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Marine Algae from the Cape of Iwai on the Pacific Coast of Northeastern Honshu, Japan

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Monthly collection of marine algae and sea grasses was carried out from the intertidal and subtidal zones at the Cape of Iwai on the Pacific coast of northeastern Honshu, Japan (38°49'N, 141°36'E) from February through December 2002. A total of 108 species of marine algae, 14 of which belong to Chlorophyta, 24 to Phaeophyta and 70 to Rhodophyta, and two species of sea grass were identified. Those appearance and maturation periods were shown in Fig. 1.

Taniguchi (1) classified the marine algae and sea grasses into the five life form groups, crustaceous algae, small annual algae, small perennial algae, large annual algae and large perennial algae. Process of the successions in subtidal zone was described as altering dominant life form groups of the four phases: pioneer, small annuals and crustaceous algae; early sere, crustaceous algae; late sere, small perennials; climax, large perennials. The season of nudation on reefs have an effect on a speed of the process associated with maturation periods of each life form group (1). The marine algae and sea grass collected from the Cape of Iwai were classified into those life form groups, and the maturation periods were observed. Sixty four small annuals as pioneer phase occurred, in which 17-20 species matured in spring. Among 32 species of small perennials as late seral phase, the maturation periods were mainly divided into the three seasons, spring such as *Analipus japonicus* and *Gloiopeltis furcata*, autumn such as *Dictyota dichotoma*, *Dilophus okamurae*, and *Calpopeltis affinis*, and year-round such as *Gelidium* and *Gracilaria*. Among large perennials as climax, the five fucoids species of *Hizikia fusiforme*, *Sargassum micracanthum*, *S. confusum*, *S. thunbergii*, and *S. yessoense* matured in summer, and the kelp *Eisenia bicyclis* did in autumn. No reproductive cells of 3 species of crustaceous algae was observed. Among 4 species of large perennials occurred, only sporophylls of *Undaria pinnatifida* was

	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
CHLOROPHYTA											
Ulotrichales											
1 ○ <i>Ulothrix flacca</i>											○
Ulvales											
2 ○ <i>Kornmannia leptoderma</i>											○ ○
3 ○ <i>Monostroma angicava</i>											○ M
4 ○ <i>Blidingia minima</i>											○ M ○ ○ ○ M
5 ○ <i>Enteromorpha intestinalis</i>											○ ○ ○ ○ ○
6 ○ <i>E. linza</i>											○ M M
7 ○ <i>Ulva pertusa</i>											○
Cladophorales											
8 ○ <i>Chaetomorpha moniligera</i>											○ ○ ○ ○ ○ ○ ○ ○
9 ○ <i>Cladophora opaca</i>											○ ○ ○ ○ ○
10 ○ <i>C. sakaii</i>											M ○ ○
Codiales											
11 ○ <i>Codium fragile</i>											M ○ ○ ○ ○
12 ▲ <i>C. hubbsii</i>											○ ○ ○ ○ ○ ○ ○
Bryopsidales											
13 ○ <i>Bryopsis plumosa</i>											○ ○ ○ ○ ○ ○ ○ ○ ○ ○
14 ○ <i>Derbesia marina</i>											○ ○ ○
PHAEOPHYTA											
Ralfsiales											
15 ● <i>Analipus japonicus</i>											U UP UP UP UP ○ ○ ○ ○ ○ ○ ○
Sphacelariales											
16 ○ <i>Sphacelaria rigidula</i>											○ ○
Dictyotales											
17 ● <i>Dictyota dichotoma</i>											○ ○ ⊕ ⊕ ⊕ ♀⊕ ⊕
18 ● <i>Dilophus okamurae</i>											○ ○ ○ ○ ○ ○ ⊕ ○ ○ ○
19 ● <i>Pachydictyon coriaceum</i>											○
20 ● <i>Spatoglossum pacificum</i>											○ ⊕
Chordariales											
21 ○ <i>Papenfussiella kuromo</i>											○ ○ ○
22 ○ <i>Elachista okamurae</i>											P P UP
23 ○ <i>Leathesia difformis</i>											○ ○ U ○ ○
Dictyosiphonales											
24 ● <i>Myelophycus simplex</i>											○ ○ ○
25 ○ <i>Punctaria latifolia</i>											UP UP UP ○
Scytosiphonales											
26 ○ <i>Colpomenia bullosa</i>											○ P ○
27 ○ <i>C. sinuosa</i>											○ P ○ ○ ○ ○
28 ○ <i>Scytosiphon lomentaria</i>											P P ○
Desmarestiales											
29 □ <i>Desmarestia liqulata</i>											○ ○
30 □ <i>D. viridis</i>											○ ○ ○ ○

FIG. 1. Appearance and maturation of marine algae and sea grasses collected from February to December 2002. M, thalli with reproductive cells; U, unilocular sporangia; P, plurilocular sporangia; ♂, male gametes; ♀, female gametes; ⊕, tetrasporangia; Symbols in front of species names represent the life forms of marine algae: ▲, crustacean algae; ○, small annual algae; ●, small perennial algae; □, large annual algae; ■, large perennial algae.

	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Laminariales											
31 □ <i>Undaria pinnatifida</i>			○	○	○	○	u	u			
32 ■ <i>Eisenia bicyclis</i>			○	○	○	○	○	u	u	u	○
33 □ <i>Laminaria japonica</i>						○					
Fucales											
34 ■ <i>Hizikia fusiformis</i>		○	○	○	○	♂♀	♀	♂	○	○	○
35 ■ <i>Sargassum confusum</i>		○	○	○		♂♀	○	○	○	○	○
36 ■ <i>S. micracanthum</i>					♂♀	♂♀	○	○	○	○	○
37 ■ <i>S. thunbergii</i>		○	○	○	♂	♂♀	♂♀	○	○	○	○
38 ■ <i>S. yezoense</i>		○	○	○	○	♂♀	♂	○	○	○	○
Rhodophyta											
Bangiiales											
39 ○ <i>Bangia atropurpurea</i>			♂♀	♂♀							
40 ○ <i>B. gloiopeltidicola</i>		○	♂♀								
41 ○ <i>Porphyra yezoensis</i>			♂♀	♀							
Nemaliales											
42 ○ <i>Nemalion vermiculare</i>						♂♀	♂♀				
Corallinales											
43 ● <i>Bossiella cretacea</i>		○	○	○	○		○	○	○	○	
44 ● <i>Corallina pilulifera</i>		○	○	○	○	○	○	○	○	○	
45 ▲ <i>Titanoderma tumidulum</i>			○			○	○		○		
Gelidiales											
46 ● <i>Gelidium divaricatum</i>		○	○	○	○		○	○			○
47 ● <i>G. elegans</i>		○	♀	♀	♀	♀	♀⊕	♀⊕	♀⊕	♀⊕	♀⊕
48 ● <i>Pterocladia capillacea</i>		○	○				⊕	○	♀⊕	○	
Bonnemaisoniales											
49 ○ <i>Bonnemaisonia hamifera</i>				○							
Gigartinales											
50 ● <i>Caulacanthus ustulatus</i>			○		○	○	⊕	○	○	⊕	○
51 ○ <i>Dumontia simplex</i>		⊕	⊕	⊕	⊕						○
52 ○ <i>Neodilsea yendoana</i>				○	○	♀	○	○	○	○	○
53 ○ <i>Pikea yoshizakii</i>			○		○						
54 ● <i>Gloiopeltis furcata</i>		○	○	○	♀⊕	♀⊕	♀⊕	⊕		○	○
55 ● <i>Chondracanthus intermedius</i>		○	○	○	○	○	○		♀		○
56 ● <i>Chondrus verrucosus</i>		♀⊕	⊕	⊕	⊕	⊕	⊕	♀⊕	♀⊕	♀⊕	♀⊕
57 ● <i>Mazzaella japonica</i>			♀	♀⊕	♀						
58 ● <i>Carpopeltis affinis</i>		○	○	○	○	○	⊕	♀⊕	⊕	♀	○
59 ● <i>C. prolifera</i>		○	○	○	○	○	⊕	⊕			○
60 ○ <i>Grateloupia elliptica</i>			○	○	○		○	○		○	○
61 ○ <i>G. filicina</i>			○					○		○	
62 ○ <i>G. imbricata</i>							♀⊕	♀⊕			
63 ○ <i>G. lanceolata</i>			○	○	○		⊕		♀	○	
64 ○ <i>G. livida</i>		⊕		○	○		♀	♀⊕	♀⊕	⊕	⊕
65 ○ <i>G. turuturu</i>							♀		○	○	♀⊕
66 ▲ <i>Peyssonnelia caulifera</i>				○							
67 ● <i>Ahnfeltiopsis flabelliformis</i>		○	○	○	○	○	○	○	♀	♀	♀
68 ● <i>A. paradoxa</i>		♀	♀	♀	♀	♀	○	♀	♀	♀	♀

Fig. 1. continued

	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
69 ● <i>Plocamium recurvatum</i>	○	○	○	○	○	○	○	○	○	○	○
70 ● <i>P. telfairiae</i>	○	○	○	○	○	○	○	○	○	○	○
71 ○ <i>Portieria japonica</i>		○	○			○					
72 ○ <i>Schizyenia dubyi</i>	○					♀					
Gracilariales											
73 ○ <i>Gracilaria vermiculophylla</i>		⊕	○	♂	♂⊕	♂♀⊕	♂♀⊕	♂♀⊕	♀	♀⊕	♀
Rhodymeniales											
74 ○ <i>Champia parvula</i>	○		○	○	○	○	♀	♀	○	♀	○
75 ● <i>Lomentaria catenata</i>	⊕	⊕		○		○	♀⊕	⊕	⊕		⊕
76 ● <i>L. hakodatensis</i>	○	⊕	○	⊕	♀⊕	○	♀⊕	♀⊕	♀⊕	♀	○
Ceramiales											
77 ○ <i>Antithamnion cristirhizophorum</i>									○		○
78 ○ <i>A. nipponicum</i>	○	○	○	○	○				○	○	○
79 ○ <i>Campylaeophora hypnaeoides</i>		○	○	○	○	○	⊕	○	○	○	
80 ○ <i>Ceramium aduncum</i>							⊕	♀	♀	⊕	○
81 ○ <i>C. japonicum</i>	○	⊕	⊕	⊕	♀⊕		♀⊕	⊕	○	♀⊕	♀⊕
82 ○ <i>C. kondoii</i>	⊕	⊕	⊕	♀	♀⊕	⊕	♀⊕	♀⊕	○	♀⊕	○
83 ○ <i>Griffithsia japonica</i>	⊕	⊕	⊕	⊕		⊕	♂	⊕		⊕	♀
84 ○ <i>Herpochondria elegans</i>	⊕	♀⊕	⊕	○			○		○		
85 ○ <i>Pleonosporium segawae</i>	○	○	○	⊕							
86 ○ <i>Pterothamnion yezoense</i>			⊕								
87 ○ <i>Reinboldiella schmitziana</i>				○			○				
88 ○ <i>Heterosiphonia japonica</i>	♀⊕	⊕	○	○	♂⊕				⊕	⊕	
89 ○ <i>H. pulchra</i>	⊕	⊕	⊕	⊕	⊕	⊕		⊕	⊕	⊕	○
90 ○ <i>Acrosorium flabellatum</i>		○									
91 ● <i>A. polyneurum</i>	⊕	⊕	⊕	⊕	⊕	⊕	⊕	○	○	⊕	○
92 ○ <i>A. venulosum</i>	○	○	○	○	○	○	○	○	○		
93 ○ <i>A. yendoii</i>	○	○	○	○	○	○	○		○	○	⊕
94 ○ <i>Branchioglossum nanum</i>	○	♀									
95 ○ <i>Delesseria serrulata</i>		⊕	⊕	⊕							
96 ○ <i>Erythroglossum minimum</i>	⊕	⊕	○	○		○					♀
97 ○ <i>Chondria crassicaulis</i>	○	○	○	○	○	○	○	○	⊕	⊕	○
98 ○ <i>C. dasyphylla</i>						○	⊕	○	⊕		
99 ○ <i>Herposiphonia fissidentoides</i>		○					○	○			
100 ● <i>Laurencia intermedia</i>								⊕			
101 ● <i>L. nipponica</i>		○									
102 ● <i>L. okamurae</i>					○	○	♀	⊕	○		
103 ● <i>Neorhodomela aculeata</i>	○	○	○	⊕	♀	○	⊕	○	○	○	○
104 ○ <i>Polysiphonia japonica</i>		♀⊕	⊕	⊕	♂♀⊕	♂♀⊕	♂♀⊕	♀⊕	♂♀⊕	♂♀⊕	♀⊕
105 ○ <i>P. senticulosa</i>		⊕	⊕	♀⊕							
106 ○ <i>P. yendoii</i>					♀	⊕	♀⊕	♀⊕	♀⊕	♀⊕	♂⊕
107 ● <i>Symphyclocladia latiuscula</i>	○	○	○	○	○	○	○	○	⊕	⊕	○
108 ● <i>S. marchantioides</i>	○	⊕	⊕						⊕	○	○
PHANEROPHYTA											
Najadales											
109 <i>Phyllospadix iwatensis</i>	○	○	○	○	○	○	○	○	○	○	○
110 <i>Zostera marina</i>		○	○	○	○	○	○	○	○	○	○

FIG. 1. continued

observed from spring to summer.

The floral index of I/H have been used to evaluate whether marine algal flora affect warm or cold current system (2). There, 'I' indicates the number of species with isomorphic alternation of generations and lacking gametophytic generation in both Chlorophyta and Phaeophyta. 'H' indicates the number of species with heteromorphic alternation of generations. Along the Pacific coast of northern Tohoku from Oshika Peninsula, where are located in subarctic floral zone (3), I/H values were 1.22 in Shimokita Peninsula (4), 1.35 in Miyako (5), 1.41 in Kitakami (6), 1.9 in Ogatsu (7) and 1.18 in Tomarihama. The value in the Cape of Iwai was 1.38, belonging to subarctic floral zone typically.

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