

Example JARPA Language: In-Substrate Culture for Geoduck

Activity	Description
Timing	In-substrate culture activities are generally tide-dependent but can occur year-round. During low tides, farm crews may be on the farm site for 3 to 6 hours before the tide re-floods an area. Activities may also occur at high tide when there is enough tidal inundation for a vessel to access farm sites. High-tide work typically occurs during the day.
Access	Access is either on foot or by vessel at high and low tides. Work vessels that are used to transport farm crews, materials, and equipment to the farm site for low tide work may either be anchored in a channel or in deep areas during low tide or be allowed to go aground. Once farm crews arrive at the farm site, culture beds within an intertidal farm site are typically accessed by foot. Work vessels used for high-tide work operate continuously across the farm site throughout the work period.
Bed Preparation and Enhancement	Generally, the substrate is not disturbed prior to planting. There may be some minor moving of larger features that will impact culture gear (e.g., large wood, rocks).
Predator and Invasive Species Control	<p>Predators may cause significant damage to in-substrate crops at various stages of their life cycles. Predator control techniques to protect crops include timing, siting, passive exclusion, relocation, and removal. Activities may be timed, and crops may be planted at specific tidal elevations, to avoid or minimize predation. Other control methods may be used to avoid or minimize predation such as the use of large seed that are less vulnerable to predation for planting.</p> <p>Predator exclusion techniques include the use of gear, such as nets and/or tubes. When area nets are used, they are bundled together and loaded onto a vessel at high tide. At low tide, farm crews install area nets on the culture bed. Area nets are secured to the substrate with rebar stakes up to 30 inches deep along the perimeter of the net. They may also be secured using rope anchors with an end piece affixing the net to the substrate installed up to 5 feet deep. Nets sit flush on top of the substrate, so disturbance is generally limited to the top 1 inch of substrate excluding rebar or rope anchors. In some instances, farm crews bury the bottom edge of their area nets. This activity may be done manually at low tide by making a narrow net perimeter up to six inches deep using a hand tool such as a shovel.</p> <p>Geoduck may also require additional predator exclusion measures at early life stages. In such cases, prior to planting, nursery tubes are installed as described in detail in the seeding subsection below. After planting, the top of the tubes may be covered by area or individual nets. Mesh tubes may be fastened at the top. Area nets may be also be installed as described above, after nursery tubes are removed.</p>
Seeding	Nursery tubes are inserted into the substrate to protect vulnerable juvenile geoduck seed from predators. Nursery tubes are currently 4 to 6 inches wide. Farm crews insert tubes up to 11 inches into the substrate, at 12 to 15 inches on center. Tubes are inserted by hand or using

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	<p>a farm implement that disturbs approximately 7 to 12 inches of substrate, or hydraulically using low-pressure, high-volume water pumped through a hose that disturbs up to 12 inches of substrate. Pumps are equipped with screens and operated by small engines located on a vessel or work platform nearby.</p> <p>Once nursery tubes are in place, 1 or more geoduck seed are pushed into the ground up to 5 inches deep or placed on the surface to dig into the substrate on their own within the tubes. After planting, depending on the type of tube used, the tubes may be covered with area or individual nets. Farm crews may access a geoduck culture bed at low tide, or dive at high tide. Nursery tubes may be used for up to 3 years of the 5- to 9-year culture cycle.</p>
Maintenance	<p>In-substrate culture crops are accessed regularly at low tide to perform maintenance activities, including inspection and inventory. Nets are inspected regularly and replaced or repaired as needed. Material that washes onto the farm site such as coarse wood or unrooted algae may be relocated outside the farm site. Nets that become fouled with biota may be manually cleaned on- or off-site. In limited regional instances, nets are cleaned in-place at low tide mechanically using a brushing implement. Nets may become covered or buried in silt due to natural shifting of the substrate or after storm events. In those instances, farm crews may use buoys to float the middle of the net to gently lift the net out of the substrate and prevent it from becoming re-buried. Nets may also need to be manually removed by hand or using a hand tool such as a shovel or pulley. Nursery tubes are inspected regularly. Epibiota (such as macroalgae) that accumulates on tubes may be manually removed and set to the side of the tubes or, in some instances, nets over the tubes may be temporarily removed to allow diving ducks or other consumers to clean the tubes of epibiota.</p> <p>Nursery tubes are removed up to 3 years after seed is planted. If individual net caps are used, they are also removed simultaneously or shortly thereafter. To remove the tubes, farm crews access the farm site at low tide and remove any area nets if one is in place. Tubes are then removed by hand and loaded onto a work platform or vessel to be transported to an upland location. In limited regional instances, divers remove tubes at high tide using low-pressure, high-volume water pumped through a hose connected to water intake lines on pumps equipped with screens. Substrate may be disturbed to a depth of up to 11 inches during tube removal.</p>
Harvest	<p>Geoduck are typically harvested between 5 and 9 years of growth, when the beds are exposed at low tide or using divers when the bed is submerged. Low-tide harvesting occurs above the water line during a low tide, and typically lasts 3 to 4 hours. Dive harvesting occurs at high tide and in subtidal culture beds, with divers working on the farm site for up to 8 hours. Both harvest methods use low-pressure, high-volume water pumped through a 1- to 2-inch-diameter hose with a probe attachment at the end to remove geoducks from the substrate. Pumps for hoses are operated by small engines located on a vessel or work platform anchored offshore. Pumps are screened to protect against potential intake of juvenile fish, per NMFS and WDFW standards.</p>

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During both low-tide and dive harvests, harvest workers insert the probe into the substrate immediately adjacent to the geoduck to gently loosen the substrate, which permits farm crews to then remove the geoduck by hand. During a low-tide harvest, additional farm crews are on the farm site to move the hose as necessary for harvest workers and collect harvested geoduck prior to transport to a processing facility. Geoduck harvesting activities may disturb up to 40 inches of substrate depth in a 1 square foot area.