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The Removal Rates of the Constituents of Litters in the Littoral Grassland Ecosystems in the Lake Paldangho Ⅱ. Nitrogen

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팔당호 연안대 초지생태계에서 낙엽 구성성분의 유실률 Ⅱ. 질 소

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ABSTRACT

Samples from the L, F, H and A_1 horizons of the *Phragmites communis, Miscanthus sacchariflorus, Scirpus tabernaemontani* and *Typha angustata* grassland were collected in Paldangho and the removal rates of nitrogen were investigated. The removal rates of nitrogen of the litters were 0.85 in *P. communis*, 0.56 in *M. sacchariflorus*, 0.45 in *T. angustata* and 0.31 in *S. tabernaemontani*.

The time required to decay 50, 95, 99 percent of the steady state levels and turnover values of nitrogen on the grassland floor were 0.81, 3.53, 5.89 years in the *P. communis*, 1.23, 5.32, 8.86 years in the *M. sacchariflorus*, 1.54, 6.68, 11.13 years in the *S. tabernaemontani* and 2.22, 9.63, 16.04 years in the *T. angustata*.

Key words: Removal rate, Accumulation, Paldangho, Nitrogen, *Phragmites communis, Miscanthus sacchariflorus, Scirpus tabernaemontani, Typha angustata.*

INTRODUCTION

Nitrogen decomposition in mature ecosystem was consisted of three interrelated process(Swift *et al.*, 1979). These are leaching, catabolism and comminution. It performs two major function within ecosystem, that is mineralization and formation of organic matter. Mineralized nitrogen(NH_4^+) was released during catabolism and organic form of nitrogen was accumulated into soil. 99% of the nitrogen in grassland soil ecosystem is organically bounded(Rosswall, 1976).

In aquatic ecosystem nitrogen with carbon and phosphorus occurs eutrophication in water and followed by amplification of algae and decreasing of dissolved oxygen. The changes in an environment shift the nitrogen contents toward a new steady state of the litter production and decay. Because of seasonal homogenetic cycle of climate and water flowing ecosystem will result in a continuing balance between the nitrogen losses and gains in the grassland ecosystem.

Numerous investigator(Greenland and Nye, 1956; Jenny *et al.*, 1959; Olson, 1963; Oohara *et al.*, 1971; Chang and Yoshida, 1973; Kim and Chang, 1975; Chang *et al.*, 1987; Chang and Oh, 1995) have used the mathematical model to describe the change of mineral nutrient element in soil as a function of time. Since in the grasslands of the steady state the net velocity of change in the annual addition of nitrogen into soil is equal to the rate of the annual removal. This study has been performed to elucidate the accumulation and mineralization of total nitrogen at the aquatic grassland floors of *Phragmites communis*, *Miscanthus sacchariflorus*, *Scirpus tabernaemontani* and *Typha angustata* on the lake Paldangho and compared terrestrial grassland ecosystem.

MATERIALS AND METHOD

The soil samples were collected by quadrat method from L, F, H and A_1 horizons in the *Phragmites communis*, *Miscanthus sacchariflorus*, *Scirpus tabernaemontani* and *Typha angustata* grassland on the lake Paldangho in April, 1996. These were taken from the boxes, air-dried, and weighted. The litter productions were calculated on a dry weight basis. Total nitrogen was determined by the micro-Kjeldhal method.

RESULT AND DISCUSSION

The sites selected for this study were the grasslands of *P. communis*, *M. sacchariflorus*, *S. tabernaemontani* and *T. angustata* on the lake Paldangho. The production and removal rates of nitrogen on the aquatic grassland floors were estimated in these area.

The amount of the total storage of nitrogen in the grassland was 41.85g/m^2 in *P. communis*, 20.00g/m^2 in *M. sacchariflorus*, 106.22g/m^2 in *S. tabernaemontani* and 44.10g/m^2 in *T. angustata* and the vertical distribution amount was shown in Table 1. As compared with a *Reinoutria sachalinesis* and a *Sasa purpurascens* grassland in Obihiro, Japan, (1.00~4.00g/m^2) these data are high. Chang and Ahn reported that the total storage of nitrogen of the litter in *Pragmites longivalvis* grassland in the delta of the Nakdong river was 15.94 g/m^2(1995). Each total nitrogen storage of grassland on Paldangho is higher than that of *P. longivalvis* grassland in Nakdong river.

The removal rate $r(=\frac{L}{Nss})$ has been determined by Olson(1963) and Chang and Yoshida(1973). L is an annual nitrogen production of fallen leaves, dead twigs, barks,

Table 1. The annual production and accumulation of organic matter and total nitrogen of the litters in the *P. communis, M. sacchariflorus, S. tabernaemontani* and *T. angustata* grassland ecosystems on the lake Paldangho

Community	Horizons	Dry weight (g /m²)	Nitrogen (g /m²)
P. communis	L	3,550.4	35.54
	F, H, A_1	810.4	6.31
M. sacchariflorus	L	3,440.0	13.48
	F, H, A_1	2,728.9	10.42
S. tabernaemontani	L	6,136.0	47.69
	F, H, A_1	3,111.2	58.43
T. angustata	L	8,308.8	13.74
	F, H, A_1	7,557.6	30.36

flowers and fruits. Nss is the total amounts of accumulation of nitrogen of L, F, H and A_1 layers. The removal rate r should not be larger than 1. The larger the value is, the larger the removal function in the grassland is. The estimates of rate r for nitrogen turnover are collected in Table 2.

Chang and Han(1987) represented that the removal rate r was 0.076 in *Carpinus* forest in Mt. Halla, 0.099 in *Quercus* forest in Mt. Sobaek and 0.080 in *Larix* forest in Mt. Taebaek. Chang and Kim(1995) also showed that the removal rate r value was 0.18 in *Zoysia japonica* and 0.17 in *Miscanthus sinensis* grassland in Mt. Kwanak. But Table 2 represents different result from them.

Nitrogen removal rates r are 0.35~0.85 in the littoral zone of the Paldangho. These values are higher than those of Chang & Han and Chang & Kim. It was supposed that the removal rates of aquatic and wetland ecosystem was very high. Because the removal function of nitrogen was affected by climate, vegitation, topography, clay content and time.

The different factor between forest and wetland ecosystem is annual water flowing.

Especially, seasonal water flooding wipes most of the organic nitrogen compound into river. At the end of the seasonal flooding, the grassland of the Paldangho littoral zone have only a small portion of nitrogen compounds. Water nitrogen quality of Paldangho

Table 2. Duration of accumulation and removal of total nitrogen on the grassland floor of *P. communis, M. sacchariflorus, S. tabernaemontani* and *T. angustata* on the lake Paldangho

Community	r	Half-time	95% time	99% time
P. communis	0.85	0.81	3.53	5.89
M. sacchariflorus	0.56	1.23	5.32	8.86
S. tabernaemontani	0.45	1.54	6.68	11.13
T. angustata	0.31	2.22	9.63	16.04

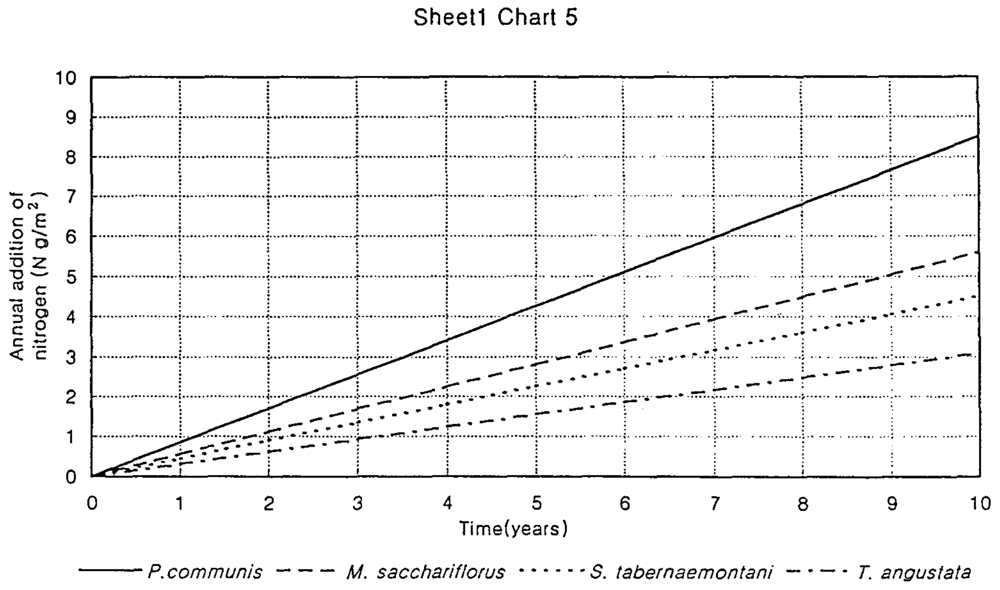

Fig. 1. The removal rate ***r*** for nitrogen in the grassland floor of *P. communis, M. sacchariflorus, S. tabernaemontani* and *T. angustata* on the lake Paldangho.

was considered by the removal rate r value in each grassland of littoral zone.

Fig. 1 presents rate r curve and relationships of annual addition of nitrogen and grassland floors. The r value corresponds not only to the wide variation between nitrogen contents and annual production of the litter but between nitrogen contents of the soil profiles and nitrogen level of the annual litter. The value r has been determined by equation($r=L/Nss$) and the removal and accumulation models of nitrogen for aquatic grassland was obtained from the equation($N=N_0e^{-rt}$) The decay time, $0.693/r = t_{0.50}$, may be viewed as a half-time in accumulation or decomposition of nitrogen of litter. The time period $3/r$ means the time required for attaining 95% of the final level of accumulation or elimination of litter, while $5/r$ should approximate the time needed to reach 99% of the final level (Chang *et al.*, 1995). The value of the exponential equation is shown Table 2.

Because a rate of any one year's production is spent in turnover during early stage of aquatic grassland floor accumulation, the storage of nitrogen must be continued when the total production was so large and the product rN gradually approaches the income amount and approximates the balance. In this case, because the velocity of change is zero, so the input is equal to the output. The amounts of annual cycle of nitrogen in the aquatic grassland ecosystems of *P. communis, M. sacchariflorus, S. tabernaemontani* and *T. angustata* are 35.54, 13.48, 47.69 and 13.74g/m^2.

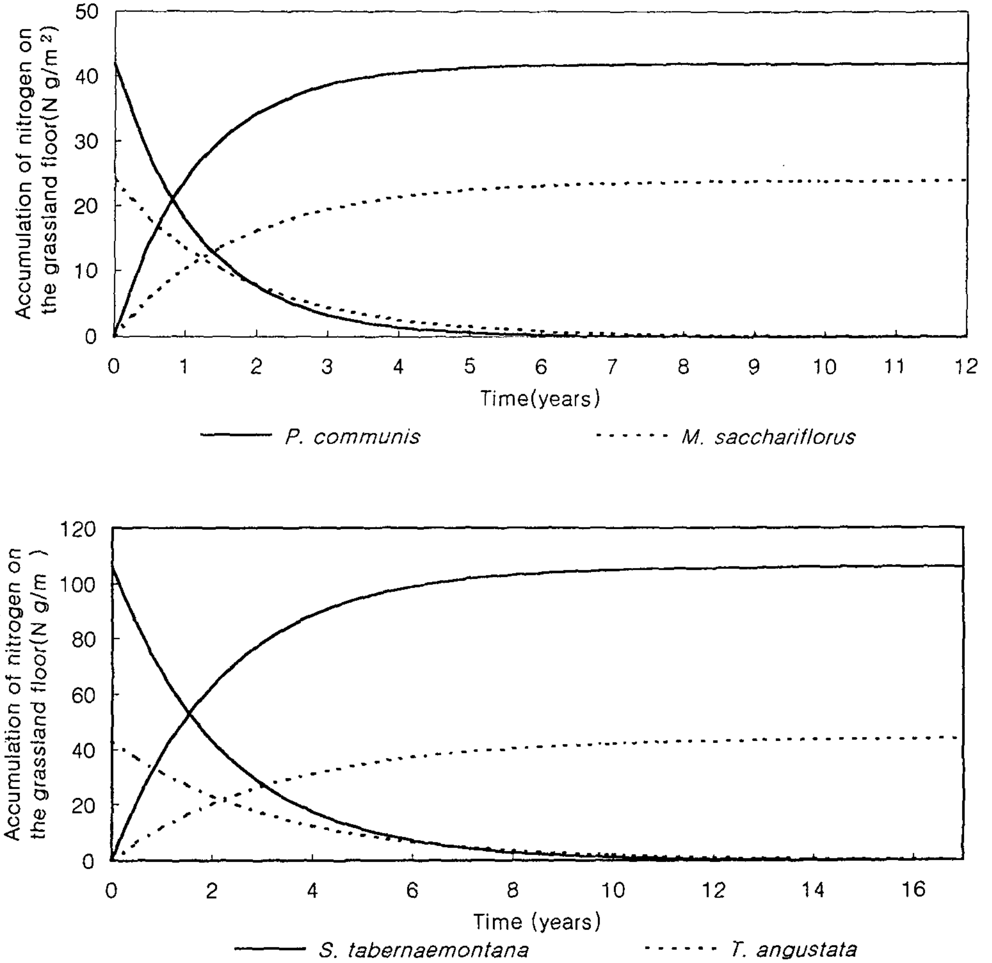

Fig. 2. The exponential equation for nitrogen in the wetland ecosystem of *P. communis, M. sacchariflorus, S. tabernaemontani* and *T. angustata* grassland on the lake Paldangho.

적 요

본 연구는 팔당호의 갈대, 억새, 고랭이, 부들의 습지 군락에서 질소의 순환과 식물군락에 의한 제거율을 규명하고자 한 것이다. 질소의 연 생산량은 갈대군락에서 41.85g/m^2, 억새군락에서 23.90g/m^2, 고랭이 군락에서 106.12g/m^2, 부들에서 44.10g/m^{2}이었다. 이러한 유기질소의 생성 및 분해는 질소축적량의 변화속도에 대한 미분 방정식으로 설명된다. 갈대, 억새, 고랭이, 부들의 질소량에 대한 분해 상수는 rp=0.85, rm=0.56, rs=0.45, rt=0.31로 나타났다. 축적된 질소가 50, 95, 99%로 분해되는데 필요한 시간은 갈대에서 0.81, 3.53, 5.89년, 억새에서 1.23, 5.32, 8.86년, 고랭이에서 1.54, 6.68, 11.13년, 부들에서 2.22, 9.63, 16.04년으로 갈대에서 질소의

순환이 가장 빨리 진행되었고 육상의 다른 군락에 비해서 더욱 빠른 것으로 나타났다.

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