生物圏科学
Biosphere Sci.
**54**：13－19 (2015)

# Studies on ecology of marine chironomids in southwestern Japan

Koichiro KAWAI[1)*], Hidetoshi SAITO[1)] and Katsuo SUGIMARU[2)]

[1)]*Laboratory of Aquatic Ecology, Graduate School of Biosphere Science, Hiroshima University, 1-4-4 Kagamiyama, Higashi-Hiroshima 739-8528, Japan*
[2)] *Research Dept., Fumakira Co. Ltd., 1-11-1, Umehara, Hatsukaichi-shi, Hiroshima 739-0494, Japan*

**Abstract** Ecological studies were conducted on marine chironomids in south-western Japan. A total of 20 species was collected. For vertical distribution, only a few species was distributed only at high or middle intertidal zone while many species were distributed only at low zone. For substrate preference, some species were collected only on rocks or in mud while many species were collected only in seaweeds. For geographical distribution, a few species was collected only in the southwestern islands or in the oceanic coast in the Japanese main islands. In contrast, some species were collected in the Seto Inland Sea and the oceanic coast in the main islands, in the oceanic coast in the main islands and the southwestern islands, or in all areas. For seasonal emergence, *Dicrotendipes enteromorphae* was collected only in summer and autumn, and *Semiocladius endocladiae* was collected in all seasons. Other species were collected only in autumn and winter, or only in winter and spring. These results suggest that many chironomid species with a variety of lifestyles dwell in intertidal zones and have some important roles in the ecosystems.
**Key Words:** sessile organisms, chironomid, distribution, intertidal zone, seaweed

## INTRODUCTION

Chironomids (Diptera: Chironomidae) are one of the widely distributed insects on the earth (Nihon yusurika kenkyu-kai, 2010). Some species live in marine habitats such as rocky or sandy seashore. Several genera are specialized in marine life in morphology and/or ecology (Wiederholm, 1989). Many studies have been reported mainly on taxonomy (Tokunaga, 1932, 1933, 1936a, 1936b). However, there are only a few studies on ecology (Hashimoto, 1975; Sunose and Fujisawa, 1982).

In this study, marine chironomids were examined from ecological viewpoints such as vertical distribution on the shore, substrate specificity, geographical distribution and seasonality, and the relationships between ecological and morphological properties were discussed.

## MATERIALS and METHODS

### Study area

Research was conducted in the southwestern Japan, including Honshu, Shikoku and Kyushu Islands, and southwestern islands in 2004 - 2006 (Fig. 1). A total of 22 sites was investigated.

Accepted on September 9, 2015 ＊ E-mail: kawagogi@hiroshima-u.ac.jp

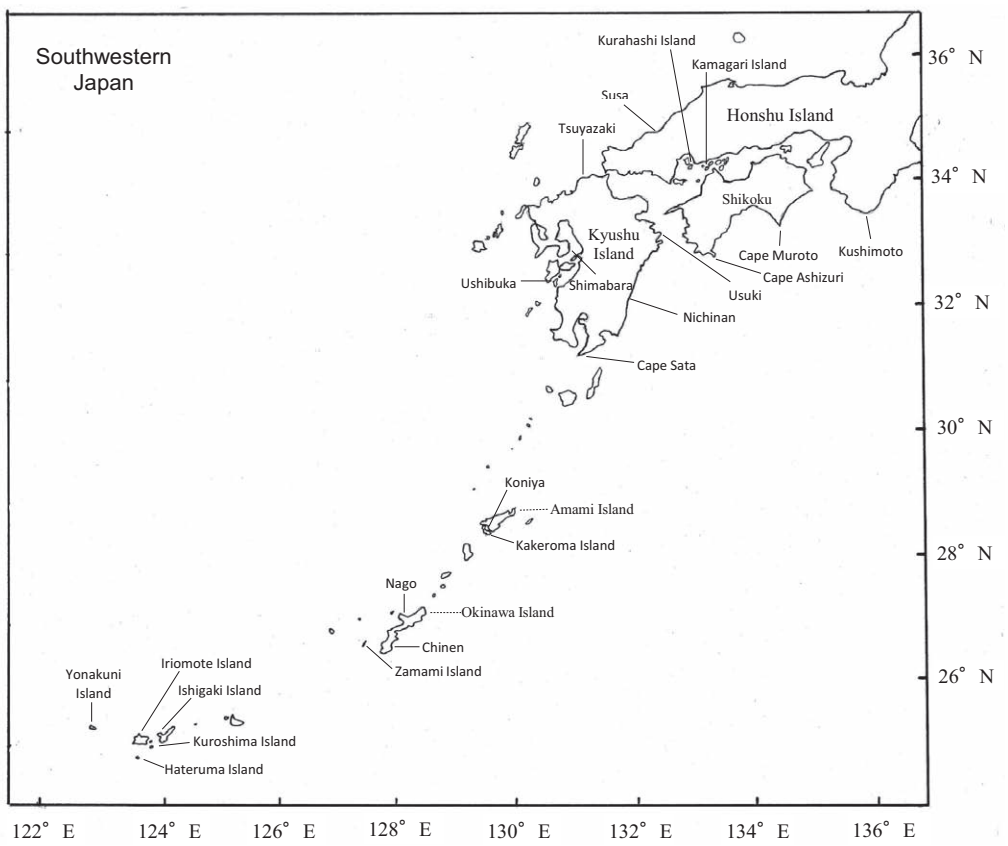


Fig. 1.Map of southwestern Japan, showing 22 sampling sites.

**Sampling**

A variety of substrates consisting of gravel, sand, mud and attached materials or sessile organisms on rocks were collected at 3 vertical levels, i.e., dried-up zone (high), shoreline zone (middle) and underwater zone (low) at ebb tides. Collected materials were transported to laboratory, transferred into a plastic container (Φ15cm×H9cm), filled with artificial sea water at 6 cm level, aerated through a small filter (Roka boy mini, Gex, Osaka) and covered with nylon mesh on the top. Emerging adults were collected every other day for about 2 months. In addition, swarming adults were collected by nylon net, and resting adults on the rocks, etc., and attracted adults to various light sources were collected using sucking tubes.

**Identification**

Male adults were mounted onto slides according to Sasa *et al*. (1980) and identified based on Wiederholm (1989), Sasa and Kikuchi (1995) and Nihonyusurika Kenkyu-kai (2010).

## RESULTS

A total of 20 species was collected. Among these, *Pseudosmittia* sp. is possible to be an undescribed species.

**Vertical distribution**（Table 1）

Only a species, *T. nemalionis* was collected only at high intertidal zone, and only a species, *C. yoshimatsui* was collected only at middle intertidal zone. As many as 11 species, e.g., *C. setonis*, were collected only at low intertidal zone. Six species, e.g., *T. japonicus*, were collected at middle to low intertidal zones.

**Substrate preference**（Table 1）

Three species, e.g., *Pseudosmittia* sp., were collected only on rocks, other 3 species, e.g., *A. tuberculatus*, were collected only in mud, and only a species, *T. nemalionis,* was collected only in clusters of sessile organisms. As many as 9 species, e.g., *C. setonis*, were collected only in seaweeds. Three species, e.g., *T. japonicus*, were collected in both seaweeds and sessile organisms.

Table 1. Vertical distribution in the intertidal zone and substrate preferences of marine chironomid species.

| Species | Intertidal zone | | | Substrates | | | | |
|---|---|---|---|---|---|---|---|---|
| | High | Middle | Low | Rock | Sand | Mud | Seaweeds | Attaching organisms |
| Orthocladiinae | | | | | | | | |
| *Clunio setonis* Tokunaga | | | ○ | | | | ○ | |
| *C. takahashii* Tokunaga | | | ○ | | | | ○ | |
| *C. tsushimaensis* Tokunaga | | | ○ | | | | ○ | |
| *C. tsushimaensis* var. minor Tokunaga | | | ○ | | | | ○ | |
| *Pseudosmittia* sp. | | ○ | | ○ | | | | |
| *Semiocladius endocladiae* (Tokunaga) | | ○ | | ○ | | | | |
| *Thalassosmittia nemalionis* (Tokunaga) | ○ | | | | | | | ○ |
| Telmatogetoninae | | | | | | | | |
| *Telmatogeton japonicus* Tokunaga | | ○ | ○ | | | | ○ | ○ |
| *T. pacificus* Tokunaga | | ○ | ○ | | | | ○ | ○ |
| *Thalassomya japonica* Tokunaga et Etsuko K. | | ○ | ○ | | | | ○ | ○ |
| Chironominae | | | | | | | | |
| Chironomini | | | | | | | | |
| *Ainuyusurika tuberculatum* (Tokunaga) | | ○ | ○ | | | ○ | | |
| *Chironomus crassiforceps* (Kieffer) | | | ○ | | ○ | | | |
| *C. yoshimatsui* Martin et Sublette | | ○ | | | | | ○ | |
| *Dicrotendipes enteromorphae* (Tokunaga) | | | ○ | | | | ○ | |
| *Polypedilum convexum* Johannsen | | | ○ | | ○ | | | |
| *P. nubifer* (Skuse) | | ○ | ○ | | | ○ | | |
| Tanytsrsini | | | | | | | | |
| *Pontomyia pacifica* Tokunaga | | | ○ | | | | ○ | |
| *Tanytarsus boodleae* Tokunaga | | | ○ | | | ○ | | |
| *T. churamarinus* Sugimaru, Kawai et Imabayashi | | | ○ | | | | ○ | |
| *T. pelagicus* Tokunaga | | ○ | ○ | ○ | | | | |
| *Yetanytarsus iriomotensis* Sasa | | | ○ | | | | ○ | |

**Geographical distribution**（Table 2）

Only a species, *C. takahashii*, was collected only in the southwestern islands, and only a species, *T. pacificus*, was collected only in the oceanic coasts in the main islands. In contrast, 3 species, e.g., *S. endocladiae*, were collected in all areas. Four species, e.g, *C. tsushimensis,* were collected in the Seto Inland Sea and the oceanic coasts in the main islands. Other four species, e.g, *C. setonis,* were collected in the oceanic coasts in the main islands and the southwestern islands.

Table 2. Geographical distribution of marine chironomid species in the southwestern Japan.

| Species | Areas | | |
|---|---|---|---|
| | Seto Inland Sea | Oceanic coasts in the main islands | Southwestern islands |
| *Clunio setonis* | | ○ | ○ |
| *C. takahashii* | | | ○ |
| *C. tsushimaensis* | ○ | ○ | |
| *Semiocladius endocladiae* | ○ | ○ | ○ |
| *Thalassosmittia nemalionis* | ○ | ○ | |
| *Telmatogeton japonicus* | ○ | ○ | |
| *T. pacificus* | | ○ | |
| *Thalassomya japonica* | | ○ | ○ |
| *Ainuyusurika tuberculatum* | ○ | ○ | ○ |
| *Pontomyia pacifica* | | ○ | ○ |
| *Tanytarsus boodleae* | | ○ | ○ |
| *T. pelagicus* | ○ | ○ | |
| *Yetanytarsus iriomotensis* | ○ | ○ | ○ |

**Seasonal emergence**（Table 3）

*Dicrotendipes enteromorphae* was collected only in summer and autumn at the Cape Ashizuri. *C. setonis* and *T. pacificus* were collected only in autumn and winter at the Cape Ashizuri. *S. endocladiae* was collected in all seasons, although it was not collected at Kurahashi in winter and not collected at the Cape Ashizuri in spring and summer. Three species, e.g., *C. tsushimensis*, were collected only in winter and spring , although it was not collected at the Cape Ashizuri in spring.

Table 3. Seasonal occurrences of marine chironomid species at the Cape Ashizuri and Kurahashi.

| Species | Spring | | Summer | | Autumn | | Winter | |
|---|---|---|---|---|---|---|---|---|
| | Ashizuri | Kurahashi | Ashizuri | Kurahashi | Ashizuri | Kurahashi | Ashizuri | Kurahashi |
| *Clunio setonis* | | | | | ○ | | ○ | |
| *C. tsushimaensis* | | ○ | | | | | ○ | ○ |
| *Semiocladius endocladiae* | | ○ | | ○ | ○ | ○ | ○ | |
| *Thalassosmittia nemalionis* | | ○ | | | | | ○ | ○ |
| *Telmatogeton japonicus* | | ○ | | | | | ○ | ○ |
| *T. pacificus* | | | | | ○ | | ○ | |
| *Dicrotendipes enteromorphae* | | | ○ | | ○ | | | |

## DISCUSSION

In this study, marine chironomids were collected in the southwestern Japan, and the differences in some ecological properties such as vertical distribution in the intertidal zone, substrate preference, geographical distribution and seasonal occurrence were examined among the species.

Only a species, *T. nemalionis,* was collected only at high intertidal zone and only in clusters of sessile organisms. This suggests that the species live in a gap between sessile animals such as barnacles and eat some algae or detritus. This was not incompatible to the first collection of the species in algal matting of rocky seashore (Tokunaga, 1936). As many as 11 species were collected only at low intertidal zone and six species were collected at middle to low intertidal zones. This shows that marine chironomid larvae usually have relatively low desiccation tolerance.

Three species were collected only on rocks, other 3 species were collected only in mud, and as many as 9 species were collected only in seaweeds. This shows that the detritivorous species are less abundant than herbivorous species in marine chironomid communities. Indeed, *S. endocladiae* was estimated to feed on some seaweeds such as *Gloiopeltis comlanata* and *Nemalion pulvinataum* in high intertidal zone (Nihon yusurika kenkyu-kai, 2010).

There were no species that were distributed only in the Seto Inland Sea area. Only one species, *T. pacificus*, was distributed only in the oceanic coasts in the main islands. Besides, only one species, *C. takahashii*, was distributed only in the southwestern islands. On the other hand, 4 species such as *T. japonicus* and *T. nemalionis* were distributed in the Seto Inland Sea and the oceanic coasts in the main islands, and other four species such as *C. setonis* were distributed in the oceanic coasts in the main islands and the southwestern islands. Further, 3 species such as *S. endocladiae* were distributed in all areas. This might suggest the origin of marine species in the tropical regions. Indeed, genera *Telmatogeton* and *Thalassosmittia* have been proven to be more derivative than genera *Clunio* and *Semiocladius* in a genetic tree (Sugimaru et al., 2010).

*Dicrotendipes enteromorphae,* a member of the subfamily Chironominae, was collected only in summer and autumn at the Cape Ashizuri, located at much lower latitude than Kurahashi. *C. setonis* and *T. pacificus,* both members of the subfamily Orthocladiinae, were collected only in autumn and winter, and *C. tsushimensis*, *T. nemalionis* and *T. pacificus*, all also members of the subfamily Orthocladiinae, were collected only in winter and spring. This phenomenon is in accord with a knowledge of an arctic origin of Orthocladiinae and a tropical origin of Chironominae.

In this study, *C. yoshimatsui*, the most widely distributed species in the Japanese Archipelagoes, emerged from a sample collected from seaweeds in middle intertidal zone. This is an extremely important record, since this species has been believed as a completely freshwater species (Sasa et Kikuchi, 1995). Further study is necessary to clarify the importance of chironomids in food web and material circulation in marine ecosystems.

## ACKNOWLEDGEMENTS

We are very grateful to the colleagues in Laboratory of Aquatic Ecology, Graduate School of Biosphere Science, Hiroshima University for their cooperation to chironomid sampling, valuable advices and continuous encouragements.

## REFERENCES

Hashimoto, H., 1975. Seasonal emergence of *Clunio aquilonius* Tokunaga (Diptera: Chironomidae). *Konchu*. **43**:52-57.

Nihon yusurika kenkyu-kai,, 2010. *Illustrated guide to the Chironomidae of Japan*. Bun-ichisogoshuppan, Tokyo. 353 pp. (in Japanese)

Sasa, M., Yasuno, M., Ito, M. and Kikuchi, T., 1980. Studies on the chironomid midges of the Tama River. Part 1. The distribution of chironomid species in a tributary in relation to the degree of pollution with sewage water. *Res. Rep. Natl. Inst. Environ. Stud.* **13**: 1-8.

Sasa, M. and Kikuchi, M., 1995. *Chironomidae of Japan*, University of Tokyo Press, Tokyo, 333 pp.

Sugimaru, K., Kawai, K. and Imabayashi, H., 2010. Relationship between morphological and genetic trees of marine chironomid species. *Biosp. Sci.* **49**: 1-6.

Sunose, T. and Fujisawa, T.,1982. Ecological studies of the intertidal chironomid *Telmatogeton japonicus* Tokunaga in Hokkaido. *Res. Popl. Ecol*. **24**: 70-84.

Tokunaga, M., 1932. Specially evolved chironomids, *Pontomyia natans* Edwards and *P. pacifica* Tokunaga, as marine insects. *Dobutsugakuzasshi*. **44**: 1-3.

Tokunaga, M., 1933. Chironomidae from Japan Ⅱ. Marine Tanytarsus. *Philip. J. Sci*. **51**: 357-367.

Tokunaga, M.,1936a. Chironomidae from Japan Ⅶ. New species and a new variety of the genus *Chironomus* Meigen. *Philip. J. Sci*. **60**: 71-85.

Tokunaga, M.,1936b. Chironomidae from Japan Ⅷ. Marine or seashore *Spaniotoma*, with description of the immature forms of *Spaniotoma melanione*, sp. nov. and *Tanytarsus boodleae* Tokunaga. *Philip. J. Sci*. **60**: 303-319.

Wiederholm, T., 1989. Chironomidae from the holarctic region-keys and dignoses. *Entomol. Scand. Suppl*. **34**: 532 pp.

# 西南日本における海産ユスリカの生態に関する研究

河合幸一郎[1)]，斎藤英俊[1)]，杉丸勝郎[2)]

[1)] *広島大学大学院生物圏科学研究科水族生態学研究室*
*〒739-8528　東広島市鏡山1-4-4*
[2)] *（株）フマキラー　研究部門　〒739-0494　廿日市市梅原1-11-1*

**要　旨**　西南日本において海産ユスリカの生態に関わる研究を行った。その結果，計20種が採集され，垂直分布では，潮間帯上部あるいは中部域のみに分布する種は少なかったが，下部域のみに分布する種は多かった。基質については岩石面や泥中のみに棲む種は少なかったのに対し，海藻類のみに棲む種は多かった。また，地理的分布では南西諸島や本土外洋沿岸域のみに分布する種は少なかった。一方，数種は，瀬戸内海沿岸と本土外洋沿岸域，本土外洋沿岸域と南西諸島，あるいは全地域に分布することが分かった。また，羽化時期については，*Dicrotendipes enteromorphae* は夏季・秋季のみ，*S. endocladiae* は周年出現し，他種は秋季・冬季のみあるいは冬季・春季のみに出現した。これらのことから，潮間帯には様々な生活様式を持つ多くの種のユスリカが棲息し，生態系において重要な役割を果たしていることが示唆された。

**キーワード**：海藻，潮間帯，付着生物，分布，ユスリカ