Phenology of brown alga *Coilodesme japonica* (Phaeophyta, Dictyosiphonales) with respect to the host-specificity along Muroran coast, North Pacific Ocean, Japan

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*Coilodesme japonica* – a brown temperate algal species grows epiphytically on three marine algal host species namely *Cystosiera hakodatensis*, *Sargassum confusum* and *Dictyopteris divaricata*. The distribution pattern, phenology and host-specificity in the field was studied. Out of the 3 hosts, *C. hakodatensis* was most favoured host by *C. japonica* (100% by May) followed by *S. confusum*. The least favourite host was *D. divaricata* (only 5% were epiphytized). The rhizoidal portion was less epiphytized in both the cases. Maximum number of *C. japonica* thalli and biomass were found on the size class 3 and 4. Host surface, age and biochemistry play important role in the *C. japonica* distribution and biomass colonization.

The role of epiphytic plants in the marine community, their distribution and their effects on the host plants were well documented. The epiphytes affect their host plants by several ways such as, they suppress the host plant growth. Reduced photosynthesis and reproduction rate of the host was also reported due to heavy epiphytism. On the other hand, several researchers suggested that the presence of epiphytes reduce the herbivory of the host plant. The genus *Coilodesme* (Class: Phaeophyceae, Order: Dictyosiphonales, Family: Coilodesmacea), predominantly grows epiphytically on several host species, and its geographical distribution is restricted to temperate and subtropical seas of the Northern hemisphere. *Coilodesme japonica* Yamada, a spring annual is one of the obligatory epiphyte that grows mainly on brown macroalga *Cystosiera hakodatensis* (Yendo) Fensholt. Other two hosts preferred are brown macroalgae namely *Saragassum confusum* C. Ag. and *Dictypteris divaricata* (Okam) Okamura. The study was particularly undertaken to study the distribution, biomass and phenology of *C. japonica* in nature and its preference to any particular host species.

**Materials and Methods**

Samples of *C. japonica* along with the three host species were collected from the intertidal zone and tide pools at Charatsunai, near the Institute of Algological Research, Muroran, Hokkaido (latitude: 42° 19’ N; longitude 141° 50’ E), at monthly intervals from February to July in the years 1991 and 1992. For observation purpose, one whole plant of *C. hakodatensis* (TCH) was sampled from 5 different tide pools. In the intertidal zone *C. hakodatensis* (ICH) and *Sargassum confusum* C. Ag. (ISC) were collected from randomly placed 1 m² quadrant (n = 5). Only one plant from each quadrant was collected because of the large size of the host plant. In the case of *Dictyopteris divaricata* growing in the intertidal zone (IDD) 5 plants from randomly placed 0.25 m² quadrants (n = 5) were collected. Numbers of epiphytized plants in all the types were recorded. Once brought to the laboratory, both *Sargassum* and *Cystoseira* plants were divided every after 15 cm and designated as class 0, 1, 2 (0 = 15 cm, 1 = 30 cm length, etc.) starting from the rhizoidal portion. Epiphytes other than *Coilodesme* were recorded just for their presence. Number of epiphytic *Coilodesme* thalli was counted on each size class and length of each thalli was measured and recorded. After separating the host and epiphytes, both were dried in an oven at 120°C for 24 h. The biomass of
Coilodesme per class was estimated as mg g⁻¹ dry weight per size class of the host plant. Statistical analysis was done using $\chi^2$ test.

Results and Discussion

*Coilodesme japonica* is a spring-summer annual growing from February till late July in the North-Pacific Ocean. Among *Dictyopteris divericata* plants, very few thalli were epiphytized throughout the season (5%), hence further studies included only *Cystosiera* and *Sargassum* (ICH, TCH and ISC). Almost all ISC, ICH and TCH plants were found epiphytized (80-100%). Young thalli of *C. japonica* start appearing from March and occasionally observed in February. Average growth of *C. japonica* in terms of length is shown in Fig. 1. In February, the thalli were microscopic. The growing pattern in all observation areas was approximately similar. Maximum growth up to 30-40 cm is achieved by June (summer). The reproductive bodies (unilocular zoosporangia) were observed growing in the subcortical cells of the macrothallus from May to July. Although plants in the intertidal region were matured earlier, in tide pools they could be collected until late July (Fig. 1). By this time, the intertidal thalli were mostly declined in number. Maturation of *C. japonica* thalli is directly proportionate to the length (Fig. 1). About 80-90% of thalli were reproductive at average height of 20-25 cm.

*Coilodesme japonica* thalli were absent on ISC in February and were rarely observed on any of the size class in March. The rhizoidal portion of *Sargassum confusum* was heavily epiphytized by several other algae like *Ulva*, *Polysiphonia*, and occasionally *Alaria* sporophytes. Maximum epiphytism in terms of number of thalli per size class was observed on size class 3, 4 and 5 in May and June (Fig. 2). Thalli were absent from apical portion and were mostly present on lower portion of the laterals. The biomass of epiphytes was maximum in June on the size class 3 (Fig. 3). The thalli were absent in July.

Compared to *Sargassum; Cystoseira* plants did not serve much as a host to other algal species. Apart from diatoms, and few *Rhodomela* (red alga) germ-lings on the rhizoidal portion, other algae were absent. The epiphytization begins in February, when number of *C. japonica* thalli were less and microscopic. The thalli were mostly found on class 0 or 1 and 2. As the host plant grows, this changes to upper size classes. In general, the total number of per host plant (in both ICH and TCH) increased from April onwards and remained relatively constant through May and June. In the intertidal areas, sudden increase in the number and of *C. japonica* was observed (Fig. 3), which declined in July. In tide pools, the thalli were still present and peak epiphytization was observed in July (Fig. 4).

![Fig. 1—Phenology of Coilodesme japonica – growth and reproduction](image-url)
Although *Coilodesme japonica* grows on three different host species, its favourite host is *C. hakodatensis*. *Dictyopteris* is least preferred. In the intertidal zone both *S. confusum* and *C. hakodatensis* showed earlier decline in epiphytic plants than the tide pool *C. hakodatensis*. The tide pool region provides safer shelter to the marine organisms than the intertidal zone and thus the steady growth can be observed. On the other hand, the intertidal zone has higher wave action due to which the nutrient contents are higher. The exposure time in the intertidal area is higher than tide pools and thus temperatures are different in these localities. This explains sudden escalation in growth from the intertidal zone.

The population structure of epiphyte is linked to the availability of host substratum for colonization\(^9,10\). *Sargassum* and *Cystoseira* plants are present throughout the year, that are only in the form of rhizoidal crust. Fresh laterals start sprouting towards February end. *Coilodesme japonica* plantlets were observed growing at the end of February. In February, very few *C. japonica* thalli were found in the field and gradually increased from March onwards. In Feb-March months the biomass was negligible. Both the host species achieve their maximum growth in early summer (April to June) and at the same time heavy epiphytization was also observed. In Spain also, *Cystoseira baccata* is highly epiphytized in summer at
Steady growth of *Coilodesme japonica* in the tide pools may be attributed to the protection provided by the tide pools. In *Ascophyllum nodosum*, the spore settlement of *Polysiphonia lanosa* on the sheltered plants was higher than on plants in the exposed area. In *Sargassum confusum* the size class 0 did not show any *C. japonica* epiphytes. This may be due to the older portions are subjected to heavy epiphytization, thus the competition for settlement is more. In the older portions, the defence mechanism is less. As observed in the present study, many other species also grow as epiphytes on the older portions.

The host specificity of the marine epiphytes may also have a chemical or physical basis. Hosts produce some chemical substances or also offer particular surface characteristics required by the epiphytes. The surface of the host may provide a definite set of ecological conditions available for the epiphytic spore settlement. *Coilodesme japonica* growth was less on *Dictyopteris divericata* than the other two species. This may be due to the surface of *D. divericata* has a leathery surface compared to smooth surfaces of *Cystoseira* or *Sargassum* thalli making the penetration difficult. Steinberg reported that the cell wall of *Dictyopteris* is tougher than that of *Cystoseira*. *Dictyopteris* is also known to have toxic substances that make other algae difficult to colonize on this species. The distribution of *Coilodesme japonica* on its host species is not restricted only to the basal portion. *Coilodesme japonica* thalli are found attached all over the host thalli and grow vigorously. Therefore, some other dynamic mechanism might be involved in the attachment and growth of *Coilodesme japonica* thalli on host plants.

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**References**