

# The Riparian Vegetation of Close-to-Nature River · Streams in Korea

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**Abstract** - The present study was undertaken to classify and describe the riparian vegetation of the 6 river · stream of Korea peninsula. As a result the vegetation was divided into nineteen communities. The vegetation units obtained in the present study were as follow: A: *Salix koreensis* community, B: *Salix gracilistyla* community, C: *Robinia pseudo-acacia* community, D: *Amorpha fluticosa* community, E: *Broussonetia papyrifera* community, F: *Phyllostachys bambusoides* community, G: *Rubus corchorifolius* community, H: *Phragmites japonica* community, I: *Phragmites communis* community, J: *Miscanthus sacchariflorus* community, K: *Miscanthus sinensis* var. *purpurascens* community, L: *Artemisia princeps* var. *orientalis* community, M: *Humulus japonicus* community, N: *Zoysia japonica* community, O: *Imperata cylindrica* var. *koenigii* community, P: *Agropyron tsukushiense* var. *transiens* community, Q: *Juncos effusus* var. *decipiens* community, R: *Rumex crispus* community, S: *Persicaria hydropiper* community. The vegetation characteristics of riversides was recovered in the surveyed results according to river · stream basin, in other words, 10 communities in the upper river · stream riparian, 15 communities in the middle river · stream riparian, 10 communities in the down river · stream riparian. The *Phragmites japonica* community in the upper and *Phragmites communis* community in the down was analyzed by common community of the 6 river · stream riparian, respectively, but none in the middle. The standing profile of vegetation across 6 river · stream was seen stepwise *Phragmites japonica* community, *Salix gracilistyla* community, *Miscanthus sinensis* var. *purpurascens* community, shrub community by natural waterway in the upper, *Salix gracilistyla* community, *Phragmites communis* community, *Rumex crispus* community, *Miscanthus sacchariflorus* community, *Humulus japonicus* community in the middle, *Phragmites communis* community in the down. The differences of distributional features of vegetation emerged from the riparian of the 6 river · stream, but don't from the the 6 river · stream.

**Key words** - Riparian vegetation, River and stream riparian, Close-to-nature stream, Vegetation units

## Introduction

The streams has geographical features that flow out surface water that are called water and water route throughout the year. Those are a ecosystem that has a high productivity as a ecotone of terrestrial and aquatic ecosystem.

The riparian vegetation that is affected overflowing of stream water and perpetually is situated for a ecotone of terrestrial and aquatic ecosystem, and has species diversity, a floodgate control, riparian protection and landscape beauty (Cho *et al.*, 2001). Stream ecosystem has many variance of species diversity according to topographical characters and environmental variation of the depth water, pH, salt contents, the eutrophication of water directly, and is special ecosystem for affecting species diversity by mean of water velocity and vegetation distribution(Lee *et al.*, 2003).

Also stream ecosystem has lots of changes of species diversity by topographical characteristics and environmental variations, and it is directly affected by physical factor of water depth and chemical factors including pH, salts contents, eutrophication, etc. In addition the velocity of running water and vegetation distribution affect to it.

Since early times, stream has supplied water to man, and not also has made an important role as a roadway for all kinds of physical distribution but been peculiar space for a local resident and as organism habitats of an natural ecosystem.

However the development of a traditional stream ecosystem has been focused on flood control and utilization of water. Even though environmental function of stream was embossed and processed recently, it doesn't reach restoration setting much value upon ecological function.

In this study ecological information, interrelations between life and environment and physical characteristics of inhabits on the vegetation ecology of stream were understood after six korean representative rivers. Those were divided into a upper stream, the

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midstream and the downstream. So this study is for restoration considering ecological function as stream is developed and restored.

So far lots of ecological studies (Kim and Yim 1990; Kim *et al.*, 1991; 1993; Song 1992; Yoon *et al.* 1993; Cho and Kim 1994; Cho 1995; Lee 1995; Yim *et al.* 1995; Song and Song 1996; Lee *et al.*, 2001; Lee and Kim 2005) have been progressed on the stream ecosystem and studies of regional ecosystems (Ahn 2002; Ahn and Lee 2000; Lee and Shin 1998; Kim *et al.*, 2003; Jeong *et al.*, 2004; You *et al.*, 2006; Lee *et al.*, 2006) have been also progressed for restoration of vegetation ecology in Korea.

There are fragmentary studies on the vegetation ecology of stream, but there are no investigations of vegetation ecology on the natural stream of the Korean Peninsula. Accordingly understanding for the present status of vegetation ecology was overall needed. In this study control plans of reasonable stream restoration was considered by understanding interrelations among species composition, structure and a community.

## Methods of study

### Object regions of study

In this study the Han river, the Nakdong river, the Keum river, the Seomjin river, the Youngsan river and the Yanyang south large stream were divided into a upper stream, the midstream and the downstream, and their vegetation ecology and cross section on an area well preserving their nature were investigated from a riverside to others side at 50M of length from Oct. 1, 2006 to Feb. 28, 2007 (Fig. 1).

### Investigation of vegetation ecology

In order to understand characteristics of vegetation ecology of the natural river and stream sides distributed at a upper stream, the midstream and the downstream of the Korean river and stream, their vegetation ecology and profiles were investigated on comparatively homogeneous sites of the stand of vegetation.

Vegetation ecology was investigated using quadrat method and Braun-Branquet (1964) after selecting plant community of the stream at important sites closed to natural vegetation ecology within investigated area. Class structure and section of community passing through stream of investigated areas were drawn up and each appeared species were recorded. The sizes of quadrat to investigate community were put on the size of vegetation ecology. They were set up at 1 × 1m, 2 × 2m, 5 × 10m.

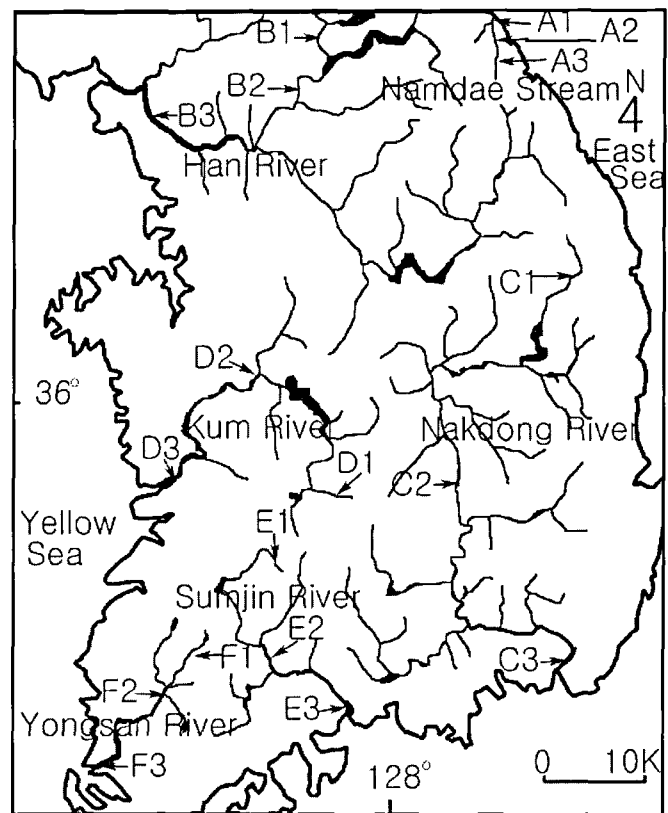


Fig. 1. A map showing of study area and survey sites.

\* A: Namdae stream (1 Upper, 2 Middle, 3 Down), B: Han river (1 Upper, 2 Middle, 3 Down), C: Nakdong river (1 Upper, 2 Middle, 3 Down), D: Kum river (1 Upper, 2 Middle, 3 Down), E: Sumjin river (1 Upper, 2 Middle, 3 Down), F: Yongsan river (1 Upper, 2 Middle, 3 Down).

## Results and Discussion

### Present status of vegetation ecology

As shown in Table 1 for vegetation ecology of this investigated areas, seven communities of a woody plant including a *Salix koreensis* community, *Salix gracilistyla* community, *Robinia pseudo-acacia* community, *Amorpha fluticosa* community, *Broussonetia papyrifera* community, *Phyllostachys bambusoides* community, *Rubus corchorifolius* community, etc were appeared. Also, Twelve communities of herbs including *Phragmites japonica* community, *Phragmites communis* community, *Miscanthus sacchariflorus* community, *Miscanthus sinensis* var. *purpurascens* community, *Artemisia princeps* var. *orientalis* community, *Humulus japonicus* community, *Zoysia japonica* community, *Imperata cylindrica* var. *koenigii* community, *Agropyron tsukushiense* var. *transiens* community, *Juncus effusus* var.



*decipiens* community, *Rumex crispus* community, *Persicaria hydropiper* community, etc were appeared. So total nineteen communities were investigated

***Salix koreensis* community.** This community was appeared at the midstream of the Keum river and the down stream of the Han river (Fig. 1). As shown in Table 1 classified species of this community was a *Salix koreensis*. Accompanied species including *Artemisia princeps* var. *orientalis*, *Erigeron canadensis*, *Chenopodium album* var. *centrorubrum*, etc were appeared. Height of the vegetation ecology was within and without 5m, and the percentage of vegetation cover was over 90%. Also the number of appeared species was 4~5.

***Salix gracilistyla* community.** As shown in Fig. 1, this community was tended to appear at whole areas of an upper stream and the midstream of the investigated zone. Classified species of this community was *Salix gracilistyla*, and Accompanied species including *Rumex crispus*, *Phalaris arundinacea*, *Cerastium holosteoides* var. *hallaisanense*, etc were appeared. Height of the vegetation ecology was within and without 2m, and the percentage of vegetation cover was 100%. In addition the number of appeared species was 2~3.

***Robinia pseudo-acacia* community.** As shown in Fig. 1 and Table 1, this community was appeared at the midstream of the Han river and a upper stream of the Nakdong river. An *Robinia pseudo-acacia* as its classified species, 85% of the percentage of vegetation cover and 5~10m of height of the vegetation ecology were showed. Nine appeared species were showed, and it means that a plantation forest was affected by a man.

***Amorpha fluticosa* community.** This community was showed in Fig. 1 and Table 1, and investigated at an upper stream of the Youngsan river. Its classified species was *Amorpha fluticosa*, and accompanied species was *Artemisia princeps* var. *orientalis*, *Agropyron tsukushiense* var. *transiens*, etc. 85% of the percentage of vegetation cover, 5~10m of height of the vegetation ecology and four appeared species was showed.

***Broussonnetia papyrifera* community.** This community was a shrub and showed in Fig. 1 and Table 1. It was investigated at an upper stream of the Nakdong river. Its classified species was *Broussonnetia papyrifera*, and accompanied species was *Humulus japonicus*, *Erigeron canadensis*, *Leersia japonica*, etc. 85% of the percentage of vegetation cover, 2m of height of the vegetation ecology and ten appeared species was showed.

***Phyllostachys bambusoides* community.** As shown in Fig. 1

and Table 1, this community was appeared at the midstream of the Seomjin river. Classified species of this community was *Phyllostachys bambusoides*, and accompanied species including *Cerastium holosteoides* var. *hallaisanense*, *Torilis japonica*, etc were appeared. Height of the vegetation ecology was 5m, and the percentage of vegetation cover was 100%. In addition the number of appeared species was 5.

***Rubus corchorifolius* community.** This community was a shrub and showed in Fig. 1 and Table 1. It was investigated at the midstream of the Seomjin river. Its classified species was a *Rubus corchorifolius*, and accompanied species was *Miscanthus sacchariflorus*, *Miscanthus sinensis* var. *purpurascens*, *Artemisia princeps* var. *orientalis*, etc. 1m of height of the vegetation ecology, 85% of the percentage of vegetation cover and six appeared species was showed.

***Phragmites japonica* community.** This community was showed in Fig. 1 and Table 1. This was appeared at an upper stream of a river and a stream. Its classified species was *Phragmites japonica*, and accompanied species was *Rumex crispus*, *Oenothera odorata*, *Artemisia selengensis*, etc. 1m of height of the vegetation ecology, 100% of the percentage of vegetation cover and 3~5 appeared species was showed.

***Phragmites communis* community.** This community was showed in Fig. 1 and Table 1. This was tended to appear at the downstream of a river and a stream. Its classified species was a *Phragmites communis*, and accompanied species was *Artemisia selengensis*, *Aster subulatus*, *Carex scabrifolia*, etc. 2m of height of the vegetation ecology, 100% of the percentage of vegetation cover and 1~4 appeared species was showed.

***Miscanthus sacchariflorus* community.** This community was showed in Fig. 1 and Table 1. This was appeared at the downstream of the south large river and the Nakdong river, and the midstream of the Seomjin river and Youngsan river. Its classified species was a *Miscanthus sacchariflorus*, and accompanied species was *Vicia tetrasperma*, *Sinapis arvensis*, *Leersia japonica*, *Rumex crispus*, etc. 1m of height of the vegetation ecology, 100% of the percentage of vegetation cover and 2~7 appeared species was showed.

***Miscanthus sinensis* var. *purpurascens* community.** This community was showed in Fig. 1 and Table 1. This was appeared at an upper stream of the Han river and the Nakdong river. Its classified species was a *Miscanthus sinensis* var. *purpurascens*, and accompanied species was *Oenothera odorata*, *Phalaris arundinacea*, *Leersia japonica*, etc. 1m of height of the vegetation

ecology, 100% of the percentage of vegetation cover and 4~5 appeared species was showed.

***Artemisia princeps* var. *orientalis* community.** This community was the roadside weeds and showed in Fig. 1 and Table 1. This was appeared at an upper stream of the south large river and the Seomjin river. Its classified species was a *Artemisia princeps* var. *orientalis*, and accompanied species was *Oenothera odorata*, *Erigeron canadensis*, etc. 0.5m of height of the vegetation ecology, 100% of the percentage of vegetation cover and 4~7 appeared species was showed.

***Humulus japonicus* community.** This community was the bine roadside weeds and showed in Fig. 1 and Table 1. This was appeared at the downstream of the Han river, the midstream of the Nakdong river and Keum river and an upper stream of the Seomjin river. Its classified species was *Humulus japonicus*, and accompanied species was *Oenothera odorata*, *Erigeron canadensis*, *Rumex crispus*, etc. 0.2m of height of the vegetation ecology, 100% of the percentage of vegetation cover and 4~5 appeared species was showed.

***Zoysia japonica* community.** This was artificial community transplanted after works of the streamside. As shown in Fig. 1 and Table 1, this was appeared at the midstream of the south large river, the an upper stream of the Han river, the downstream of the Seomjin river. Its classified species was a *Zoysia japonica*, and accompanied species was *Imperata cylindrica* var. *koenigii*, *Agropyron tsukushiense* var. *transiens*, etc. 0.1m of height of the vegetation ecology, 100% of the percentage of vegetation cover and 4~5 appeared species was recorded.

***Imperata cylindrica* var. *koenigii* community.** This community was showed in Fig. 1 and Table 1. This was appeared at the midstream and downstream of the Youngsan river. Its classified species was *Imperata cylindrica* var. *koenigii*, and accompanied species was *Vicia tetrasperma*, *Agropyron tsukushiense* var. *transiens*, etc. 0.3m of height of the vegetation ecology, 100% of the percentage of vegetation cover and five appeared species was recorded.

***Agropyron tsukushiense* var. *transiens* community.** This was artificial community formed after works of the streamside. As shown in Fig. 1 and Table 1, this was appeared at the midstream of the south large river, the midstream of the Han river. Its classified species was a *Agropyron tsukushiense* var. *transiens*, and accompanied species was *Oenothera odorata*, *Capsella bursa-pastoris*, *Artemisia selengensis*, etc. 0.3m of height of the vegetation

ecology, 100% of the percentage of vegetation cover and 4~5 appeared species was recorded.

***Juncus effusus* var. *decipiens* community.** As shown in Fig. 1 and Table 1, this was appeared at the midstream of the south large river. Its classified species was a *Juncos effusus* var. *decipiens* as a unique species without accompanied species. 0.3m of height of the vegetation ecology, 100% of the percentage of vegetation cover and one appeared species was recorded.

***Rumex crispus* community.** As shown in Fig. 1 and Table 1, this was appeared at the midstream of the Nakdong river. Its classified species was a *Rumex crispus*, and accompanied species was *Persicaria hydropiper*, *Phalaris arundinacea*, *Capsella bursa-pastoris*, etc. 0.3m of height of the vegetation ecology, 100% of the percentage of vegetation cover and six appeared species was recorded.

***Persicaria hydropiper* community.** As shown in Fig. 1 and Table 1, this was appeared at the downstream of the Han river. Its classified species was a water pepper, and there is no accompanied species. 0.2m of height of the vegetation ecology, 100% of the percentage of vegetation cover and one appeared species was recorded.

## Distribution and cross section of vegetation ecology on the watered area

Distribution and cross section of vegetation ecology on the watered area for this study were showed in Fig. 2 and Table 2.

**Structure of vegetation ecology at an upper stream.** At an upper stream area of this study, total ten vegetation communities including *Salix gracilistyla* community, *Robinia pseudo-acacia* community, *Broussonnetia papyrifera* community, *Amorpha fluticosa* community as shrubs, and *Phragmites japonica* community, *Artemisia princeps* var. *orientalis* community, *Humulus japonicus* community, *Zoysia japonica* community, *Miscanthus sacchariflorus* community, *Miscanthus sinensis* var. *purpurascens* community as herbs were appeared. Among them, *Phragmites japonica* community as common community was appeared at the entire area (Table 2). Cross section of vegetation ecology of the representative upper area showed that *Phragmites japonica* community inhabited at the waterside with flowing water like an upper stream of the Nakdong river. At the back, *Salix gracilistyla* community, and *Miscanthus sinensis* var. *purpurascens* community, and shrubs including *Robinia pseudo-acacia* community, *Broussonnetia papyrifera* community were tended to

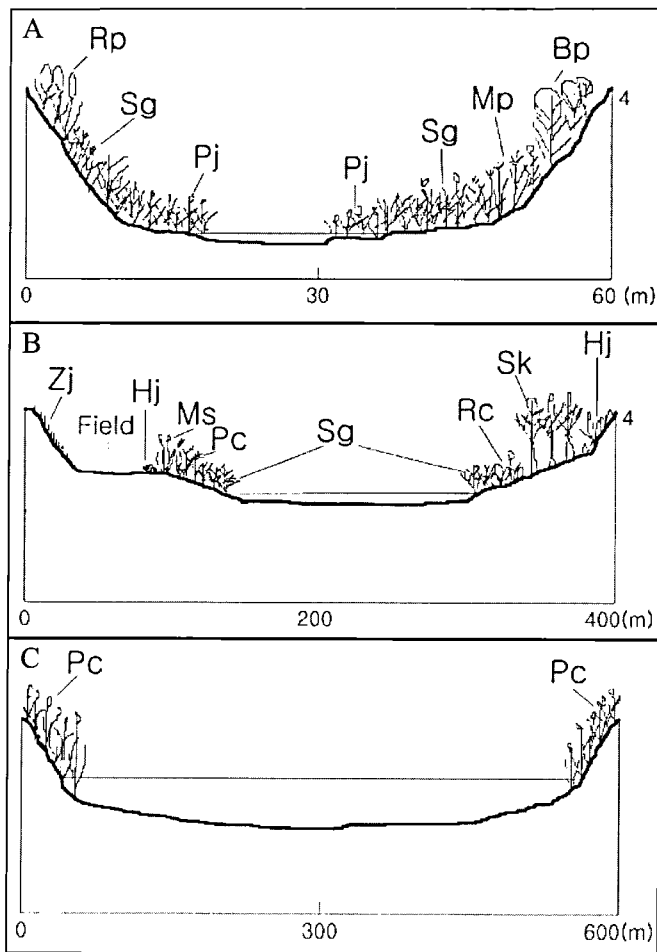


Fig. 2. A standing profiles of vegetation established cross the Nakdong river.

\* A: Upper stream, B: Middle stream, C: Down stream

\* Abbreviations are the same as table 2.

appear successively (Fig. 2).

**Structure of vegetation ecology at an middle stream.**

Vegetation ecology of the midstream area was Shrubs and herbs. Shrubs were *Robinia pseudo-acacia* community, *Salix koreensis* community, *Salix gracilistyla* community, *Phyllostachys bambusoides* community, *Rubus corchorifolius* community was appeared, and herbs were *Phragmites japonica* community, *Miscanthus sacchariflorus* community, *Artemisia princeps* var. *orientalis* community, *Humulus japonicus* community, *Zoysia japonica* community, *Imperata cylindrica* var. *koenigii* community, *Agropyron tsukushiense* var. *transiens* community, *Rumex crispus* community, *Persicaria hydropiper* community, *Phragmites communis* community, etc. Fifteen communities were appeared and more community was tended to appear compared to an upper and the downstream (Table 2). Common ecology didn't appeared at the midstream, but *Salix gracilistyla* community, *Phragmites japonica* community, etc were tended to appear at the entire area. It is thought that *Robinia pseudo-acacia* community, *Agropyron tsukushiense* var. *transiens* community and *Imperata cylindrica* var. *koenigii* community were artificially planted among the appeared communities. As shown in Fig. 2 on the cross section of the midstream area *Salix gracilistyla* community was appeared along the waterside, and *Phragmites communis* community, *Rumex crispus* community, *Miscanthus sacchariflorus* community, *Salix koreensis* community, *Humulus japonicus* community were appeared in order. Also lots of cultivated land was formed at the waterside along the midstream and downstream.

Table 2. The vegetation communities of the upper, middle and down river and streams of the Korean peninsula

Basins	River and Stream		No. of Communities		Common Community			
	A	B	C	D	E	F		
Upper	Pj	Zj, Sg	Rp, Pj	Pj	Hj, Ap	Af	12	Pj
	Sg	Pj, Mp	Sg, Mp	Hj	Pj, Sg	Pj		
	Ap		Bp			Ms		
Middle	Zj, Ap	At, Rp	Zj, Ms	Hj, Sk	Ru, Ms	Mp, Ic	18	Non
	Pj, Sg	Sg, Pj	Hj, Sg	Pj, Sg	Ph, Pb	Ms, Pj		
			Pc, Rc					
Down	Ap, Pc	Hj, Pc	Pc	Pc	Zj	Ic	10	Pc
	Ms, Je	Ph, Sk			Pc	Pc		
	At							

\* A: Namdae stream, B: Han river, C: Nakdong river, D: Kum river, E: Sumjin river, F: Yongsan river

\* Pj: *Phragmites japonica*, Sg: *Salix gracilistyla*, Ap: *Artemisia princeps* var. *orientalis*, Zj: *Zoysia japonica*, Pc: *Phragmites communis*, Ms: *Miscanthus sacchariflorus*, At: *Agropyron tsukushiense* var. *transiens*, Je: *Juncos effusus* var. *decipiens*, Mp: *Miscanthus sinensis* var. *purpurascens*, Rp: *Robinia pseudo-acacia*, Hj: *Humulus japonicus*, Ph: *Persicaria hydropiper*, Sk: *Salix koreensis*, Bp: *Broussonetia papyrifera*, Rc: *Rumex crispus*, Ru: *Rubus corchorifolius*, Pb: *Phyllostachys bambusoides*, Af: *Amorpha fluticosa*, Ic: *Imperata cylindrica* var. *koenigii*.

**Structure of vegetation ecology at the downstream stream.** A *Phragmites communis* community was absolutely dominant at the vegetation ecology of the downstream area. Total ten communities including *Salix koreensis* community, *Artemisia princeps* var. *orientalis* community, *Miscanthus sacchariflorus* community, *Juncus effusus* var. *decipiens* community, *Agropyron tsukushiense* var. *transiens* community, *Humulus japonicus* community, *Persicaria hydropiper* community, *Zoysia japonica* community, *Imperata cylindrica* var. *koenigii* community, etc were appeared (Table 2). *Phragmites communis* formed community at most of the areas except the south large river and the Han river. As shown in Fig. 2 on the profile of community in case of the Nakdong river *Phragmites communis* community possessed the waterside and the stream side.

From results of the investigation on distribution of vegetation ecology of the six rivers and streams in the Korean peninsula, characteristics of distribution of vegetation ecology didn't show specific tendency on each stream, but community of the vegetation ecology on each watered area showed that *Phragmites japonica* community was appeared as the common ecology and a *Phragmites communis* community was appeared. This tendency indicates community characteristics of the vegetation ecology on each watered area. There's no common community at the midstream, and this indicates that the area was affected by lots of artificial interference and destruction.

Vegetation ecology of the stream side has grown exposed to very particular environments including regular watering, high water line, half watering, etc. In addition it is very fragile on the environment affection, especially artificial affection including man's interference and grazing, shore protection works, etc. So it is needed to give his attention to use and manage the stream.

In case of filth as water pollution to affect the vegetation ecology of the stream, the *Persicaria thunbergii* community was dominant at less heavy area, and *Rumex crispus* community, *Persicaria hydropiper* community, etc was dominant at more heavy area (Kim et al., 1991, 1993). On the contrary Mun and Cho (1996) suggested that *Persicaria thunbergii* community was dominant at more heavy and eutrophicated area. However, lots of constituent species to constitute vegetation ecology of the stream side was cosmopolitan, and it is hard to use them as indicator species because they have characteristics to well adapt themselves to various environments.

Since ancient times, the stream riparian of Korea has used arable land at from middle streams to down streams. So it was regarded as

a pollution source to cause water pollution and destruction of an ecosystem by artificial interference.

On the one hand studies on a role of the vegetation ecology of the stream side to give the lakefront has been widely progressed in Germany and other European nations. Seibert and Zielokowski (1972) suggested a scene management plan on preservation of scene protection area of the Germany stream based on plant sociologic study. Vegetation ecology of the stream side is very important for stream ecosystem and function of water utilization of the stream. So thing to think over in the first place when the stream is restored is that information on vegetation ecology of nature to adapt these habitate and inhabit regional characteristics must be understood. It is thought that restoration of natural stream based on the information must be restored, and it is very important (Winward 2000).

As shown in this study *Phragmites japonica* community, *Salix gracilistyla* community, etc were appeared at an upper stream and the midstream of natural stream, and *Phragmites communis* community as dominant species at the downstream in the Korean peninsula. So It is thought that communities of vegetation ecology naturally appeared and inhabited at the environment of the Korean Peninsula are very important for stability of the stream, preservation of the ecosystem and species diversity in order to restore destroyed and unnaturally constructed stream or restored stream as artificial structure.

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## Literature Cited

- Ann, G.Y. and E.H. Lee. 2000. A Study on the plan of plant state for improvement of stream-ecosystem - in case of Chungrang stream. *J. Korean Env. Res. & Reveg.* 3: 35-46.
- Ahn, H.K. 2002. Analysis of habitat on physical characteristic for river ecological restoration - In the case of Bokha river in Yeosu. *Kor. J. Env. Eco.* 16: 56-59
- Braun-Branquet J. 1964. *Pflanzensoziologie. Grundze der Vegetationskunde.* Springer - Verlag. Wien.

- Cho, D.S. 1995. A study on the distribution of streamside vegetation in Kyonganchon. Korean J. Ecol. 18: 55-62.
- Cho, K.H. and J.H. Kim. 1994. Distribution of aquatic macrophytes in the littoral zon of lake Paldangho, Korea. Korean J. Ecol. 17: 435-442.
- Cho, K.H., J.A. Kim, H.M. Lee and O.B. Kwon. 2001. Status of riparian vegetation and implication for restoration in the Seunggi stream, Incheon. J. Korean Ecn. Res & Reverg. Tech. 4: 62-73.
- Jeong, J.A., H.J. Kim and E.H. Lee. 2004. The comparison of plants and vegetation transect in a straight and a restoration section-A case study of Bulgwang stream in Seoul, Korea-, Kor. J. Env. Eco. 18: 61-74.
- Kim, D.C., Y.S. Yoon and I.S. Park. 2003. An evaluation of stream naturalness for close-to-nature stream restoration in case of Hakui stream. J. Korean Society of Industrial Application 4(4): 315-324.
- Kim, S.H., S.J. Kim and Y.O. Kim. 1991. The vegetation change and Water pollution of several streams of Han river. Report of Korean Association for Protection of Nature 11: 134-141.
- Kim, S.H., S.J. Kim and Y.K. Kim. 1993. The Distribution of riparian plant and hydrophytes in growing in several streams of Han river. Report of Korean Association for Protection of Nature 12: 19-30.
- Kim, Y.B. and Y.J. Yim. 1990. Environmental factor and the distribution of aquatic macrophytes community in TanChon. Korean J. Ecol. 13: 279-309.
- Lee, C.S. 1995. The vegetation status according to environmental changes of Chungrangchon, Seoul. Report of Korean Association for Protection of Nature 14: 17-39.
- Lee, C.S., J.S. Moon, H.S. Woo, H.G. Ahn, G.H. Cho. Y.S. Bae and H.G. Byun. 2006. An analysis on landscape structure and biodiversity of the Nokha stream as a model to restore the degraded urban stream. J. Ecol. field Biol. 29: 113-124.
- Lee, I.S., P.H. Lee, S.G. Son, C.S. Kim and K.H. Oh. 2001. Distribution and community structure of *Salix* species along the environmental gradients in the Nam-river watershed. Korean J. Ecol. 24: 289-296.
- Lee, J.H. and J.Y. Shin. 1998. A study on the conservation, rehabilitation and creation of naturality of rivers - Based of the indicative plants of pollution near the rivers -. Env. J. of plant and human of Korea 1: 125-132.
- Lee, K.B., C.H. Kim, D.B. Lee, J.G. Kim, C.W. Park and S.Y. Na. 2003. Species diversity of riparian vegetation by soil chemical properties and water quality in the upper stream of Mankyong River. Korean Journal of Environmental Agriculture 22: 100-110.
- Lee, Y.K. and J.W. Kim 2005. Riparian vegetation of South Korea. Keimyung University press pp. 293.
- Mun, H.T. and S.R. Cho. 1996. Effects of group breeding of herons on pine community. Korean J. Ecol. 19: 47-53.
- Seibert, P. and W. Zielonkowski. 1972. Landschaftsplan "Pupplinger und Ascholdinger Au". Schriftenreihe fur Naturschutz und Landschaftspflege 2: 1-40.
- Song, J.S. 1992. Vegetation changes and their causes in Andong dam areas. Korean J. Ecol. 15: 411-431.
- Song, J.S. and S.D. Song. 1996. A phytosociological study on the riverside vegetation around Hanchon, an upper stream of Nak-tong river. Korean J. Ecol. 19: 431-451.
- Winward, Alma H. 2000. Monitoring the vegetation resources in riparian areas. Gen. Tech. Rep. RMRS-GTR-47. Ogden, Ut: U.S. Department of Agriculture. Forest Service, Rocky Mountain Research Station pp. 49.
- Yim, Y.J., Y.D. Kim and J.Y. Bang. 1995. Changes in sream water quality according to land use at Kyong-an sream. Korean J. Ecol. 18: 341-352.
- You, J.H., S.G. Jung and C.H. Lee. 2006. Analysis on the vegetation and flora for the ecological restoration of the river. Korean J. Plant Res. 19: 471-479.
- Yoon, K.W., B.H. Kim and H.K. Yoo. 1993. A pollution biological study of water environments by bock analysis of aquatic plant of branch stream of Mankyeng river. Report of Korean Association for Protection of Nature 12: 31-42.

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