

pollution levels among several different freshwaters. The present study examines if the ciliate community structures could be a bioindicator even among stations in a single river, which might be similar pollution levels. Samplings were done at monthly intervals from Jan. to Dec. 2002 at 8 stations from the upper to lower streams of the Shirakawa River, Kumamoto Pref. Ciliate species were categorized by their feeding preferences; bacteriovore, omnivore, and carnivore. Pollutions were determined by bacterial counts and by 9 physico-chemical parameters. All the data of the pollution levels were standardized and compared with the ciliate data. Total numbers of ciliates well correlated positively with the pollution levels. The percentage of species as categorized above correlated well positively (bacteriovore) or negatively (omnivore) with the pollution levels.

A STUDY ON THE ABNORMALITIES IN SENSORY ORGAN IN *SINOTAIA QUADRATA HISTRICA*

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We already reported the abnormalities in eye number in *Sinotaia quadrata histrica* from Lake Hachiro (Akita Prefecture, Japan)(The 73rd annual meeting). In this study, we also showed abnormalities of antennae. For example, we collected the animal with no antenna. Then, the ratio of animals with abnormal antennae was 27.3%. The seasonal change of ratio of animals with abnormal antennae was as same tendency as that of ratio of animals with abnormal number of eyes. That is, both ratio were high in spring and autumn, but low in summer.

REPRODUCTIVE CYCLE BASED ON HISTOLOGICAL OBSERVATIONS OF JAPANESE PYGMY SQUID, *IDIOSEPIUS PARADOXUS*, IN THE *ZOSTERA* BED ON THE COAST OF CENTRAL JAPAN

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The annual reproductive cycle of the Japanese pygmy squid *Idiosepius paradoxus* in the *Zostera* bed on the temperate coast of central Honshu was examined on the basis of size, structure and histological observations of reproductive organs. The body size (dorsal mantle length) of *I. paradoxus* showed a similar seasonal variation in both male and female. Dorsal mantle length gradually increased from December, reached maximum in April or May, and remarkably decreased between May and June. Almost male all specimens appearing in the *Zostera* bed had spermatophores in Needham's sac throughout a year. However, the population of female shift sexual maturity from mature to immature both between May and June, and September and October. Therefore, the alternation of generations seemed to occur in these periods. In conclusion, it was suggested that *I. paradoxus* has at least two generations within one year, namely, the small-sized summer spawning generation from June to October and the large-sized spring spawning generation from November to May. Moreover, it seemed that the photoperiod was concerned with spawning of the female and spermatogenesis of the male.

SEASONAL CHANGES IN GONADAL DEVELOPMENT IN THE SLUG *LEHMANNIA VALENTIANA*

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The slug *Lehmannia valentiana* (Ferussac) (Gastropoda: Pulmonata, Limacidae) is originally distributed in Europe, but is artificially introduced to various countries including Japan. In the present study, slugs were collected in Osaka, Japan in every month, and the development of their hermaphroditic organs was examined. Histological examination revealed that spermatogenesis and oogenesis were suppressed until September. Sperm bundles were observed from September to May and developed oocytes were from October to May. These results show that *L. valentiana* reproduces in winter.

MOLECULAR PHYLOGENY AND BIOGEOGRAPHY OF LAND SNAILS IN THE RYUKYU ARCHIPELAGO

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Land snails of the Ryukyu Archipelago are highly diversified. There are many species or subspecies indigenous to a single or several islands. Pattern of genetic divergence among these land snails should have reflected a complex geological history of the archipelago associated with repeated land-bridge formations and isolations. However, there have been no molecular genetic approaches to the land snails living in the archipelago.

We have examined genetic relationships and phylogeography of land snails of the families Enidae, Camaenidae and Trochomorphidae, which show extensive geographic variation and speciation within the archipelago, based on mtDNA sequences. Results of our study is not necessarily concordant with the current taxonomy based mainly on shell morphology. Biogeographic significance of our finding will be discussed.

THE DRIFT DISPERSAL AND THE DYNAMICS OF DOWNSTREAM-DISTRIBUTION BY STREAM GRAZER, *MICRASEMA QUADRILLOBA* DUE TO COMPENSATE THE SCARCE OF FOOD.

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In stream ecosystem, periphyton quantities at a station where grazer inhabited locally with high density were depleted dramatically. In order to compensate the scarce of food, invertebrate grazer that had less ability of movement might migrate to a new habitat where had more food resource by drift dispersal. Therefore, a downstream-distribution of invertebrate grazers might expanded widely to lower stations when the grazer had most requirement for food, i.e., at the final instar. In present study, a hypothesis that a species of invertebrate grazer, *Micrasema quadriloba* performed the drift dispersal due to compensate the scarce of food was inspected.

THE BEHAVIORAL PROGRAM OF NEST BUILDING IN THE LEAF-CUTTER BEE, *MEGACHILE TSURUGENSIS*

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Megachile tsurugensis provide a useful system where we attempt to investigate the behavioral program that executes a sequence of nesting activities. Since they easily nest under artificial environments, a series of behavioral experiments were performed to study how these activities are organized with respect to the nest structures. When the nests were partially destroyed or manipulated, they repaired the nests to have some preferred dimensions by lining the nests' internal surface with leaf discs that they cut in various sizes. These leaf cutting and lining activities are organized in such a way that the nests' dimensions seem to be measured in each step, and the measurements are integrated into the behavioral program. To support this view, three dimensional image analyses of both activities found some correlations between the bees' stepping actions when cutting a leaf and walking inside the nests.

CO-EVOLUTION BETWEEN INSECT AND PLANT IN ASIA: AN ORIENTAL ORCHID USES HONEY BEE COMMUNICATION LANGUAGE FOR POLLINATION

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Flowers of an oriental orchid, *Cymbidium floribundum* (Cf), attract drones, workers, queens and swarming colonies of the Japanese honeybee, *Apis cerana japonica* (Acj), for pollination. The European honeybee *Apis mellifera* is not attracted. Cf flowers have no nectar and the pollinia can not be used by the bees because they attach on the back of the thorax. This unusual relationship is presumably established in southern China between the orchid and the Chinese honeybee, *Apis cerana cerana* (Acc), because the orchid distributes originally in southern China and brought to Japan by human. To examine a hypothesis that the orchid uses honeybee communication chemicals to attract the bees, chemical analyses of Cf flower aroma and those of honeybee pheromones and behavioral bioassays were done. GC/MS analyses of Cf aroma and honeybee gland extracts showed that Cf aroma contained the same compounds that were found in Acj and Acc glands extracts. These compounds were identified as semiochemicals of the Asian honeybees by GC/EAD and by bioassays. These results support Cf have obtained the ability to biosynthesize the honeybee semiochemicals through evolutionary process with the Asian honeybee.

SOLDIER-SPECIFIC CATHEPSIN B-LIKE PROTEASE IN AN EUSOCIAL APHID, *TUBERAPHIS STYRACI*

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In eusocial aphids, soldiers and normal nymphs are, although genetically identical due to parthenogenesis, remarkably different in their morphology, behavior, and