Patagonian glaciers as insect habitats

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Abstract. Glacier structures as the habitat for glacier insects found during biological research on three glaciers in the Patagonia Northern Icefield, San Rafael Glacier (western side), Soler Glacier and icefield near Mt. Largo (eastern side) are described. One structure is the various melt-water systems of these glaciers, which is necessary for the distribution of the stonefly. Another is a structure of the surface ice, which seems to be related to the distribution of the snow flea. Both species are different from the Himalayan ones in their habitats in the glacier and in their life styles. This seems to reflect the glaciological characteristics of the Patagonian glaciers. Especially, the large melt-water networks inside the glacier which characterize the glaciers in this region were found to be the main habitat of the stonefly youngs. This is a new insect habitat previously unsuspected.

1. Introduction

During recent research on the Himalayan glaciers, previously unsuspected insects which spend their entire life cycles in the snow and ice of the glaciers have been discovered and biological studies of the glaciers have been started. Based on these researches the glacier structures as an insect habitat were preliminarily reported (KOHSHIMA, 1984a; 1984b). However, our knowledge of glacier structures important from the biological viewpoint is still very poor and almost nothing is known about that of the Patagonian glaciers.

This time, we did a glacio-biological research on three glaciers in the Patagonia Northern Icefield and found two types of glacier insects: stonefly (Plecoptera, Family Gripopterygidae, Fig. 1) and snow flea (Collembola, *Isotoma* sp., Fig. 2). They are different from Himalayan counterparts (Diptera, *Diamesa* spp.) in their life styles. This report aims to briefly describe the glacier structures as the habitat for these Patagonian glacier insects and their distribution patterns which seem to reflect some differences in glaciological characteristics among these glaciers. Analysis of other ecological and glacio-biological data is now proceeding to explain

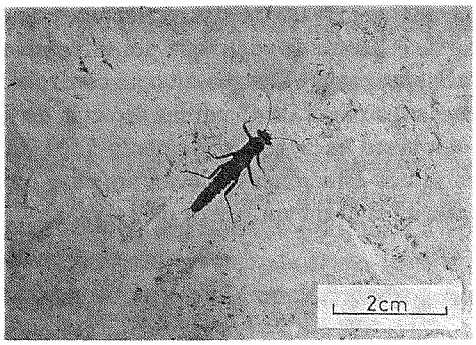

Fig. 1. Adult of the stonefly (Plecoptera, Gripopterygidae).

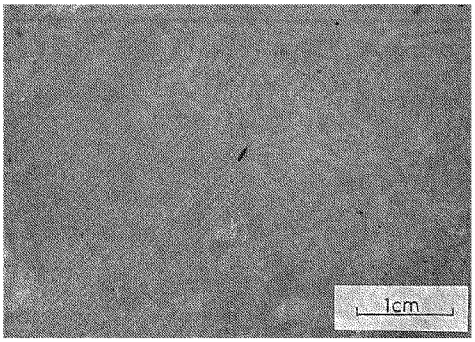

Fig. 2. Snow flea (Collembola, *Isotoma* sp.).

the distribution pattern of these insects. In the future, comparative studies of these insects will give us some glaciologically important information.

2. Outline of the research

The study was done at three glaciers in the Patagonia Northern Icefield: San Rafael Glacier (western side), Soler Glacier and the icefield near Mt. Largo (eastern side), from late November, 1983 to early January, 1984. At each glacier, specimens of glacier insects and dust particles in the glacier ice were collected at various parts of the glacier, and observation of the glacier structures as insect habitats were carried out.

3. Glacier insects in the study area

The stonefly (Plecoptera, Gripopterygidae) is a kind of stream insect. It was found to spend its young stage in the melt-water systems of these glaciers and the adults were found to walk on the surface of the glacier ice. The snow flea (Collembola, Isotoma sp.) was found to live on the glacier surface and in small cavities in the ice near the surface. Both are cold-tolerant insects active in the cold environment as low as the freezing point.

4. Distribution and habitat of the stonefly species

The stonefly was found in the ablation area with well-developed melt-water systems on the glacier surface. Such areas are located in the upper part of the ablation area of San Rafael Glacier (600–1100 m in altitude), from the terminus to the upper region of the ablation area of Soler Glacier (350–700 m), and in the icefield (1000–1200 m) near Mt. Largo (Figs. 3 and 4) All these areas are relatively flat, bare-ice fields with regularly arranged crevasses (Fig. 5). There are many melt-water streams, water-filled pits (moulin ?, Fig. 6) and water-filled crevasses on these surfaces. These streams terminate by flowing into moulins, crevasses or tunnel-like water channels beneath the ice. Almost all stonfly youngs were found in these melt-waters, especially in the openings of such tunnel-like channels and in the water-filled pits or crevasses. Very few youngs were found in the surface streams. Many adults were observed to creep up to the glacier surface from these places. These observations show that the main habitats of the youngs are the melt-water systems beneath the ice. Considering the length of

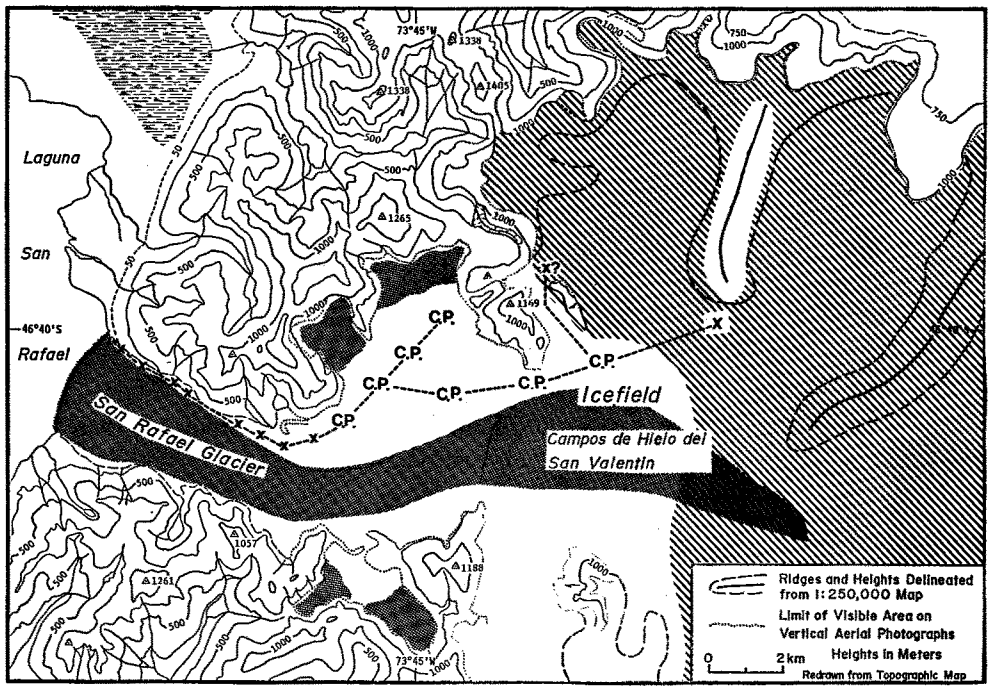

Fig. 3. Distribution pattern of the glacier insects in San Rafael Glacier.
P: Collection site of the stonefly.
C: Collection site of the snow flea.
x: No insects were collected.
?: Uncertain.
Dot pattern: Area with heavily broken ice.
Slanted line pattern: Inferred accumulation area.

its young stage estimated from the life history of similar species (more than two years) and the stability of these small waters in the moving glacier ice, the existence of large melt-water networks inside the glacier connecting these structures seems to be a critical condition for their survival and dispersion. In the lower part of the ablation area of San Rafael Glacier (0–600 m), the glacier ice is heavily broken into numerous blocks by fast glacier movement and no stable structures with melt-water were found. In some stagnant parts of the glacier margin, at which the glacier movement is relatively slow because of large friction between the ice and side walls, small scale melt-water systems could be found. However, no insects were found even in these places (Fig. 3). This is probably because there are no water-networks beneath the ice developed enough for the survival and dispersion of the youngs. In the accumulation area of the icefield near Mt. Largo (higher than 1200 m in altitude), the surface was covered with new snow and neither melt-water systems nor insects were found.

Compared with Himalayan glacier insects (*Diamesa* spp.) which live on the glacier surface and in the ice near the surface, the young of this species uses the deeper part of the glacier ice. This is a new type of the insect habitat previously unsuspected. The melt-water systems inside the glacier ice, which is the main habitat of the stonefly youngs, characterize warm glaciers such as the Patagonian glaciers (SUGUDEN and JOHN, 1976). The studies on this insect will

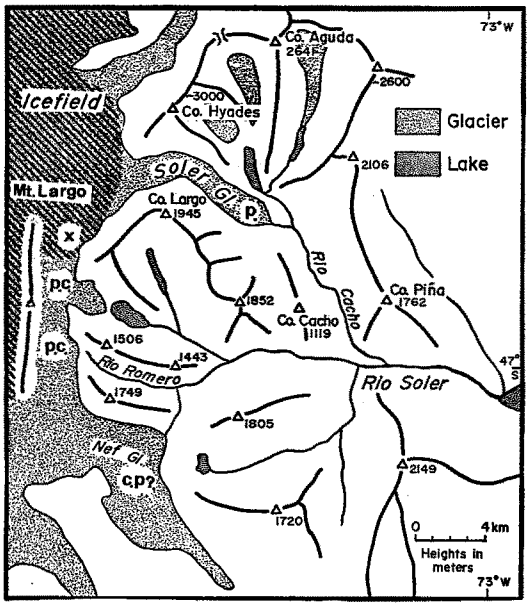

Fig. 4. Distribution pattern of the glacier insects in the glaciers at the eastern part of the Patagonia Northern Icefield.

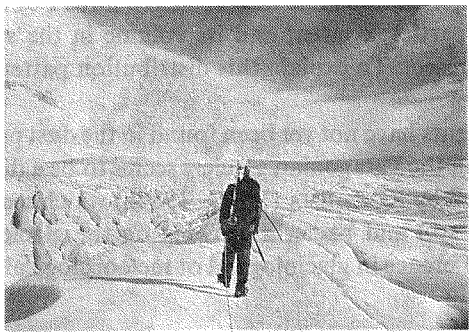

Fig. 5. The ablation area (1100 m in altitude) of the icefield near Mt. Largo. The stoneflis and snow fleas were found in this area.

give us some interesting information on these invisible water systems beneath the ice, which are probably related to glaciologically important phenomena such as surges.

5. Distribution and habitat of the snow flea

The snow flea was found in the upper part of the ablation area (600–1100 m in altitude) of San Rafael Glacier and in the ablation area (1000–1200 m) of the icefield near Mt. Largo (Figs. 3 and 4). The surface ice of these areas was composed of large ice grains (1–5 cm in diameter) and housed many snow fleas in their small cavities. In the accumulation area of the icefield near Mt. Largo, the surface was covered with new snow and the insects were not found. On Soler Glacier and the stagnant parts of the lower ablation area of San Rafael

Fig. 6. A water-filled pit (moulin ?) on the upper part of the ablation area in San Rafael Glacier (700 m in altitude). Many youngs and adults of the stonefly were collected here.

Glacier (0–600 m), in spite of the similar structure of the surface ice, we could not find this insect (Fig. 4). This suggests that there are other unknown limiting factors for their distribution, for example, meteorological conditions or food. Since it is not probable that Soler Glacier differs so much in the meteorological condition from the nearby Nef Glacier in which the insects were found, other factors must be considered now. For example, we are analyzing and comparing the dust particle content and its volume in the surface ice. Dust particles provide the food for this insect. To explain this distribution pattern, it is necessary to study its life history in the glacier.

Because living micro-plants have not yet been found in the dust particles on which the snow fleas feed, the ecosystem on the Patagonian glaciers seems to be a different type from that of a Himalayan glacier reported by KOHSHIMA (1984a, 1984b) which seems to be based on a blue-green algae (*Phormidium* sp.) and bacteria growing on the glacier ice. This result is also thought to reflect some difference in glaciological or meteorological conditions between Patagonia and the Himalaya.

6. Conclusion

By this research on the characteristics of glacier insects on the Patagonian glaciers, previously-unknown insect habitats in the glaciers and an interesting distribution pattern were revealed. The differences in the insect fauna and distribution pattern among these glaciers strongly suggest that the glaciers can be categorized from a biological viewpoint. These insects and their habitats seem to reflect the glaciological characteristics of the Patagonian glaciers. In the future, we will be able to obtain some glaciologically important information from the studies of the distribution and the habitats of these insects.

References

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KOHSHIMA, S. (1984b): Living micro-plants in the dirt layer dust of Yala Glacier, Nepal Himalaya. in Glacial studies in Langtang Valley (K. Higuchi ed.). Data Center for Glacier Research, Japanese Society of Snow and Ice, 91–97.
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Resumen. Glaciares Patagónicos como habitat de insectos

Se encontró dos especies de insectos durante la investigación biológica en tres glaciares del Hielo Patagónico Norte: Glaciar San Rafael (vertiente oeste), Glaciar Soler y el Campo de Hielo cercano al Cerro Largo (vertiente este). Una de las especies pertenece al orden Plecoptera (Fig. 1) y la otra a Collembola (Fig. 2) (KOHSIMA, no publicado). Ambos son insectos tolerantes al frío hasta el punto de congelamiento (KOHSHIMA, no publicado).

La especie de Plecoptera se encontró en zonas que presentaban sistemas bien desarrollados de agua de derretimiento sobre el hielo. Estas áreas se distribuyen en la porción superior de la zona de ablación (600–1100 m de altura) en el Glaciar San Rafael y, desde la región superior hasta el término de la zona de ablación (350–700 m) en el Glaciar Soler y en el Campo de Hielo (1000–1200 m) cercano al Cerro Largo (Figs. 3, 4). Todas estas áreas consistían en zonas de hielo relativamente planas con grietas dispuestas regularmente (Fig. 5). En la superficie habían numerosos cauces de fosión, grietas y hoyos rellenos de agua (moulins) (Fig. 6). Algunos de estos cauces terminaban en hoyos, en las grietas o en canales de agua tipo túnel bajo la superficie de hielo. Prácticamente todos los juveniles de Plecoptera fueron encontrados en las entradas de estos canales tipo túnel y en los hoyos y grietas cubiertos de agua, a la vez que se observó a numerosos adultos emergiendo de estos lugares. Esto sugiere la existencia de amplias redes de agua dentro del glaciar, conectando estas estructuras. En la parte inferior de la zona de ablación en el Glaciar San Rafael, el hielo estaba muy fracciprado en numerosos bloques debido al rápido movimiento del glaciar y, no se encontró ni insectos ni un sistema estable de agua derretida en la superficie (Fig. 3). Estos resultados sugieren que los sistemas estables de agua de derretimiento en el hielo glacial son necesarios para la distibución y la sobrevivencia de los insectos.

La especie de Collembola fue encontrada en la parte superior de la zona de ablación (600–800 m de cota) en el Glaciar San Rafael (Fig. 3) y, en la zona de ablación bajo los 1000–1200 m en el campo de hielo cercano a Cerro Largo (Figs. 4, 5). El hielo superficial de esta área consistía en granos grandes (1–5 cm de diámetro) y albergaba en sus pequeñas cavidades a numerosos individuos de Collembola. A pesar de que en el Glaciar Soler el hielo superficial presenta una estructura similar, no se pudo encontrar este insecto. Existe la posibilidad de que entre estos glaciares haya alguna diferencia en la condición alimentaria del hielo de superficie.

En el futuro esperamos obtener información glaciológica importante del estudio de la distribución de estos insectos.