2.5 Wetlands

(1) The natural environment around Patos and Mirim lakes is remarkably characterized by innumerable and vast wetlands. There is a sub-basin which is 29% wetland (48% if including paddy field). The wetlands were categorized according to natural conditions (vegetation, hydrology and origin): three coastal wetlands, five inland wetlands, and four artificial wetlands. Fifty wetlands were identified around Patos and Mirim lakes (**Fig. 2.5-1**).

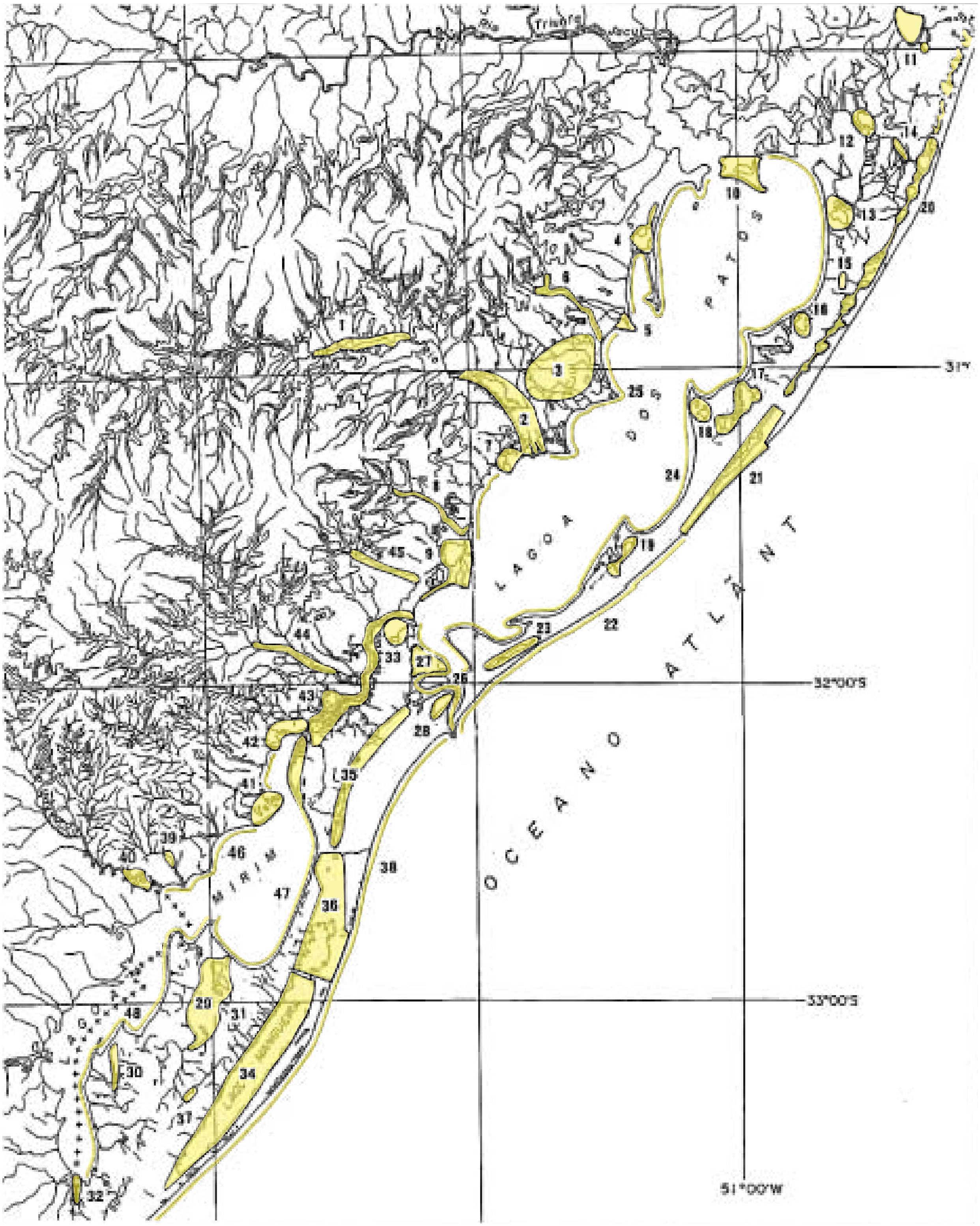
(2) As sources of irrigation water, many of the wetlands are economically valuable. Wetlands around Patos Lake are pool type wetlands directly adjacent to farmlands, and have few swamps. On the other hand, those around Mirim Lake have broader swamps probably because developments in the vicinity of the Patos Lake area are more progressive than in the Mirim Lake area.

(3) Factors that influence the water level and/or salinity in the above mentioned 50 wetlands, and the potential threats to water balance and water quality were examined. Wetlands around Patos and Mirim lakes seem to have a fragile water balance, as their catchment areas are generally small and due to restricted rainfall (water balance is also determined by precipitation). Mirim Lake has a gently sloping shore and the shoreline is significantly affected by seasonal changes in water level. The impact of wind conditions on water level also affects the shoreline.

(4) Expansion or development of rice fields and pastures, water intake for irrigation, illegal drainage and siltation are among the manmade factors that affect the water level of wetlands around Patos and Mirim lakes.

(5) Factors that would imply water quality deterioration in the wetlands were not confirmed. The proliferation of water blooms or water hyacinth was not significant enough to indicate eutrophication. Agrochemical contamination, however, could be a potential threat since most wetlands are surrounded by farmlands.

(6) The ecological characteristics of 50 wetlands and the potential threats to their ecological systems were examined. Cattle encroachment was the most common and obvious threat to wetland vegetation. Water balance also affects wetland ecosystems through changes in vegetation.



THE STUDY ON THE ENVIRONMENTAL MANAGEMENT OF THE HYDROGRAPHIC BASIN OF PATOS AND MIRIM LAKES IN THE FEDERATIVE REPUBLIC OF BRAZIL	**Fig. 2.5-1**
JAPAN INTERNATIONAL COOPERATION AGENCY KOKUSAI KOGYO CO., LTD. / PACIFIC CONSULTANTS INTERNATIONAL	**Location of 48 Selected Wetlands**

(7) Among the wetlands around Patos and Mirim lakes, Peixe Lake had already been registered under the Ramsar Convention as an important transit site for migratory birds. Many of the wetlands are also valuable in terms of ecological biodiversity. For example, the riverine forests downstream of Camaquã River not only protect various fauna and flora species but also provide safe places for fish spawning.

(8) Though the natural vegetation type of this area, especially in the wetlands, is remarkably unique even for a country as vast as Brazil, local residents and institutions do not seem to be aware of this fact and have little interest in wetlands. 50 wetlands were surveyed in terms of accessibility and availability of educational and recreational facilities. The results show that only a handful of wetlands are easily accessible to the general public.

2.6 Hydrological Conditions of Patos Lake

(1) Available data shows that except for Rio Grande in the southern extremity, annual fluctuation in lake shore water level is similar overall. Water level is at its lowest in the dry season (December to March) and at its highest in the rainy season (July to October). Average annual fluctuation in water level is less than 0.6m in São Lourenço do Sul mainly due to fresh water inflow. The water level fluctuation pattern at Rio Grande differs from other sites due to tidal fluctuation.

(2) According to recent 1 year data on wind conditions, northeastern winds prevail all year round in the surrounding lake area. In summer, the winds blow from north-east to east-north-east, and from north to north-north-east and west-south-west to west in winter.

(3) A fixed point survey using a self-recording current meter (three points) and a sectional survey using an acoustic Doppler current profiler (four sections) were carried out twice, in February (summer) and August (winter) 1999, in the course of this study (**Fig. 2.6-1**). Together the results of these surveys clearly showed that the flow is predominantly southwards in the northern and central lake areas. However, under certain meteorological and hydrological conditions, the flow at the mouth of Guaíba Lake (R1) moves northward; even in the central section, backflow was observed.

(4) In the southern lake area, the flow was also predominantly southwards, although certain meteorological and hydrological conditions trigger northward flow. In particular, the flow direction in the bottom of Rio Grande channel was northward despite a southward movement in the surface.

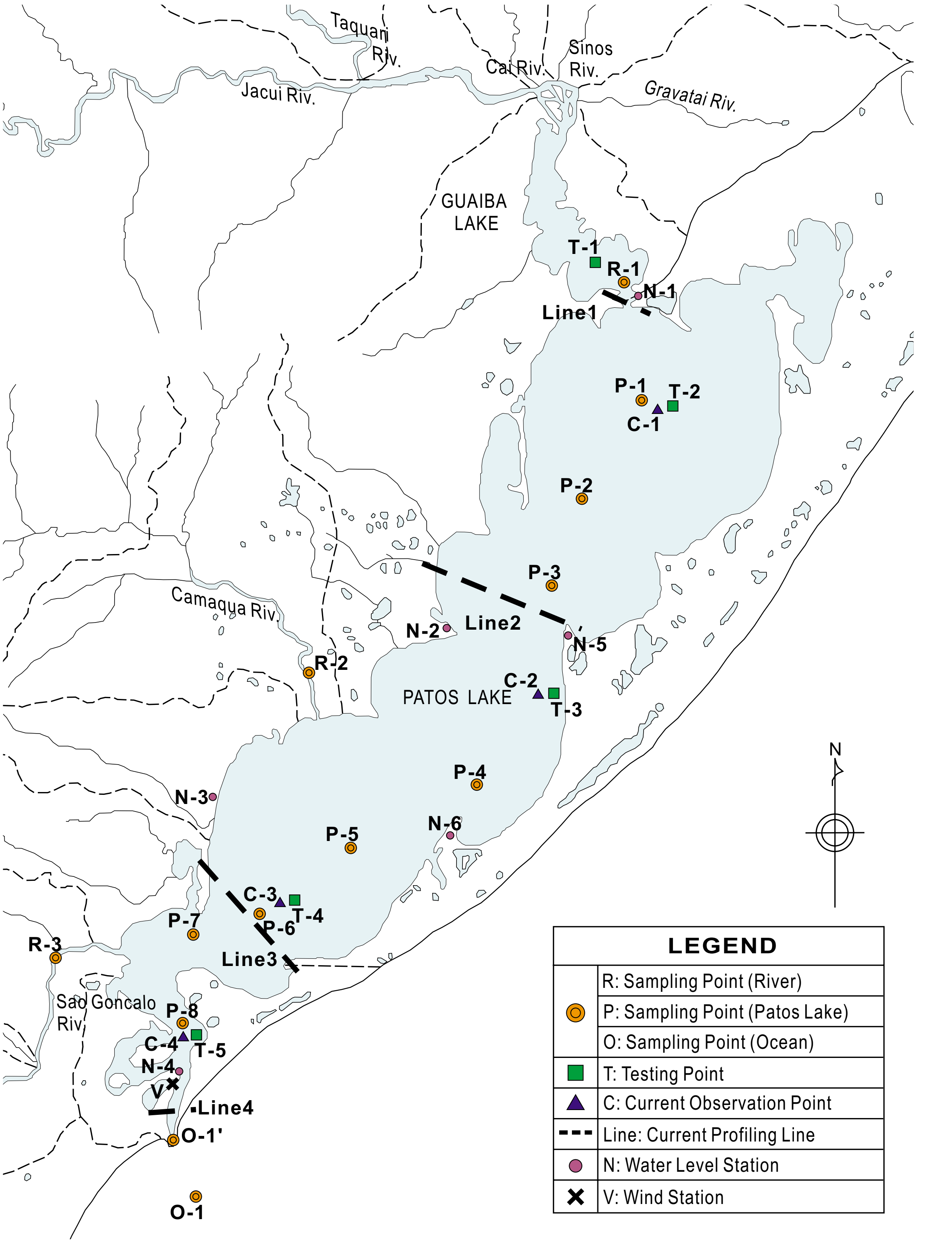
(5) The rainfall amount in the winter of 1999 was smaller than in normal years, hence distinct seasonal changes in flow conditions, which are largely influenced by river flux, were not observed. However, wind and flow conditions were found to be closely correlated presumably due to the shallowness of the lake and the prevalence of NE-SW winds with a velocity of around 10m/s. Wind conditions and river water volume were also found to influence flow conditions in the Rio Grande channel; only a few sections are affected by tidal conditions.

(6) Differences in surface and bottom flows were not observed in the northern lake area where the depth is shallow, and the central area. In contrast, a huge discrepancy was observed in the southern area which is deep and easily influenced by tidal fluctuations.

(7) In the water quality monitoring survey, the vertical distribution of salinity, water temperature, pH, DO, transparency, and turbidity was measured. The survey results showed sharp changes in the distribution pattern at a depth of 2 to 5m in the southern area, indicating seawater intrusion. In the central and northern areas hardly any changes were observed.

(8) The distribution of water temperature, turbidity and chl-a concentration was analyzed using satellite images taken on June 12, 1996. The results showed lower turbidity and chl-a concentrations in the central lake area compared with the northern and southern lake areas. Remarkably high turbidity and chl-a concentration was also observed in semi-closed areas such as Guaíba Lake, Saco de Tapes and Saco da Mangueira.

(9) According to available data, clayey silt and silt are predominantly distributed in the northern lake area, whereas silty sand and sand predominate in the southern area. Such granular variation is rather consistent with the flow patterns mentioned previously.



THE STUDY ON THE ENVIRONMENTAL MANAGEMENT OF THE HYDROGRAPHIC BASIN OF PATOS AND MIRIM LAKES IN THE FEDERATIVE REPUBLIC OF BRAZIL	**Fig. 2.6-1**
JAPAN INTERNATIONAL COOPERATION AGENCY KOKUSAI KOGYO CO., LTD. / PACIFIC CONSULTANTS INTERNATIONAL	**Location Map of Monitoring Survey**