INTRODUCTION

Chironomids have an important role in the food network of aquatic communities, representing a major link between producers and secondary consumers (Tokeshi, 1995). Chironomidae is a large group of invertebrates found in various water worldwide, with a reported diversity of 8,000 ~ 20,000 species (Armitage, 2012). Although adult chironomids inhabit areas near the riparian zone of rivers or lakes, the larvae are aquatic organisms distributed in diverse aquatic habitat patches (Pinder 1986, 1995). Chironomid larvae was potentially represent more than 70% abundance of the total arthropod numbers in hypersaline waters and are opportunistic omnivores, ingesting a wide variety of food sources (Cummins and Klug, 1979). In general, these larvae ingest five kinds of food such as algae, detritus and associated microorganisms, macrophytes, wood debris, and other invertebrates (Berg, 1995). Moreover, recent eDNA metabarcoding-based gut content analysis of chironomid larvae indicated the presence of various small planktons, such as Desmodesmus armatus, Eolimna minima, and Tetradesmus dimorphus, in the weirs (Jo et al., 2020).

Kwak (2015) introduced 24 genera and 43 species of chironomid larvae based on visibly identified taxonomical adult stages in South Korea. The morphological studies of larvae are scarce: Yoon and Chun (1992) described the abdomen characteristics through simple drawings of eight Chironomus larval species. Ree (1981, 1998) described the larva of Cricotopus oryzaphagos. In this study, we provide the detailed pictorial features and morphological keys to 16 genera present in Korea.

Key words: chironomid larvae, morphological character, antenna, mentum, mandible, Chironomidae
MATERIALS AND METHODS

Chironomid larvae were collected from four important freshwater rivers in South Korea from April to June in 2018 and 2019. Collections were made using a Ponar grab (20 cm×25 cm) and a sieve (mesh size: 500 µm). The samples were fixed and preserved using 90% ethanol and about 16.9°C (range: 8.76~23.35°C) the field water temperature was measured using portable equipment (Model: YSI Professional Plus, Ohio, USA).

Specimens were dissected and the dissected parts were mounted on slides using a glycerol mounting medium. The dissection was performed on a glass slide under a microscope (Olympus SZX12). The body was dissected with a needle and appendages were used to prepare the slides. The sandwich method was used for setting the position and rotating the specimen. The permanent mount slide was sealed with transparent nail varnish. All drawings were made using a drawing tube on an Olympus BX51 differential interference contrast microscope. The descriptive terminology follows Epler (2001).

RESULTS AND DISCUSSION

A total of 16 genera and 20 species were identified from four major rivers in Korea (Table 1). The classification criteria were determined according to the morphological characteristics. Chironomid larvae have a cylindrical body shape and are well-segmented. Some appendages located on head capsule and posterior part is very important for identification.

Table 1. List of the 16 genus of Chironomids in South Korea.

<table>
<thead>
<tr>
<th>Subfamily</th>
<th>Genus</th>
<th>Korean name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tanypodinae</td>
<td>Conchapelopia</td>
<td>민다리깔따구속</td>
</tr>
<tr>
<td></td>
<td>Tanypus</td>
<td>늪깔따구속</td>
</tr>
<tr>
<td></td>
<td>Chironomus</td>
<td>까 najbli따구속</td>
</tr>
<tr>
<td></td>
<td>Cryptochironomus</td>
<td>음깔따구속</td>
</tr>
<tr>
<td></td>
<td>Einfelia</td>
<td>다포깔따구속</td>
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<td></td>
<td>Glyptotendipes</td>
<td>초각깔따구속</td>
</tr>
<tr>
<td></td>
<td>Harnischia</td>
<td>무깔따구속</td>
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<tr>
<td></td>
<td>Microtendipes</td>
<td>꼬마깔따구속</td>
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<td></td>
<td>Polypedilum</td>
<td>무늬깔따구속</td>
</tr>
<tr>
<td></td>
<td>Stictochironomus</td>
<td>반지깔따구속</td>
</tr>
<tr>
<td></td>
<td>Tanytarsus</td>
<td>장부깔따구속</td>
</tr>
<tr>
<td>Orthocladinae</td>
<td>Chaetocladius</td>
<td>아기딸따구속</td>
</tr>
</tbody>
</table>
|            | Cricotopus  | 까<ApplicationUser>\
| Orthocladinae | Diplocadius | 까<ApplicationUser>\
| Orthocladinae | Tokunagayusurika | 볼간도꾸나가깔따구 |
ment or at its apex are important, as is the location of the ring organ.

2) Mandible (Fig. 3)

The mandible is located on the right and left side of the body at the front of the head capsule (Fig. 1). Strong teeth are located foremost, which used for holding on tightly to food. Several complex characteristics was used for identification, including the number and shape of the inner apical teeth, the present or absence of a seta interna, the morpho-type of seta subdentalis, and the pectin mandibularis.

3) Mentum (Fig. 4)

The strong teeth with ventromental plates are located at the center of the head capsule. The shape and number of teeth are the most important characteristics for identification. The shape of the ventromental plate and the presence or absence of a beard are noticeable features.

2. Morphological key for the 16 genera of the chironomid larvae in South Korea

1. Posterior parapods long, relatively; the ratio of length/width of the head capsule is 1.5~2.0 times ............................................ (Tanypodinae) 2
   - Posterior parapods short; the ratio of length/width of the head capsule is 1.0 to 1.3 times ........................................... (Chironominae / Orthocladiinae) 3
2. The shape of the ligular teeth is V-shaped type (Fig. 5A) .......................................................... genus Conchapelopia
   - The shape of the ligular teeth is aligned (Fig. 5B) .......................................................... genus Tanypus
3. Antenna extremely elongated (Fig. 6A); Mandible with 1 to 2 apical teeth ......................................................... 4
   - Antenna not elongated (Fig. 6B) .............................................. 5
4. The first segment of the antenna with a seta, located in the middle part of the segment .............. genus Tanytarsus
   - First segment of the antenna without seta ......................................................... genus Tokunagayu surika
5. Labrum with naked or simple seta ........................................ 6
   - Labrum with plumose seta .................................................. 8
6. Ring organ in antenna located above 1/2 (Fig. 6C) ........... 7
   - Ring organ in antenna located under 1/2 (Fig. 6D) ........

Fig. 2. Basic structure of the antenna in the head capsule (Einfeldia dissidnus).

Fig. 3. Basic structure of the mandible in the head capsule (Chironomus sp.).
The ratio of the first segment of the antenna is long (about 10 times) C. oryzaphages
7. The mentum is a plate-type (Fig. 7A) C. sylvestris
- The mentum is a V-shaped type (Fig. 7B) C. oryzaphages
8. Antenna with 5-segmented C. sylvestris
- Antenna with 6-segmented 9
9. Tubules presented; Mentum teeth is 6:3:6 (Fig. 8A) C. sylvestris
- Tubules absent; Mentum teeth is 6:2:6 (Fig. 8B) C. sylvestris
** includes Chironomus kiiensis, C. flaviplumus, C. sp.

3. Taxonomic account

1) Subgenus Tanypodinae

Diagnosis. Posterior parapods long. The ratio of length/width of the head capsule is 1.5 to 2.0 times. Antenna 4-segmented, retractile into the head capsule. Anal tubules usually well developed in Korean freshwater species. Genus Conchapelopia and Tanypus can easily be distinguished by the shape of the ligular teeth.

Ecology. This subfamily consists of free-swimming or crawling predators; some burrow in the bottom mud. Conchapelopia and Tanypus are identified and recognized from different water temperature. Conchapelopia is found at a high temperature (19.80°C), Tanypus punctipennis is a low (9.30°C).
2) Subgenus Chironominae

Diagnosis. Posterior parapods short. The head capsule is mostly of the same aspect ratio (1.0 to 1.3 times). Antenna usually 4 to 6-segmented. Mentum teeth is 6 : 3 : 6, well sclerotized teeth, sometimes reduced. Anal tubules usually present. Ecology. The most abundant subfamily in South Korea. 9 genera and 11 species are recognized. According to Epler (2001), this group also inhabits brackish and marine water. Most larvae build tubes using sediment. The genus *Chironomus* has hemoglobin, exhibits a red color, and could survive in low oxygen conditions. The *Chironomus* species occur under ordinary temperature conditions (15 ~ 22°C) in April and May. Three species were identified: *C. kiiensis*, *C. flaviplumus*, *C. sp.*. Species of genera *Microtendipes* and *Tanytarsus* could occur under low temperature conditions in early spring.

3) Subgenus Orthocladiinae

Diagnosis. Posterior parapods short, sometimes reduced. Antenna with 3 ~ 7 segments; sometimes strongly reduced or could be longer than the head capsule. Mentum well sclerotized. There are two recognized *Cricotopus* species that could be easily identified by the ratio of the first antennal segment.

Ecology. Orthocladi larvae are found in a variety of freshwater habitats. Most larvae are scrapers, collectors. Five genera and 7 species have been recognized in this study. These species are found in the spring season (March to June) and can survive at 13°C.

**REFERENCES**


