Characters of nutrient load from influent rivers of Lake Shumarinai

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Lake Shumarinai locates at Horokanai Town in Hokkaido, and is a man-made lake completed in 1943 for the purpose of power generation. A reservoir area (2,373ha) is maximal in Japan. Most watershed of this lake is composed of conifer and broad-leaved tree.

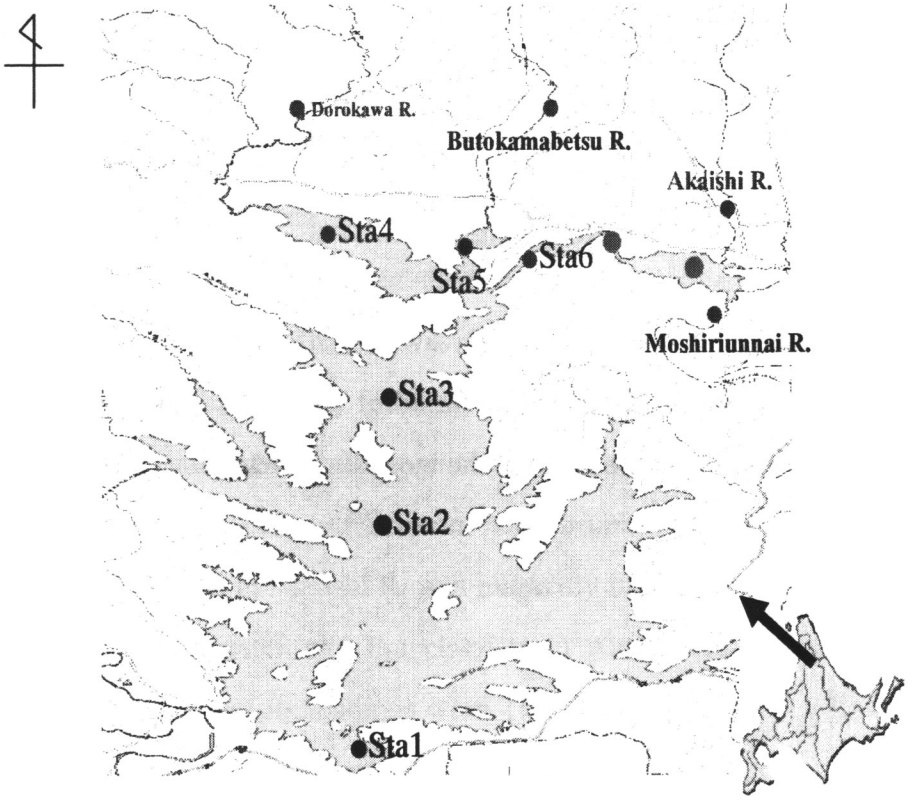

Fig.1 Map of sampling stations and inflowing rivers of Lake Shumarinai.

We surveyed at sampling stations at the lower part of the four major influent rivers of Lake Shumarinai in 2002 to 2005 to understand about nutrients loading into the lake from the rivers; Sta.D, Sta.B, Sta.A and Sta.M were the sampling stations of Doro R. Butokamabetsu

R., Akaishi R., and Moshiriunnnai R., respectively. Watersheds of Doro R. and Butokamabetsu R. are almost natural forest area, but those of Akaishi R. and Moshiriunnnai R. are used to cattle farming partly. Especially, Akaishi R. was polluted by dairy wastewater, which has 44 kg/day in TOC load, 5.3 kg/day in TN load and 1.5 kg/day in TP load. A half of TP loading in Sta.A originated from the wastewater. The ratio in flow rate Sta. D : Sta. B : Sta. A : Sta. M was about 2 : 4 : 1 : 1.

As flow rate of Butokamabetsu R. (Sta.B) was largest in inflowing rivers, TOC loading was also high and the loading accounted for 48% to the total amount. However, amount of Akaishi R. and Moshiriunnai R. for N loading and P loading were larger as compared to the amount of their flow rate (25%) and accounted 44% and 70%, respectively. In contrast TOC loading of Butokamabetsu R should derive from forest area as pollutant source was observed in the basin.

Lake water near estuary of Doro R. (Sta.4) was not polluted at all by nutrient loading than lake water near estuary Butokamabetsu R. (Sta.5) and that near Akaishi R. (Sta.6). However, water environment of Sta.4 was very eutrophic as similarly as Sta.5 and Sta.6; it was suggested that nutrients supplied by other mechanism besides nutrient loading by Doro R. We observed in the meandering watercourse near river mouth inflowing of Doro R. in 2003 July 2. We found the place where water qualities varied in haste; nutrients level and phytoplankton biomass increased radically at the place in the meander watercourse.

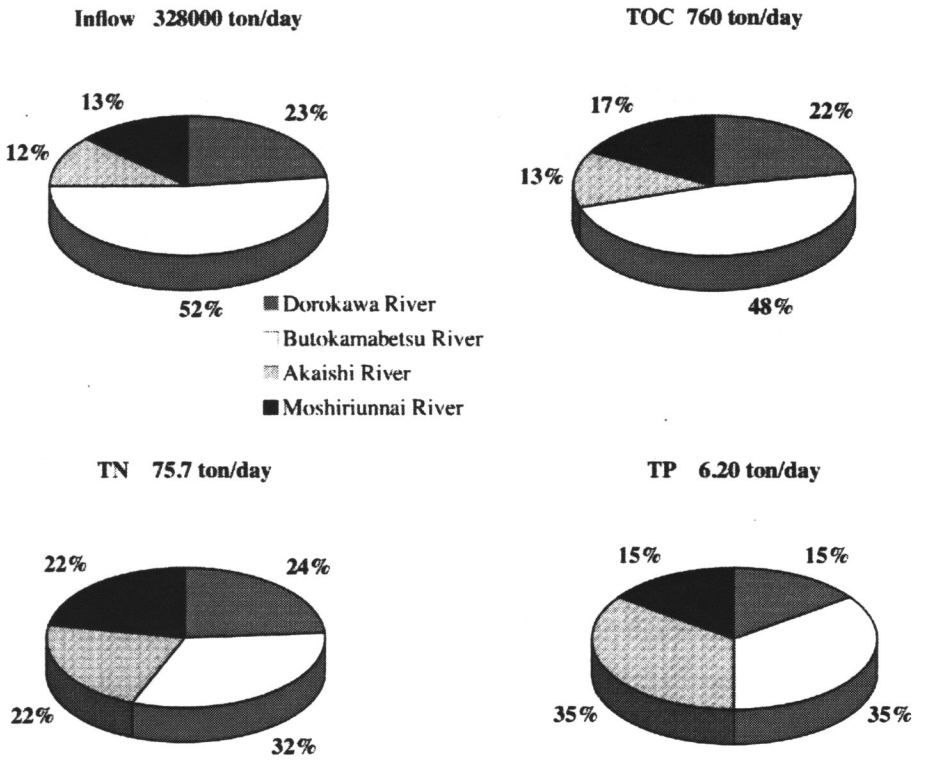

Fig.2 Loading of TOC, TN, and TP from influent rivers to Lake Shumarinai (2002-2003)

High level of dissolved inorganic nitrogen was detected at Akaishi R. and Moshiriunnai R. polluted by dairy wastewater from Stock form. As well as NO_3^--N, NH_4^+-N also detected in Akaishi R. This means that oxidation of nitrogen source in wastewater does not proceed in Akaishi. Although phosphorus concentration in Moshiriunnai R. is also high level as compared to other rivers, R. that in Akaishi R. was markedly higher as well as nitrogen. Fig.3 shows loading of dairy wastewater and branch-river in Akaishi R. Dairy wastewater to Akaishi R. inflows at Sta.A-A and its loadings were TOC 44 kg/day, TN 5.3 kg/day, and TP 1.46 kg/day. Loadings of N and P with basic unit method were 196 kg/day and 28.3 kg/day and 2.7% and 5.2% to the total amount were outflowed, respectively. Contributions to Akaishi R. of wastewater from Stock form A were TOC 26%, TN 22.4%, and TP 48.5%, and loadings from Bifukakoshizawa R. (branch river) located another stock farm was also high (TOC 90kg/day, TN 9.9 kg/day, and TP 1.13 kg/day). The amounts of loading of two pollutant sources were TOC 134kg/day, TN 15.2/day, and TP 2.59 kg/day. At Sta. M-L (the lower reaches of inflowing of wastewater and branch river), inflowing and TOC loading were

3.5 fold and 3.85 fold to those of Sta. A-1 as upper reaches of Akaishi R. In contrast, those of TN, and TP were 7.16 fold and 2.52 fold. Although TP loading markedly increased, TN loading is not so much as compared to inflowing. This might be due to contribution of nitrogen outflow from forest area at upper reaches of Akaishi R.

As shown in Fig. 2, nitrogen loading to Lake Shumarinai is larger than that of phosphorus (TN 75.7 ton/day and TP 6.20 ton/day). This is due to large amount of nitrogen loading as compared to phosphorus loading except for Akaishi R. This N/P ratio is higher than that of Redfield ratio. Therefore, it is possible that phosphorus is limiting factor in Lake Shumarinai. In contrast, water bloom appears by the eutrophication in Sta.6 loaded much nitrogen and phosphorus in Lake Shumarinai.

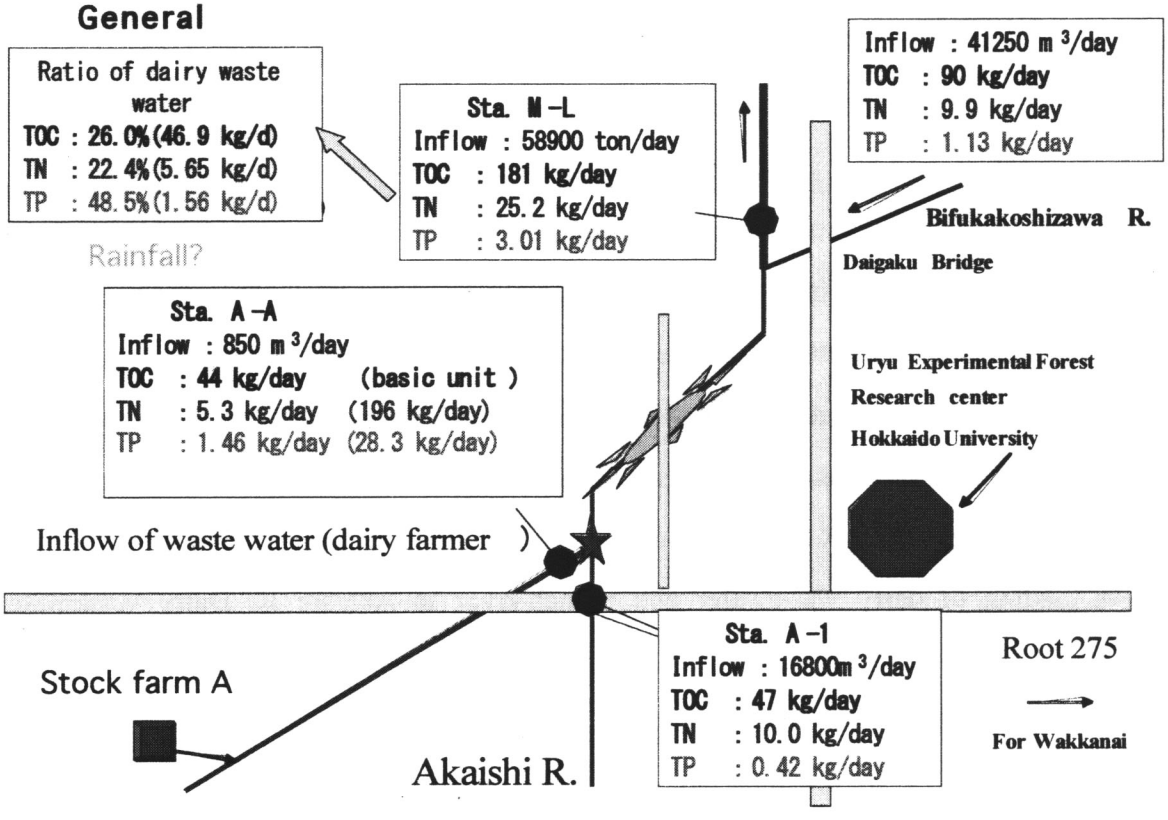

Fig.3 Loading of waste water from Akaishi River.