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ESM 585
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Pest Risk Assessment for Club Tunicate (Styela clava) and the Transparent Tunicate (Ciona savignyi) in Oregon

Identity

Name: *Styela clava*
Taxonomic Position: Phylum Chordata, Class Ascidiacea, Order Stolidobranchia, Family Styelidae
Common Name: Club tunicate, sea squirt

Identity

Name: *Ciona savignyi*
Taxonomic Position: Phylum Chordata, Class Ascidiacea, Order Enterogona, Family Cionidae
Common Name: Transparent tunicate

Styela clava ***Ciona savignyi***

Risk Rating Summary

Relative Risk Rating: Moderate
Numerical Score: 4 (On a scale of 1-9)

Status: *Styela clava* is established in only one location in Oregon but has likely been here for at least 20 years. It was first recorded in Coos Bay in 1993. Presumed vectors for transportation include ship fouling or stock contamination with oysters (1). The transparent tunicate, *Ciona savignyi*, has not been recorded in Oregon but is established along the West Coast in California, Washington, and Prince Edward Sound, Canada.

Continual monitoring and eradication efforts in Coos Bay and other ports may prevent further spread or establishment of *S. clava*. Although *C. savignyi* is abundant in certain locations in San Francisco Bay, physiological constraints will undoubtedly continue to limit spread further north except for small isolated populations (2). Monitoring may be a preventative tool for the establishment and spread of *C. savignyi* in Oregon State.

Description

Styela clava is a solitary tunicate, with a cylindrical shape and a leathery outer skin that is yellowish or dark brown. It can grow to 8-12 cm long and uses siphons, located on the top of its body, for feeding on detritus and plankton (3). It is native to the Sea of Okhotsk, Sea of Japan, and the coasts of Japan, Korea, and China (4). It is known to have spread to NW Europe, North America, and Australia. *S. clava* has spread with the help of humans by attaching to ships' hulls or in ballast water. They may also have spread by attaching to oysters and were transferred during shipments. They are sessile macro invertebrates and attach to substrates such as, floating docks, ropes, rocks, and the outer shell of bivalves. On natural substrates, oyster beds or rocks, *S. clava* may reach densities of 50-100 m^2 (4). *S. clava* is a hermaphrodite, releasing eggs and sperm into the water column, where the eggs are fertilized (5). The larvae will stay suspended in the water for a few days before settling and attaching to a substrate, where is will complete metamorphosis. As an adult, it can live for 1-3 years and withstand various temperatures and salinities.

Ciona savignyi is a solitary tunicate, transparent or cream in color, has two siphons with slightly scalloped edges, and can reach six inches in length (6). This sessile tunicate also attaches to hard substrates and is the first colonizers of cleared substrates (7). It is native to Japan and has been introduced to the west coast from Canada to southern California. Transportation vectors such as fouled ships and ballast water may be the cause of introduction to these areas. *C. savignyi* is a hermaphrodite with embryos hatching within 24 hours and larvae may function within 48 hours (7). It reaches maturity within six weeks and can live up to one year. In the Pacific Northwest, studies

have shown non-spawning tendencies during the coldest months. In California, they have been able to spawn year round (7).

Risk Rating Details:

Establishment Potential: High

Justification:

The increase in available surface area near docking and aquaculture facilities increases the potential of tunicates settling and establishing. For both species, the life span of their larvae are short, therefore, most long distance dispersal has been attributed to shellfish transfers, or to shipping vectors (8). *S. clava* was likely introduced to California in the late 1920s from shipping vectors and is now distributed from San Francisco Bay to San Diego (4). Ruiz et al. (2000) found most invasions from shipping resulted from ballast water and hull fouling communities (9). In 1970, it was found off the coast of Massachusetts and has spread north and south. In 1972, it was reported in Australia (4). In 1998, a fisherman found *S. clava* within mussel cultures and it has quickly spread through out the Prince Edward Estuary since then. *C. savignyi* was found in a subtidal pool in Alaska in 1903 and on a floating dock in British Columbia in 1937. It is now abundant in British Columbia (7). Due to the proximity of these areas, Oregon is a potential location for further establishment of these tunicates.

Fast reproduction rates of both tunicates may increase the possibility of establishing in Oregon. *S. clava* begins spawning when temperatures rise above 15º Celsius (10). *S. clava* is able to withstand a wide range of water temperatures, making it adaptable to Oregon's winters. Currently, *C. savignyi* is abundant in the areas it was first spotted. It has been found in the Puget Sound and other ports south of there. Likely, their reproduction rates are high as well and able to adapt to changing environmental factors.

Spread Potential: Moderate

Justification:

Transport and processing of aquaculture and recreational boating creates a high risk for the spread of *S. clava* and *C. savignyi.* Recreational boating can be responsible for the spread of non-native species, especially on a local scale (11). Extensive to very heavy fouling was found on twenty percent of yachts examined in Scotland. Recreational yachts often travel short distances increasing the likelihood that the source and recipient areas will be within the same climatic region, and that the fouling species will survive in the receiving habitat if similar environmental conditions exist (11). Bivalve aquaculture provides a habitat, refuge from predation, reduces physical and physiological stress, increases settlement and recruitment, and increases food supply (12) for *S. clava* and *C. savignyi*. The transfer and processing of bivalves may be a vector for the spread of these tunicates. The vectors mentioned above may increase the propagule pressure of these tunicates, allowing them to spread in Oregon.

Environmental Potential: Moderate

Justification:

Styela clava and *Ciona savignyi* have potential to harm the environment near their habitat. Tunicates filter feeding capacity is immense, and when abundant, their ability to filter a large portion of the water column will obviously affect the nutrients and plankton as well as pollutants in the water (2). They feed on phytoplankton, zooplankton, and other suspended material, decreasing the amount of food for other native species. *S. clava* dispenses noxious secondary metabolites deterring predators (13). Both species can form monocultures on substrates, decreasing space for native species, ultimately displacing them. In Southern California, *S. clava* has effectively displaced indigenous species becoming the dominant tunicate species. Once established on bivalve socks, invasive tunicates have the potential to reduce water flow and availability of food and oxygen thereby harming mussels and sessile filter feeding epifauna (14). If introduced to Oregon, these tunicates may alter the diversity of native species, effect aquaculture, and decrease food for other species.

Economic Potential: Moderate

Justification:

The economic impact caused by *Styela clava* and *Ciona savignyi* may be significant to Oregon state. The projected economic impact of this species on shellfish production for Canada alone was estimated at between $34,000 and $88,000 per year (7). This estimate was calculated several years ago and may be higher. Adult *S. clava* attach to mussels and aquaculture gear, weigh down the long lines and increase drop off and loss of mussels (14). The time and cost for maintenance and cleaning may have an impact on Oregon's aquaculture industry.

In the field, mechanical and chemical control agents are used for removal of tunicates. Mechanical tools include hand removal, high pressure water jets, scraping or suction, desiccation, or starvation (7). The use of acetic acid has been an effective chemical tool for the control of tunicates. Research has found evidence that UV irradiation is harmful to adult *C. savignyi*, but that the early life history phases are resistant to harmful UV effects (7). These tools can be costly and negatively impact the water and species around the target area.

Health Potential: Low

Justification:

Styela clava and *Ciona savignyi* have little impact on human health. In Korea, *S. clava* is a delicacy and used in a local dish called "mideuduck" (13). It is transported from Korea to other parts of the world for consumption. There are no known threats to humans caused by *C. savignyi*.

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