

## Oribatid mites of Daikoku-Jima Island of Hokkaido, northern Japan (Acari: Oribatida)

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**Abstract** — The oribatid mite fauna of Daikoku-Jima Island, northern Japan, was surveyed. Thirty-four families, 45 genera and 56 species of oribatid mites were recorded there. Three of these species, *Hafenrefferia gilvipes* (C.L. Koch, 1839), *Oribella pectinata* (Michael, 1885), and *Eupelops curtipilus* (Berlese, 1916), are newly recorded from Japan.

**Key words** — Daikoku-Jima Island, Hokkaido, new record in Japan, oribatid mites

### Introduction

Daikoku-Jima Island is a small island, 1.08 km<sup>2</sup> in area, and the highest point is 105 m above sea level. It is located about 3 km from Akkeshi Town, Hokkaido, northern Japan, on the Pacific Ocean. The surrounding cliffs give the island a trapezoid cross-section with sandy beach. The island has some flat parts containing wooded areas and grass fields. Many kinds of birds live there, including Leach's storm-petrel (*Oceanodroma leucorhoa*) a migrant bird that creates nesting-burrows in the ground of grassy fields.

The oribatid mite fauna of Daikoku-Jima was investigated initially by Ohnishi (1981), who reported 56 species from 17 sampling points. Some were not fully identified: for instance, *Liacarus chiebunensis akkeshi* Aoki, 2006 was mentioned as *Liacarus* sp. in his report (Ohnishi, pers. comm.). Later, in 2004, the second faunal study was started in Hokkaido University's COE program (e.g. Ito et al., 2007), and many oribatid specimens were obtained from soil samples collected during 2004–2006. Among them, *Hermannia shimanoi* was recently described as a new species from Daikoku-Jima (Aoki, 2006). Our purpose is to clarify the fauna of oribatid mites collected from various environments in the Daikoku-Jima as a part of the program.

### Materials and methods

In Daikoku-Jima (42°57'N, 144°52'E: Fig. 1), 16 soil samples were taken at several different times (Table 1). Oribatid mites and soil arthropods were extracted by Tullgren funnels, and immediately fixed and preserved in 70–80% ethanol. After this procedure, the mites were mounted on slides and studied under a light microscope.

### Species in Daikoku-Jima

Thirty-four families, 45 genera and 56 species of oribatid

mites recorded from Daikoku-Jima are listed below. The sample code in this survey (Table 1) is shown for each species. [\*\*\*: species new to Japan, \*\*: species new to Hokkaido, \*: species not recorded by Ohnishi (1981). †: Ohnishi (2010) recorded from Hokkaido after submission of this manuscript.]

#### HYPOCHTHONIIDAE BERLESE, 1910

*Hypochthonius rufulus* C.L. Koch, 1836 01-002, 01-004, 02-001, 02-003, 02-004, 02-005, 02-006.

\**Hypochthonius luteus* Oudemans, 1917 02-005.

#### ENIOCHTHONIIDAE GRANDJEAN, 1947

*Hypochthoniella minutissima* (Berlese, 1904) 02-005.

#### EULOHMANNIIDAE GRANDJEAN, 1931

\**Eulohmannia ribagai* (Berlese, 1910) 01-002, 01-004.

#### ORIBOTRITIIDAE GRANDJEAN, 1954

*Oribotritia fennica* Forsslund & Märkel, 1963 02-001.

*Oribotritia* sp. 01-012.

*Maerlotritia kishidai* (Aoki, 1958) 02-002, 02-006.

#### EUPHTHRACARIDAE JACOT, 1930

*Acrotritia ardua* (C.L. Koch, 1841) 01-005, 01-013, 02-001.

#### PHTHRACARIDAE PERTY, 1841

\**Phthiracarus setosus* (Banks, 1895) 02-001, 02-005.

*Atropacarus striculus* (C.L. Koch, 1836) 02-004, 02-005, 02-012.

#### MALACONOTHRIDAE BERLESE, 1916

*Malacothrus* sp. 02-005, 02-012.

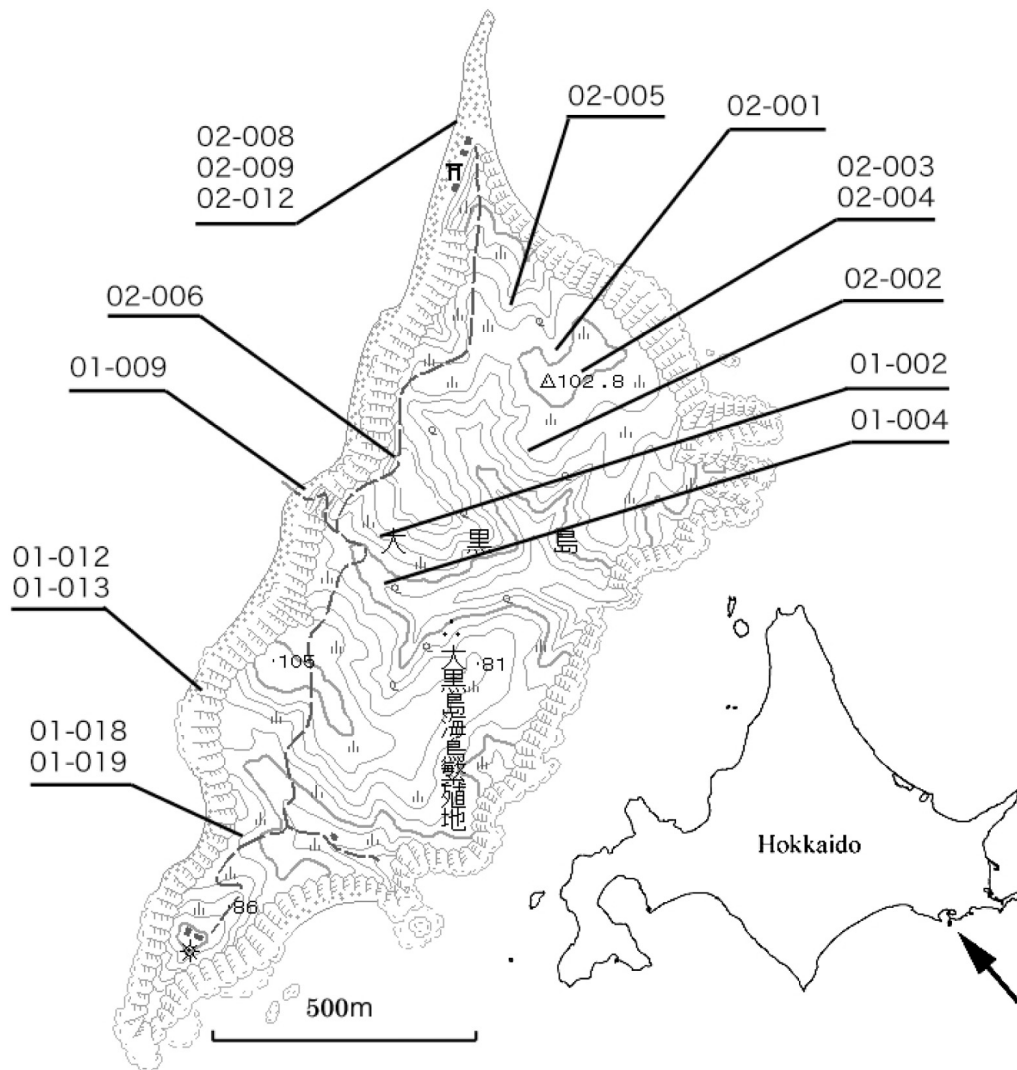


Fig. 1. The sampling points on Daikoku-Jima Island, Hokkaido. A sample code (Table 1) is given to each sampling point. Arrow: location of Daikoku-Jima Island.

#### NOTHRIDAE BERLESE, 1896

*Nothrus palustris* C.L. Koch, 1839 02-001, 02-003, 02-004, 02-005.

\**Nothrus ezoensis* Fujikawa, 1999 01-013, 02-002.

\*\**Nothrus sadoensis* Fujikawa, 1999 02-006, 02-009.

#### CAMISIIDAE OUDEMANS, 1900

*Heminothrus yamasakii* Aoki, 1958 02-001, 02-003, 02-004, 02-005.

#### NANHERMANNIIDAE SELLNICK, 1928

*Nanhermannia nana* (Nicolet, 1855) 01-004, 02-004, 02-009, 02-012.

*Nippohermannia parallela* (Aoki, 1961) 02-002, 02-004.

#### HERMANNIIDAE SELLNICK, 1928

*Hermannia shimanoi* Aoki, 2006 01-018, 02-008.

#### DAMAEIDAE BERLESE, 1896

*Damaeidae* sp. 02-001, 02-012.

#### CEPHEIDAE BERLESE, 1896

\**Cepheus cepheiformis* (Nicolet, 1855) 02-001, 02-004, 02-005.

\**Cepheus hokkaiensis* Fujikawa, 1992 02-005.

#### NODOCEPHEIDAE PIFFL, 1972

\**Nemacepheus dentatus* Aoki, 1968 02-012.

#### LIACARIDAE SELLNICK, 1928

*Liacarus acutidens* Aoki, 1965 02-004.

\**Liacarus chiebunensis akkeshi* Aoki, 2006 01-012, 02-001, 02-002, 02-003, 02-004, 02-005, 02-006, 02-007, 02-009.

#### XENILLIDAE WOOLLEY and HIGGINS, 1966

\**Xenillus tegeocranus* (Hermann, 1804) 02-005.

**Table 1.** The sampling points for oribatid mites on Daikoku-Jima Island, Hokkaido.

| Sample code | Location                          | Date           | Collector* | Habitat         |
|-------------|-----------------------------------|----------------|------------|-----------------|
| 01-002      | Grassy field                      | 15-18-VI-2004  | C-S-I      | Soil and litter |
| 01-004      | Small wooded area                 | 15-18-VI-2004  | C-S-I      | Soil and litter |
| 01-005      | Grassy field                      | 11-14-VII-2005 | C-S-I      | Soil and litter |
| 01-009      | Beach                             | 11-14-VII-2005 | C-S-I      | Soil and litter |
| 01-012      | Beach                             | 11-14-VII-2005 | C-S-I      | Soil and sand   |
| 01-013      | Beach                             | 11-14-VII-2005 | C-S-I      | Soil and sand   |
| 01-018      | Beside pond                       | 11-14-VII-2005 | C-S-I      | Soil and litter |
| 01-019      | Beside pond                       | 11-14-VII-2005 | C-S-I      | Soil and litter |
| 02-001      | Small wooded area                 | 15-VII-2006    | S          | Soil and litter |
| 02-002      | Small wooded area                 | 15-VII-2006    | S          | Soil and litter |
| 02-003      | Petrel burrow in soil             | 15-VII-2006    | S          | Soil and litter |
| 02-004      | Grassy field                      | 15-VII-2006    | S          | Soil and litter |
| 02-005      | Grassy field                      | 15-VII-2006    | S          | Soil and litter |
| 02-006      | Grassy field                      | 15-VII-2006    | S          | Soil and litter |
| 02-007      | Sea gull's nest (grass)           | 15-VII-2006    | S          | Soil and litter |
| 02-008      | Coastal vegetation                | 15-VII-2006    | S          | Sand            |
| 02-009      | Japanese butterbur field on beach | 15-VII-2006    | S          | Sand            |
| 02-012      | Kelp mass washed onto beach       | 15-VII-2006    | S          | deacying kelp   |

\*C-S-I: A.R. Chittenden, Y. Saito and K. Ito, S: S. Shimano (the author).

**Table 2.** Comparison of some characters of *Oribella pectinata* (Michael, 1885) among three papers.

|                   | European specimen<br>Fujikawa (1978) | European specimen<br>Bernini (1980)                 | Japanese specimen<br>The present study                                   |
|-------------------|--------------------------------------|---|--|
| Lamella           | long, slender ridge                  | long, slender ridge                                 | short, strong ridge  |
| Sensillus         | (not illustrated)                    | long, gently with a distinct<br>and swollen portion | with short swollen portion   |
| Ventral setae     | all distinctly                       | ?   | only aggenital setae pectinate and a<br>part of epimeral setae pectinate |
| Notogastral setae | densely pectinate                    | moderately barbed                                   | minutely barbed  |

## TENUIALIDAE JACOT, 1929

\*\*\**Hafenrefferia gilvipes* (C.L. Koch, 1839) 01-012, 02-005.

*Tenuialoides fusiformis* Aoki, 1969 02-005.

## EREMOBELBIDAE BALOGH, 1961

*Eremobelba japonica* Aoki, 1959 02-004, 02-005, 02-006.

## ORIBELLIDAE KUNST, 1971

\*\*\**Oribella pectinata* (Michael, 1885) 02-003.

\**Oribellopsis kushiroensis* Aoki, 1992 01-009.

## OPPIIDAE GRANDJEAN, 1951

*Oppiella nova* (Oudemans, 1902) 02-004, 02-008, 02-012.

\**Neotrichoppia zushi* (Aoki, 1984) 01-019.

\**Multioppia brevipectinata* Suzuki, 1975 02-001.

*Brachioppia* sp. 02-005.

*Oppiidae* sp. 02-002.

## SUCTOBELBIDAE JACOT, 1938

*Suctobelbella* sp. 02-005, 02-009.

## TECTOCEPHEIDAE GRANDJEAN, 1954

*Tectocephus velatus* (Michael, 1880) 02-003, 02-007.

## PHENOPELOPIDAE PETRUNKEVITCH, 1955

\*\*\**Eupelops curtipilus* (Berlese, 1916) 02-001, 02-003, 02-

004, 02-005.

## TEGORIBATIDAE GRANDJEAN, 1954

*Lepidozetes dashidorzsi* Balogh & Mahunka, 1965 02-001, 02-002, 02-005, 02-007.

## ORIBATELLIDAE JACOT, 1925

*Oribatella* sp. 02-004, 02-005, 02-006.

## CERATOZETIDAE JACOT, 1925

\**Ceratozetes gracilis* (Michael, 1884) 02-001, 02-003, 02-004, 02-005, 02-007.

\**Melanozetes meridianus* Sellunick, 1928 02-007.

†*Ghilarovizetes maruyamai* Hirauchi, 1999 02-007.

*Ceratozetidae* sp. 02-004.

*Trichoribates* sp. 01-002, 01-004, 01-009, 02-001, 02-002, 02-006, 02-007.

## CHAMOBATIDAE GRANDJEAN, 1954

\**Chamobates geminus* Fujikawa, 1997 02-012.

## LIEBSTADIIDAE BALOGH &amp; BALOGH, 1984

\**Liebstadia similis* (Michael, 1888) 02-003, 02-004, 02-006.

## SCHELOBATIDAE GRANDJEAN, 1933

*Schelobates pallidulus* (C.L. Koch, 1841) 02-001, 02-005,

02-006.

(= *S. latipes* (C.L. Koch, 1844))

*Scheloribates* sp. 02-002, 02-003, 02-005, 02-007, 02-009.

#### HAPLOZETIDAE GRANDJEAN, 1936

*Lauritzenia* sp. 02-005.

#### PROTORIBATIDAE BALOGH & BALOGH, 1984

*Protoribates* sp. 02-005.

#### MOCHLOZETIDAE GRANDJEAN, 1960

*Unguizetes* sp. 02-001, 02-002, 02-003, 02-005, 02-006.

#### ORIBATULIDAE THOR, 1929

\**Oribatula sakamorii* Aoki, 1970 02-007.

(= *Eporibatula sakamorii* (Aoki, 1970))

\**Phauloppia tuberosa* (Fujikawa, 1972) 02-001.

(= *Eporibatula tuberosa* Fujikawa, 1972)

#### PARAKALUMMIDAE GRANDJEAN, 1936

*Neoribates roubali* (Berlese, 1910) 02-001, 02-004.

\**Neoribates parvisetiger* (Aoki, 1965) 02-001, 02-005.

(= *Protokalumma parvisetigerum* Aoki, 1965)

#### Species Newly Recorded from Japan

##### *Oribella pectinata* (Michael, 1885)

[Japanese name: Kenaga-ooana-dani]

(Figs. 2A-C)

*Notaspis pectinata* Michael, 1885; 1888.

*Dameosoma crinitum* Berlese, 1916.

*Oribella pectinata*: Berlese, 1908; Willmann, 1931; van der

Hammen, 1952; Fujikawa, 1978; Bernini, 1980.

*Xenillus pectinatus*: Oudemans, 1913; Sellnick, 1928.

*Xenillus limburgensis*: Oudemans, 1912.

**Specimens examined.** Fourteen examples: Daikoku-Jima, Hokkaido, N. Japan. 15-VII-2006. S. Shimano. Collected from nest on the ground of nocturnal bird (*O. leucorhoa*).

**Sample code.** 02-003.

**Measurement.** Body length 294-330 (av. 308)  $\mu\text{m}$ . width 165-192 (av. 175)  $\mu\text{m}$ .

**Distribution.** Europe, USA and Japan (new record).

**Remarks.** We are confident that the specimens from N. Japan represent *Oribella pectinata* (Michael), although some differences can be detected among the detailed redescrptions of European specimens by Fujikawa (1978) and Bernini (1980) and the Japanese materials as mentioned below (Table 2). Lamella are drawn by these authors as slender ridges, but in the Japanese materials they each consist of a basal short strong ridge with fine striation and an anterior row of several light spots connecting the ridge and insertion of lamella seta. In the figures of Bernini (1980) the sensillus seems to have a long, gently swollen portion, while in the Japanese specimens it has a more distinct and

short swollen portion. Fujikawa (1978) illustrated all ventral setae of the Oudemans's collection as being distinctly pectinate, while in the Japanese materials only aggenital setae, and a part of the epimeral setae are distinctly pectinate (Fig. 2C). The notogastral setae of the Japanese specimens are not so densely barbed as in Fujikawa's figure of the Michael's type specimen. However, specimens were not compared directly, and because we are uncertain if these differences are real, the Japanese specimens are determined at the present moment as belonging to the European species, *O. pectinata*.

##### *Eupelops curtipilus* (Berlese, 1916)

[Japanese name: Chibige-enma-dani]

(Fig. 2D)

*Pelops curtipilus* Berlese, 1916.

*Pelops depilatus* Berlese, 1916.

*Eupelops curtipilus*: Bernini, 1970; Pérez-Íñigo, 1972.

**Specimens examined.** Fifteen examples: Daikoku-Jima, Hokkaido, N. Japan. 15-VII-2006. S. Shimano.

**Sample code.** 02-001, 02-003, 02-004, 02-005.

**Measurement.** Body length 545-595 (av. 553)  $\mu\text{m}$ . width 410-475 (av. 444)  $\mu\text{m}$ .

**Distribution.** Europe, South Africa and Japan (new record).

**Remarks.** The characteristic features of this species are (1) strongly barbed interlamellar setae, (2) clavate sensilli, (3) short notogastral setae, (4) the anterior median projection of notogaster with a flat margin or with a very weak swelling, and (5) body surface minutely granulate.

##### *Hafenrefferia gilvipes* (C.L. Koch, 1839)

[Kombou-marutsuya-dani]

(Fig. 2E)

*Oribata gilvipes* C.L. Koch, 1839.

*Liacarus auritus* Nordenskiöld, 1901.

*Liacarus pterotus* Coggi, 1900.

*Hafenrefferia gilvipes*: Sellnick, 1928; Willmann, 1931;

Woolley, 1955; 1971; Schweizer, 1956; Norton, 1983.

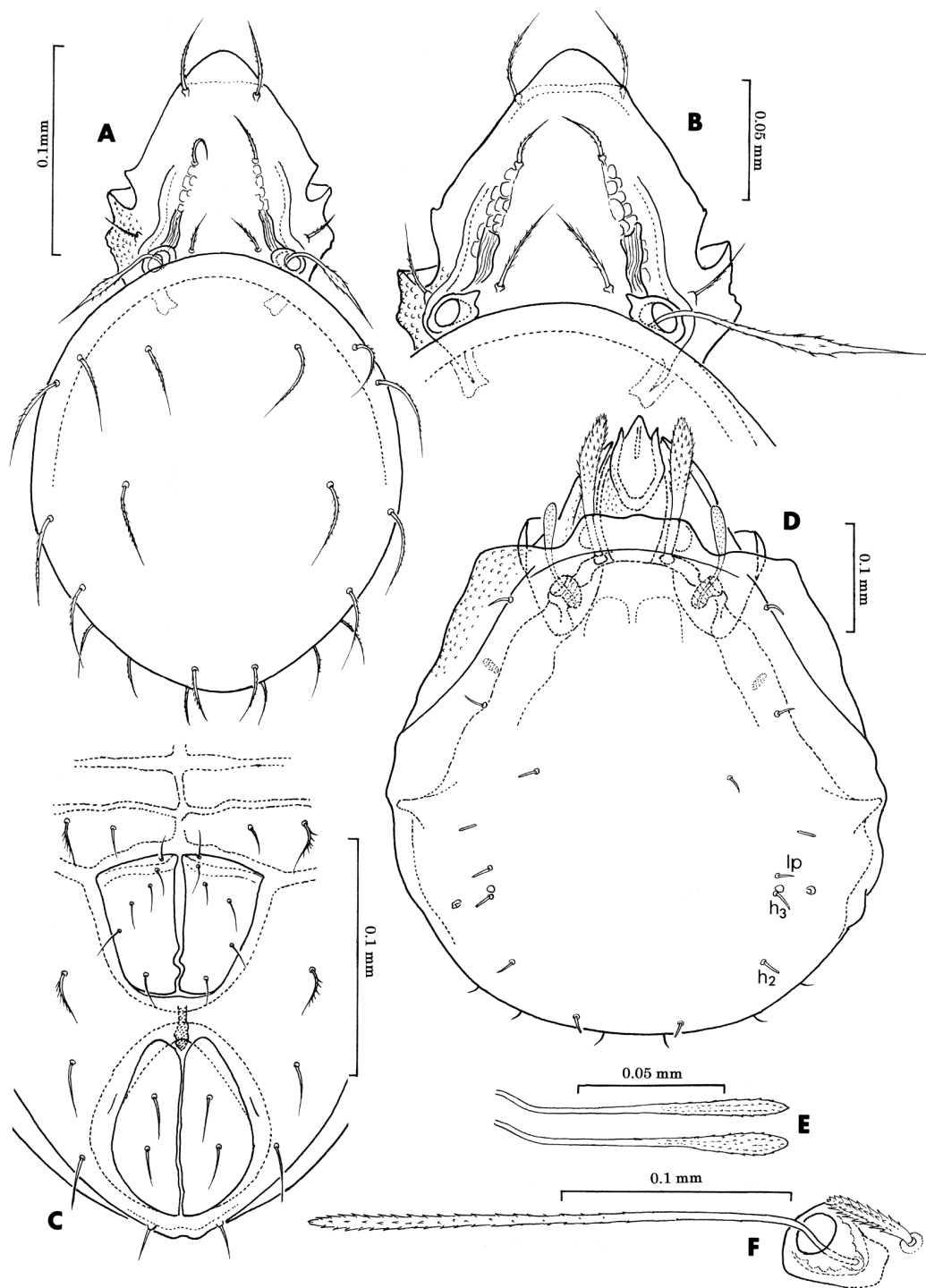
**Specimens examined.** 2 examples. Daikoku-Jima, 11-VII-2005. A.R. Chittenden, Y. Saito and K. Ito.

**Sample code.** 01-012, 02-005.

**Measurement.** Body length approximately 900  $\mu\text{m}$ ; unfortunately, the specimens were broken before we could observe them.

**Distribution.** Palaearctic region: Japan (new record).

**Remarks.** The characteristic features of the species are (1) lamella connecting with short interlamella at a level slightly anterior to their middle, (2) lamellar cusps projecting forward in parallel, (3) sensillus nearly setiform, (4) pteromorpha sharply pointed anteriorly, and weakly bending outward.



**Fig. 2.** A-C: *Oribella pectinata* (Michael, 1885). A: Dorsal aspect of body. B: Enlarged dorsal aspect of proterosoma. C: Genito-anal region. D: *Eupelops curtipilus* (Berlese, 1916). Dorsal aspect. E: *Hafenrefferia gilvipes* (C.L. Koch, 1839). Sensillus. F: *Nothrus sadoensis* Fujikawa, 1999. Sensillus and interlamellar seta.

#### Species Newly Recorded from Hokkaido

*Nothrus sadoensis* Fujikawa, 1999  
(Fig. 2F)

*Nothrus sadoensis* Fujikawa, 1999.

**Specimens examined.** 8 examples. Daikoku-Jima, 15-VIII-2006. S. Shimano leg.

**Sample code.** 02-006, 02-009.

**Measurement.** Body length 745-780 (av. 756)  $\mu\text{m}$ , width 370-395 (av. 383)  $\mu\text{m}$ .

**Distribution.** Japan (Sado Island as the type locality and Daikoku-Jima, new record from Hokkaido).



**Remarks.** The species has been known only from the type locality, Sado Island, Japan (Fujikawa 1999). It is reported from Hokkaido for the first time. The specimens of Sado Island are slightly larger (body length 785–857 (av. 821)  $\mu\text{m}$ , width 428–485 (av. 457)  $\mu\text{m}$ ).

### Discussion

The faunistic data in this paper do not indicate any remarkable tendencies between distributions of oribatid mites and environments in Daikoku-Jima Island. The species number, 56 species, is similar to that of Ohnishi (1981), however, the appearances of some particular species are notable.

Two of the three species newly recorded from Japan—*Oribella pectinata* and *Eupelops curtipes*—were found in the soil sample (sample code, 02-003 in Table 1) from the opening of a nest burrow of a migrant petrel (*O. leucorhoa*). In particular, *O. pectinata* was found only from this sample. Krivolutsky and Lebedeva (2004) recorded 146 species of living oribatid mites from feathers of 150 bird species. In their report, *Oribella castanea*, *O. paoli*, *Eupelops torulosus* and *E. sp.* were found from the plumage of some bird species (not including *O. leucorhoa*). Lebedeva and Krivolutsky (2003) reported living oribatid mites from birds' bodies; they found 44 out of 64 species from soils in Arctic islands. They discussed that oribatid mites and other micro-arthropods that were found in soil covered with ice under severe climatic conditions of Arctic islands were probably spread to the islands by birds. Although the list of Lebedeva and Krivolutsky (2003) did not include species of *Oribella* or *Eupelops*, it seems likely that the migration of birds could help to widen oribatid mite distributions in islands of the subarctic zone, including Daikoku-Jima Island.

Additionally, *Ghilarovizetes mariyamai* was found only from the nest of a sea gull (sample 02-007), *Larus schistisagus*. Several previous studies have shown that various oribatid mite species inhabit the nest of birds (e.g. Nordberg, 1936; Krivolutsky et al., 2001). *O. pectinata* was included in one such report (Nordberg, 1936).

To authors' knowledge, the relationships between bird/bird-nest and oribatid mites still have not been studied in Japan. Thus, important ecological and biogeographical themes (e.g. *do birds help dispersion of soil mites?*) remain to be studied in several climate zones and archipelago areas of Japan.

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### References

- Aoki, J. 2006. Oribatid mites collected from drift litter on the beach of Daikoku-jima Island. Hokkaido (Acari: Oribatida). Bull. Kanagawa pref. Mus. (Nat. Sci.), 35: 61–65.
- Aoki, J. & Ohnishi, J. 1974. New species and record of oribatid mites from Hokkaido, North Japan. Bull. Natn. Sci. Mus. Tokyo, 17: 149–156.
- Bernini, F. 1980. Notulae Oribatologicae XXIV. Gli Acari Oribatei di alcune piccole Grotte del Senese. Redia, 63: 359–405.
- Fujikawa, T. 1978. Revision of the family Banksinomidae (Acari, Oribatei). – Acarologia, 20: 433–467.
- Fujikawa, T. 1999. Eight new species of genus *Nothrus*. Edaphologia, 36: 5–54.
- Hirauchi, Y. 1999. Some new taxa of the family Ceratozetidae (Oribatida) from Tateyama Mountains, Central Japan. J. Acarol. Soc. Jpn., 8: 103–116.
- Ito, M., Shimano, S. & Naraki, Y. 2007. Earthworm fauna of Daikokujima Island, North Japan, with a redescription of *Amyntas yunoshimensis* (Hatai, 1930) (Annelida, Clitellata, Megasclecoidea). Biogeography, 9: 83–88.
- Krivolutsky, D. A. & Lebedeva, N. V. 2004. Oribatid mites (Oribatei) in bird feathers: Passeriformes. Acta. Zool. Lituanica, 14: 19–38.
- Krivolutsky, D. A., Lebedeva, N. V. & Matyukhin, A. V. 2001. Oribatid mites (Oribatei) in the plumage of birds. Parazitologia, 35: 275–283.
- Lebedeva, N. V. & Krivolutsky, D. A. 2003. Birds Spread Soil Microarthropods to Arctic Islands Dokl. Akad. Nauk, 391: 138–141.
- Nordberg, S. 1936. Biologisch-Ökologische Untersuchungen über die Vogelnidicolen. Acta Zool. Fenn., 21: 1–168.
- Ohnishi, J. 1981. Oribatid mite fauna of Daikoku-jima Island and its surroundings. pp. 22–28. In: Eastern Hokkaido sea line research group (ed.) The report of Eastern Hokkaido sea line research group. The Kushiro Municipal Museum, Kushiro, 65 pp (in Japanese).
- Ohnishi, J. 2010. Oribatid fauna on lakeside of Harutoriko, Kushiro city I. Sylvicola, 28: 97–106.

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