

Seasonal prevalence and migration of aquatic insects in paddies and an irrigation pond in Shimane Prefecture

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Abstract: Faunal composition and seasonal changes in the number of aquatic Coleoptera and Hemiptera were investigated in paddies and an adjacent irrigation pond in Shimane Prefecture, Japan. Nine species of Hemiptera and Twenty-four species of Coleoptera were collected from both the paddies and the pond. The number of species of adult insects in the paddies increased from May to June, then gradually decreased toward autumn. In contrast, the number in the pond was highest during autumn. The number of species of larval insects was high in paddies especially from May to July, but low in the pond throughout the year. Sixteen of the aquatic insect species observed were classified into four types on the basis of their habitat utilization pattern: A) those using the pond for both non-reproductive and reproductive purposes, B) those using the pond as the main habitat and the paddies for reproduction, C) those using both the pond and paddies as a living habitat and also the paddies for reproduction, and D) those using the paddies for both non-reproductive and reproductive purposes. My observations indicate that paddies play an important role in the reproduction of aquatic Coleoptera and Hemiptera, whereas the pond provides stable habitat for non-reproductive stages, as well as a place for reproduction of some species. This means that the coexistence of paddies and ponds is important for the species richness of aquatic insects in this region.

Keywords: Habitat utilization, Aquatic Coleoptera, Aquatic Hemiptera

1. Introduction

Lentic insects such as diving beetles and giant water bugs live in rice paddy water system, which consists of paddies, irrigation ponds and irrigation channels, as main or the last habitat in western Honshu, Japan. However, due to the use of pesticide and the recent reduction of rice paddy fields, these insect populations have been declining [1, 2 and 3]. It is essential to have a good knowledge of seasonal habitat utilization of lentic insects, in order to contribute to an insect conservation activity in rice paddy water system.

2. Study Site and Methods

The study was conducted in eastern Shimane Prefecture, from April, 1997 to November, 1998. This study site was comprised of six paddies and an adjacent irrigation pond (Fig.1).

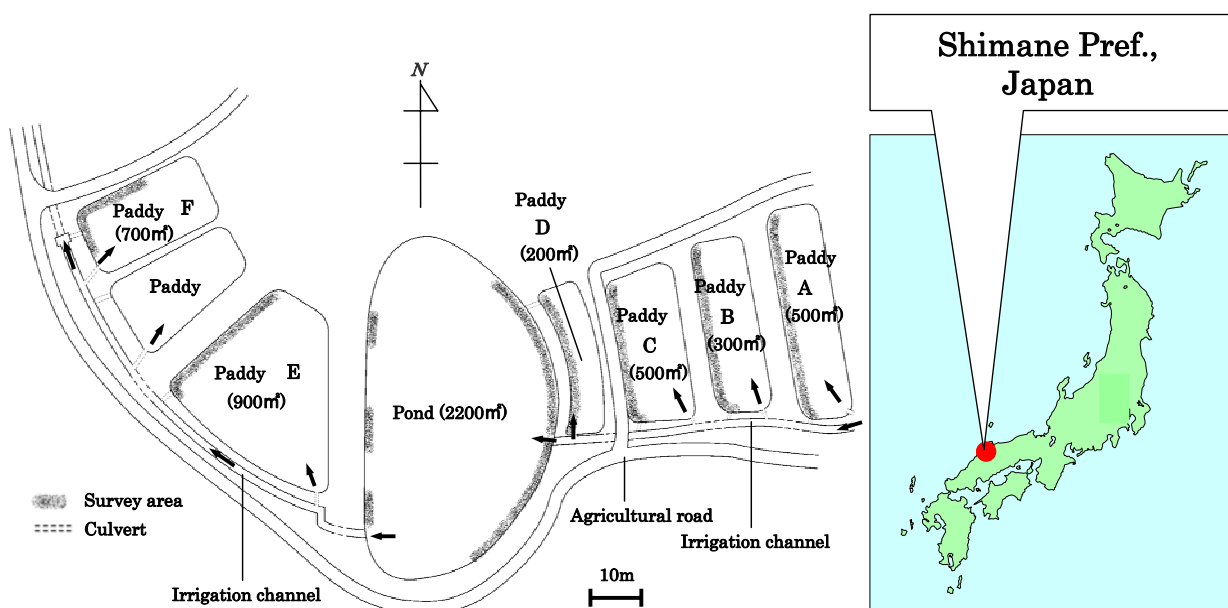


Fig. 1. Map showing the surveyed paddies and the irrigation pond. Arrows indicate the direction of water flow. Each area is shown in parentheses.

The paddies held water from mid April to mid June, and then were irrigated intermittently until the end of August (Fig. 2). In contrast, the irrigation pond was filled with water throughout the year. Samples were collected with a D-frame net and fish meat traps. Larger beetles (e.g. *Cybister chinensis*) were effectively captured by the traps.

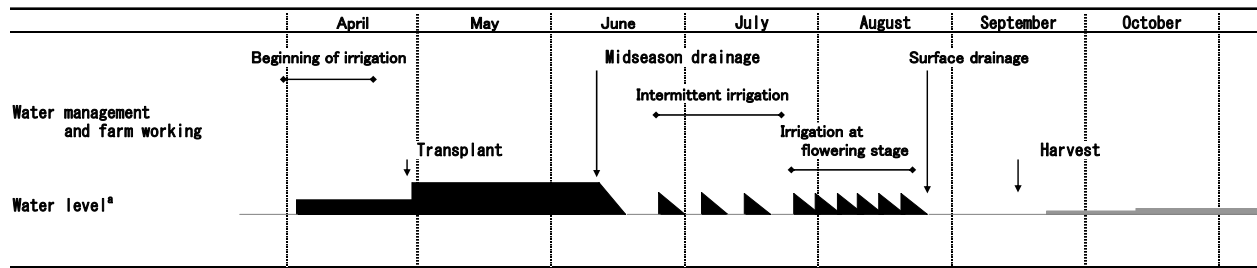


Fig. 2. Water management and water level of the paddies ^aVertical scale indicates relative depth of water.

3. Results and Discussion

Nine species of aquatic Hemiptera and twenty-four species of aquatic Coleoptera were collected in the study area (Table 1). 28 of these 33 species were collected from both the paddies and the pond. The dominant family was the Dytiscidae, represented by 13 species.

Table 1. Aquatic insects collected by sweeping from the irrigation pond and the paddies. Figures given are the total numbers of individuals collected from April to November in 1997.

Order	Family	Species	Japanese name	Pond		Paddies	
				Adults	Larvae	Adults	Larvae
Hemiptera	Belostomatidae	<i>Appasus major</i> (Esaki, 1934)	Oo-kooimushi	7	20	13	98
		<i>Kirkaldyia deyrolli</i> (Vuillefroy, 1864)	Tagame	-	1 ^a	1 ^a	-
	Nepidae	<i>Laccotrephes japonensis</i> Scott, 1874	Taikouchi	1 ^a	2 ^a	9	28
		<i>Ranatra chinensis</i> Mayr, 1865	Mizukamakiri	21	-	2	10
	Notonectidae	<i>Notonecta triguttata</i> Motschulsky, 1861	Matsumomushi	96	6	25	131
	Pleidae	* <i>Paraplea japonica</i> (Horv��th, 1904)	Marumizumushi	-	-	1 ^a	-
		* <i>P. indistinguenda</i> (Matsumura, 1905)	Hime-marumizumushi	20	20	-	-
	Corixidae	<i>Sigara septemlineata</i> (Paiva, 1918)	Esaki-komizumushi	2	-	222	80
		* <i>Hesperocorixa</i> sp.	Mizumushi sp.	-	-	-	1 ^a
Coleoptera	Haliplidae	<i>Peltodytes intermedius</i> (Sharp, 1873)	Kogashiramizumusi	122	-	32	1
		* <i>Haliplus japonicus</i> Sharp, 1873	Kubiboso-kogashiramizumushi	-	-	- ^d	-
		<i>Haliplus sharpi</i> Wehncke, 1880	Madara-kogashiramizumushi	1	-	5	-
	Noteridae	<i>Noterus japonicus</i> Sharp, 1873	Kotsubugengorou	6	-	4	-
	Dytiscidae	<i>Hyphydrus japonicus</i> Sharp, 1873	Keshi-gengorou	224	-	59	42
		* <i>Hydrovatus acuminatus</i> Motschulsky, 1859	Ko-marukeshi-gengorou	- ^d	-	-	-
		<i>Hydroglyphus japonicus</i> (Sharp, 1873)	Chibi-gengorou	3	-	21	2
		<i>Laccophilus difficilis</i> Sharp, 1873	Tsubu-gengorou	462	-	66	} 49 ^b
		<i>L. kobensis</i> Sharp, 1873	Koube-tsubu-gengorou	4	-	7	
		<i>Agabus japonicus</i> Sharp, 1873	Mame-gengorou	6	-	23	3
		<i>A. conspicuus</i> Sharp, 1873	Kurozu-mame-gengorou	18	1	32	8
		<i>Rhantus suturalis</i> (MacLeay, 1825)	Hime-gengorou	57	1 ^a	71	11
		<i>Hydaticus bowringi</i> Clark, 1864	Shima-gengorou	11	-	4	4
		<i>H. grammicus</i> (Germar, 1830)	Ko-shima-gengorou	11	-	22	-
		<i>Graphoderus adamsii</i> (Clark, 1864)	Marugata-gengorou	5	-	13	11
		<i>Cybister brevis</i> Aub��, 1838	Kuro-gengorou	28	7	15	38
		<i>C. chinensis</i> Motschulsky, 1854	Gengorou	34	1 ^a	2	9
	Gyrinidae	* <i>Dineutus orientalis</i> (Modeer, 1776)	Oo-mizusumashi	1 ^a	1	-	-
	Hydrophilidae	<i>Enochrus simulans</i> (Sharp, 1873) ^c	Kiiru-hirata-gamushi	20	2	40	2
		<i>Hydrophilus acuminatus</i> Motschulsky, 1853	Gamushi	38	5 ^a	5	16
		<i>Sternolophus rufipes</i> (Fabricius, 1792)	Hime-gamushi	17	1	4	-
		<i>Regimbartia attenuata</i> (Fabricius, 1801)	Mame-gamushi	11	-	22	-
		<i>Berosus japonicus</i> Sharp, 1873	Yamato-gomafu-gamushi	35	-	97	1
Total				1261	68	817	545

^aLarvae of these species were identified to the genus level.

^bCollected only in qualitative surveys.

^cProbably also includes *Helochaeres striatus* Sharp, 1873.

^dCollected only in 1998 surveys.

Only those species collected from either the irrigation pond or the paddies are marked *.

The number of species of adult insects in paddies increased from May to June, then gradually decreased toward autumn (Figure 3a). In contrast, the number in the ponds was highest during autumn. The number of species of larval insects was high in paddies especially from May to July, but low in the pond throughout the year (Figure 3b).

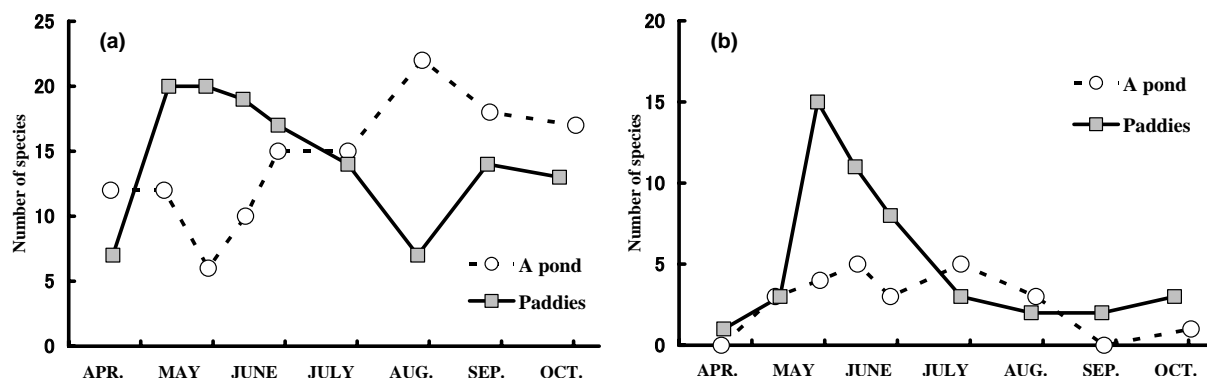


Fig. 3. Seasonal changes in the number of aquatic insect species represented by adults (a), and larvae (b) in the irrigation pond and paddies.

16 of the aquatic insect species observed were classified into four types on the basis of their habitat utilization pattern (Table 2). This classification was based on the major habitat of the adults and the site used for reproduction:

- A. Species using the pond for both non-reproductive and reproductive purposes.
- B. Species using the pond as the main habitat and the paddies for reproduction.
- C. Species using both the pond and paddies as a living habitat and also the paddies for reproduction.
- D. Species using the paddies for both non-reproductive and reproductive purposes.

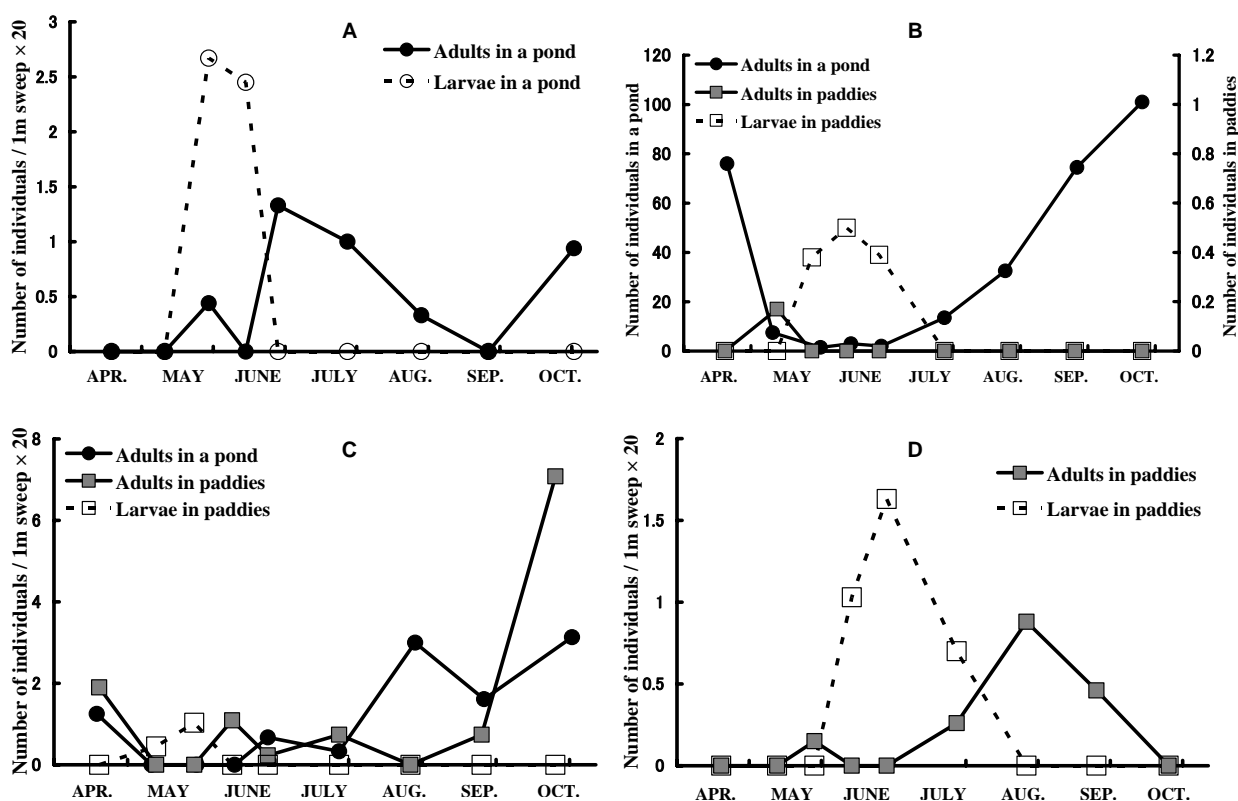


Fig. 4. Seasonal changes in the number of (A) *Parapleia indistinguenda*, (B) *Cybister chinensis*, (C) *Rhantus sturalis* and (D) *Laccotrephes japonensis* collected by sweeping. The adults of (B) *Cybister chinensis* in the irrigation pond were counted by collection in fish meat traps (5 traps per half hour). The adults and larvae of (B) *Cybister chinensis* in the paddies were counted by sweeping (Each number was standardized for 20 one-meter sweep).

Table 2. Ecological classification of 16 aquatic insect species found in the study area. Classification is based on the main habitat and the site used for reproduction.

Type	Species [Order] (Japanese name)	Habitat of adults		Reproduction place	
A	<i>Paraplea indistinguenda</i> [Hem.] (Hime-marumizumushi)	Pond	—	Pond	—
B	<i>Ranatra chinensis</i> [Hem.] (Mizukamakiri)	Pond	> Paddy	Pond	< Paddy
	<i>Notonecta triguttata</i> [Hem.] (Matsumomushi)	Pond	> Paddy	Pond	< Paddy
	<i>Peltodytes intermedius</i> [Col.] (Kogasiramizumushi)	Pond	> Paddy	Pond	< Paddy
	<i>Hyphydrus japonicus</i> [Col.] (Keshi-gengorou)	Pond	> Paddy	Pond	< Paddy
	<i>Laccophilus difficilis</i> [Col.] (Tsubu-gengorou)	Pond	> Paddy	Pond	< Paddy
	<i>Cybister brevis</i> [Col.] (Kuro-gengorou)	Pond	> Paddy	Pond	< Paddy
	<i>Cybister chinensis</i> [Col.] (Gengorou)	Pond	> Paddy	Pond	< Paddy
	<i>Hydrophilus acuminatus</i> [Col.] (Gamushi)	Pond	> Paddy	Pond	< Paddy
C	<i>Appasus major</i> [Hem.] (Oo-kooimushi)	Pond	& Paddy	Pond	< Paddy
	<i>Agabus conspicuus</i> [Col.] (Kurozu-mame-gengorou)	Pond	& Paddy	Pond	< Paddy
	<i>Rhantus suturalis</i> [Col.] (Hime-gengorou)	Pond	& Paddy	Pond	< Paddy
D	<i>Laccotrephes japonensis</i> [Hem.] (Taikouchi)	Pond	< Paddy	Pond	< Paddy
	<i>Sigara</i> sp. ^a [Hem.] (Komizumusi sp.)	Pond	< Paddy	Pond	< Paddy
	<i>Agabus japonicus</i> [Col.] (Mame-gengorou)	Pond	< Paddy	Pond	< Paddy
	<i>Berosus japonicus</i> [Col.] (Yamato-gomafu-gamushi)	Pond	< Paddy	Pond	< Paddy

 Mesh indicates the major habitat.

^a *Sigara* sp. include *Sigara septemlineata*.

Paraplea indistinguenda was the only species belonging to type A, and stayed in the irrigation pond throughout the year (Fig. 4A). *Ranatra chinensis*, *Notonecta triguttata*, *Peltodytes intermedius*, *Hyphydrus japonicus*, *Laccophilus difficilis*, *Cybister brevis*, *Cybister chinensis* (= *Cybister japonicus*) and *Hydrophilus acuminatus* were type B insects (Fig. 4B). Their adults immigrated (probably from the pond) into the paddies and reproduced from May to July. The new adults then migrated to the irrigation pond before the watered area of the paddies dried up. Type C included *Appasus major*, *Agabus conspicuus* and *Rhantus suturalis* (Fig. 4C). *Laccotrephes japonensis*, *Sigara* sp., *Agabus japonicus* and *Berosus japonicus* were classified as type D, and they were seldom found in the pond (Fig. 4D). These results indicate that paddies play an important role in the reproduction of aquatic Hemiptera and Coleoptera, whereas the pond provides stable habitat for non-reproductive stages, as well as a place for reproduction of some species. This means that the coexistence of paddies and ponds is important for the species richness of aquatic insects in this region.

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