

Comments on the Benthic Habitat and Biota and its Destructive Modification by *Zostera japonica*:

Japanese eelgrass (*Zostera japonica*) should be considered a direct threat to the productivity of the marine intertidal areas of Willapa Bay. It excludes by blocking sunlight and currents while modifying the chemical and physical properties of the benthos. It in effect reduces biodiversity and abundance of the important micro biota that in turn is critical to the entire food web.

When *Z. japonica* invades the intertidal three interconnected aspects become negative impacts and include the sedimentary contribution, the primary plant producers and key zooplankton. These are benthic phenomena which account for intertidal productivity. *Z. japonica* changes key parameters of the benthic with a change from open productive mudflat to a covered protected non-contributing decomposing area rich in organic detritus and worms. Although vital nutrients might be derived from some other sources the weathering of igneous silicate minerals by fresh water and CO₂ contact is key to fuel the intertidal productivity. Important components such as silicic acid and a bicarbonate ion which works with various cations such as Ca, Mg, Na, Zn, etc., are thus made available to phytoplankton (diatoms). The open (uncovered) undisturbed sedimentary mudflat and biofilm is the physical habitat, which initiates, contributes and hosts the important productive layers of the food web. This portion of the critical relationship

involves the interplay of the geologic aspects of weathering, erosion and ultimate deposition of sediments, which influence the primary production of diatoms and the micro zooplankton.

The Willapa estuary has extensive exposed intertidal flats comprised of deposited weathered or weathering igneous silicate minerals as fine sand or silt. When the intertidal is covered with *Z. japonica* natural cycling of key nutrients and availability of sunlight change the important role of the exposed intertidal mudflat. Those who judge the habitat change by the invasive dwarf eelgrass more 'valuable' than this important area for diatom production are not just in error but risk being party to and thus enabling irreparable harm to the marine nearshore by large reductions in the biota. Of course, the Japanese eelgrass will not only block currents but also depletes those nutrients from the intertidal sediments which effectively keeps them from entering into a viable and natural food web. In fact it is often reported that *Zostera japonica* meadows increase deposition and retention of decomposing organic matter. This would seem the normal result as the sea grass decreases tidal and wind currents that would remove the soft buildup of organic detritus and thus stops the vital input of nutrients from entering the food web. Japanese eelgrass is making a very similar threat to the whole bay as did *Spartina* - the cord grass.

Submission of these comments is to emphasize the deleterious impacts *Zostera japonica* has and will continue

to have on the flora and fauna of upper intertidal marine areas. The comments are not restricted to commercially farmed shellfish areas but the thousands of already infested areas not utilized for shellfish. Again to emphasize that even though shellfish are impacted by Japanese eelgrass, this sea grass is also impacting many other benthic species. Conversely, shellfish and shellfish farming add and contribute to the productive intertidal benthic area. As the biological and economical damage to other than commercial shellfish beds is being better understood the need to use a proven control tool will become even more critical. It is important to understand the effect the reduction or loss of these high intertidal areas is for primary productivity. Where sunlight is converted by the plant kingdom and in turn is passed onto the numerous species in the estuary. Shellfish are just a part of the mix along with dozens of other forms such as the crustaceans, birds, fish etc. Shellfish growers are trying to call attention to the damage being imposed on the benthic areas by Japanese eelgrass as they did with Spartina. Those interested in the environment and the resource agencies should learn and listen.