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The Removal Rates of the Constituents of Litters in the Littoral Grassland Ecosystems in the Lake Paldangho Ⅵ. Cu, Fe and Zn

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팔당호 연안대 초지생태계에서 낙엽 구성성분의 유실률 Ⅵ. Cu, Fe 및 Zn

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ABSTRACT

The investigation was performed to reveal the removal rate of metal constituents of litters in a *Phragmites communis, Miscanthus sacchariflorus, Typha angustata* and *Scirpus tabernaemontani* grasslands in the lake Paldangho.

The removal rates of metal constituents are determined by the mathematical models. The removal rates and time required to decay up to a percentage of each metal constituent were calculated using these model. The removal rates of Cu, Fe and Zn were 0.61, 0.58 and 0.79 in *Phragmites communis;* 0.39, 0.47 and 0.68 in *Miscanthus sacchariflorus;* 0.26, 0.09 and 0.23 in *Typha angustata;* 0.56, 0.27 and 0.67 in *Scirpus tabernaemontani*, respectively. The periods required to reach half time to the stedy state of the removal and accumulation for Cu, Fe and Zn were 1.13, 1.19 and 0.79 years in *Phragmites communis;* 1.79, 1.49 and 1.02 years in *Miscanthus sacchariflorus;* 2.70, 7.43 and 2.96 years in *Typha angustata*; 1.23, 2.58 and 1.04 years in *Scirqus tabernaemontani*, respectively.

Key words: *Phragmites communis, Miscanthus sacchariflorus, Typha angustata* and *Scirpus tabernaemontani*, lake Paldangho, Removal rate, Cupper, Iron, Zinc.

INTRODUCTION

The removal rates of the litter productions and losses afford a reliable index to evaluate the water purificaton. There are a few reports about the addition and decomposition of the pollutants in water.

According to Chang *et al.* (1987), the litter accumulation, decay and turnover models in river water reported as the bases of the decay models of organic and inorganic constituents.

Cu is generally higher in soils derived from igneous rocks and tends to be lower in extreme acid and alkaline soils. The soil availability levels are similar to Zn although its requirement by plants is generally lower. It activates certain enzyme systems in plants, especially those linked with oxidation processes. However, Cu in excess can be harmful and pollution occurs in areas where Cu ores are found and worked and it is also extensively used as a fungicide and insecticide and in metallurgical and ceramic industries. It is especially toxic to water life.

Fe is a major component of most soils. The predominant Fe minerals are the oxides but iron is also present in many other minerals. Although it is widely distributed, Fe deficiencies can occur due to its low solubility in alkaline soils and also to phosphate fixation. Fe occurs in the respiratory pigment porphyrin which is required in electron transfer processes in plants and aminals. It also activates some oxidases and is considered to be necessary for chlorophyll synthesis.

Zn is associated with various igneous minerals, but in soils is generally held in the lattice of clay minerals and then retained by the soil colloids as the clays weather. It is freely available to plants over a wide pH range but less so in very acid soils. It is necessary for most organisms since it activates certain enzyme systems. Zn can be a serious pollutant, especially in areas close to industrial plants engaged on smelting, refining and galvanizing processes. Sewage effluent often has a high Zn content which can be serious since Zn is harmful to aquatic life.

Numerous investigators(Jenny, 1941; Walker, 1956; Barthorn and Kirkham, 1960; Jenkinson, 1963; Jansson, 1963, 1968; Oohara *et al.*, 1971) have used the mathematical model to describe changes in the soil metal as a function of time. Since in the grasslands of the steady state the net velocity of change in the annual addition of metal into soil is equal to the rate of the annual removal, this investigation has been performed to elucidate the accumulation and turnover of metals on the grassland floor.

MATERIALS AND METHODS

Add 60% $HClO_4$ 1ml, Conc. HNO_3 5ml and Conc. H_2SO_4 0.5ml to a 0.5g of dried sample in a 100ml Kjeldhal flask. Boil shaking it gently at low temperature to digest slowly. Boil for 12~15 minutes from the white fume state and then cool at room temperature. Dilute to 50ml with D.W. after filtering the cooled solution with Whatman No. 44. Quantitify this extracted solution at 324.8nm wavelength for Cu, 248.3nm for Fe and 213.8nm for Zn using the atomic absorption spectrophotometer.

RESULTS AND DISCUSSION

The investigated sites were *Phramites communis, Miscanthus sacchariflorus, Typha angustata* and *Scirpus tabernaemontani* grasslands in the lake Paldangho. The removal rates of Cu, Fe and Zn on the grassland floors were estimated in these areas (Chang *et al.*, 1995 a, b, c, d).

The soil air dry weights and total Cu, Fe and Zn contents of the surface soils for the aquatic grasslands ecosystem were given in Table 1. The soil air dry weights were 4,360.8, 6,168.96, 15,866.4 and 9,247.2g / m^2 in *Phramites communis, Miscanthus sacchariflorus, Typha angustata* and *Scirpus tabernaemontani* grasslands, respectively. And the amounts of the total Cu, Fe and Zn were 17.2, 547.03 and 59.62mg / m^2 in *Phramites communis*; 18.48, 392.81 and 62.34mg / m^2 in *Miscanthus sacchariflorus*; 72.08, 9,342.13 and 345.24mg / m^2 in *Typha angustata*; 19.74, 3,651.2 and 190.68mg / m^2 in *Scirpus tabernaemontani*, respectively. As shown in Table 1, the soil air dry weight and Cu, Fe and Zn contents is the highest in *Typha angustata* grassland.

The estimates of removal constant r for Cu turnover are collected in Fig. 1 and Table 2. It is determined by Fig. 1 from the data of Table 1. These values show r=0.61 in *Phragmites communis*, r=0.39 in *Miscanthus sacchariflorus* r=0.26 in *Typha angustata* and r= 0.56 in *Scirpus tabernaemontani* grassland, respectively. The time needed to reach 50 %, 95 % and 99 % loss of Cu are 1.13, 4.90 and 8.17 years in *Phragmites communis*; 1.79, 7.77 and 12.95 years in *Miscanthus sacchariflorus*; 2.70, 11.67 and 19.43 years in *Typha angustata*; 1.23, 5.33 and 8.89 years in *Scirpus tabernaemontani*, respectively.

The removal constant r for Fe is 0.58, 0.47, 0.09 and 0.27 in *Phragmites communis, Miscanthus sacchariflorus, Typha angustata* and *Scirpus tabernaemontani* grassland, respectively(Table 3 and Fig. 2). The time needed to reach 50, 95 and 99% loss of Fe are 1.19, 5.16 and 8.60 years in *Phragmites communis*; 1.49, 6.43 and 10.72 years in *Miscanthus sacchariflorus*; 7.43, 32.16 and 53.59 years in *Typha angustata* ; 2.58, 11.19 and 18.65 years in

Table 1. The annual production and accumulation of Cu, Fe and Zn in the grasslands in the lake Paldangho

Species	Horizon	Dry weight (g / m^2)	Cu (mg / m^2)	Fe (mg / m^2)	Zn (mg / m^2)
L *Phragmites communis*	3,550.40	10.53	318.13	47.31	
	Css	810.40	6.67	228.90	12.31
Miscanthus sacchariflorus	*L*	3440.00	7.14	183.20	42.31
	Css	2728.96	11.34	209.61	20.03
Typha angustata	*L*	8308.80	18.53	871.59	80.76
	Css	7557.60	53.55	8470.54	264.48
Scirpus tabernaemontani	*L*	6136.00	11.11	979.12	127.44
	Css	3111.20	8.63	2672.08	63.24

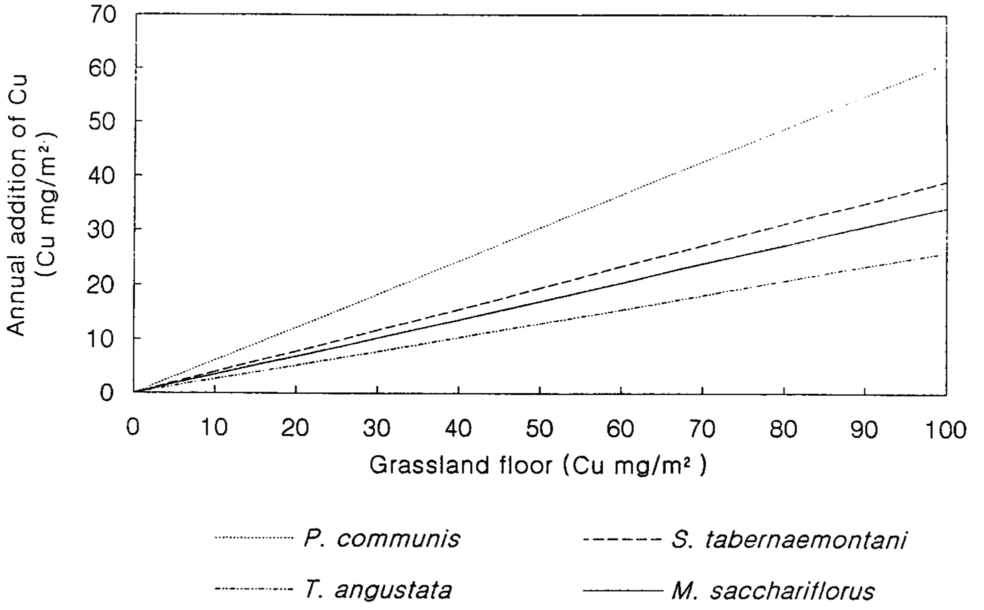

Fig. 1. The removal constant r of Cu in the grasslands in the lake Paldangho.

Table 2. The parameter and periods(year) for removal and accumulation of Cu in the grasslands in the lake Paldangho

Species	r	$r_{0.5}$	$r_{0.95}$	$r_{0.99}$
Phragmites communis	0.61	1.13	4.90	8.17
Miscanthus sacchariflorus	0.39	1.79	7.77	12.95
Typha angustata	0.26	2.70	11.67	19.45
Scirpus tabernaemontani	0.56	1.23	5.33	8.89

Table 3. The parameter and periods(year) for removal and accumulation of Fe in the grasslands in the lake Paldangho

Species	r	$r_{0.5}$	$r_{0.95}$	$r_{0.99}$
Phragmites communis	0.58	1.19	5.16	8.60
Miscanthus sacchariflorus	0.47	1.49	6.43	10.72
Typha angustata	0.09	7.43	32.16	53.59
Scirpus tabernaemontani	0.27	2.58	11.19	18.65

Scirpus tabernaemontani, respectively. In these result, the removal constant of *Typha angustat* is very low, so the time needed to reach 50, 95 and 99% loss of Fe is very high,

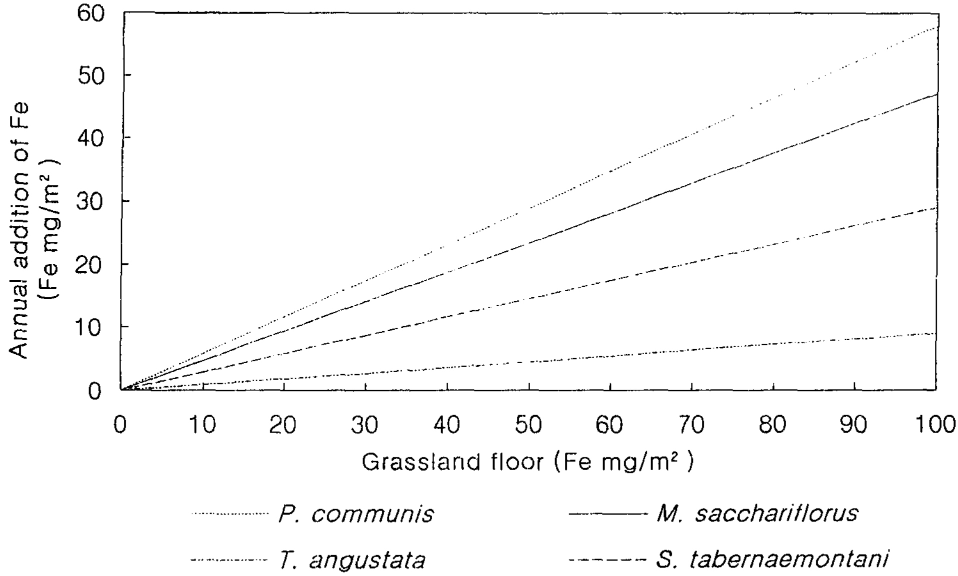

Fig. 2. The removal constant r of Fe in the grasslands in the lake Paldangho.

especially.

The removal constant r for Zn is 0.79, 0.68, 0.23 and 0.67 in *Phragmites communis, Miscanthus sacchariflorus, Typha angustata* and *Scirpus tabernaemontani* grassland, respectively(Table 4 and Fig. 3). The time needed to reach 50, 95 and 99% loss of Zn are

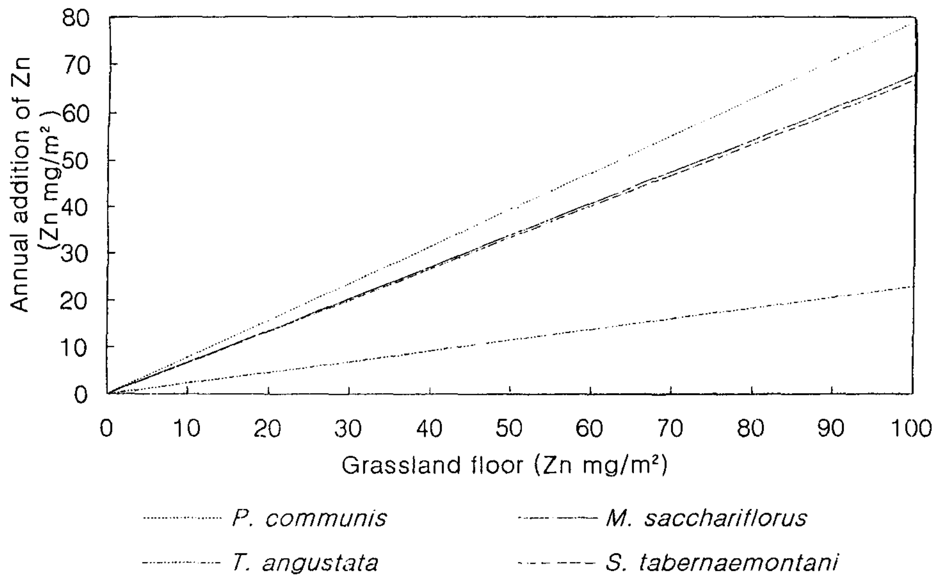

Fig. 3. The removal constant r of Zn in the grasslands in the lake Paldangho.

Table 4. The parameter and periods(year) for removal and accumulation of Zn in the grasslands of the lake Paldangho

Species	r	$r_{0.5}$	$r_{0.95}$	$r_{0.99}$
Phragmites communis	0.79	0.87	3.78	6.30
Miscanthus sacchariflorus	0.68	1.02	4.42	7.37
Typha angustata	0.23	2.96	12.82	21.37
Scirpus tabernaemontani	0.67	1.04	4.49	7.48

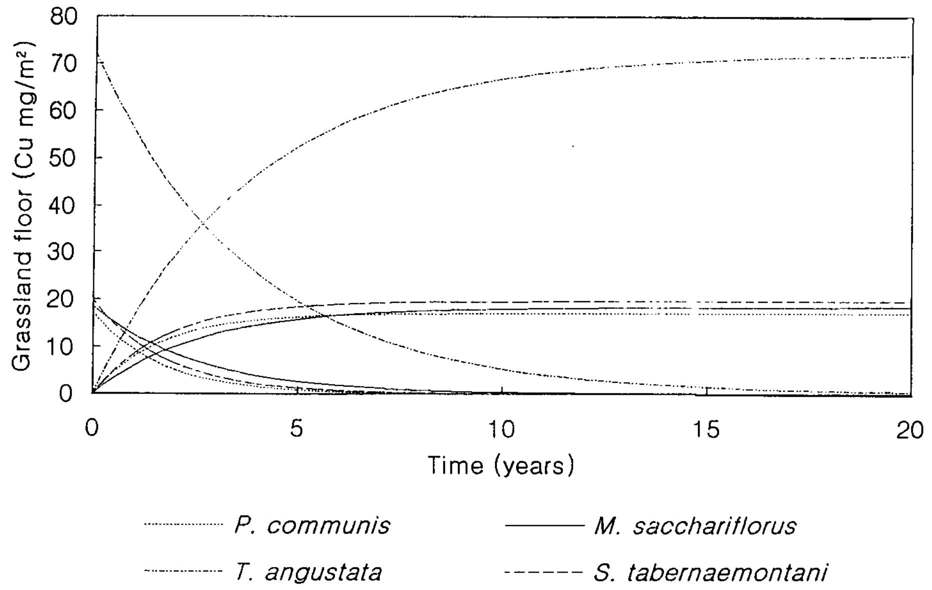

Fig. 4. The exponential curves for Cu in the grasslands in the lake Paldangho.

0.87, 3.78 and 6.30 years in *Phragmites communis*; 1.02, 4.42 and 7.37 years in *Miscanthus sacchariflorus*; 2.96, 12.82 and 21.37 years in *Typha angustata*; 1.04, 4.49 and 7.48 years in *Scirpus tabernaemontani*, respectively.

The curves for accumulation and turnover of Cu, Fe and Zn in each grassland ecosystem are shown in Fig. 4, Fig. 5 and Fig. 6. These curves are the mirror image of the curve for accumulation of Cu, Fe and Zn on the grassland floors in Fig. 4, Fig. 5 and Fig. 6.

적 요

본 연구는 팔당호의 갈대, 억새, 부들 및 고랭이 초지군락에서 Cu, Fe 및 Zn의 순환을 규명하고자 한 것이다. 이들 금속 성분의 생성 및 유실을 수학적 모델을 이용하여 설명할 수 있다. 갈대, 억새, 부들 및 고랭이의 Cu 유실상수는 각각 r=0.61, r=0.39, r=0.26과 r=0.56이고, Fe 유실상수는 각각 r=0.58, r=0.47, r=0.09과 r=0.27이며, Zn 유실상수는 각각 r=0.79, r=0.68,

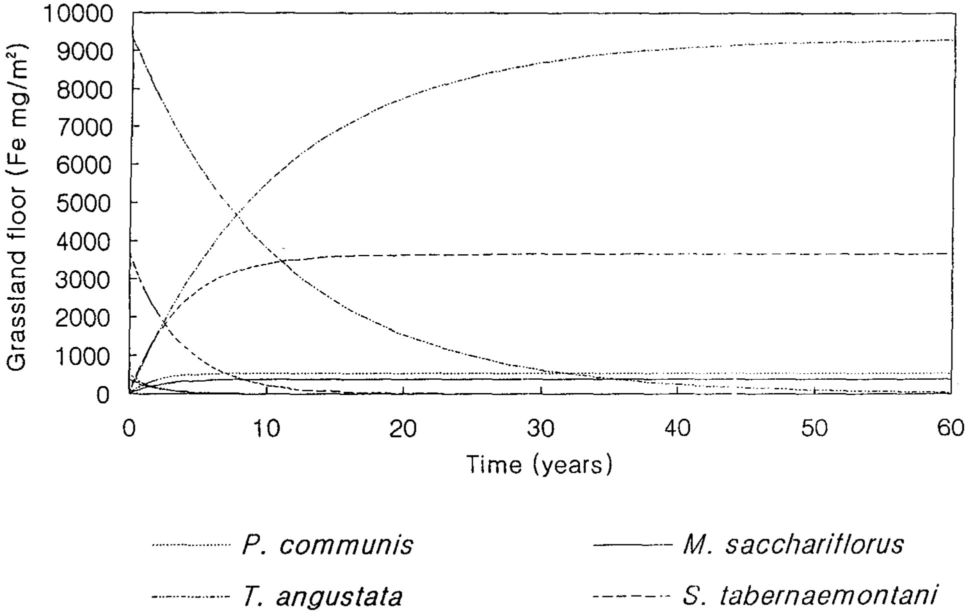

Fig. 5. The exponential curves for Fe in the grasslands in the lake Paldangho.

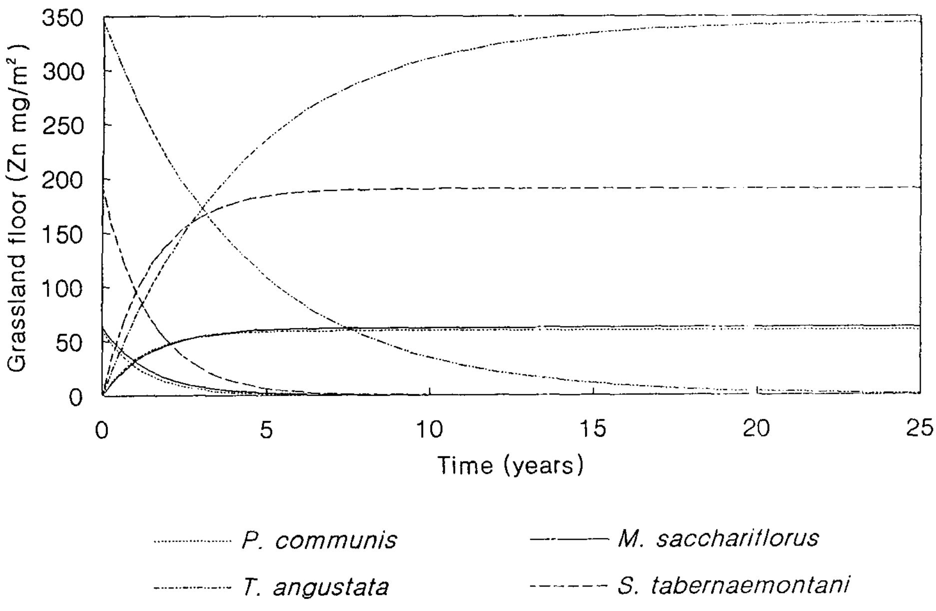

Fig. 6. The exponential curves for Zn in the grasslands in the lake Paldangho.

r=0.23과 r=0.67이었다.

축적된 Cu가 50, 95, 99%로 분해되는데 필요한 시간은 갈대, 억새, 부들 및 고랭이 초지에서 각각 1.13, 4.90, 8.17년, 1.79, 7.77, 12.95년, 2.70, 11.67, 19.45년 및 1.23, 5.33, 8.89년이었고, Fe는 1.19, 5.16, 8.60년, 1.49, 6.43, 10.72년, 7.43, 32.16, 53.59년 및 2.58, 11.19, 18.65년이었고, Zn은 각각 0.87, 3.78, 6.30년, 1.02, 4.42, 7.37년, 2.96, 12.82, 21.37년 및 1.04, 4.49, 7.48년이었다.

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