

Identification guide of seaweeds on Japanese tsunami debris



Floating dock originated from Misawa Port and stranded to Oregon coast in 2012. Its surface was covered with abundant healthy seaweeds and benthic animals. Photographs by Oregon State University.

Since 2012 marine debris caused by the 2011 Great East Japan Earthquake and Tsunami has been arriving on Northeastern Pacific shores. Often healthy seaweeds (marine macroalgae) were attached to them, which may become introduced to the Northwestern Pacific coasts. To date, about 80 species have been identified on debris based on morphological characters, and about 50 of the larger forms have been genetic analyzed for confirmation. Since many of these species do not yet occur in the NE Pacific, their introduction and dispersal could cause considerable impacts to the ecosystem. To help prevent the introduction and possible invasion of these species, it is important that any new recruitment of these species is discovered so that measures can be taken to minimize their spread.

This identification guide provides information for morphologically identifying some of the most prominent species of seaweeds found on the marine debris.

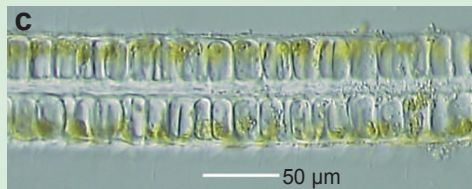
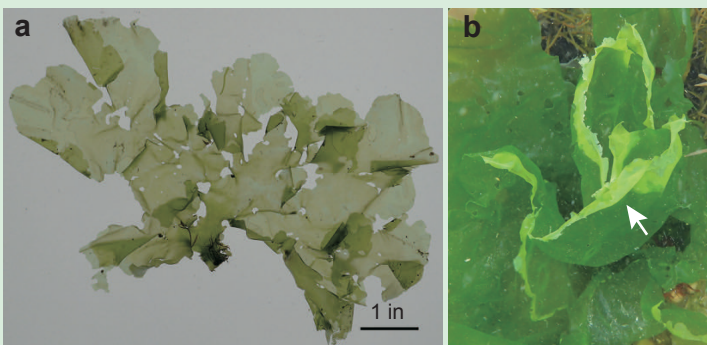
Representative seaweed species found on the Japanese tsunami debris along the Washington and Oregon coasts and identified by morphology and genetic analyses. The species shown in bold are described in this brochure.

Green algae: *Blidingia minima*, *Bryopsis plumosa*, *Chaetomorpha linum*, *Cladophora albida*, *Cladophora vagabunda*, *Codium fragile*, *Ulva compressa*, *Ulva lactuca*, *Ulva linza*, ***Ulva pertusa* (= *U. australis*)**, *Ulva prolifera*, *Ulva simplex*.

Brown algae: *Alaria crassifolia*, *Analipus japonicus*, *Costaria costata*, *Desmarestia japonica*, *Ectocarpus commensalis*, *Ectocarpus crouaniorum*, *Feldmannia irregularis*, *Feldmannia mitchelliae*, *Kuckuckia spinosa*, ***Mutimo cylindricus***, *Petalonia fascia*, *Petalonia zosterifolia*, *Petroderma maculiforme*, *Punctaria latifolia*, ***Saccharina japonica***, ***Scytosiphon gracilis***, *Scytosiphon lomentaria*, *Sphacelaria rigidula*, ***Undaria pinnatifida***.

Red algae: *Bangia fuscopurpurea* complex, *Ceramium cimbricum*, ***Chondrus giganteus***, ***Chondrus yendoi***, *Colaenema* sp., *Cryptopleura ruprechtiana*, *Grateloupia livida*, *Grateloupia turuturu*, *Neodilsea yendoana*, *Palmaria palmata* auct. japon., *Polysiphonia koreana*, *Polysiphonia morrowii*, ***Pyropia yezoensis***, ***Schizymenia dubyi***, *Tsunamiya transpacificica*.

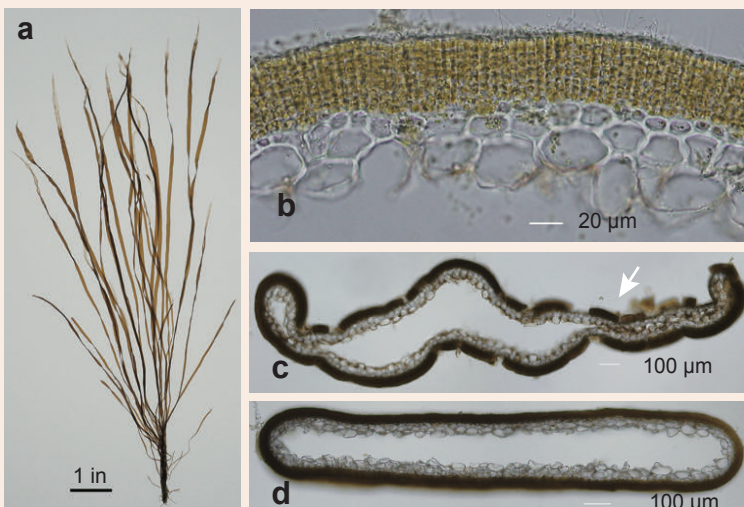
Ulva pertusa (= *U. australis*)



a, Habit of fresh thallus. **b**, Surface view of fertile thallus showing marginal fertile portions (arrow). **c**, Cross section of distromatic thallus.

Ulva pertusa (= *U. australis*) forms distromatic membranous thallus. The species resembles *U. lactuca*, but tends to have more perforation of thallus. Original distributional range of the species is Northwestern Pacific but the species has been introduced to wide ranges in the Pacific and Atlantic coasts. Recently the species was suggested to be synonymous to *U. australis* by genetic analysis.

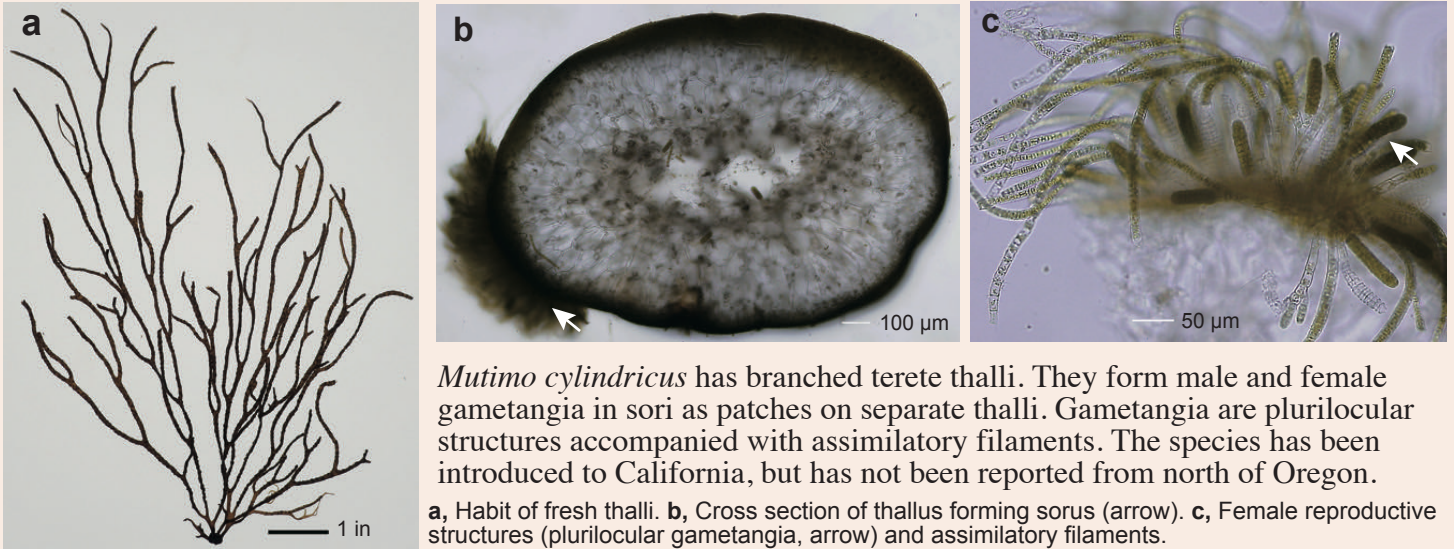
Scytosiphon gracilis



Scytosiphon gracilis forms gregarious, linear saccate thalli. The species resembles *Scytosiphon lomentaria*, but differs in having more flattened thalli without constrictions and forming plurilocular gametangia lacking paraphyses (ascocysts). The thalli are basically hollow, but may become partly solid. The original distributional range of the species is Northwestern Pacific Ocean, but the species has been introduced to Baja California and Chile.

a, Habit of fresh gregarious thallus. **b**, Cross section of fertile thallus forming plurilocular gametangia lacking paraphyses. **c**, Cross section of middle portion of thallus with fully fertile and emptied (arrow) gametangia. **d**, Cross section of lower part of thallus.

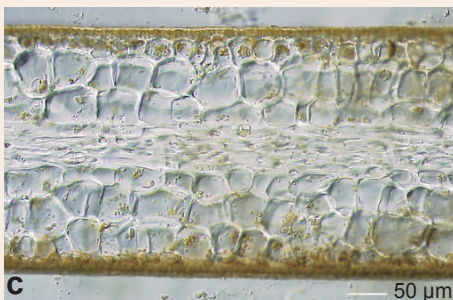
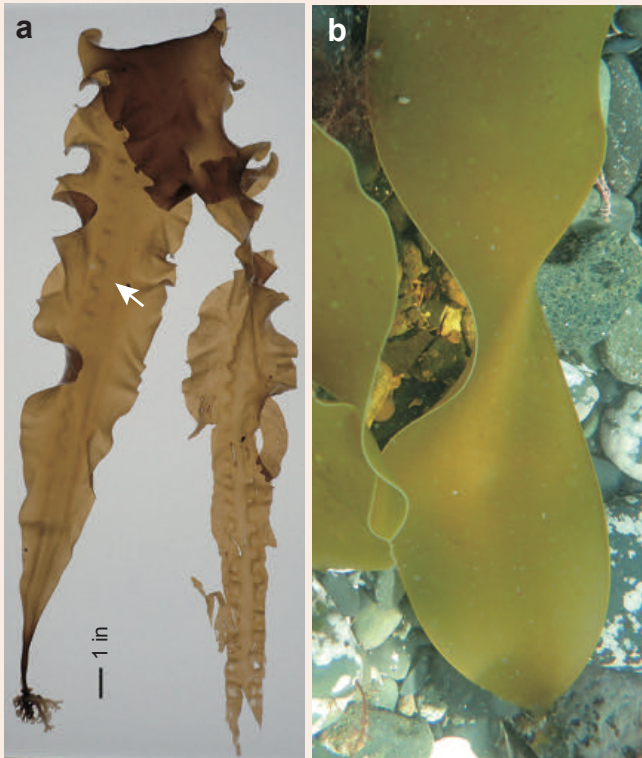
Mutimo cylindricus



Mutimo cylindricus has branched terete thalli. They form male and female gametangia in sori as patches on separate thalli. Gametangia are plurilocular structures accompanied with assimilatory filaments. The species has been introduced to California, but has not been reported from north of Oregon.

a, Habit of fresh thalli. **b**, Cross section of thallus forming sorus (arrow). **c**, Female reproductive structures (plurilocular gametangia, arrow) and assimilatory filaments.

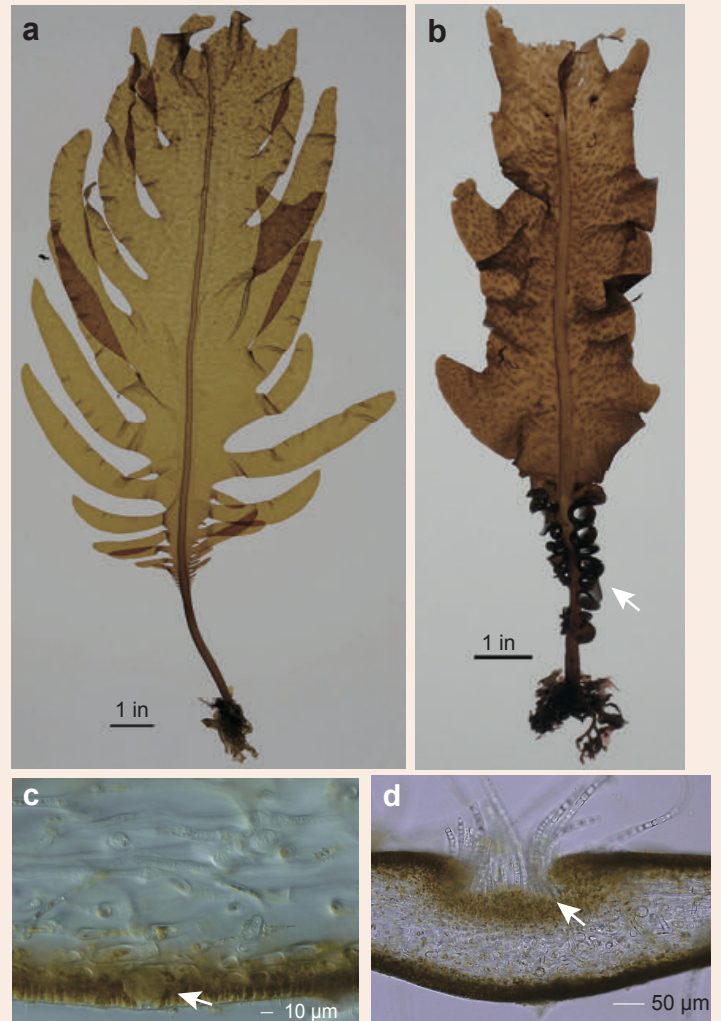
Saccharina japonica



a, Habit of fresh thallus. **b**, Underwater photograph of the thallus. **c**, Cross section of thallus.

Saccharina japonica (makonbu) is a basically biannual kelp that may exceed several meters in length. The blades have undulations when young, but later becomes smooth. This is an economically important species in NE Asia and widely cultivated in Japan, Korea and China. Externally, the young thalli resemble *S. latissima*, but when mature, the stipes are shorter and the blade base is narrower (more acute) than in most other *Saccharina* species occurring in the NE Pacific. The species has not been reported from eastern Pacific coasts.

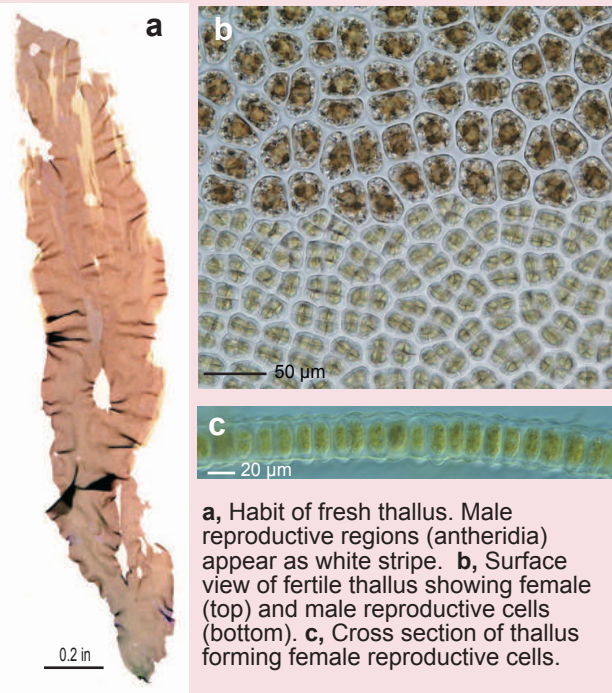
Undaria pinnatifida



Undaria pinnatifida (wakame) is an annual kelp having a distinct midrib and lobed membranous blade. When mature, sori are formed along the side of stipe and the portion becomes ruffled. The blade has gland cell and hair conceptacles on the surface. This is an economically important species in Northeastern Asia and widely cultivated in Japan, Korea and China. The species has been introduced worldwide including California, but has not been reported from north of Oregon.

a, Habit of young thallus. **b**, Habit of fertile thallus forming sori along the stipe (arrow). **c**, Cross section of blade forming gland cell (arrow) in the cortical layer. **d**, Cross section of blade forming hair conceptacle (arrow).

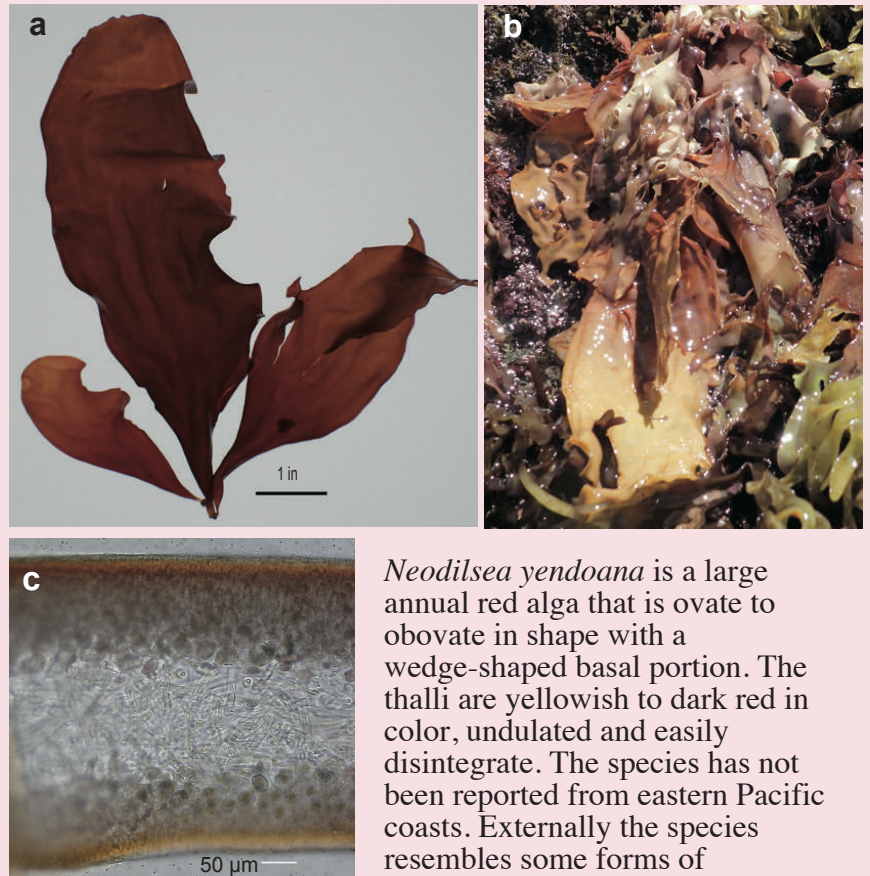
Pyropia yezoensis



a, Habit of fresh thallus. Male reproductive regions (antheridia) appear as white stripe. **b**, Surface view of fertile thallus showing female (top) and male reproductive cells (bottom). **c**, Cross section of thallus forming female reproductive cells.

Pyropia yezoensis (susabi-nori) is a monostramatic red alga forming male and female reproductive cells on the same thallus. The shape of the thalli is rather variable from lanceolate to obovoid. This is economically important species in Northeastern Asia and widely cultivated in Japan, Korea and China. The species has not recruited into natural areas of the Northeastern Pacific, but it has been commercially cultivated in Washington.

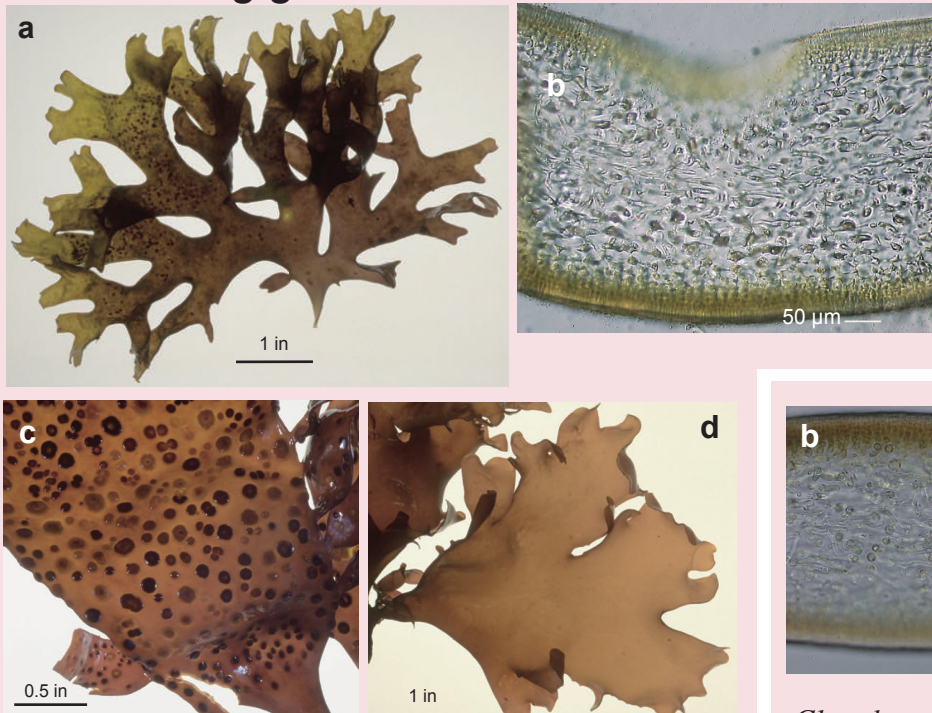
Neodilsea yendoana



a, Habit of fresh thalli. **b**, Habit of the thalli in the field. **c**, Cross section of thallus.

Neodilsea yendoana is a large annual red alga that is ovate to obovate in shape with a wedge-shaped basal portion. The thalli are yellowish to dark red in color, undulated and easily disintegrate. The species has not been reported from eastern Pacific coasts. Externally the species resembles some forms of Northeastern Pacific *Grateloupia doryphora* but the thalli of *Neodilsea* are somewhat bullate and not smooth as in *Grateloupia*.

Chondrus giganteus



a, Habit of fresh tetrasporopytic thallus. **b**, Cross section of thallus. **c**, Female gametophyte forming protruded cystocarps. **d**, Male gametophyte.

Chondrus giganteus has a thick, regularly dichotomously branched thallus with broadly rounded to highly lobed tips. Often thinner proliferous blades develop from the margin. The species has not been reported from Northeastern Pacific.

Chondrus yendoi



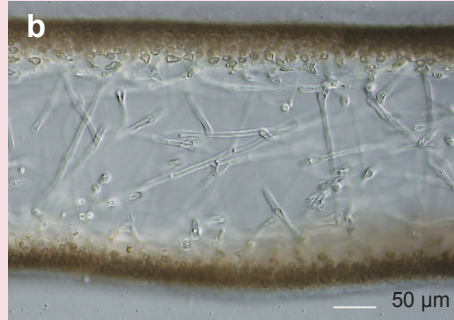
a, Habit of fresh thallus. **b**, Cross section of thallus.

Chondrus yendoi has gregarious tough, simple or irregularly branched thalli. The upright thalli are annual, but the basal system is perennial. The species resembles some forms of *Mazzaella parksii*, a species that occurs in the high intertidal of OR and WA, but it is about twice the size. In Alaska, it resembles several species, including *Mazzaella phyllocarpa*. The species has not yet been reported from Northeastern Pacific.

Grateloupia turuturu

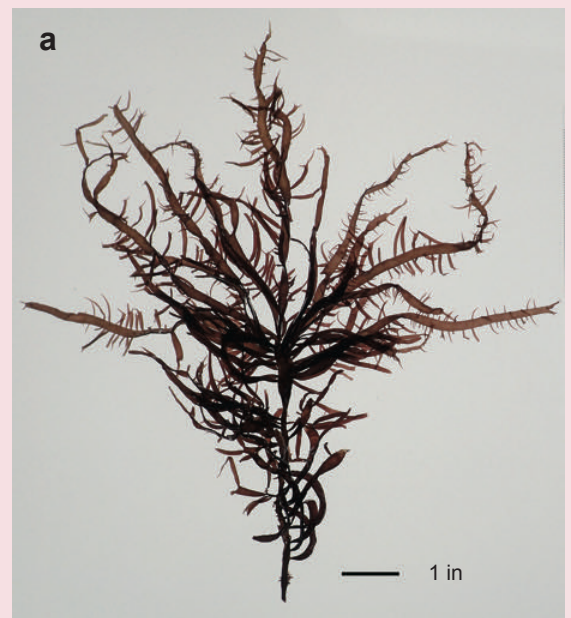


a, Habit of fresh thalli. **b**, Cross section of thallus.



Grateloupia turuturu is a red alga with an elliptical to lanceolate undulate thallus that is attached to the substratum by a short stipe and discoidal holdfast. The thallus has a characteristic slippery mucilagenous texture, and the medullary layer are filled with loosely intertwined filaments. Morphologically, the species resembles some Northeastern Pacific *Halymenia* species. The species has been introduced to many areas along both Pacific and Atlantic coasts. In the NE Pacific, it has been found in California, but it is not known from areas further north.

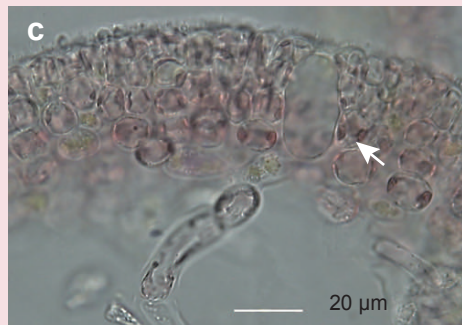
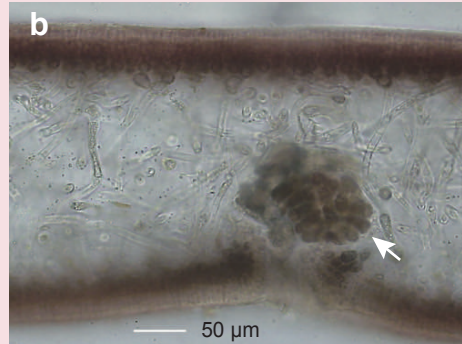
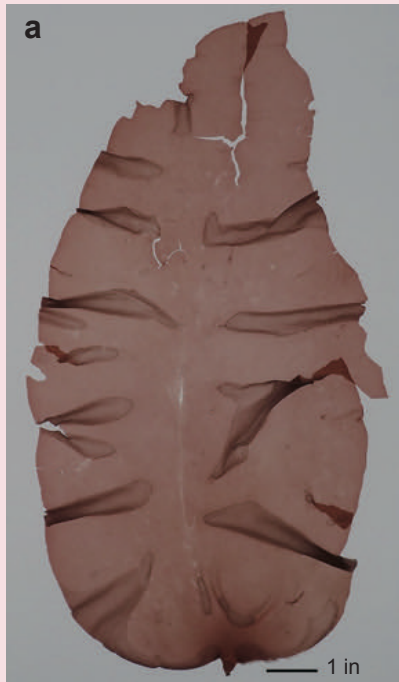
Grateloupia livida



a, Habit of fresh thallus. **b**, Cross section of thallus.

Grateloupia livida is a red alga having branched strap-shaped thalli with acute apices. The thalli are simple to one to two times branched, but highly variable in the external morphology. The thallus frequently forms adventitious branched on the edges. The inner medullary layer is filled with relatively densely intertwined filaments. The species is distributed in Northeastern Asia, and has not been reported from Northeastern Pacific.

Schizymenia dubyi



a, Habit of fresh thalli. **b**, Cross section of thallus. **c**, Female gametophyte forming cystocarps (arrow). **c**, Gland cell (arrow).

Schizymenia dubyi bears a short stipe and an ovate to broadly lanceolate foliose thallus that can be deeply split. The thallus is soft and slippery when young, but later becomes somewhat leathery. The inner medullary layer is filled with loosely intertwined filaments. Characteristic gland cells are formed in the cortical layer. The species has a heteromorphic life history alternating between an upright gametophyte and a crustose sporophyte. In female thalli, carposporophytes are thickly dispersed in the subcortex giving the thallia mottled appearance. The species has a relatively broad distributional range. However, in the Northeastern Pacific, it has only been found in California.

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