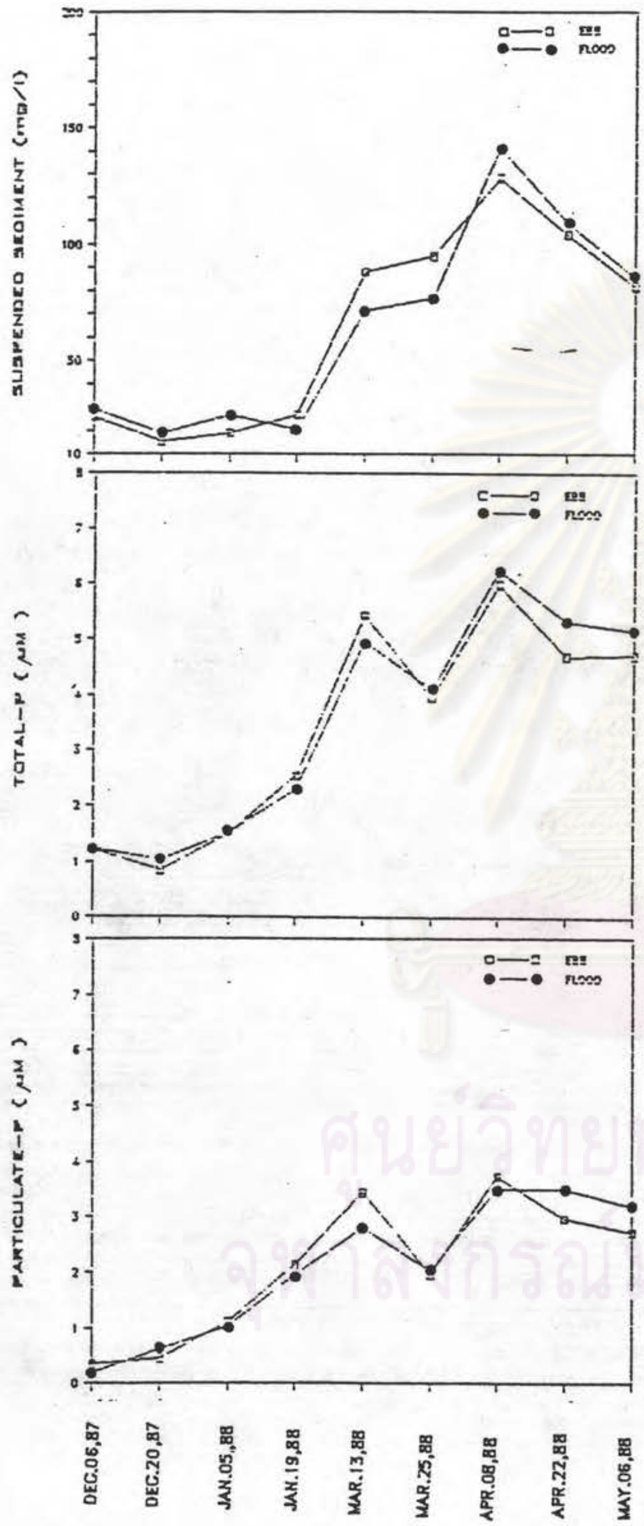


Figure 12 The salinity distribution (‰) at the Pak Kret Station on December 20-21, 1987.

Table 4 Mean flow weighted concentration ± standard deviation, with number of samples in parentheses, during flood and ebb at the Pak Kret Station during December 6, 1987 to May 6, 1988.

Date	Flood					Ebb				
	SS.(mg/l)	PO4-P (μM)	Total-P (μM)	Part.-P (μM)	Silicate (μM)	SS.(mg/l)	PO4-P (μM)	Total-P (μM)	Part.-P (μM)	Silicate (μM)
Dec.06,87	29 ± 6 (3)	1.05 ± 0.01 (3)	1.25 ± 0.07 (3)	0.20 ± 0.07 (3)	208 ± 4 (3)	26 ± 8 (10)	0.88 ± 0.10 (10)	1.22 ± 0.16 (10)	0.35 ± 0.19 (10)	224 ± 43 (10)
Dec.20,87	19 ± 10 (4)	0.42 ± 0.07 (4)	1.04 ± 0.06 (4)	0.62 ± 0.04 (4)	172 ± 16 (4)	15 ± 6 (9)	0.39 ± 0.06 (9)	0.84 ± 0.11 (9)	0.45 ± 0.12 (9)	178 ± 16 (9)
Jan.05,88	27 ± 7 (4)	0.48 ± 0.11 (4)	1.53 ± 0.56 (4)	1.04 ± 0.46 (4)	141 ± 37 (4)	19 ± 6 (9)	0.40 ± 0.10 (9)	1.51 ± 0.26 (9)	1.12 ± 0.30 (9)	182 ± 28 (9)
Jan.19,88	20 ± 4 (6)	0.35 ± 0.07 (6)	2.29 ± 0.14 (6)	1.95 ± 0.15 (6)	231 ± 23 (6)	27 ± 7 (7)	0.40 ± 0.08 (7)	2.53 ± 0.61 (7)	2.14 ± 0.66 (7)	219 ± 26 (7)
Mar.13,88	72 ± 21 (7)	2.22 ± 0.31 (7)	4.96 ± 0.55 (7)	2.81 ± 0.75 (7)	167 ± 56 (7)	88 ± 16 (6)	2.03 ± 0.34 (6)	5.43 ± 0.89 (6)	3.43 ± 1.23 (6)	134 ± 39 (6)
Mar.25,88	77 ± 13 (7)	2.08 ± 0.40 (7)	4.10 ± 0.79 (7)	2.02 ± 0.07 (7)	216 ± 32 (7)	95 ± 23 (6)	2.01 ± 0.30 (6)	3.96 ± 0.25 (6)	1.95 ± 0.44 (6)	199 ± 16 (6)
Apr.08,88	141 ± 23 (8)	2.77 ± 0.26 (8)	6.26 ± 0.75 (8)	3.50 ± 0.51 (8)	134 ± 38 (8)	128 ± 27 (5)	2.32 ± 0.32 (5)	5.99 ± 0.79 (5)	3.73 ± 0.81 (5)	158 ± 40 (5)
Apr.22,88	109 ± 15 (7)	1.83 ± 0.18 (7)	5.33 ± 0.76 (7)	3.49 ± 0.85 (7)	79 ± 11 (7)	104 ± 17 (6)	1.69 ± 0.20 (6)	4.70 ± 1.05 (6)	2.96 ± 1.19 (6)	116 ± 21 (6)
May.06,88	86 ± 15 (6)	1.98 ± 0.22 (6)	5.16 ± 0.98 (6)	3.19 ± 1.05 (6)	129 ± 24 (6)	82 ± 10 (7)	2.01 ± 0.14 (7)	4.73 ± 0.42 (7)	2.72 ± 0.42 (7)	139 ± 41 (7)

SS. ..... Suspended Sediment



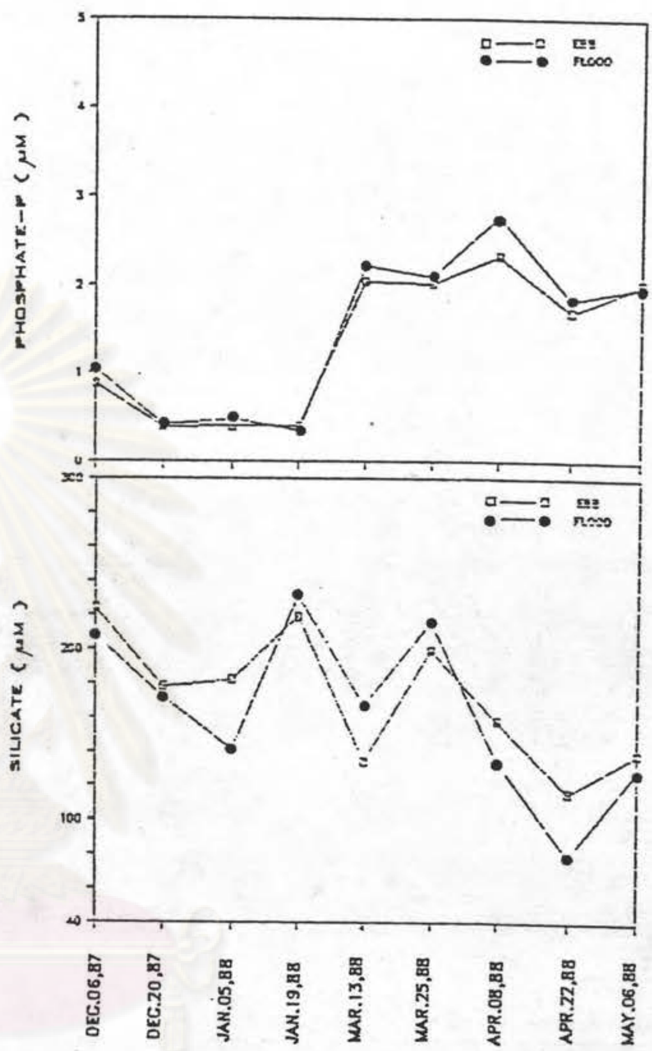


Figure 13

Variations of daily mean flow-weighted flood and ebb concentrations during Period 1 to Period 2 of Pak Kret Station.

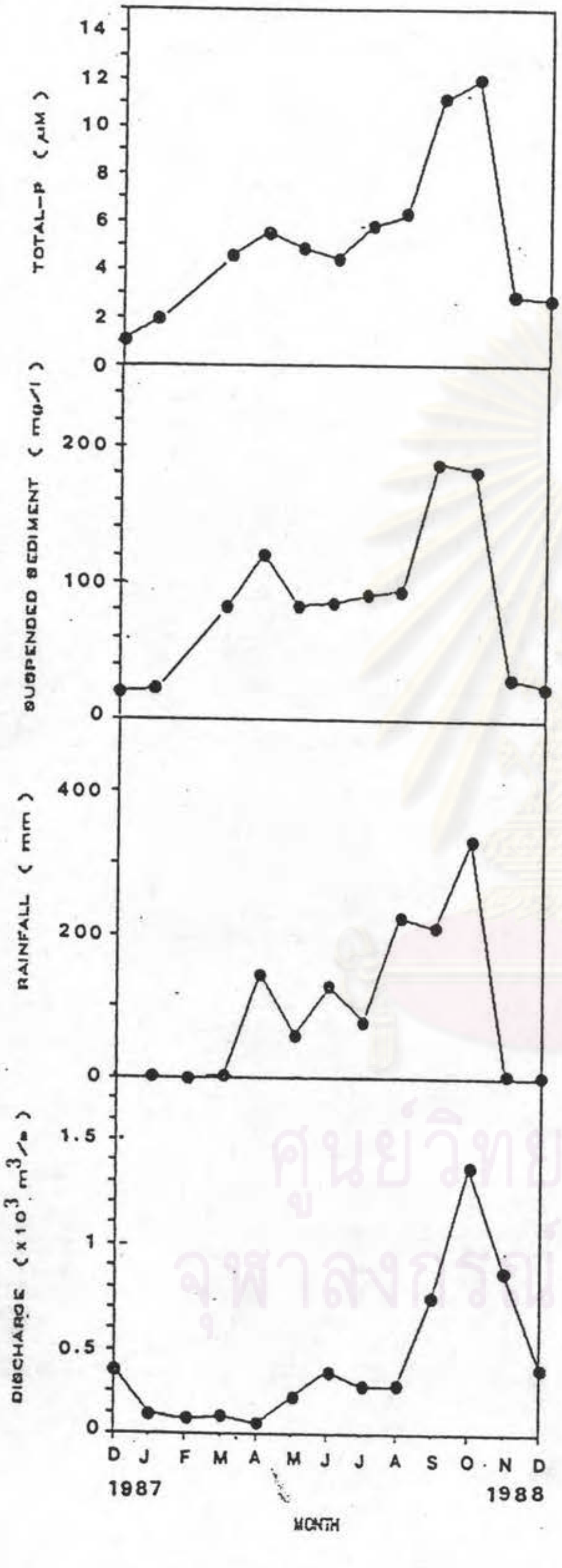
seasonal variations by comparing with the regimes of discharge and rainfall (Fig. 14). Trends of the particulate matter regimes of suspended sediment, total phosphorus and particulate phosphorus attained peaks between September 1988 and October 1988 corresponding to the flow regimes. In contrast, the regimes of dissolved phosphate concentration attained peaks in April 1988 and July 1988 and of dissolved silicate concentration attained peaks between July 1988 and August 1988. The monthly mean data of all parameters were summarized in Table 5.

Material Fluxes

The instantaneous material fluxes were varied depending on instantaneous discharge multiplying with a corresponding flow-weighted concentration. The daily net fluxes of material through Pak Kret Transect during Period 1 and Period 2 were mostly exported except on some tidal cycles were imported as can be seen on April 8,1988 (Fig. 15). This probably because the flood current effect during low discharge condition was relatively more dominant than ebb current.

The representative tidal cycles used to describe time series variations of the material concentrations (mg/l) and fluxes (g/sec) through the Pak Kret Transect during high discharge condition (January 5, 1988) and during low discharge condition (April 8, 1988) were selected and shown in Fig. 16-20 (A) and compared with (B) of Bang Sai Transect on April 8, 1988.

From the results in Table 6, it was found that the estimated fluxes of particulate forms at Pak Kret Transect during low discharge



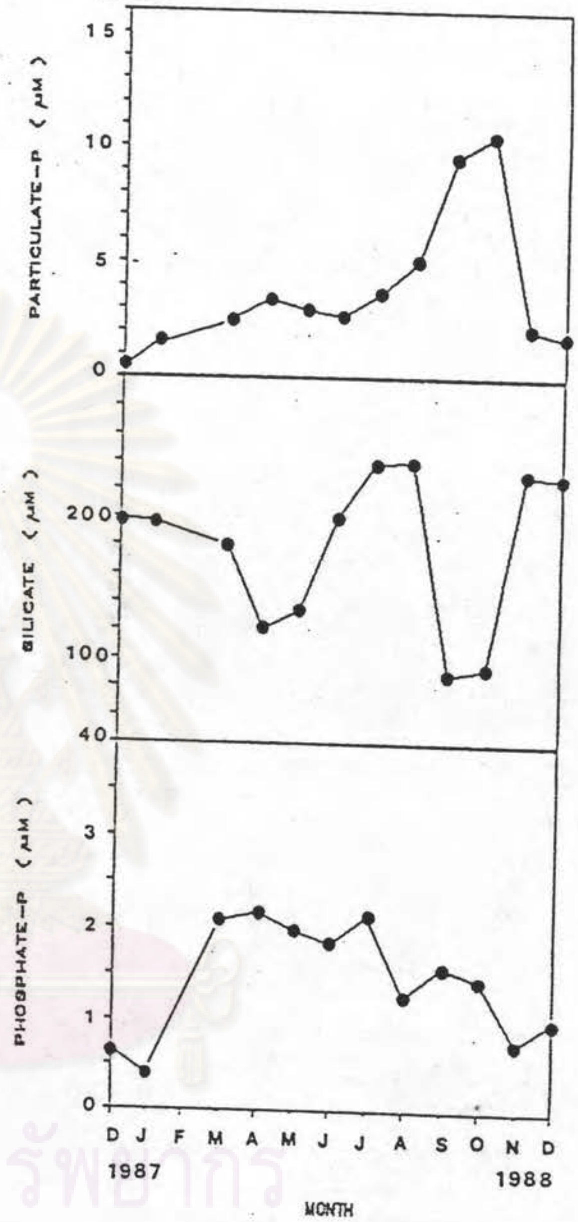


Figure 14

The annual regimes of the monthly mean data of discharge, rainfall suspended sediment, total-P, particulate-P, silicate and phosphate of the Pak Kret Station.

Table 5 Monthly mean data at the Pak Kret Station during December 1987 to December 1988.

Month	SS.(mg/l)	PO4-P	Total-P	Part.-P	Silicate	Discharge	Rainfall
Dec. 87	21	0.66	1.07	0.41	198	405.8	0.0
Jan. 88	23	0.40	1.97	1.57	197	195.9	0.0
Feb. 88	**	**	**	**	**	170.8	0.4
Mar. 88	82	2.09	4.61	2.52	180	185.1	1.6
Apr. 88	121	2.18	5.57	3.39	121	151.4	146.8
May. 88	83	1.99	4.93	2.93	134	275.8	60.6
June 88	85	1.84	4.48	2.64	200	401.1	129.4
July 88	91	2.15	5.80	3.65	239	327.8	80.5
Aug. 88	94	1.27	6.27	5.00	240	328.0	227.3
Sep. 88	188	1.59	11.13	9.54	89	754.8	212.6
Oct. 88	182	1.45	11.98	10.53	93	1370.5	332.5
Nov. 88	30	0.76	2.92	2.16	232	873.3	0.0
Dec. 88	24	1.02	2.77	1.75	229	420.6	**
Average	85.33	1.45	5.29	3.84	179.33	450.84	99.31

Unit: SS. ..... Suspended Sediment in mg/l

Phosphate-P, Total-P, Particulate-P and Silicate in μM

Discharge in m^3/sec

Rainfall in mm

** ..... not determined

Table 6 Comparison of daily net fluxes in metric tons per day of suspended sediment, phosphate-P, total-P, particulate-P, silicate and discharge in m^3/sec through the Pak Kret (PK) and Bang Sai (BS) Transects during March 25, 1988 to April 22, 1988. Positive (+) flux is export, negative (-) flux represents import.

Date	Discharge (m^3/s)		Suspended Sediment		Phosphate-P		Total-P		Particulate-P		Silicate	
	PK	BS	PK	BS	PK	BS	PK	BS	PK	BS	PK	BS
Mar.25,88	105.17	+145.94	965.06	1867.11	0.54	1.010	0.62	3.26	0.09	2.26	18.56	76.88
Apr.08,88	-33.61	38.01	-1738.46	525.32	-0.75	0.090	-1.19	0.48	-0.28	0.38	-12.28	46.29
Apr.22,88	273.13	107.89	2019.91	641.19	0.98	0.443	2.89	0.83	1.82	0.386	82.20	9.64

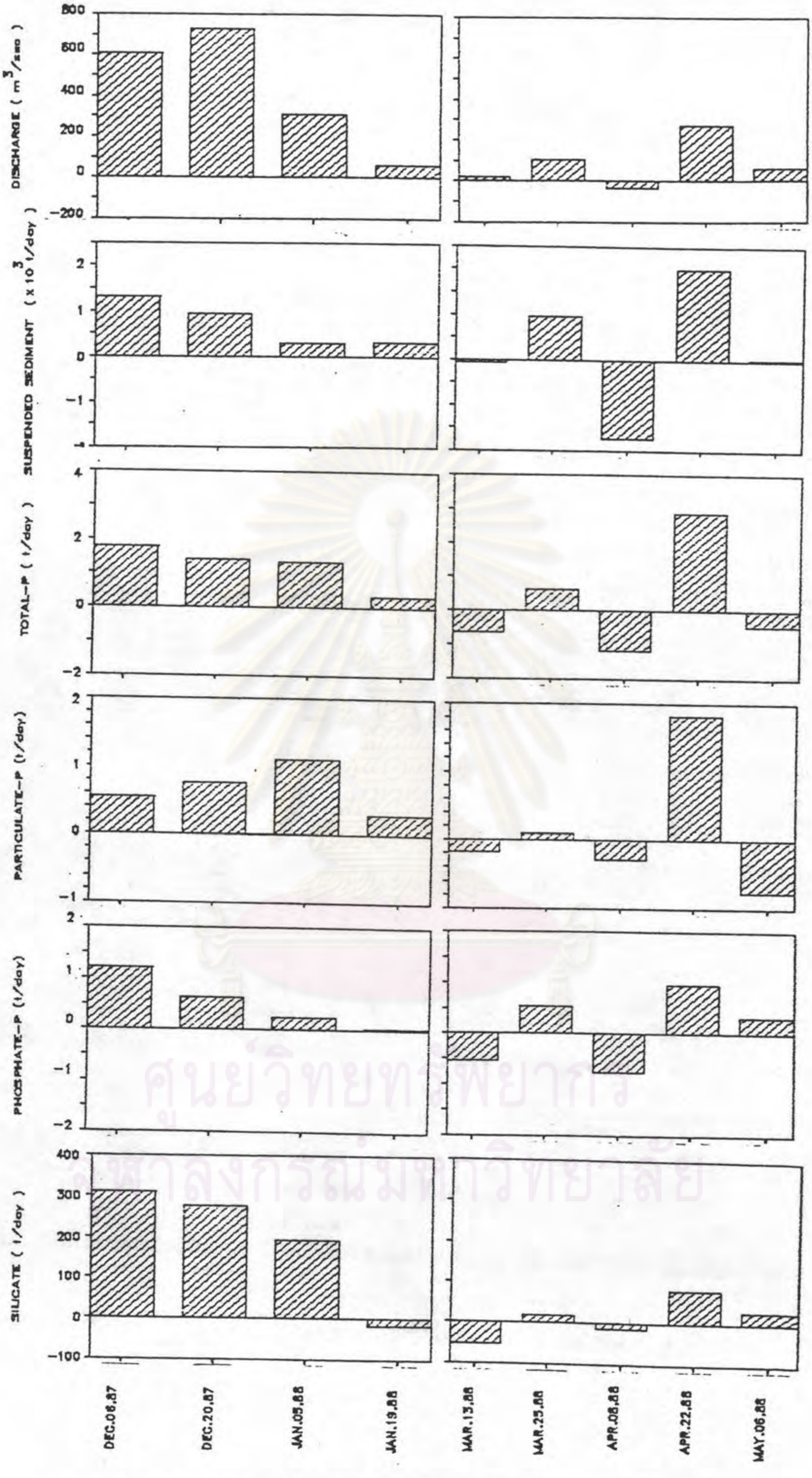


Figure 15 Comparison of the daily net fluxes of Pak Kret Transect between Period 1 and Period 2.

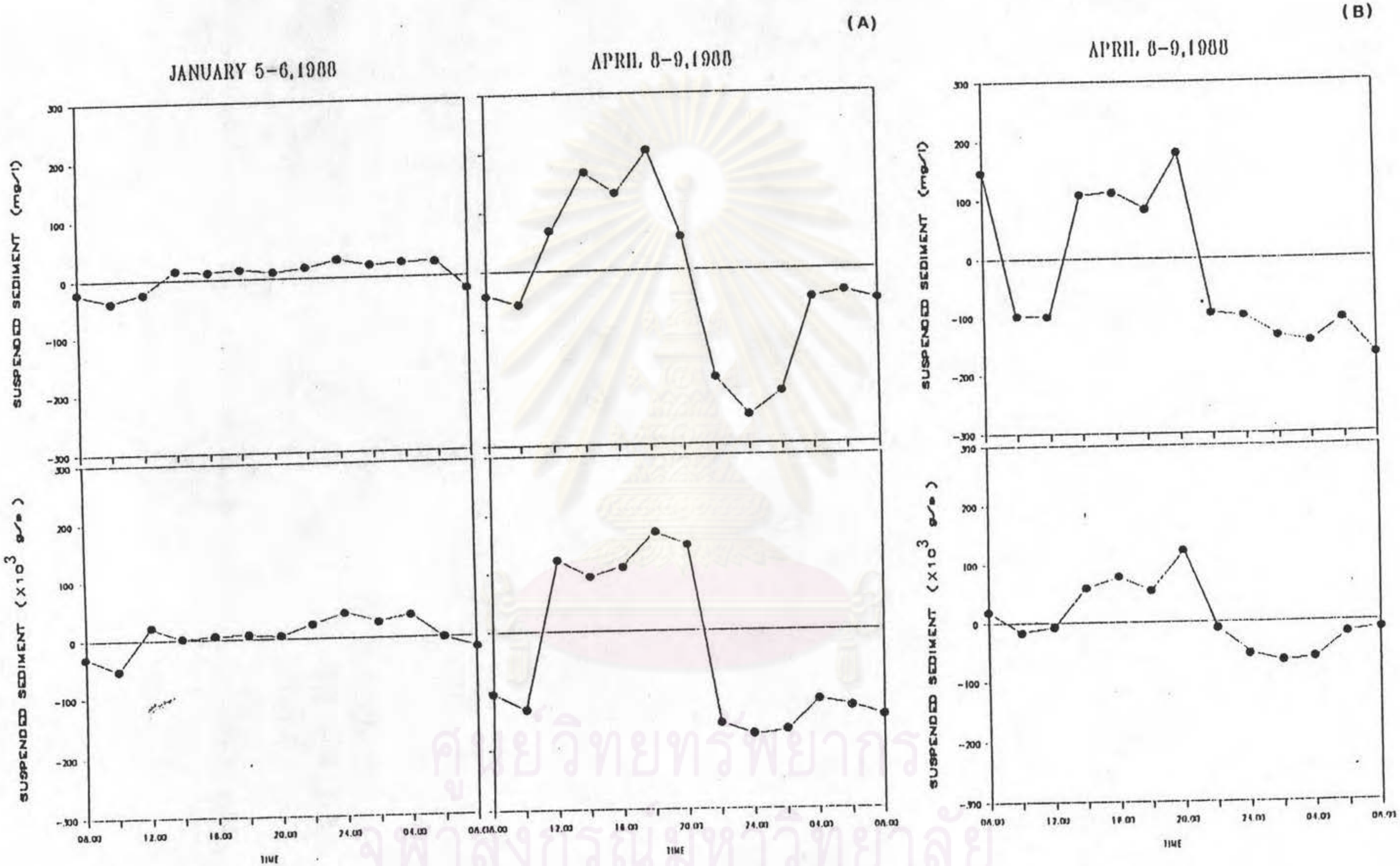


Figure 16 Time series variations of the concentration (mg/l) and flux (g/sec) of suspended sediment at the Pak Kret Transect (A) and at the Bang Sai Transect (B). Positive (+) in ebb direction and negative (-) in flood direction.

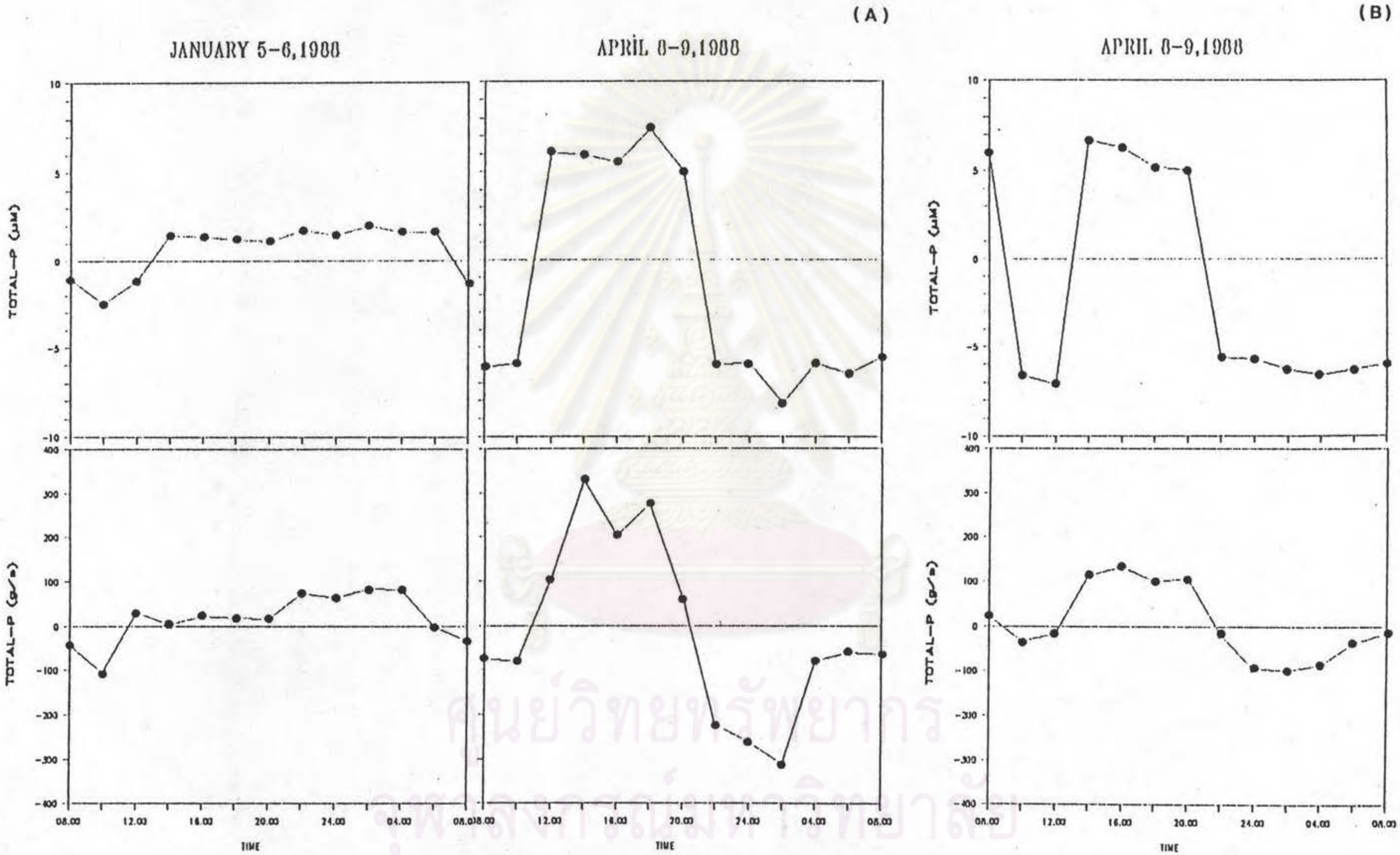


Figure 17 Time series variations of the concentration (μM) and flux (g/sec) of total phosphorus at the Pak Kret Transect (A) and at the Bang Sai Transect (B). Positive (+) in ebb direction and negative (-) in flood direction.

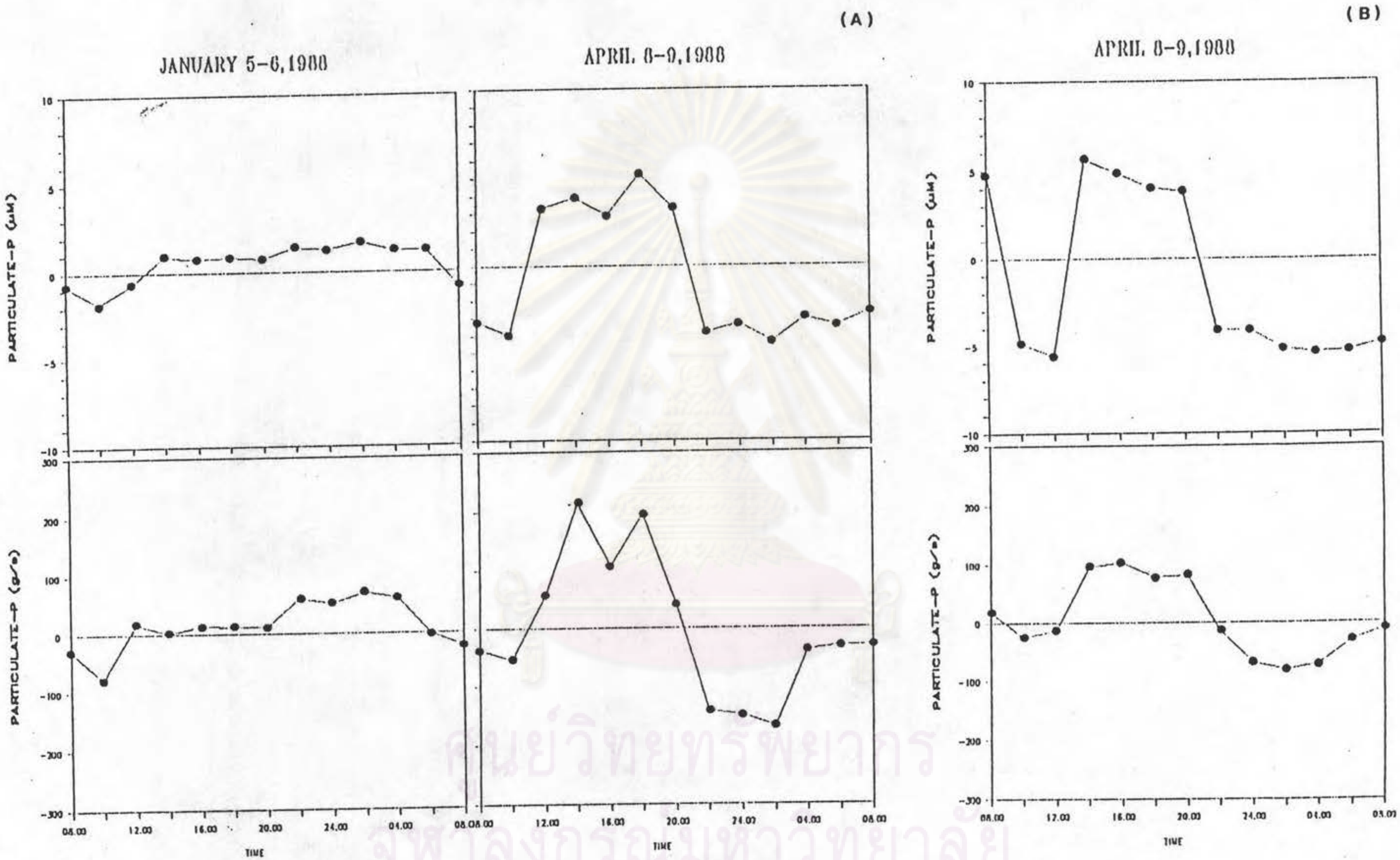


Figure 18 Time series variations of the concentration (µM) and flux (g/sec) of particulate phosphorus at the Pak Kret Transect (A) and at the Bang Sai Transect (B). Positive (+) in ebb direction and negative (-) in flood direction.

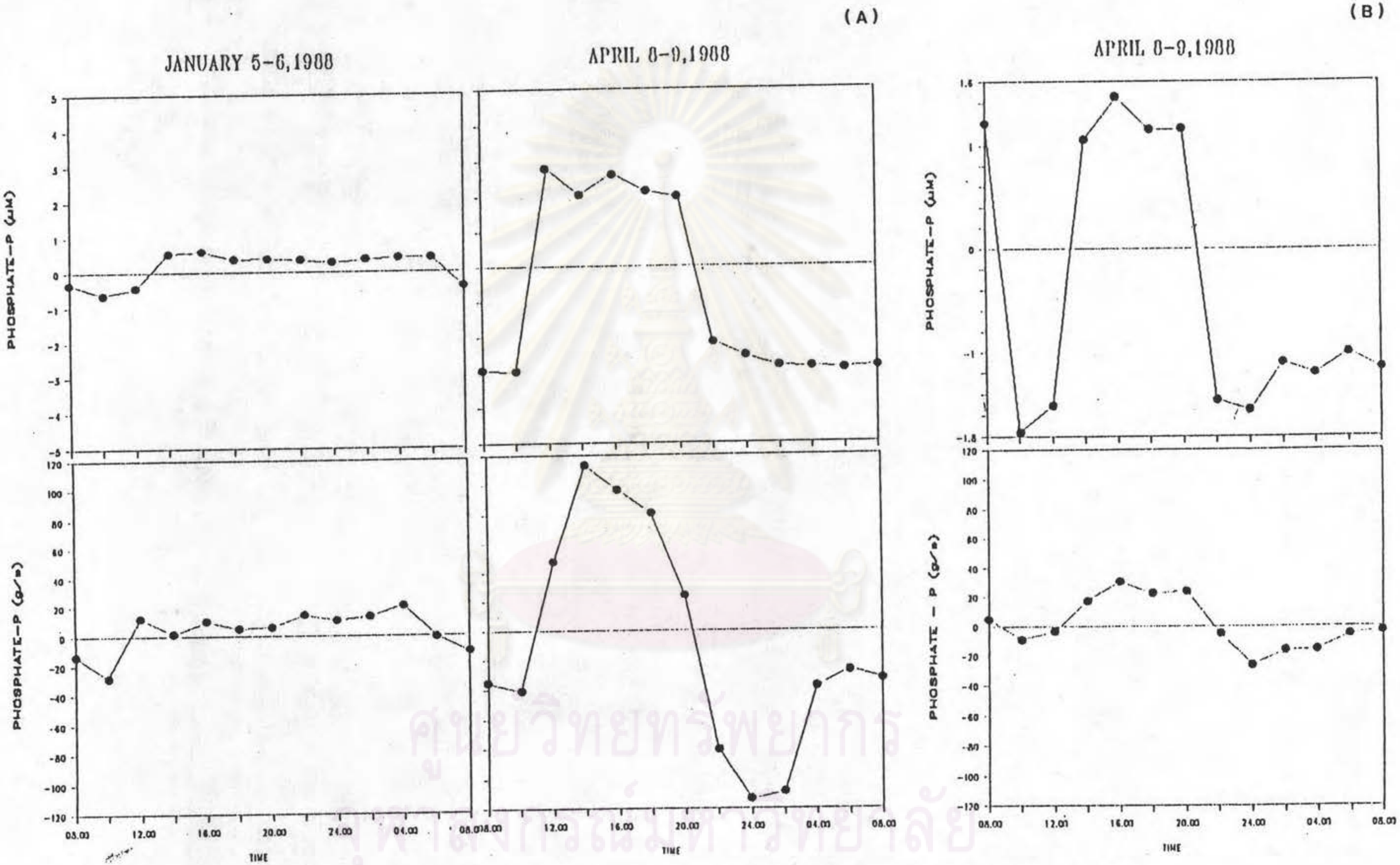


Figure 19 Time series variations of the concentration (μM) and flux (g/sec) of phosphate phosphorus at the Pak Kret Transect (A) and at the Bang Sai Transect (B). Positive (+) in ebb direction and negative (-) in flood direction.

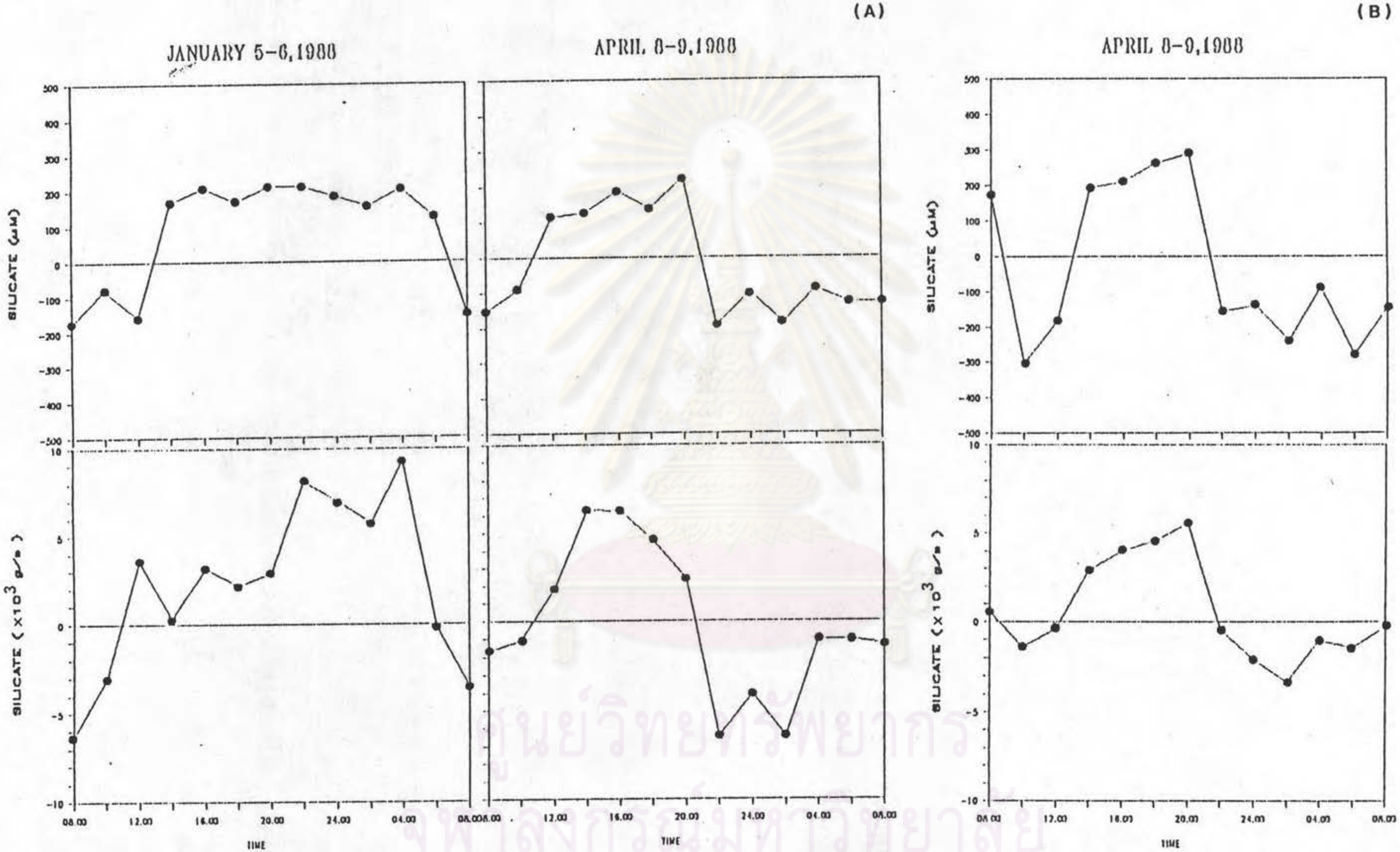


Figure 20 Time series variations of the concentration (µM) and flux (g/sec) of silicate at the Pak Kret Transect (A) and at the Bang Sai Transect (B). Positive (+) in ebb direction and negative (-) in flood direction.

condition (April 22, 1988) yielded a maximum export of 2019.91 tons/day of suspended sediment, 2.89 tons/day of total phosphorus and 1.82 tons/day of particulate phosphorus respectively. This was compared to the Bang Sai Transect which yielded a maximum export of 1867.11 tons/day of suspended sediment, 3.260 tons/day of total phosphorus and 2.260 tons/day of particulate phosphorus on March 25, 1988. Thus, it can be concluded that material transport of both Transects were spatial and temporal variations (Fig. 21). In contrast, at Pak Kret Transect the maximum export of dissolved fluxes of phosphate phosphorus and silicate occured during high discharge condition (December 6, 1987) in an order of 1.22 tons/day and 308.78 tons/day respectively. This was obvious that the seasonal difference was very important in controlling the material loads in the river. The material fluxes of all parameters depend on the flow regimes and the behavior of material in river system.

In order to describe the patterns and trends of material fluxes through the Chao Phraya River, therefore, the monthly mean fluxes at Pak Kret Transect were also estimated. It was found that variations in the annual regimes of material fluxes were controlled by the monthly mean discharge corresponding to the monthly mean concentration at the time of sampling. From these patterns, it was obvious that most of the material flux regimes attained peaks during high discharge condition between October 1988 and December 1988 as shown in Fig. 22.

Furthermore, the annual mean of material fluxes through the lower basin of the Chao Phraya River during December 1987 to December 1988 were estimated in metric tons yr^{-1} and as specific transport rate

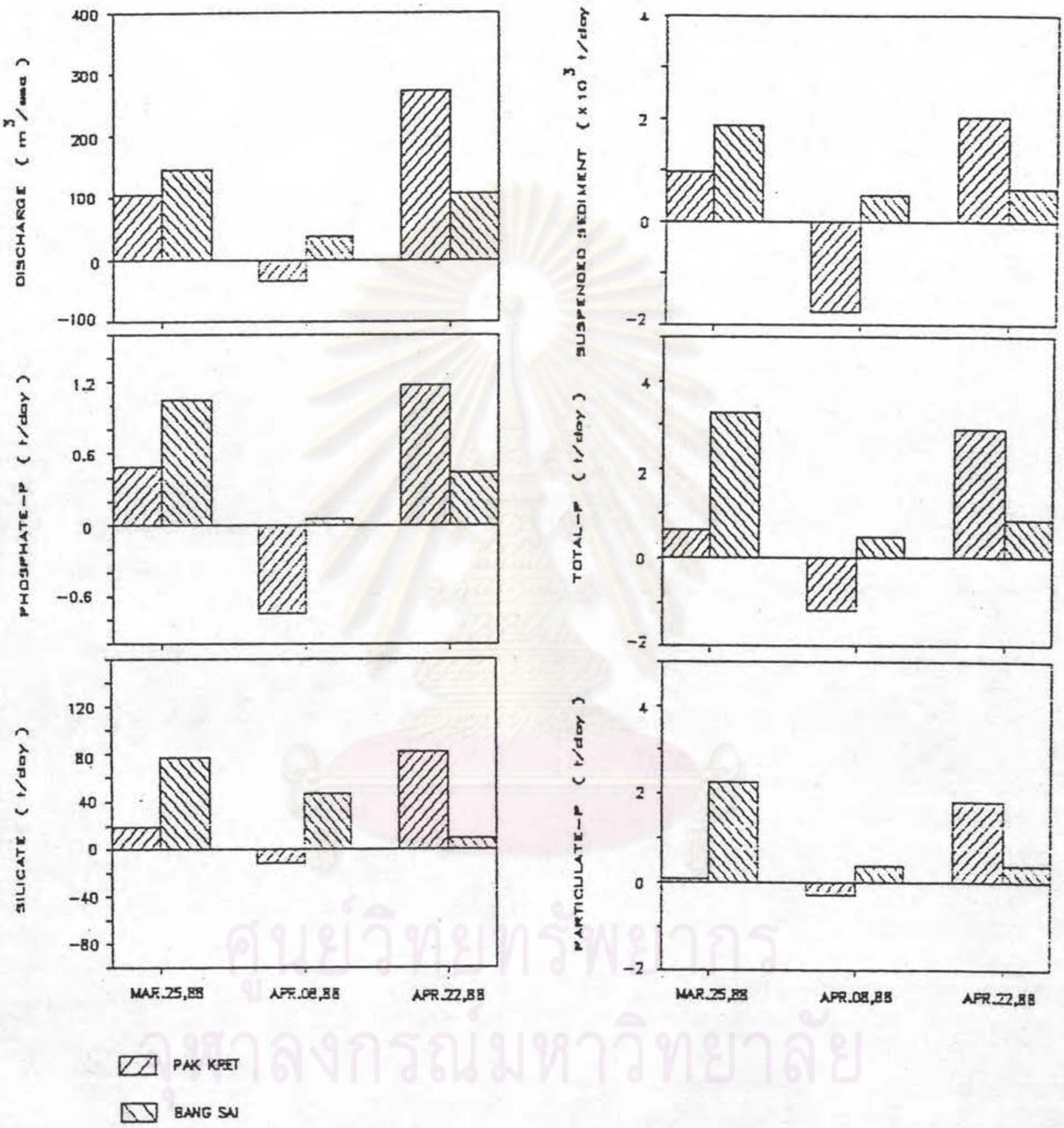
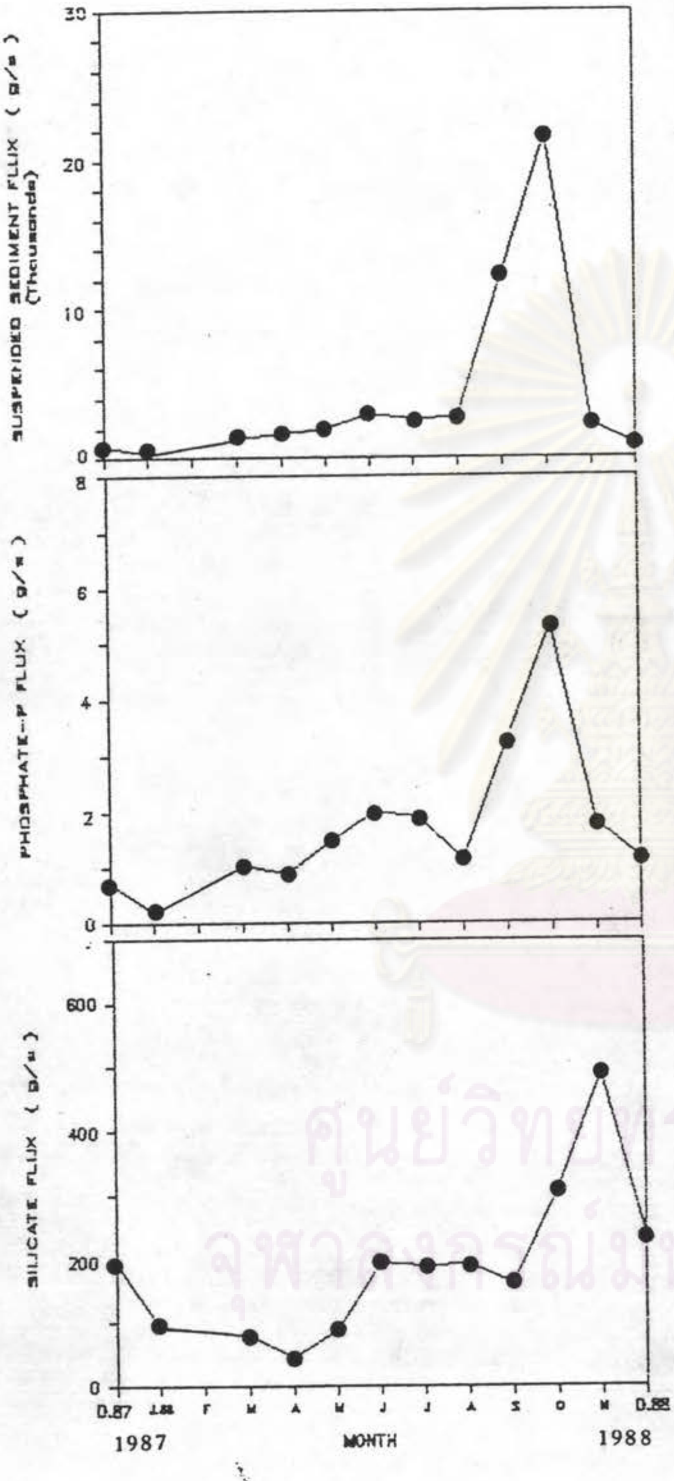


Figure 21 Comparison of the daily net fluxes between the Pak Kret and Bang Sai Transects.



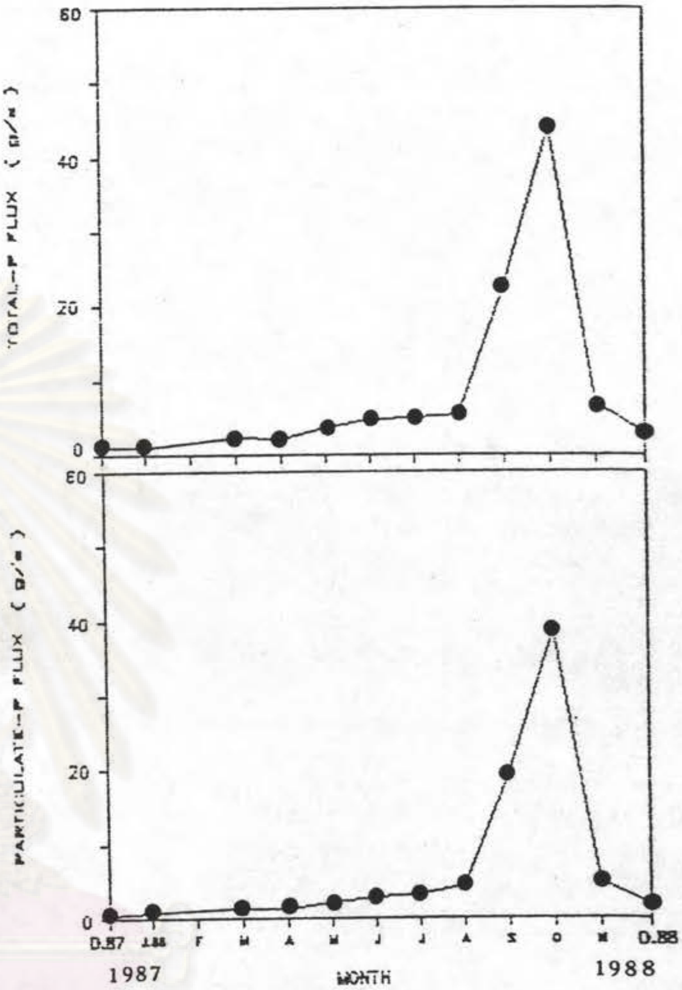


Figure 22

The annual regimes of the monthly mean fluxes of suspended sediment, total-P, particulate-P, phosphate-P and silicate through the lower basin of the Chao Phraya River during December 1987 to December 1988.

(load per unit drainage area) for the discharge of $154.8 \times 10^8\ m^3\ yr^{-1}$ draining from the upper and central basins covering an area of about 142,000 km^2. The results were summarized in Table 7.

Table 7 The annual mean fluxes of suspended sediment, phosphate phosphorus, total phosphorus, particulate phosphorus and silicate through the lower basin of the Chao Phraya River during December 1987 to December 1988.

Parameter	tons yr^{-1}	as specific transport rate
Suspended Sediment	$1,566.02 \times 10^3$	11.02 tons $km^{-2}\ yr^{-1}$
Phosphate Phosphorus	0.63×10^3	4.43 kg P $km^{-2}\ yr^{-1}$
Total Phosphorus	3.13×10^3	22.04 kg P $km^{-2}\ yr^{-1}$
Particulate Phosphorus	2.49×10^3	17.54 kg P $km^{-2}\ yr^{-1}$
Silicate	69.48×10^3	489.30 kg Si $km^{-2}\ yr^{-1}$

<u>The Relationships between the Material Concentrations and the Discharges</u>

To better understand about some patterns and trends of material fluxes in the Chao Phraya River the material concentrations of suspended sediment, reactive phosphorus, total phosphorus, particulate phosphorus and dissolved silicate were plotted against the discharges using both daily and monthly mean values. The daily mean discharge obtained from this field measurements, but the monthly mean discharge received from the Royal Irrigation Department. These monthly mean discharges derived by summing between the discharge measured at Amphoe Tha Rua of the Pasak River and at Ang Thong Province of the Chao Phraya River (see the arrows in Fig. 1), which were then transported through the lower basin of the Chao Phraya River from Ayutthaya and finally to the estuary.

Material fluxes in river systems were not only estimated from the interpolation method but also most often derived from the extrapolation method by regression techniques of the relationships between discharge and water chemistry (Hall, 1970; Davis and Zobrist, 1978; Foster, 1978; Whitfield, 1981; Jansson, 1985). Unfortunately, such relationships were nonlinear and time-dependent for Pak Kret and Bang Sai Station in the Chao Phraya River. This phenomenon was the hysteresis effects (Fig. 23-25). The relationships here plotted in the time sequence of occurrence between December 1987 - December 1988. Most of the relations of Pak Kret Station form loops in a clockwise direction, and of Bang Sai form loops in a counterclockwise direction (Table 8). The overall loops may be attributed to seasonal difference in river conditions and storage - discharge relationships as had been occured in the Fraser River basin, British Columbia (Milliman, 1981; Whitfield, 1981).

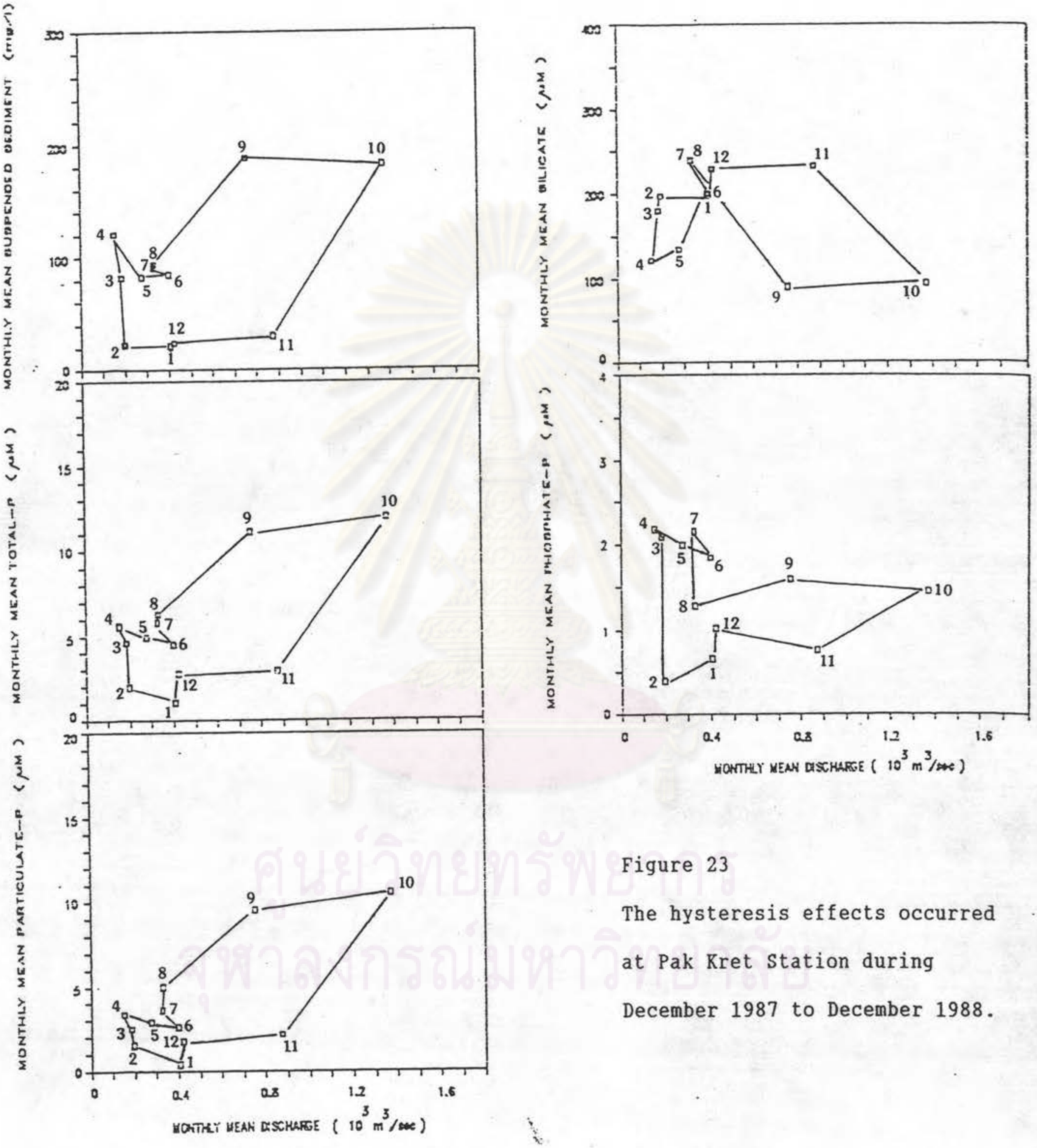


Figure 23

The hysteresis effects occurred at Pak Kret Station during December 1987 to December 1988.

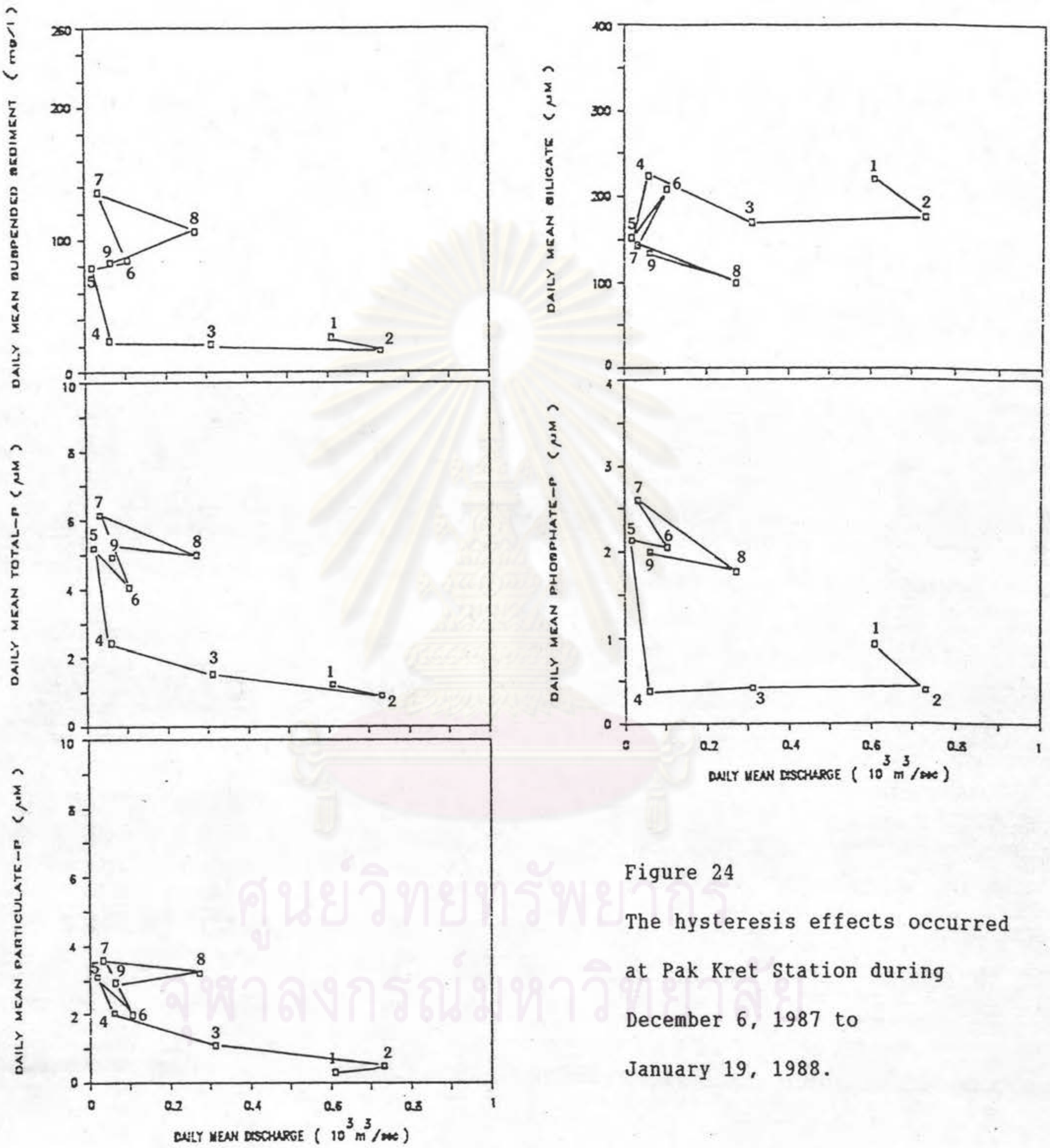


Figure 24

The hysteresis effects occurred at Pak Kret Station during December 6, 1987 to January 19, 1988.

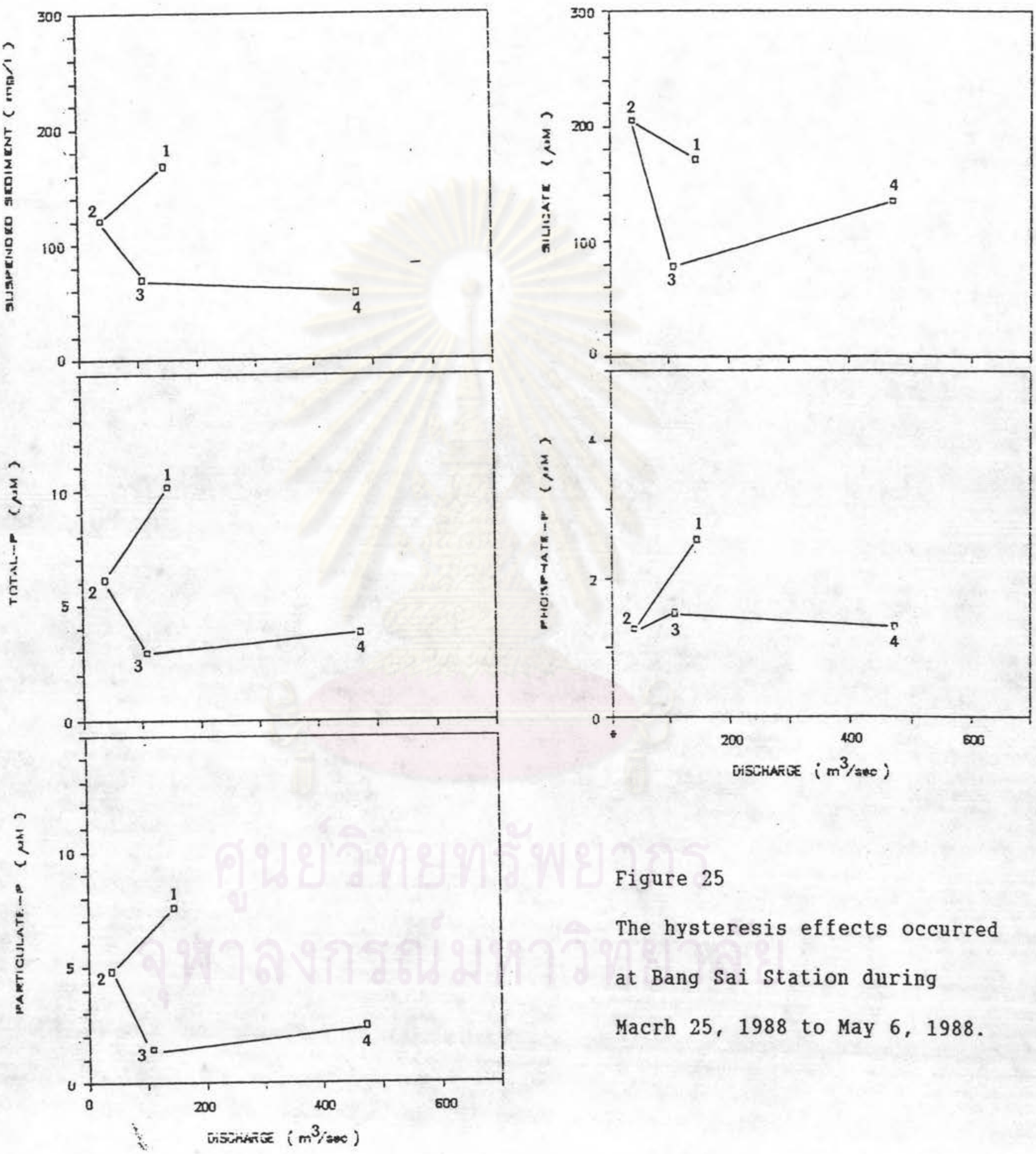


Figure 25

The hysteresis effects occurred at Bang Sai Station during Macrh 25, 1988 to May 6, 1988.

Table 8 Summary of hysteresis direction on water chemistry-discharge relationships of Pak Kret and Bang Sai Stations in the Chao Phraya River during December 1987-December 1988.

Positive (+) = clockwise direction

Negative (-) = counterclockwise direction

± = Mixed loop changes direction.

Parameter	Relationships with the Discharge		
	Monthly mean data	Daily mean data	
	Pak Kret	Pak Kret	Bang Sai
Suspended sediment	+	+	-
Phosphate-P	±	+	-
Total-P	+	+	-
Particulate-P	+	±	-
Silicate	±	±	-

<u>The Relationships between the Concentrations of Total Phosphorus and Suspended Sediment</u>

In addition, the relationships between the concentrations of total phosphorus and suspended sediment were determined, it was revealed that they had a good correlation with the regression lines, $r^2 = 0.94$ and 0.90, for plotting of monthly mean data and daily mean data respectively (Fig. 26). The linear regressions could be fitted for the models which are as follows:

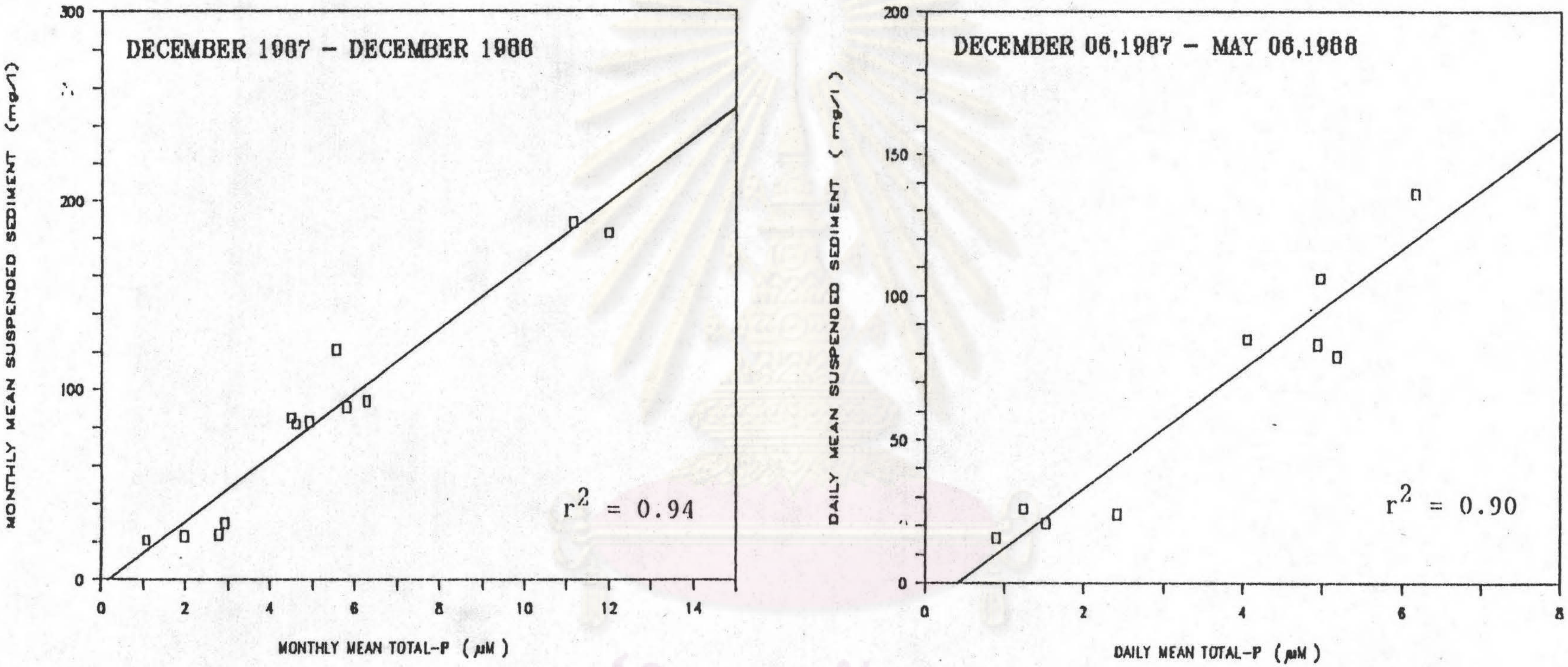


Figure 26 Relationship between the contents of total phosphorus and suspended sediment of the Pak Kret Station.

$$x = 0.167 + 0.060\,y \quad \ldots\ldots (1)$$

$$x = 0.422 + 0.047\,y \quad \ldots\ldots (2)$$

where x = Total Phosphorus (μM)

and y = Suspended Sediment (mg/l)

Equation (1) is the model for plotting of monthly mean data

Equation (2) is the model for plotting of daily mean data

This implies that the total phosphorus concentration varied as a function of suspended sediment concentration due to the adsorption/desorption processes of reactive dissolved phosphorus onto river-borne suspended sediment.

<u>The Laboratory Simulation on Conservative and Non-conservative Behavior of Phosphorus</u>

The behavior of dissolved phosphate in the lower part of the Chao Phraya River was studied using the simulated mixing experiment of water samples from under Krungthon Bridge as had been mentioned in chapter 2. The study suggested that dissolved phosphorus mostly undergoes linear dilution except at the initial mixing in the region of 0-18 ‰ exhibited a small removal when river water mixed with seawater. Using the approach of Boyle, Collier, Dengler, Edmond and Stallard (1974), the possible maximum removal of dissolved phosphorus was 52 % . After removal was complete (above 18 ‰) the phosphorus was conservative, there is no loss or gain of the phosphorus in solution during the estuarine mixing, but may be linearly diluted by physical mixing processes in the river (Fig. 27).

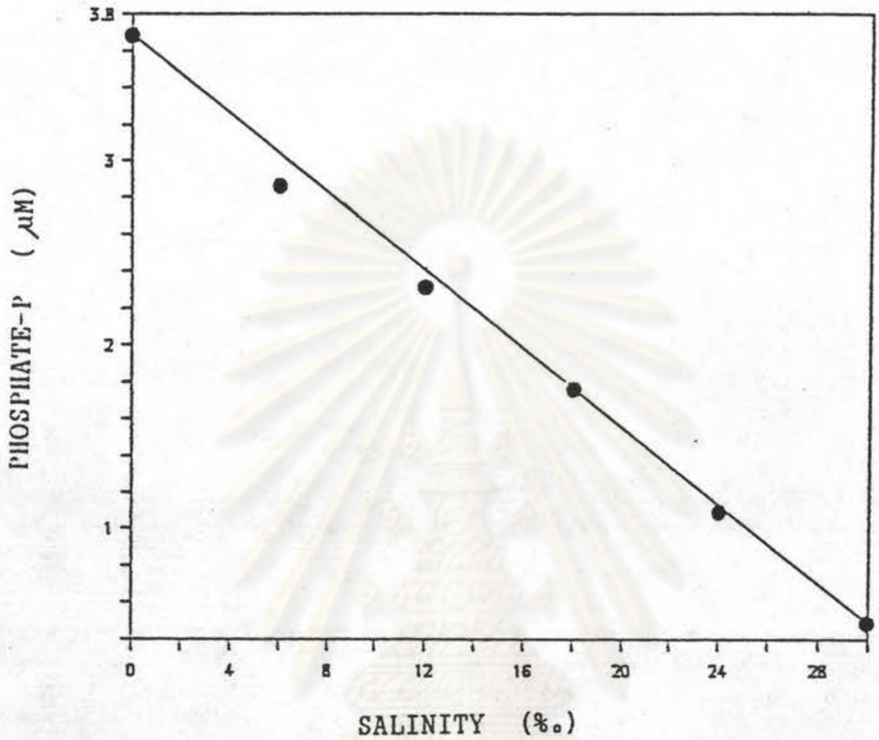


Figure 27 Relationship between dissolved phosphorus and salinity of the mixing experiment using unfilter river water collected from under Krungthon Bridge with unfiltered seawater from Sichang Island on July 12,1989.

Adsorption Capacities of Phosphorus

The experiments of this study were based on the variables of pH, salinity and dissolved phosphorus concentrations which prepared from anhydrous potassium dihydrogen phosphate (KH_2PO_4). Before starting the experiments the contents of initials available dissolved phosphorus and the organic matter of river sediment were determined. It was found that the Chao Phraya River sediment which containing 1.96 - 2.02 % of readily oxidizable organic matter there will be the content of available phosphorus in the range of 40.64 - 50.70 µmole P per gm dry sediment.

The experimental results implied that the adsorption capacities of phosphorus were depend on pH , salinity and total concentrations of dissolved phosphorus in the overlying medium between sediment and water interface. The results were summarized as follows:

1. High contents of phosphorus adsorption on the sediments was favored by a lower pH (Table 9).

2. Phosphorus adsorption capacities in fresh water tends to be greater than saline water (Fig. 28).

3. The maximum range of phosphorus adsorption capacities on wet sediments in the medium of fresh water and saline water (13 ‰), containing 48 - 72 µmole-P under room temperature at pH 7.0 - 7.1 were 65.55 - 67.77 µmole-P/g S (dry weight) and 52.61 - 53.77 µmole-P/g S respectively (Fig. 29). This was around 1-1.3 fold of the original content in river sediment. Thus, it can be elucidated that the influence of adsorption on bottom sediments should be one of among processes in controlling and modifying the dissolved phosphorus

concentration in the river.

Table 9 Amounts of phosphate phosphorus adsorbed on the Chao Phraya River sediment as a function of pH in the medium of river water sample (Salinity = 0 ‰).

pH	P-added to a mixture sample (μmole-P/100 ml)	P-adsorbed (μmole-P/gm S)
7.80	4	8.84
7.30	4	15.68
7.80	6	13.98
7.25	6	20.85
7.50	18	29.76
7.20	18	34.64
6.95	18	41.69
7.40	30	36.09
7.20	30	43.30

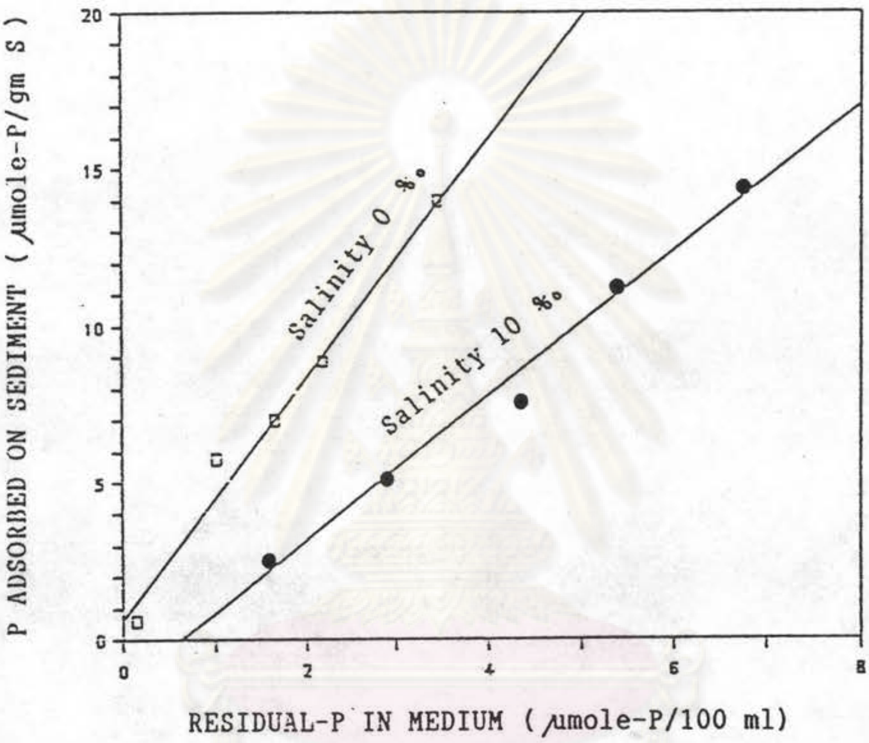


Figure 28 The adsorption isoterms of dissolved phosphorus on the Chao Phraya River sediments.

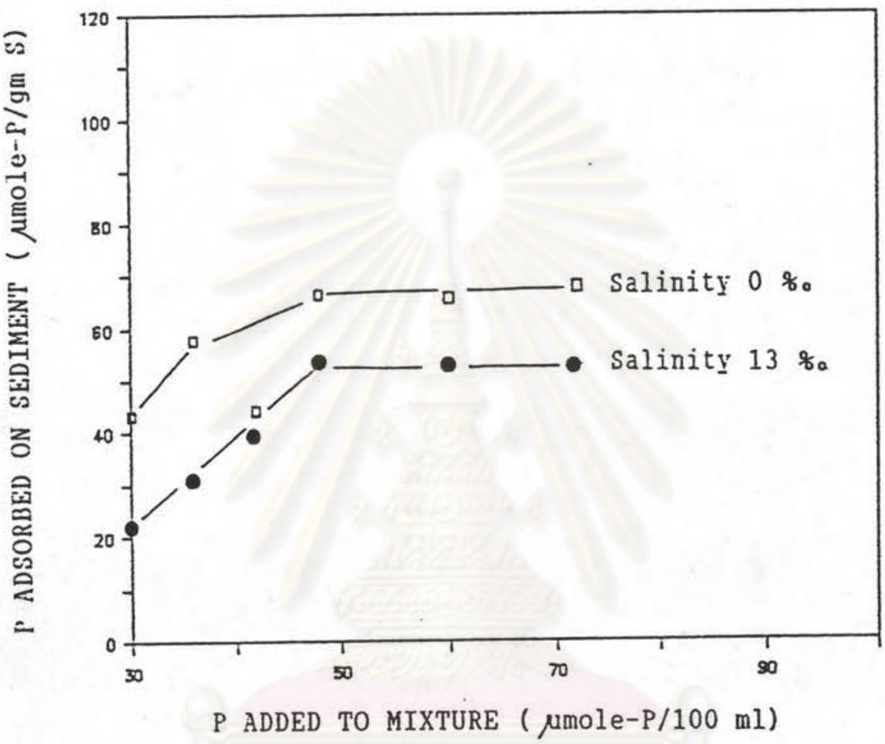


Figure 29 Phosphorus adsorption capacities on the Chao Phraya River sediment in the medium of freshwater (0 ‰) and seawater (13 ‰).