AN ANALYSIS OF THE DISTRIBUTION PATTERN OF POLYPS OF AURELIA AURITA

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There found a variety of invertebrate species which adhere to the bottom of the floating bridges around the Kagoshima Bay area. Furthermore, the formation of the colony of Aurelia aurita polyps is observed on the surface of these invertebrates; in particular, many polyps were found on the shell of Mytilus edulis and on the bodies of Styela plicata. The distribution shows a random one through a year. Moreover, the population formation of the asexual reproduction of transplanted polyps were observed and analyzed in our laboratory. At the early stage, all four modes of the asexual reproduction of polyp show a concentrated pattern and the pattern was independent of inhabited circumstances, an amount of food, and temperature changes. The distribution pattern becomes random as the colony grows. From this fact it can be inferred that there exist some recognition and identification between polyps.

NEMATODE ASSEMBLAGE IN A SMALL COVE POLLUTED BY FISH FARMING.

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Fauna and population dynamics of the nematode assemblage was studied in the Tomoe Cove, Amakusa, where bottom water and sediment were polluted by the organic input from fish farming. Periodic sampling was carried out from June 1993 to June 1994, to investigate the seasonal change of the assemblage in response to the fluctuations of physico-chemical conditions of the bottom environment. The present report has dealt with a part of the results concerning species composition, abundance and distribution of the nematodes in the cove.

Diversity of the nematode fauna was low and 14 species have been distinguished for the present. Individual number of the nematodes was abundant at the station located near the floating cages for fish farming and facing on the mouth of the cove, more than 2800 ind./10 cm^2 throughout the year. Nematode density decreased in September when the total sulfide content increased and the RPD layer rose up to near or on the surface of the bottom sediment. Significant decrease of their number occurred at the station surrounded by the cages, 4 ind./10 cm^2 at lowest. Nematode species respectively showed a specific vertical distribution in the sediment.

AGE, GROWTH, MATURATION, AND PHENOMENON OF THE UPS-AND-DOWNS OF AURELIA AURITA.

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In Kagoshima Bay, ephyra emerges during January and March, metephyra emerges during February and April, and medusa does from late in February. By determining the age from the number of water vascular canal branches, it was found that the population consists of the biennial (1993) and new (1994) individuals. The population of these individuals' growth rapidly in the period of a rising water temperature-during March and June; the new individual becomes the same size mode as the biennial one after June. The degree of maturation by age indicates that the sixth-branched biennial reached its maturation in March, the fifth- branched biennial reached the maturation in April, and after May the fourth branched new individual reached the maturation and ejected planulae.

The ups-and-downs of Aurelia aurita disappears from the surface and moves in the bottom where the change of the salt concentration is less affected. The same result was also obtained by our Laboratory experiment. Thus it can be said that the main cause of the ups-and-downs in the salt content of sea water.

THE NUDIBRANCH, *GYMNODORIS NIGRICOLOR* BABA, PARASITIC WITH MARINE GOBIES.

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A short report on symbiosis between a nudibranch and a goby has been described (Williams Jr and Williams, 1986) from Okinawan water. Similar associations between the same nudibranch species and the same and other two species of gobies were confirmed in Oujima and Sesokojima islands, both off shore the Okinawajima island in 1993 and 1994. The adult nudibranchs, *Gymnodoris nigricolor* Baba were found abundant on the fins of the three species of gobies, *Amblyeleotris ogasawarensis*, *Ctenogobiops pomastictus* and *C. feroculus* simbiotic all with snapping shrimps.

Population densities were 1.8 nudibranchs / 15.4 gobies (per every $25m^2$) and 1 / 50 in Oujima and Sesokojima respectively. The nudibranchs attached to all kinds of fins of fishes. They fed on fin membranes usually and even on fin rays rarely in the laboratory. Under a laboratoey condition in a small container they attached even to the free living goby, *Fusigobius neophytus* ?. Glass tubes used as habitats for the fishes attracted the nudibranchs (5 / 7 and 4 / 5) suggesting the nudibranchs may be attracted to mucus secreted by fishes.

Spawnings by adult were observed in the laboratory. An egg mass consisted of about 700 single eggs (ca 150 μm in diameter) contained in an egg capsule (ca 180 μm). Hatching occured at about ten days from oviposition. Hatched veliger larvae bore a brown shell and paired eyes.

Feeding behavior of the nudibranch shown above revealed that this type of association seems to be parasitic rather than symbiotic.

RELATIONS BETWEEN THE PHASE MODALITY OF TIDAL RHYTHMS AND THE HABITAT IN INTERTIDAL AND ESTUARINE CRABS

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The larval release activity of intertidal and estuarine crabs is synchronized with the times of high tide. This study focussed on how the phase modality of these tidal rhythms is determined. Experimental animals were Hemigrapsus sanguineus inhabiting intertidal shores, Macrophthalmus japonicus, an inhabitant of the lower part of estuary, and Sesarma erythrodactylum inhabiting the upper part of estuary. The tidal rhythm of H. sanguineus coincided with the semidiurnal unequality of tides, showing a UNIMODAL phase IN APPEARANCE. The pattern of the tidal rhythm of M. japonicus showed a BIMODAL phase, but that of S. erythrodactylum was a UNIMODAL phase, and larval release occurred only at night. Comparison of these activity patterns with the habitat of each species suggested that the phase modality of tidal rhythms is strongly correlated to tidal conditions in each habitat.

BEHAVIORAL ANALYSIS ON TRACKS OF CELL LOCOMOTION OF THE HELIOZOAN Actinophrys sol

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Motile behavior of heliozoan cells is in most cases mediated by shortening and re-elongation of axopodia which carry out various kinds of activities such as locomotion, food capture and cytokinesis.

In this study, we made an analysis of tracks of the heliozoan Actinophrys sol to clarify the mechanism of mutual recognition among cells during the locomotory behavior. The tracks of organisms were monitored by a video camera interfaced to a personal computer. A software was made to detect positions of the cells, to follow their tracks for a predefined period of time, and to calculate direction and speed of movement for further mathematical analysis.

PHOTOTAXIS IN FUNGIID CORALS

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This is the first demonstration that some fungiid corals (Scleractinia, Fungiidae) perform phototaxis. Positive phototaxis was observed in free-living fungiid corals, such as discs of Fungia that had detached from the stalks via asexual reproduction and Diaseris. Many species with different sizes moved toward a light. On the sand substrate, small and active coral D. distorta moved faster (max. speed of 1cm h^{-1}) than other species tested. Soft tissues in a shaded portion of a coral swell during movement. The mechanism of movement, however, was not elucidated. These corals have symbiotic unicellular alga, but their behavior was not affected by the treatment of DCMU (5μM), a specific inhibitor of photosynthesis. Corals moved even on a glass plate and climbed up a gentle slope. It is suggested that phototaxis in fungiid corals must be an important talent to escape from unfavorable shaded sites such as under rocks.

RELATION OF EMERGENCE OF THE MUDSKIPPER ON THE MUDFLAT TO TIDAL CYCLE AND TEMPERATURE.

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The mudskipper, *Periophthalmus modestus* is amphibious fish and inhabits tideland. In summer, this fish feed and court on the mud flat at ebb tides.

We investigated the influences of tidal cycles and temperature on the number of emergence and the number of crawling fish onto the tidal flat at ebb tides in two different populations of the mudskipper at Kasaoka and Wakayama.

In both populations, the number of emergence and the number of crawling fish onto the tidal flat in the mudskipper decreased in association with the duration of emersion of the mudflat. This tendency was clear in summer, especially at Kasaoka. Temperature does not seem to be a direct factor to induce these behaviors, but dryness of mudflat due to high temperature is the important factor. The dryness of mudflat becomes greater in association with the duration of emersion of mudflat. To avoid desiccation of the epidermis even though the mudskipper needs skin respiration. They seem to retreat into the mud in a hole full of sea water. Thus, population at Kasaoka, where desiccation of the mudflat is severer seems to have shown a more distinct pattern in retreating into the mud.

THE EFFECTS OF FOOD DEPRIVATION, FOOD AND WATER DEPRIVATION AND NON-STARVATION ON THE FRACTAL FEEDING BEHAVIOR IN Drosophila

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The difference in the effects of non-starvation, food andwater deprivation, food deprivation on the feeding behavior was clearly observed in the dwelling time distribution on food. The order of effects generally increases in the same manner, but fractal dimensions were almost unchanged. Autocorrelation in the dwelling time under the food and water deprivation condition was higher than those under the other two conditions. Locomotor velocity, cumulative dwelling time and displacement were analyzed quantitatively and compared each other under the above three conditions.

CIRCADIAN LOCOMOTOR ACTIVITY RHYTHMS IN THE AFRICAN CLAWED FROGS: INFLUENCE OF AGING AND BLINDING.

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We recorded locomotor activity rhythms in the African clawed frog (*Xenopus laevis*) under light-dark cycles (LD 12:12) and in constant darkness (DD) and constant light (LL).

Under LD12:12, tadpoles, youngs just after metamorphosis and adults showed nocturnal behavior. The L/D ratio in the amount of activity for adults was significantly higher than those for tadpoles and youngs.In adults, locomotor activity rhythms in both intact and blinded frogs were entrained to LD cycles. Direct response to light onset was observed at high intensity of light in blinded frogs. Under DD, free-running periods of locomotor activity rhythms in blinded frogs were significantly shorter than those in intact frogs. Under LL, however, the free-running periods between intact and blinded frogs were not significantly different.

In conclusion, (1) the L/D ratio in the amount of activity increases during the course of aging, (2) there is a circadian oscillator somewhere outside the eye, and (3) the eyes are involved in the circadian oscillator system of frogs.

SOCIAL BEHAVIOR AND SEMIOCHEMICALS IN THE JAPANESE, *Apis cerana japonica* Rad. AND EUROPEAN HONEYBEE, *Apis mellifera* L.

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In 1877, the European honeybee (*Am*) was introduced into Japan. Since then, the Japanese honeybee (*Acj*) has been obliged to share the same habitat. Scientific studies of *Am* have been conducted worldwide and the resulting literature is extensive. On the other hand, little is known about the chemical ecology of *Acj*. In this paper, the role played by semiochemicals in *Acj* social behavior was investigated, and the results were compared with *Am*.

Social behavior such as alarm behavior, aggregation behavior, and recognition are controlled by semiochemicals from the sting apparatus, Nasonov gland, feet, and cuticles. Extracts from the sting apparatus, Nasonov gland, tarsi, and body surface of both species were analyzed by GLC and GC/MS. Nasonov gland extracts induced aggregation behavior in both species, but the GLC profiles of the extracts from *Am* and *Acj* were quite different. Similar GLC profiles were obtained with sting apparatus extracts, but alarm behavior was different between the two species. *Am* hydrocarbon profiles were more complicated than *Acj* profiles. Differences between the species might be due to differences in semiochemicals, sensitivity, and signal processing in the CNS.

LOCOMOTOR ACTIVITY RHYTHMS IN WHITE AND EYELESS STRAINS OF THE AXOLOTL

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We recorded locomotor activity rhythms in white and eyeless strains of the axolotl (*Ambystoma mexicanum*) and blinded animals in the white strain under light-dark cycles (LD 12:12) of different light intensities (10 and 500 lux) and constant dim light (1 lux).

All males in the white strain were entrained to L-D cycles and showed nocturnal activity. Females in the white strain showed a similar tendency with a few non-entrained animals. Locomotor activity rhythms in the eyeless strain were less clear than those in the white strain. Entrained animals in the eyeless strain were diurnal under L-D cycles of 10 lux and nocturnal under L-D cycles of 500 lux. Blinded animals were entrained to L-D cycles of 10 lux but could not be entrained to L-D cycles of 500 lux. Thus, the axolotl has an extra-ocular photoreceptor(s), but the extra-ocular photoreceptor seems to less functional than the eyes. Free-running rhythms were observed in the eyeless strain and in the blinded animals of the white strain and there were no differences in the free-running periods among groups. This indicates that the circadian oscillator is somewhere outside the eye.

INDISTINGUISHABLE ACOUSTICAL PROPERTIES OF TWO SONG BEHAVIORS DIFFERING IN CONTEXTS.

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Song behaviors in the male Bengalese finch *Lonchura striata* can be classified into two types, depending on the behavioral contexts. One is undirected song behavior (US) addressing no particular objects, and the other is directed song behavior (DS) produced during courtship. Although the US and DS sound similar to human ears, they differ in testosterone-dependency (Ikeda *et al.* 1993). We analyzed and compared acoustical properties of US and DS in order to examine whether they are acoustically distinguishable.

Analysis using a sound spectrograph indicated that US and DS had a basic structure of phrase (song unit) in common, but US was significantly more rigid than DS with respect to stereotypy of temporal pattern, stability of sequence and so on. ***Sound pressure level*** that was measured at 10 m away from a singing subject did not significantly differ between US and DS.

To test whether conspecific birds can discriminate between US and DS, we observed ***female solicitation displays*** in response to playback of US and DS. There was no significant difference in the females' responses to US and DS.

These results suggest that US and DS are acoustically indistinguishable. Although US and DS differ in the behavioral context and the hormonal regulation, they may share a common song production mechanism.

LATITUDINAL COMPARATIVE STUDY OF SEXUAL REPRODUCTION OF *Oulastrea crispata* IN JAPAN.

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We compared the development of gonads in *O. crispata* from Sesoko, Okinawa (26°38'N), Aitsu, Kyushu, Shirahama, Kii peninsula, Ushimado, Seto inland sea, Shimoda, Izu peninsula and Uchiura, Noto peninsula (37°18'N) within use hystlogical samples collected in each month from March in 1993 to February in 1994. We could identify mature gonads from July to September from Sesoko. However, mature gonads were observed only in July and/or August in other northern places. Living colonies were transplanted from Shirahama and Uchiura to Sesoko on the fall of 1992 and 1993. We observed spawning behavior of these specimens in the following summer. The specimens collected at Sesoko continually spawned eggs at an interval of several days, from July to October, regardless of the lunar phase. In July, the spawning was firstly observed after attaining 29 °C in sea water temperature. The corals from Shirahama and Uchiura have started spawning of eggs and sperm in middle May when the sea water temperature was about 23 °C at Sesoko.

ENTRAINMENT PATTERN OF LOCOMOTOR ACTIVITY RHYTHMS TO LIGHT-DARK CYCLES IN THE JAPANESE WOOD MOUSE

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In the activity rhythms of Japanese wood mice, we found much difference in the phase angle difference for activity onset between animals under a long photoperiod and under a short photoperiod. In order to investigate the relation between the duration of dark phase and phase angle difference, we lengthened the dark phase by advancing light-off in the long photoperiod group and shortened the dark phase by delaying ligt-off in the short photoperiod group. In both cases, activity onset and offset did not change much, so that the phase angle difference for activity onset depended on the duration of dark phase. But when we lengthened the dark phase by delaying light-on by 2 hours, the onset of activity scarcely changed, although the offset of activity somewhat delayed. So, the phase angle difference for activity onset seems to be influenced not only by the duration of dark phase, but also by the direction of change of dark phase. When we delayed the whole dark phase, the activity phase shifted according to the shift of dark phase. Therefore, the timing of activity onset appears to be determined by both signals of light-on and light-off in the Japanese wood mouse.

ABSENCES OF WATER SURFACE AND FOOD AFFECT LONGEVITY AND REPRODUCTION IN WATER STRIDERS, AQUARIUS PALUDUM AND GERRIS LATIABDOMINIS.

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Overwintered adults collected in spring were transferred under one of the following three conditions after reared for 13-20 days on water surface with sufficient food: (A) on water surface and supplied with sufficient food; (B) on water surface and with no food; (C) on wet paper and with no food. Adults in the three groups were reared under 15.5L-8.5D and at 20±2°C. In the both species, females of B- and C-groups survived for 7.1-10.7 days on the average after the reproductive period of 4.4-6.1 days, while females of A-group continued to lay eggs for 9.7 (A. paludum) or 14.1 days (G. latiabdominis) and died. There were no significant differences in the longevity of females and males among the three groups in G. latiabdominis. In A. paludum, both sexes of B- or C-group survived longer than those of A-group. There were no significant differences in the fecundity between B- (16.4 eggs per 1 female: mean) and C- (20.9) groups in G. latiabdominis. Females in B-group (59.3) tended to be more fecund than those in C-group (42.1) in A. paludum. Even overwintered adults, which reproduce actively seem to have some tolerance to absence of water surface and accompanying starvation.

THE CHANGE OF THE HABITAT WATER QUALITY AND INHABITATION OF FRESHWATER SPONGES IN THE RIVER YOKOTONE.

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The distribution of freshwater sponge species can be correlated with physicochemical properties of the habitat water and the individual tolerance of the species to those factors. The River Yokotone that connect the Lake Kasumigaura to the River Tone was the water area abundant in freshwater sponge species. Till the middle of 1980's seven species of fresh water sponges distributed there, and number of individuals and size were large. Recently, the number of species and individuals in this area has rapidly decreased, and large size sponges could not find. The reason is considered that the water pollution of this area has affected sexual and/or asexual reproduction.
Compared with the water area of the River Shintone that is inlet of the Lake Kasumigaura, both number and species were much abundant. Compared with the water quality on pH, COD, DO, turbidity, silicon, nitrogen and phosphoric acid of both water bodies, special differences not distinguished. The River Yokotone is a fishing place of Carassius, and there had lived many Macrobrachium and Cipangopaludina till 1980's. Recently the fauna component has extremely changed. The larva of Chironomus and Pectinatella have replaced Cipangopaludina and Macrobranchiuum.
When gemmules cultured in filtrate habitat water of Yokotone they could hatch 100%, and developed normally. It is considered that the change of water condition in freshwater sponges is more affected by the pollution of delicate eutrophication than changes of physicochemical component of habitat water.

LIFE CYCLE ADAPTATION IN *AELIA FIEBERI* IN RELATION TO HOST PLANTS

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Many true bugs (Insecta, Heteroptera) reproduce under long-day conditions whereas enter adult diapause under short-day conditions. The critical daylength for these photoperiodic responses is between 13 and 14 hr in many species in Japan. However, *Aelia fieberi* Scott, which feeds on seeds of gramineous grasses, has a longer critical daylength of about 14.5 hr for the induction of adult diapause. Seeds of gramineous grasses exist in the field from spring to autumn, although some of them were suitable and the others were unsuitable as food for the development of *Aelia fieberi*. The suitable food disappears in August, and therefore *Aelia fieberi* has a longer critical daylength and enters adult diapause as early as in August.

DOWNSTREAM DIFFERENCES IN LIFE CYCLES OF *MICRASEMA QUADRILOBA*.

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A species of stream-living caddisflies, *Micrasema quadriloba*, have a one-year life cycle, and the timing of life cycle events is highly synchronous with emergence occurring in spring at Takami River, Nara Pref.

We studied the differences in development and growth of this species on five successive downstream stations and a tributary station of the Takami-River to investigate the influence of water temperature on the life history. Samples were taken once a month from May 1993 to June 1994.

First instar larvae appeared in early June, and third instar larvae in late July. The development from the first to the third instar at higher stations was slower than that at lower stations. In contrast to the preceding instars, the occurrence of the fourth instar larvae (mostly in October) was earlier at higher stations. But, after the molting, the development accelerated more at lower stations. Most of the larvae overwintered in the state of fifth instar, and grew constantly during winter at all stations except the highest one. The size of full-grown larvae based on their cases in March was larger in relation to the downward length of the river.

These results suggest that high water temperature over some critical point in summer inhibits the development of larvae, but higher temperature in the other seasons accelerates the development and growth of this species.