NON-INDIGENOUS AQUATIC SPECIES OF CONCERN FOR ALASKA

Fact Sheet 5 — Dead Man's Fingers

Codium fragile (ssp. Tomentosoides)

BIOLOGY & PHYSIOLOGY

Physical Description: Dead Man's Fingers contain at least six distinct subspecies in addition to having morphologically heterogeneous subpopulations (same subspecies whose morphology varies in different environments). Dead Man's Fingers is typically a large, upright, dichotomously (branching into approximately two equal divisions) branching alga and its color is pale to dark green and grows to a length of 3 feet or more. The thallus (body) is spongy and cylindrical. As this alga grows, each branch splits into two new branches giving it a bush-like structure. The alga's surface is covered with long colorless hairs giving live plants a soft fuzzy feel to them. The thallus has an annual growth pattern causing the branches to die back every season. Dead Man's Fingers is equipped with a perennial holdfast (a single root-like structure) from which new branches form each growing season.

Photo by: Dr. Scheibling, Doulhousie University.

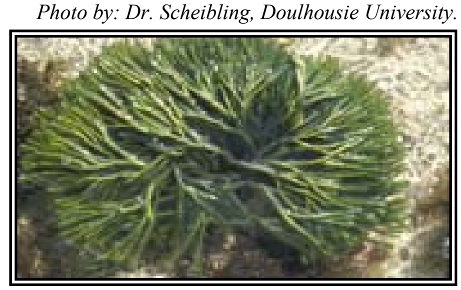

Photo by: M.D. Guiry

Nutrition Requirements: Dead Man's Fingers' ecological success is partially due to its ability to readily obtain nitrogen to meet its nutrition requirements. It can obtain nitrogen from nitrites/nitrates, ammonia, urea and to a lesser extent from nitrogen fixing bacteria. It also photosynthesizes to obtain carbon.

Reproduction: Dead Man's Fingers is an annual alga that reproduces during the summer and fall. It exhibits both sexual and asexual reproduction. Most Codium species are dioecious meaning that the male and female gametangia (structures containing the eggs and sperm) are located on separate plants. One method of asexual reproduction is by parthenogenesis (eggs germinate without fertilization). Reproduction is triggered by exposure to light and tides. Dead Man's Fingers can also reproduce asexually from broken filaments, thallus fragments (plant body), and vegetative buds which can attach to a substrata and grow into a new thalli. Dead Man's Fingers need temperatures between 54-59°F, for at least part of the year, for successful reproduction.

Lifecycle Stages: Dead Man's Fingers has a simple life cycle, with monoecious (having both male and female reproductive parts on the same plant) adults reproducing either sexually or parthenogenetically (without fertilization). Gametes (eggs) settle generally in less than one day and germinate into an undifferentiated, juvenile, vaucherioid (mat-forming) stage; these mats can persist for months to years. Release, settlement, and germination of gametes occur in summer and fall.

Habitat: Dead Man's Fingers is found on hard bottom surfaces and rocky shores of temperate and boreal (northern region of North America) regions of both marine and estuarine (where ocean water meets mouths of rivers) shores. It typically inhabits the lower intertidal zones; however, in some areas, such as the East Coast of the United States, it can be found in the shallow subtidal zone. Depending on the availability of primary space, Dead Man's Fingers either grows attached to a rock or epiphytically (attached) on other algae. In geographic regions where intertidal organisms freeze in the winter, this alga occurs primarily subtidally. In regions where freezing occurs infrequently, this alga often forms dense intertidal stands. When fully established, Dead Man's Fingers can form bushy meadows. Dead Man's Fingers can withstand broad ranges of temperatures and salinities. It prefers protected to semi-exposed habitat. Optimal water temperature for growth and reproduction is 75°F but it can also grow and reproduce at temperatures of 54°F. Adults can survive winter temperatures as low as 28°F. Studies have reported salinity tolerance levels for Dead Man's Fingers at 17.5-40 ppt (parts per thousand) and partial survival at 12.5 and 15 ppt. Dead Man's Fingers tends to spread in areas that have been cleared of other species of algae as a result of grazing from sea urchins. Some studies suggest that a successful invasion by Dead Man's Fingers into a new habitat can be facilitated by low floral species diversity within the habitat and/or a biological disturbance such as an invasion by another species. Overall, this alga is very persistent in the face of environmental fluctuations, and grows under a wide variety of light exposure and nutrient conditions.

DISPERSAL POTENTIAL

Historical and Current Introduction/Spread: Dead Man's Fingers is believed to have originated in Japan. It can now be found along the coasts of Britain, Australia, New Zealand, the Mediterranean and on both the East and West Coasts of North America. It was first collected in the San Francisco Bay in 1977 and was first discovered on the shores of Nova Scotia in 1989. Since then, it has spread 1,200 km along the shores of Nova Scotia, Prince Edward Island, and New Brunswick. Samples of Dead Man's Fingers collected in 2002 along these shores showed a high diversity of morphological characteristics. This could either indicate that Dead Man's Fingers was introduced in this area at different times or that it is extremely adaptable to local environments. A form of this species was first reported in Prince William Sound Alaska in 1998. It is possible that this form is a subspecies of native Codium found in Alaska; molecular studies will be needed to determine their relationship to each other. Dead Man's Fingers' establishment in Prince William Sound Alaska represents a range extension and possible introduction from Southeastern Alaska.

Dispersal Methods: Dead Man's Fingers is spread by attaching themselves to ship hulls, oyster shells, drag nets, and as packing material for fishery products. Dead Man's Fingers has also been known to be introduced to new habitats via ballast water. Spreading can also occur by mobile gametes (eggs), vegetative reproduction (detached sections of plants that generate into new plants), and by ocean currents.

IMPACTS AND CONTROL

General Impacts: Dead Man's Fingers is the most invasive alga in the world. Kelp and sea urchins normally follow a natural cycle whereby one is dominant over the other at different times. Dead Man's Fingers can disrupt this natural cycle by preventing native kelp from reestablishing itself. Because sea urchins do not typically feed on this alga, Dead Man's Fingers can more readily invade new territory where sea kelp has been stripped bare by sea urchins. On the other hand, where kelp is plentiful, Dead Man's Fingers is typically unable to establish itself in abundance. Studies have shown that areas dominated by Dead Man's Fingers typically have lower biodiversity when compared to areas dominated by kelp. Dense mats of Dead Man's Fingers also hinder movement by fish and large invertebrates and can adversely impact shellfish and the aquaculture industry. Dead Man's Fingers can attach itself to oysters, scallops and clams hindering their feeding and movement and can attach itself to and foul other surfaces such as fishing nets, boats and ship hulls. There is also evidence that herbivores (e.g. sea slugs) will shift their preferred host from a native alga to an introduced alga, such as Dead Man's Fingers, which may result in new ecological interactions with unknown consequences to the food web.

Management Information: Research suggests that native herbivores exhibit little grazing pressure on Dead Man's Fingers. Some studies have shown that sea slugs can effectively control local populations of this alga. All eradication efforts where Dead Man's Fingers is well established have had little or no success. Preventive measures for the continued introduction of Dead Man's Fingers into Prince William Sound should include ship fouling and ballast water management.

Key Notes: Attributes that make Dead Man's Fingers a successful invader include: (1) a rapid growth rate, (2) early maturation, (3) several dispersal mechanisms (gametes, adults, and fragmentation of adults), (4) broad physiological tolerance, (5) phenotypic plasticity (different morphologies between geographic regions), (6) polyphagy (capability of utilizing various nitrogen sources), and (7) parthenogenesis (germination of eggs without fertilization).