

**AN AGRICULTURAL HABITAT INDICATOR FOR WILDLIFE**  
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**Group 2-A. Wild Species Dependent or Impacted by Agricultural Activities**

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## **An Agricultural Habitat Indicator for Wildlife**

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### ***Abstract***

The purpose of this study was to evaluate the effects of agricultural practices on wildlife populations and to explain how cropping practice might be related to the distribution and abundance of these populations. Populations of wildlife from rice paddy fields were compared with those from adjoining semi-agricultural habitats and mountain forest types. Two hundred forty species of birds were recorded during the study period, one hundred sixty nine in the rice paddy fields, 158 species in semi-agricultural habitats and 147 species in the mountain forest habitats. Eight species of mammals were observed in arable lands whereas 19 species were found in non-arable lands. Dominant species in arable land, Tree sparrow *Passer montanus*, Rufous turtle dove *Streptopelia orientalis*, House swallow *Hirundo rustica*, Spot-billed duck *Anas poecilorhyncha*, Crow tit *Paradoxornis webbiana*, Magpie *Pica pica* and Great egret *Egretta alba modesta* was different from semi-agricultural habitat and mountain forest habitat.

The Great Egret *Egretta alba modesta*, Little Egret *Egretta garzetta*, Intermediate Egret *Egretta intermedia* and Cattle Egret *Bubulcus ibis* utilized more often in the rice paddy field as feeding habitat than those of other habitats.

The wintering population of Hooded crane *Grus monacha* in Dalsung county and west Daegu region have not wintered since 1998, this might be because of the increase of green houses on the rice paddy.

Keywords : avian indicator, green house, rice paddy, ploughing, habitat selection, Korea

### ***Introduction***

As is well known from many sources the popular definition, “biodiversity” may be considered as “the total variety of life on earth, which includes all genes, species and ecosystems and the ecological processes of which they are part”. Biodiversity, thus, is the basic resources for ecological services and for sustaining the Earth’s life support system.

Basic unit should be taken species, because the species plays an important and unique role in ecosystem. Ecosystem diversity relates to the variety between and within ecosystem types and agricultural practice area has a broad range of ecosystem types ranging from the Mountain grassy meadows to intensive rice paddy and different kinds of wetlands found in those areas. Ecosystems are very complex systems in which many different organisms and species interact. Certain species (species group) changes in accordance with the habitat conditions. It is important to inventory these sensitive species because they themselves can become the important indicators. Among the living organism, birds are regarded as important indicators because:

- are valuable in their own right;
- are sensitive indicators of biological richness and environmental condition. And also integrate and accumulate environmental stresses over time because they are usually high level in the food chain and have relatively long life-spans. Thus birds can be used as indicators of unexpected environmental problems, when declining numbers and breeding success of birds such as the White-tailed Eagle *Haliaeetus albicilla*, Osprey *Pandion haliaetus*, Golden Eagle *Aquila chrysaetos* and Black Kite *Milvus migrans*;

- are vital for ecological functions in the natural environment;
- have a direct and indirect economic and cultural value to people;
- are well known organisms. Because the biology, ecology, behavior, and evolutionary histories of many birds have been extensively studied, scientists have a foundation to ask the most pertinent questions, base hypotheses, to obtain answers, and to cultivate solutions. This background knowledge reduces risk of misinterpretation, allowing scientists to use birds, sensitive to stresses in predictable ways, as a proxy measure of environmental change. Furthermore, this background knowledge yields cost-effective research, since studies using other groups of animals often requires several years of basic data gathering before monitoring can begin.
- provide a useful means to improve our scientific knowledge and understanding of the environment;
- are beautiful and inspirational, and a source of happiness and pleasure for many people;
- are very useful for promoting conservation awareness.

Birds are international resource, because every year an estimated 50 billion birds make migratory journeys, along a network of routes that encompasses the whole world. Sometimes travelling tens of thousands of kilometres, crossing continents and oceans, migratory birds have become so well adapted to this task that they can traverse the largest deserts and seas, the highest mountains and expanses of ice. The record for distance covered in a single year belongs to the Arctic Tern (*Sterna paradisaea*) and is of the order of 50,000 km, with songbirds not far behind with journeys of 20,000 to 30,000 km. Waders migrating from Siberia, Russia via Korea, China and Japan to Tasmania, Australia hold records for non-stop flight, over distances that probably somewhat exceed 7,000 km. Seabirds wing their way over all the world's oceans and seas.

### ***Agriculture in Korea***

Korea and Japan is the only East-Asian OECD countries. The characteristic agriculture system of both countries is the composition of rice paddy. In Korea, the rice paddy area is 1,149 thousand hectares which form 60.8% of total arable land area, 1,889 thousand hectares (Table 1). The arable land area per farming family is 1.37 hectares, this figures are relatively small scale. Many of the rice paddies are patched and surrounded by forest or mountains, and have played an ecological roles for two thousand years.

**Table 1. The importance of rice paddy in agriculture of Korea**

<i>Major Indexes</i>	<i>Year</i>	<i>1990</i>	<i>1995</i>	<i>1998</i>	<i>1999</i>	<i>2000</i>
Total land area *		9,926	9,927	9,941	9,943	9,946
Arable land area *		2,109	1,985	1,910	1,899	1,889
-composition rate		21.2%	20.0%	19.2%	19.1%	19.0%
Rice paddy area *		1,345	1,206	1,157	1,153	1,149
Crop field area *		764	779	753	746	740
Percentage of Rice paddy area in Arable land area		63.8%	60.8%	60.6%	60.7%	60.8%
Arable land area per family **		1.19	1.32	1.35	1.37	1.37

\* : units are 1,000 hectares

\*\* : units are one hectares

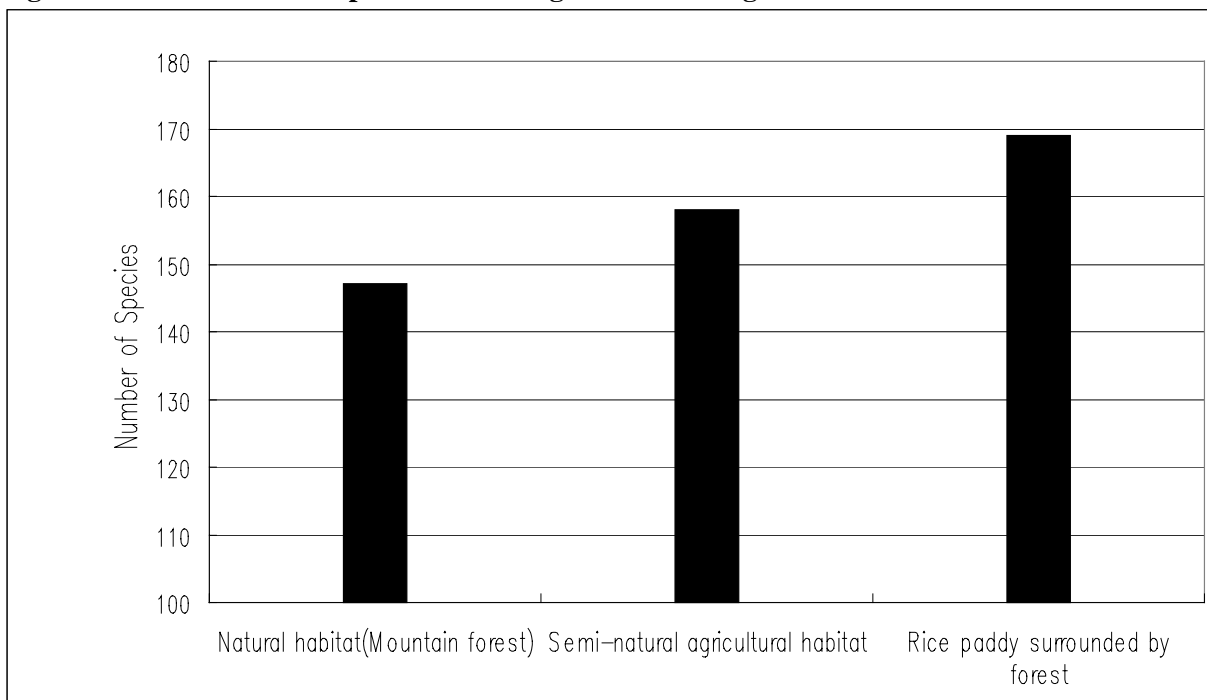
Source: Ministry of agriculture and forestry. [http://www.maf.go.kr/html/pds/pds01\\_01.htm](http://www.maf.go.kr/html/pds/pds01_01.htm)

### ***Number of bird species in three agricultural categories***

To compare the differences between agricultural habitat types, 405 wildlife survey plots (30 hectare scale) were divided into natural habitats (mountain forest), semi-natural agricultural habitats and agricultural habitats (rice paddy surrounded by forest). From 405 survey plots, 128 plots were classified as natural habitats, 127 plots were classified as semi-natural agricultural habitats and 92 plots were classified as agricultural habitats. The total number of bird species surveyed from January to December in 2000 was 169 species in rice paddies surrounded by forest, 158 species in semi-natural agricultural habitats and 147 species in mountain forests. The high avian species diversity in the habitats of rice paddy surrounded by forest can be explained by the role of forest patches and edge effects on the avian community, furthermore the rice paddy plays important role as a good wetland habitat for some kinds of waterbirds which do not occur in the mountain forest habitats. And also the water channels and reservoirs set up for farming purpose support some waterbirds as a kind of wetlands.

The dominant species in rice paddies surrounded by forest were Tree sparrow, Roufous-necked turtle dove, House swallow, Spot-billed duck, magpie and Great egret. In semi-natural agricultural habitats, dominant species were Crow tit, Roufous-necked turtle dove, Great tit, Azure-winged magpie, Brown-eared Bulbul, Tree sparrow and Magpie. In natural habitats, the dominant species were Crow tit, Long-tailed tit, Roufous-necked turtle dove, Azure-winged magpie, Great tit, Brown-eared Bulbul, Jay and Yellow breasted bunting. The dominant species between natural and semi-natural habitats have similarities. mountain forests. The high avian species diversity in the habitats of rice paddy surrounded by forest can be explained by the role of forest patches and edge effects on the avian community, furthermore the rice paddy plays important role as a good wetland habitat for some kinds of waterbirds which do not occur in the mountain forest habitats. And also the water channels and reservoirs set up for farming purpose support some

**Figure 1. Numbers of bird species in three agricultural categories**



### *Number of mammal species in three agricultural categories*

In the same study plots, mammal species were surveyed from July to October. But the results were reverse to those of bird. In October, 8 species and 55 individuals were surveyed in rice paddies surrounded by forest, 14 species and 244 individuals in semi-natural agricultural habitats and 19 species and 283 individuals were surveyed in mountain forests. One of the reason of the high mammal species diversity in the habitats of mountain forest may be the abundance of hides, on the other hand the rice paddy is lack of hide.

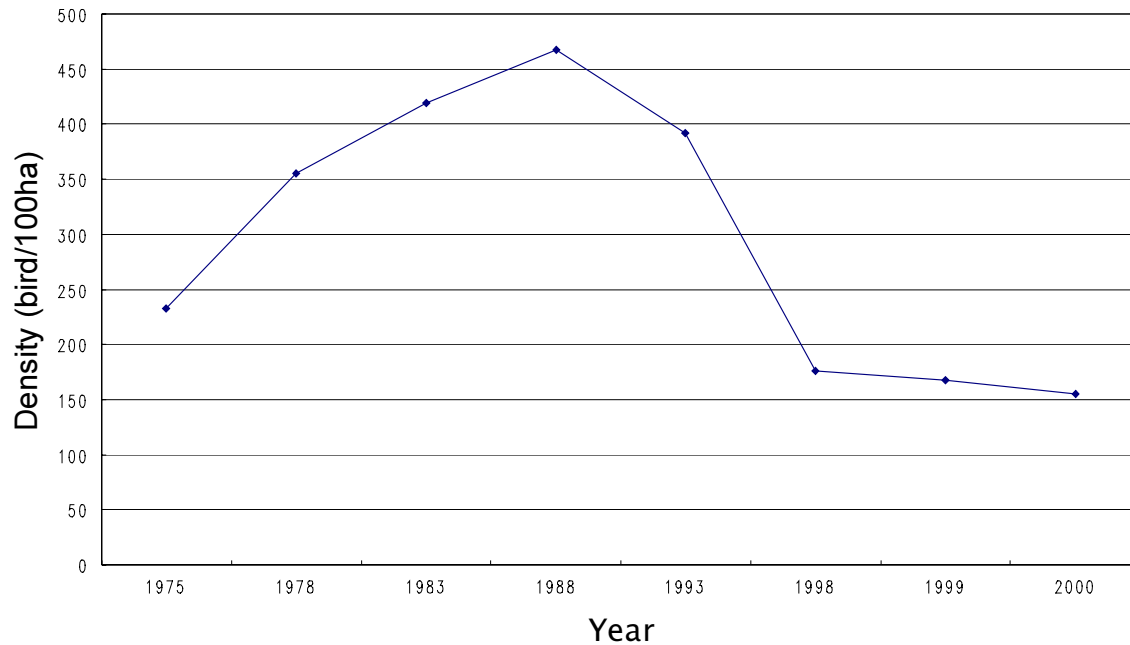
**Table 2. Numbers of mammal species in three agricultural categories**

<i>Habitat</i>	<i>Month</i>	<i>July</i>	<i>August</i>	<i>September</i>	<i>October</i>
Natural habitats(Mountain forest)		16 species	17 species	16 species	19 species
		268 ind.	265 ind.	267 ind.	283 ind.
Semi-natural agricultural habitats		13 species	14 species	15 species	14 species
		228 ind.	224 ind.	236 ind.	244 ind.
Agricultural habitats (rice paddy surrounded by forest)		6 species	5 species	7 species	8 species
		20 ind.	26 ind.	38 ind.	55 ind.

### *Population dynamics of avian index species of farmland*

One of the representative avian species in Korea is Tree sparrow *Passer montanus*. Their density was low till 1970's and after then their density was increased to 467.6 individuals per one hundred hectare in 1988. In this period, housing renovation movement was taken place as a part of rural development. This cause the deficiency of suitable nesting places for sparrow, formerly they can easily nest in the thatched houses. Whith this effect and the spread of chemicals, pesticides and herbicides cause the decrease to 176.2 individuals per one hundred hectare in 1998(Figure 2).

**Figure 2. The population dynamics of Tree sparrow in rural areas in Korea**



**Habitat selection of birds in farmland especially rice paddy**

*Egrets*

These species use rice paddy mainly for foraging ground after rice plantation from when the water control begin (Table 3). Thus in Korea, most egret breeding colonies located near big scaled rice paddy.

*Waders*

Most waders are passage migrant. Some species use rice paddy for stop-over site and very few species use for nesting place. But most species use tidal flat for their habitat.

*Cranes, dabbling Ducks and Geese*

Migrate from northern breeding area and wintering mainly feed on rice residues on the rice paddy.

*Crakes and Rails Rallidae*

These species use rice paddy as breeding, foraging and resting site. Intensive agricultural practices lead the dramatical decrease of these species.

*Birds of prey*

These species use rice paddy running after ducks and small rodent, their food resources.

Also rice paddy serve as a good foraging ground for Crows, Rofous turtle dove and Pheasant in winter and autumn.

**Table 3. The habitat utilizations of rice paddy by different bird taxa in Korea**

<i>Taxon</i>	<i>Breeding</i>	<i>Foraging</i>	<i>Resting</i>	<i>Remarks</i>
Egrets		☑	☑	Summer visitor
Ducks and Geese		☑	☑	Winter visitor

Waders		♂	♂	Passage migrant
Cranes		♂		Winter visitor
Crakes	♂	♂	♂	Summer visitor
Gulls		♂	♂	Resident
Birds of prey		♂	♂	Winter and Summer visitor
Passeriformes	♂	♂	♂	Resident and migrant
Crows		♂		Winter visitor

To identify the habitat selection of Egrets, we investigate their feeding sites. Great egret *Egretta alba modesta* use reservoirs most (32.4%) for their feeding site, rice paddies (27.6%) and water channels (25.5%). Little egret *Egretta garzetta* use rice paddy most (43.8%) and next is water channels (23.4%). On the other hand, Intermediate egret *Egretta intermedia* and Cattle egret *Bubucis ibis* were surveyed to use only rice paddy for foraging (Table 4).

**Table 4. The feeding site selection of Egrets**

<i>Species</i>		<i>River</i>	<i>Stream</i>	<i>Rice paddy</i>	<i>Channel</i>	<i>Reservoir</i>	<i>Total</i>
Great Egret	%	2.1	12.4	27.6	25.5	32.4	100
	Observed ind.	3	18	40	37	47	145
Little egret	%	14.1	14.1	43.8	23.4	4.7	100
	Observed ind.	9	9	28	15	3	64
Intermediate Egret	%	-	-	100	-	-	100
	Observed ind.	-	-	15	-	-	15
Cattle egret	%	-	-	100	-	-	21
	Observed ind.	-	-	21	-	-	-
Grey Heron	%	16.7	1.6	13.5	25.5	42.7	100
	Observed ind.	32	3	26	49	82	192

#### ***Impact of green house on Hooded cranes wintering population***

About 200-300 The Hooded cranes (*Grus monacha*) had wintered at Dasan-myun, Goryeong county, Kyungsangbuk province and Dalsung-dong Daegu. And furthermore this area is one of three possible flyways of Hooded cranes from breeding ground in far eastern Russia to the main wintering ground in Izumi Japan. So at least three thousand Hooded cranes are believed to use this area for their annual route and some populations use this area as a stopover area and wintering ground. This area possess seven thousand hectares scaled rice paddy along Nakdong river. In this rice paddy, the grain of rice residues were the primary food for Hooded cranes during the wintering period and for passage migrants during spring northern migration period. Hooded cranes ate more than 98% of rice grains in paddy fields and ate less than 1% plants tubers and vegetables in upland fields (Cho and Won, 1998). The mean density of crop residues (mainly unhulled rice grains) decreased from 3.52g dry wt/Y in October to 2.08g dry wt/Y in March after the departure of the Hooded cranes (p<0.05). The amount of rice grain residues are sufficient for the wintering hundred Hooded cranes based on crane-use days.

The increase of green houses affect negatively to the Hooded cranes wintering population. The area of green houses increased to 48.1% than 1993. In 1997 the percentage of green houses rose to 650 hectare and this resulted no more wintering cranes (Table 5).

**Table 5. The impacts of green houses to the Hooded cranes wintering population**

<i>Year</i>	<i>Area of rice paddy(ha)</i>	<i>Crop field (ha)</i>	<i>Area of Green houses (ha)</i>	<i>Number of Wintering Hooded Cranes</i>
1988	- *	-	-	214
1989	-	-	-	253
1990	-	-	-	315
1993	7,035.2	2,930.2	498.1	-
1994	7,013.5	2,906.5	579.6	175
1995	6,830.1	2,774.0	599.8	-
1996	6,813.4	2,766.6	596.9	110
1997	6,789.3	2,753.0	650.8	0
1998	6,743.0	2,730.1	690.7	0
1999	-	-	737.8	0

\* : not available

#### ***Impact of ploughing on wintering waterfowl community***

During wintering season many waterfowls use rice paddy for food and for shelter mainly escapes from their roosting site by human interferences. Some Farmers began to plough the rice paddy for next year, but this agricultural practice affect the movement of waterfowl community.

In the vicinity of Kanwol reservoir (Seosan reclaimed area A) there are big rice paddy which ran by private company. Normally from November the farmers began to set fire on the rice paddy for easy ploughing and they finished ploughing by December or January. Ploughing decreased the availability of food resources especially for ducks. The density of Mallards *Anas platyrhynchos* and Baikal teal *Anas formosa*, the dominant species in this area decreased from December rapidly (Figure 3). While the Kum river area, where ploughing began from March, the density of ducks increased till February (Figure 4).

#### ***Habitat loss by land reclamation for intensive agricultural use***

One of the main cause of threats to wetlands and biodiversity in Korea is reclamation. In the west coast of Korea, most places are disturbed by human interference. In the 1960's the main purpose of reclamation was to meet the needs of agriculture production, particularly rice. From the 1970's reclamation pressure was also a result of industrialization, urbanization and waste deposit needs – all occurring on a large scale(Figure 5). Reclamation of tidal flats crucially affects marine ecosystems, bentic invertebrates, fish and shorebirds population. Many land reclamation projects either completed or currently being carried out revealed many anticipating problems, such as pollution from sewage, ecosystem function failure and economic impacts to the aquatic-products industry. Recognizing the seriousness of the loss of wetlands and their biodiversity caused by the land reclamation, the government enacted the Coastal Management Act in 1997 to stipulate the provisions for establishing an integrated coastal management mechanism which can comprehensively coordinate policies with regard to conservation, utilization and development of coastal wetlands. Currently, action plan on the integrated coastal management prepared by the Ministry of Environment and Ministry of Maritime Affairs and Fishery.

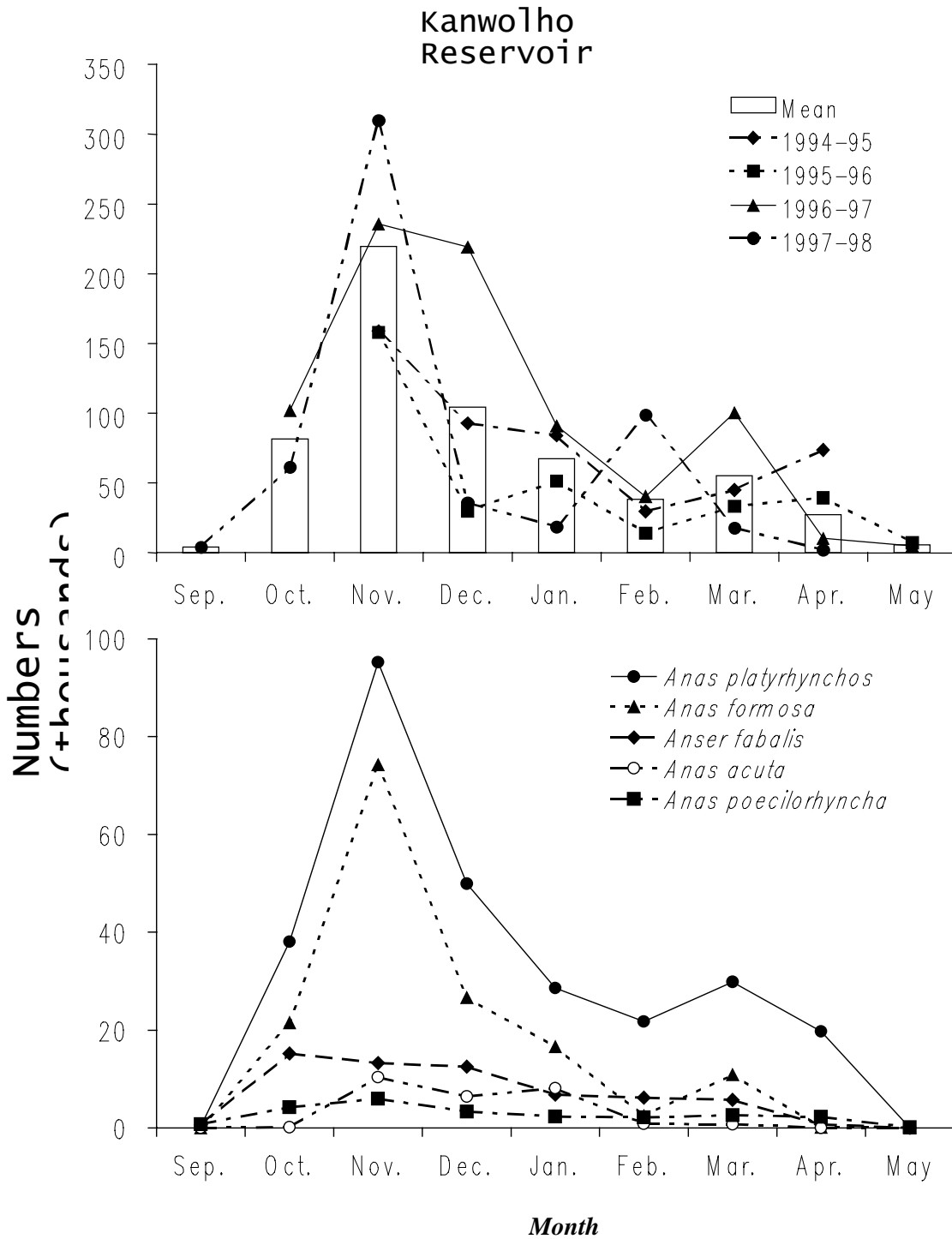
## ***Conclusion***

The high species diversity recorded in the agricultural fields(rice paddy) illustrate the importance of these areas as feeding and breeding grounds for wildlife. But in other instances croplands might act as barriers to dispersal of certain species, thereby limiting them to habitats provided by the corridors of forest edges and other habitats.

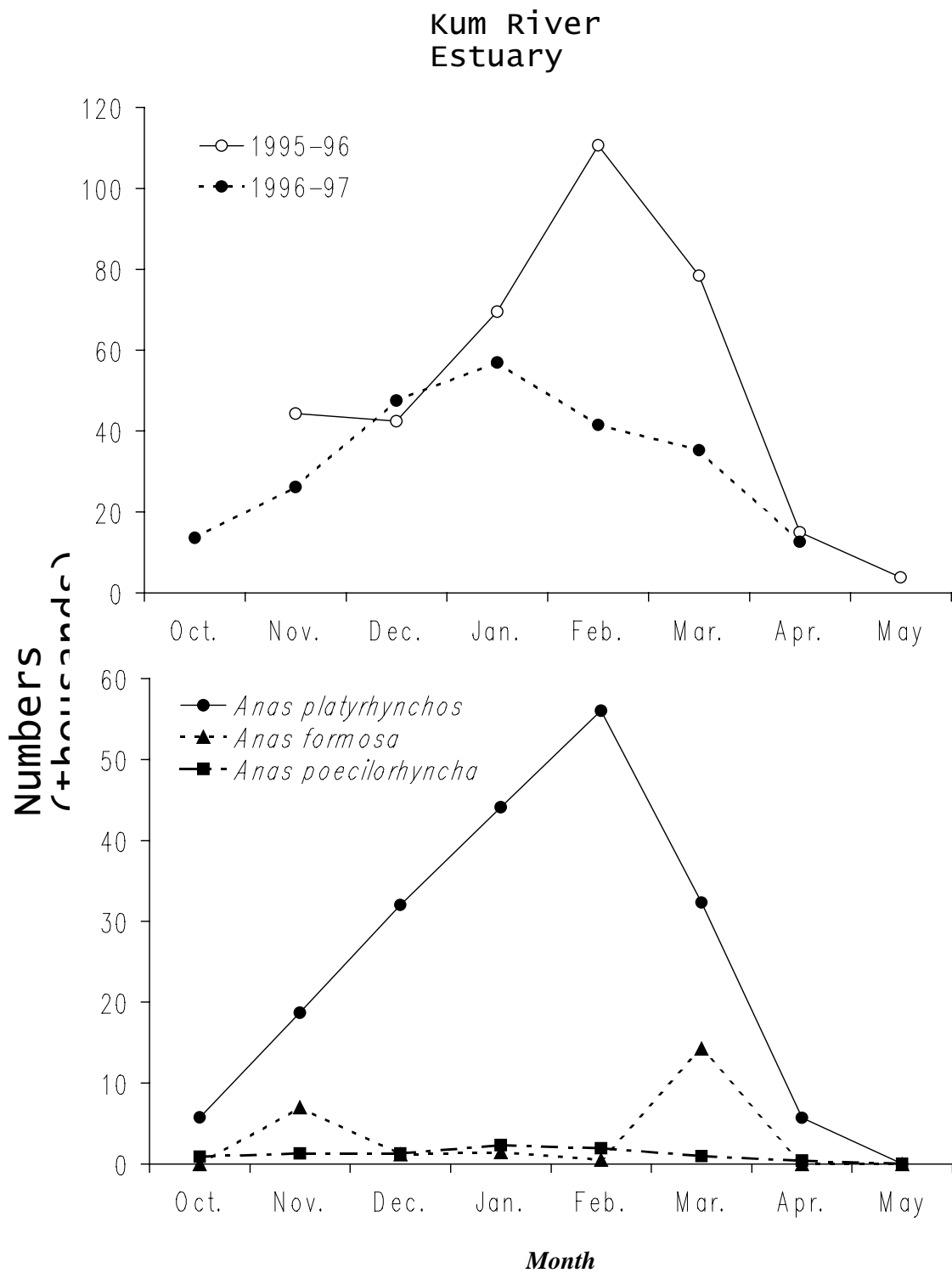
Agricultural installations such as green houses affect negatively to the avian diversity and habitat utilization. Ploughing time is very essential for migratory birds since they use the limited resources in mass flocks and in a relatively short period. Next step of study might be focused on the sustainable and adequate agricultural practice details and management system.

In another point of view, we may consider the flyways of migratory birds as well as rare and endangered species in developing the Agri-environment index. Some areas estimated as normal habitats but actually have been supported large numbers of rare and endangered species.

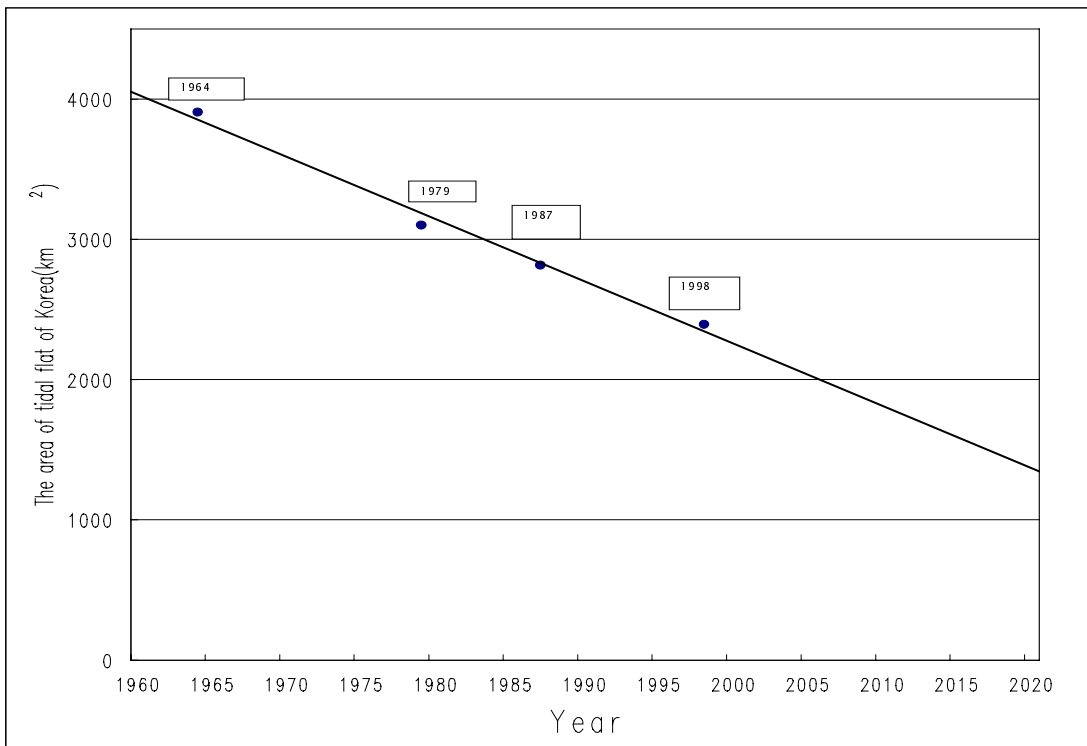
**Figure 3. Numbers of waterbirds and the dominant species on Kanwolho Reservoir of Chonsu Bay during 4 years from Nov. 1994 to Apr. 1998. Numbers of the dominant species were averaged on the data of 4 years. (source : Lee, 2000)**



**Figure 4. Numbers of waterbirds and the dominant species on the estuary of Kum River, Korea, from Nov. 1995 to Apr. 1997. Numbers of the dominant species were averaged on the data of 2 years. (source : Lee, 2000)**



**Figure 5. The decrease of tidal flat in Korea**



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