Codium fragile ssp. tomentosoides 简体中文 正體中文

System: Marine

Kingdom	Phylum	Class	Order	Family
Plantae	Chlorophyta	Chlorophyceae	Bryopsidales	Codiaceae

Common name dead man's fingers (English), green sea fingers (English), oyster thief (English), green fleece (English), Sputnik weed (English)

Synonym *Codium mucronatum* , var. *tomentosoides* van Goor

Similar species *Codium fragile*

Summary *Codium fragile* ssp. *tomentosoides* is an alga that has been introduced around the globe through shellfish aquaculture, recreational boating, and transport on ship hulls. The species fouls shellfish beds and causes a myriad of impacts on shellfish communities. This species also causes a nuisance to humans when it accumulates on beaches and rots producing a foul odor. *C. fragile* ssp. *tomentosoides* has been documented altering benthic communities and habitats causing serious environmental implications.

view this species on IUCN Red List

Species Description

Trowbridge (1999) reports that, \"*C. fragile* ssp. *tomentosoides* is a large branching species that can reach lengths of 1 metre and can weigh up to 3.5kg. The alga has up to ten orders of dichotomous branching; the cylindrical or terete branches are 3-10mm in diameter (Trowbridge 1998a). Fronds arise out of either a spongy, basal holdfast or a vaucherioid mat. Differentiated macroscopic thalli are formed by the interweaving of siphonous filaments that compose two regions of the thallus. The central region (medulla) is composed of long, colourless filaments (medullary filaments) that run longitudinally within the thallus and are densely intertwined. These vary in size among different subspecies but are typically 26-68 µm in diameter (Trowbridge 1998a). The peripheral region (cortex) is formed of cylindrical or club-shaped siphonous swellings called utricles that are tightly compressed together.\" Hubbard and Garbary (2002) state that the medullary filaments are surrounded by the utricles and that, \"The utricles, which are the swollen cortical tips of the filaments, typically have mucrons (i.e. colourless, spine-like to rounded terminal cell wall projections), colourless hairs and gametangia.\"

Notes
Trowbridge (1999) reports that, \"*C. fragile* is currently recognised as a single species with morphologically (i) homogeneous populations considered subspecies, and (ii) heterogeneous populations referred to just as *C. fragile*. Two of the six described subspecies are currently recognised as introduced and a third subspecies may be introduced (Silva 1955, 1957). One of these subspecies, ssp. *tomentosoides* is among the most invasive seaweeds in the world, with extensive trans-oceanic and inter-oceanic spread this century (reviewed by Carlton and Scanlon 1985, Ribera 1994, Verlaque 1994, Trowbridge 1995, 1998a, Trowbridge and Todd 1999).\"
Hubbard and Garbary (2002) add that, \"There are six described subspecies of *C. fragile*, the diagnostic features of which are the size and shape of the utricles, especially the mucron. Less reliable diagnostic characters include length and thickness of the thallus and frond flatness below dichotomies. Of the six subspecies of *C. fragile*, only ssp. *scandinavicum* Silva, ssp. *atlanticum* (Cotton) Silva and ssp. *tomentosoides* (Van Goor) Silva are considered invasive.\"
Begin and Scheibling (2003) believe that, \"The success of *C. fragile* ssp. *tomentosoides* in colder waters north of Cape Cod, in regions previously considered unsuitable for this species, suggests a new ecotype along the northern extent of its range.\"

Habitat Description
Begin and Scheibling (2003) state that, \"*C. fragile* ssp. *tomentosoides* tolerates large variations in salinity and temperature, enabling it to colonise a wide range of environments. This species appears to thrive in sheltered habitats such as harbors and bays, which may facilitate its transport by human activities. Our study shows that this invasive alga also survives and grows in tide pools on wave-swept intertidal shores. *C. fragile* occurs at relatively high density in low and mid zone pools.\" These species also accumulates profusely on wharf pilings, jetties, ropes, and beaches (Trowbridge, 1999).

Reproduction
Begin and Scheibling (2003) state that, \"*C. fragile* ssp. *tomentosoides* can reproduce either sexually or parthenogenetically, releasing swarmers in the water column that are dispersed locally. It also reproduces vegetatively by fragmentation of the thallus, particularly in winter. New plants are established from fragments that are dispersed by currents and re-attach elsewhere, or from basal holdfasts that remain after fragmentation. Advective transport of fragments or entire plants may be particularly important in long-distance dispersal of this alga.\" Prince and Trowbridge (2004) claim that, \"Sexual reproduction in the siphonaceous green seaweed *C. fragile* appears to be solely parthenogenetic in *C. fragile* ssp. *tomentosoides* (van Goor) Silva.\"

General Impacts
Begin and Scheibling (2003) have found that the invasive success of *C. fragile* ssp. *tomentosoides* in the northwest Atlantic can be attributed to various characteristics of the alga's life history and physiological ecology. This species exhibits various modes of reproduction, which is a common trait in many invaders. It can reproduce sexually, parthenogentically, and vegetatively. Water currents can and will carry this species over long distances introducing it to new locations. *C. fragile* is also tolerant of a variety of salinity and water temperature levels. It also thrives in sheltered habitats, which facilitate human mediated dispersal (Begin and Scheibling, 2003).
Provan *et al.* (2005) state that, \"*C. fragile* ssp. *tomentosoides* has serious economic implications for aquaculture industries. Indeed, the tendency of this species to overgrow and smother oyster beds has earned it the nickname 'oyster thief' (Naylor *et al.* 2001).\" The Benthic Ecology Lab (2001) adds that it has found that, \"In its quest for a stable substrate *C. fragile* ssp. *tomentosoides* will often make its home on the shells of oysters, scallops, and clams. This can cause problems because an attached adult plant can hinder the movement and feeding of the shellfish. In cases where the attached plant is relatively large and wave exposure is high, the shellfish can be swept away with the plant.\"
Trowbridge (1999) reports that, \"The most detrimental effect of *C. fragile* ssp. *tomentosoides* is the fouling of shellfish beds, particularly on NW Atlantic shores. There are several direct and direct effects of this attachment (Trowbridge 1998a); these include: 1) smothering mussels and scallops by preventing opening of the valves, clogging scallop dredges, and interfering with the collecting of clams. *C. fragile* ssp. *tomentosoides* also is a fouling agent of nets of fin and squid fishers increasing labor costs during harvesting and processing associated with the need to remove the alga from shellfish and the replacement of nets. The authors also state that, \"The main negative social effect is that the introduced alga grows profusely and fouls wharf pilings, jetties, ropes, and beaches thereby reducing the amenity associated with the use of coastal areas. Furthermore, the accumulation of masses of *C. fragile* ssp. *tomentosoides* rotting on beaches of the NW Atlantic, Mediterranean, and New Zealand produces a foul odor that drives away visitors.\"
The Benthic Ecology Lab (2001) states that, \"The morphological structure of *C. fragile* ssp. *tomentosoides* will likely increase sedimentation. *C. fragile* ssp. *tomentosoides* is a \"low lying\" alga, making it difficult for some large invertebrates and fish to move among the plants and live in the space between the bushy parts of the algae and the seabed (the understory). In a kelp bed, many species can freely move under the canopy of fronds because the stems (stipes) are narrow and widely spaced. They rely on this understory environment for food, habitat and protection from predators. Replacement of kelp by *C. fragile* ssp. *tomentosoides* will undoubtedly affect such species.\"

Management Info
There are few options available to manage *C. fragile* ssp. *tomentosoides*. Chemical herbicides are not a viable option of control and end up doing harm. Mechanical removal techniques such as trawling, cutting, and suctioning may reduce density temporarily, but they are expensive and the populations will quickly rebound. Manual removal will not work either. *C. fragile* ssp. *tomentosoides* readily reproduces from fragments. There are a variety of naturally occurring organisms that feed on *C. fragile* ssp. *tomentosoides* but no one or combination of species can offer sufficient control these species do not readily discriminate between the native and introduced *C. fragile* subspecies. Preventing the spread of *C. fragile* ssp. *tomentosoides* through quarantine measures and public education are some of the only ways to insure it does not become spread (Trowbridge, 1999).
A two year study was undertaken for the Department of Environment and Heritage (Australia) by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) to identify and rank introduced marine species found within Australian waters and those not found within Australian waters.
All of the non-native potential target species identified in this report are ranked as high, medium and low priority, based on their invasion potential and impact potential. *C. fragile tomentosoides* is identified as one of ten most damaging potential domestic target species, based on overall impact potential (economic and environmental). A hazard ranking of potential domestic target species based on invasion potential from infected to uninfected bioregions identifies *C. fragile tomentosoides* as a 'medium priority species' - these species have a reasonably high impact/or invasion potential.
For more details, please see Hayes *et al.* 2005.
The rankings determined in Hayes *et al.* 2005 will be used by the National Introduced Marine Pest Coordinating Group in Australia to assist in the development of national control plans which could include options for control, eradication and/or long term management.
Nyberg and Wallentinus (2005) state that *C. fragile* ssp. *tomentosoides* is one of five top risk species in Europe. The authors study quantitatively ranked species traits which facilitate introduction and predominance using interval arithmetic to search for common patterns among 113 marine macroalgae introduced in Europe. From the abstract Nyberg and Wallentinus (2005) “Three main categories were used: dispersal, establishment and ecological impact. These were further subdivided into more specific categories, a total of 13. Introduced species were compared with the same number of native species randomised from the same families as the introduced. Invasive species (i.e. species having a negative ecological or economical impact) were also compared with non-invasive introductions, separately for the three algal groups. In many categories, as well as when adding all species, the introduced species ranked more hazardous than the native species and the invasive species ranked higher than the non-invasive ones. The ranking within the three main categories differed, reflecting different strategies between the species within the three algal groups. When all categories (excluding salinity and temperature) were summed, the top five risk species, all invasive, were, in descending order, *C. fragile* ssp. *tomentosoides*, *Caulerpa taxifolia*, *Undaria pinnatifida*, *Asparagopsis armata* and *Grateloupia doryphora*, while *Sargassum muticum* ranked eight and *Caulerpa racemosa* ten. Fifteen of the twenty-six species listed as invasive were among the twenty highest ranked

Pathway
Codium fragile was first reported in the northwest Atlantic at Long Island Sound in 1957, presumably introduced by ships from Europe (Bouck and Morgan 1957) (Begin and Scheibling, 2003).
Ship hulls are considered a likely vector of *C. fragile* (Trowbridge, 1999).*Codium fragile* dispersal was probably aided by human activities such as boating or shellfish aquaculture (Coffin and Stickney 1967) (Begin and Scheibling, 2003).
C. fragile has been known to be introduced through oysters. The alga arrives attached to the oysters (Trowbridge, 1999).

Principal source: Trowbridge, 1999. An assessment of the potential spread and options for control of the introduced green macroalga *Codium fragile* ssp.*tomentosoides* on Australian shores

Compiler: National Biological Information Infrastructure (NBII) & IUCN/SSC Invasive Species Specialist Group (ISSG)

Review: Dr Jim Provan, Lecturer in Evolutionary Genetics School of Biology and Biochemistry, Queen's University Belfast UK

Pubblication date: 2005-11-08

ALIEN RANGE

[1] ALGERIA
[11] AUSTRALIA
[2] CHILE
[6] FRANCE
[14] IRELAND
[1] JERSEY
[2] NETHERLANDS
[1] NORWAY
[2] SLOVENIA
[5] SPAIN
[1] TUNISIA
[7] UNITED KINGDOM
[1] ATLANTIC - NORTHWEST
[16] CANADA
[1] DENMARK
[2] GREECE
[2] ITALY
[2] MEDITERRANEAN & BLACK SEA
[4] NEW ZEALAND
[1] PORTUGAL
[1] SOUTH AFRICA
[1] SWEDEN
[1] TURKEY
[16] UNITED STATES

BIBLIOGRAPHY

13 references found for **Codium fragile ssp. tomentosoides**

Managment information

Hewitt, C.L, Campbell, M.L. and Gollasch, S. 2006. Alien Species in Aquaculture. Considerations for responsible use. IUCN, Gland, Switzerland and Cambridge, UK. viii + 32 pp.

Summary: This publication aims to first provide decision makers and managers with information on the existing international and regional regulations that address the use of alien species in aquaculture, either directly or indirectly; and three examples of national responses to this issue (New Zealand, Australia and Chile).
Available from: http://data.iucn.org/dbtw-wpd/edocs/2006-036.pdf [Accessed 22 September 2008]

Trowbridge, C. D. 1999. An assessment of the potential spread and options for control of the introduced green macroalga *Codium fragile* ssp. *tomentosoides* on Australian shores. Center for Research on Introduced Marine Pests and CSIRO Marine Research.

Trowbridge, C. D. 2001. Coexistence of introduced and native congeneric algae: *Codium fragile* and *C. tomentosum* on Irish rocky intertidal shores. Journal of Marine Biology Ass. U. K. 81:931-937.

Trowbridge, C. D., and W. F. Farnham. 2004. Spatial variation in littoral *Codium* assemblages on Jersey, Channel Islands (southern English Channel). Botanica Marina 47 (2004): 501-503.

General information

Begin, C., and R. E. Scheibling. 2003. Growth and Survival of the Invasive Green Alga *Codium fragile* ssp. *tomentosoides* in Tide Pools on a Rocky Shore in Nova Scotia. Botanica Marina Vol. 46, 2003, pp. 404-412.

Benthic Ecology Lab. 2001. *Codium fragile* ssp. *tomentosoides* (Dead Man`s Fingers). Dalhousie University: Marine Invasive Species in Nova Scotia.

Summary: Available from: http://myweb.dal.ca/rescheib/codium.html [Accessed 21 June 2005]

CONABIO. 2008. Sistema de informaci&#65533;n sobre especies invasoras en M&#65533;xico. Especies invasoras - Algas. Comisi&#65533;n Nacional para el Conocimiento y Uso de la Biodiversidad. Fecha de acceso.
Summary: English:
The species list sheet for the Mexican information system on invasive species currently provides information related to Scientific names, family, group and common names, as well as habitat, status of invasion in Mexico, pathways of introduction and links to other specialised websites. Some of the higher risk species already have a direct link to the alert page. It is important to notice that these lists are constantly being updated, please refer to the main page (http://www.conabio.gob.mx/invasoras/index.php/Portada), under the section Novedades for information on updates.
Invasive species - Algae is available from: http://www.conabio.gob.mx/invasoras/index.php/Especies_invasoras_-_Algas [Accessed 30 July 2008]
Spanish:
La lista de especies del Sistema de informaci&#65533;n sobre especies invasoras de m&#65533;xico cuenta actualmente con informaci&#65533;n aceca de nombre cient&#65533;fico, familia, grupo y nombre com&#65533;n, as&#65533; como h&#65533;bitat, estado de la invasi&#65533;n en M&#65533;xico, rutas de introducci&#65533;n y ligas a otros sitios especializados. Algunas de las especies de mayor riesgo ya tienen una liga directa a la p&#65533;gina de alertas. Es importante resaltar que estas listas se encuentran en constante proceso de actualizaci&#65533;n, por favor consulte la portada (http://www.conabio.gob.mx/invasoras/index.php/Portada), en la secci&#65533;n novedades, para conocer los cambios.
Especies invasoras - Algas is available from: http://www.conabio.gob.mx/invasoras/index.php/Especies_invasoras_-_Algas [Accessed 30 July 2008]
Guiry, M.D., Nic Dhonncha, E. & Rindi, F. 2005. *Codium fragile* spp. *tomentosoides* AlgaeBase version 3.0. World-wide electronic publication, National University of Ireland, Galway.
Summary: AlgaeBase is a database of information on algae that includes terrestrial, marine and freshwater organisms.
AlgaeBase is available from: http://www.algaebase.org; *Codium fragile* spp. *tomentosoides* information is available from: http://www.algaebase.org/speciesdetail.lasso?species_id=46&sk=50&from=results&-session=abv3:82D801A71130505486Wsj31A4A89 [Accessed 19 June 2005]
Hubbard, C. B., and D. J. Barbary. 2002. Morphological Variation of *Codium fragile* (Chlorophyta) in Eastern Canada. Botanica Marina Vol. 45, 2002, pp. 476-485.
ITIS (Integrated Taxonomic Information System). 2005. Online Database *Codium fragile* ssp. *tomentosoides*
Summary: An online database that provides taxonomic information, common names, synonyms and geographical jurisdiction of a species. In addition links are provided to retrieve biological records and collection information from the Global Biodiversity Information Facility (GBIF) Data Portal and bioscience articles from BioOne journals.
Available from: http://www.itis.gov/servlet/SingleRpt/SingleRpt?search_topic=TSN&search_value=623995 [Accessed March 2005]
Narragansett Bay Biota Gallery of Algae. UNDATED. *Codium fragile* sp. tomentosoides. US EPA & the University of Rhode Island.
Summary: Available from: http://omp.gso.uri.edu/doee/biota/algae/chloro/cod.htm [Accessed 21 June 2005]
Prince, J. S., and C. D. Trowbridge. 2004. Reproduction in the green macroalga *Codium* (Chlorophyta):characterization of gametes. Botanica Marina 47 (2004): 461-470 2004.
Provan, J., S. Murphy, and C. A. Maggs. 2005. Tracking the invasive history of the green alga *Codium fragile* ssp. *tomentosoides*. Molecular Ecology (2005) 14 , 189-194.