Pest Risk Assessment for
Asian kelp in Oregon

Identity

Name: *Undaria pinnatifida*

Taxonomic Position: order Laminariales, family Alariaceae

Common Names: Japanese kelp, wakame, Asian kelp

Risk Rating Summary

Relative Risk Rating: High

Numerical Score: 6 (1-9)

Uncertainty: HIGH

The high uncertainty of this risk assessment is due to a few factors, one being that the format for this assessment was not intended for marine species and may not incorporate unique factors for this ecosystem. Additionally, some of the information regarding species interaction and dispersal was variable and contradictory at times. Interactions with potentially threatened or endangered species are all hypothetical, as there have been no studies regarding these species and their interaction with Asian kelp.

Recommendation

Abundant hard substrate, water temperature data, proximity to California, and large amounts of both recreational and commercial boat use puts Oregon at high risk for invasion by *Undaria pinnatifida* (Asian kelp). Water temperature data indicates that the entire Oregon coast is a suitable habitat for Asian kelp, and has the potential to reproduce in overlapping generations. If the Asian kelp were to establish in Oregon, it could have detrimental effects on the fishing industries and on native habitats and species. Several factors increase the concern if establishment were to occur: decrease of managed, and potentially ecologically important habitat and the high levels of boating traffic that could increase invasion likelihood and spread. While many invasions of the Asian kelp have demonstrated contradictory patterns, Oregon is at

particular risk for an invasion on all parts of the coast, having an impact on a wide array of species, and therefore all reasonable efforts should be made to keep it out of the state. Oregon could also potentially serve as a vector to facilitate spread into Washington state and other parts of the Pacific ocean.

Risk Rating Details

Establishment potential is HIGH

Justification: *Undaria pinnatifada*(Asian kelp), has a history of establishment in temperate waters. Originally native to Russia, Japan, China and Korea, since 1970, Asian kelp has been found in France, England, Argentina, New Zealand, and parts of North America (Thornber *et al*, 2004). On the west coast of the United States, Asian kelp can be found from Ensenada, Mexico to Monterey, California (Thornber *et al*, 2004:70).

Asian kelp practices recruitment during periods of cold water temperatures, typically during winter in their native range. In invaded areas, it has been found to recruit any time the water temperature is less than 20°C, and may have a potential of overlapping generations if the water temperatures are between 15°C to17°C (Thornber *et al*, 2004). Oregon water temperatures are rarely above 20°C, even in summer months, and often drop beneath 15°C during the winter months (NOAA, 2010). Asian kelp also prefers highly disturbed locations to colonize; recruiting best where native canopy was very recently removed (Valentine and Johnson, 2003). Since winter storms regularly uproot the native *Nereocystis leutkeana* (bull kelp) (Mackey, 2003), these locations could provide good habitat for the Asian kelp.

Asian kelp are biophasic, however, their microscopic gameotophyte stage can lie dormant for up to five years (Heinonen, 2007), making them easily transportable. They are known to have been transported on aquaculture equipment and through ballast water (Heinonen, 2007). Microscopic motile spores are also released that are capable of natural wave dispersal upwards of 100 meters (Raffo, 2009). They also do not have native predators capable of preventing growth. Sea urchins feed on Asian kelp (Schaffelke and Hewitt, 2007), and the native crab *Pugettia product* grazes on young blades, however, other locations with these same species indicate that herbivore pressure is not enough to prevent establishment (Thornber *et al*, 2004).

Asian kelp can colonize most hard substrates. It is often found in the low intertidal zone up to 25 m in depth (Heinonen, 2007), however, it is also often found on man-made structures, such as docks (Pickering *et al*, 2007) and also on urchin barrens (Valentine and Johnson, 2003). Unlike the native bull kelp, it can also persist in polluted waters (Heinonen, 2007).

Spread Potential is MODERATE

Justification: Asian kelp demonstrates many weed like attributes; it rapidly colonizes disturbed areas and reproduces very quickly (Heinonen, 2007).The removal of native bull kelp by high wave action in the winters (Mackey, 2003), creates the ideal habitat for the Asian kelp to colonize, particularly since it also has a higher wave tolerance (Heinonen, 2007:24).

The extended period of spore formation allows for a high propagule pressure (Heinonen, 2007). Asian kelp also has a very effective natural dispersal during the motile micro zoospore stage, able to expand very quickly in new habitat (Thornber *et al*, 2004). The yearly expansion rate of Asian kelp has been estimated to be 10-100m per year (Raffo, 2009), however, it could be as high as several kilometers (Valentine and Johnson, 2003). In the microscopic gameotophyte stage, it can lie dormant for up to five years, allowing for long dispersal on boats and in ballast water (Heinonen, 2007). Since the dispersal phases are microscopic, it is also a difficult species to identify immediately when spreading to new habitat.

Economic Impact is MODERATE

Justification: Asian kelp is known to foul fish cages, mussel ropes, and ships (Heinonen, 2007). Removal of the kelp from these areas is typically most effective when done manually, which increases the labor costs of such industries (Heinonen, 2007). Outside its native range, Asian kelp is most frequently found on docks in marinas, and in Argentina, it has led to a decrease in tourism boating and recreational beach use (Raffo, 2009).

The loss of bull kelp will also result in a decline in the bull kelp harvest. Oregon allows for unlimited kelp harvest in a 40 mile stretch of submerged lands by an individual (Mackey, 2006). The loss of kelp as a habitat could also cause some fisheries to decline. The commercial and

recreational fishing industry could both experience impacts from a decrease of bull kelp caused by Asian kelp. Rockfish, perch, and a variety of invertebrates use bull kelp forests as nursery grounds and habitat (Good, 2000). In Oregon, several of the fish species found in bull kelp forests have been used as substitutes for the salmon industry after population declines caused stricter regulations (Mackey, 2006). The commercial rockfish industry accounts for approximately $2.5 million (ODFW, 2009), and loss of their habitat could cause the need for more regulations to be put into place to protect their populations, which would decrease the yearly landings of these species.

Environmental Impact is HIGH

Justification: Asian kelp grows in a very dense canopy in good conditions (Raffo, 2009), which could possibly shade out native kelp species. The waters in Oregon are cold enough, that the continuous growth of Asian kelp could prevent the spring growth of bull kelp due to shading (Thornber *et al*, 2004). Bull kelp forests are highly diverse, and Asian kelp has been found to have a significantly different understory (Schaffelke and Hewitt, 2007) and a decrease of native diversity by upwards of 175% (Casas *et al*, 2004:414). Asian kelp is also known to demonstrate some weed like attributes; it has a tendency to move in quickly following disturbances and reproduce quickly (Heinonen, 2007).

Bull kelp forests cover less than 1% of Oregon (Mackey, 2003), however, they provide habitat and feeding grounds for seabirds, shorebirds, marine mammals, fish, and invertebrates. They also are an integral part of the offshore reef habitats, helping prevent sedimentation (Good, 2000), a service not provided by Asian kelp, which can also decrease native species recovery (Schaffelke and Hewitt, 2007). Kelp forests also can potentially serve as habitat for some threatened and endangered species, including sea otters (ODFW, 2011), although whether the Asian kelp would successfully serve as habitat for these species is unknown.

It is unclear how Asian kelp will interact with the perennial *Macrocystis pyrifera* (giant kelp). Giant kelp and Asian kelp have not been show to vary species density in regards to flora, but faunal diversity is typically higher in giant kelp forests (Raffo, 2009). If giant kelp is already established in a location, it is likely that the competition will favor this native (Raffo, 2009),

however, if the disturbance caused by winter storms facilitates it, then perennial kelps may face a higher impact from Asian kelp (Thornber *et al*, 2004).

Human Health Impact is LOW

Justification: Asian kelp is not known to facilitate any toxins or parasites that affect humans. It also does not appear to cause harmful algal blooms or other similar problems. Since it has invaded other parts of the west coast of North America without harmful effects, it is unlikely to cause any effects in Oregon.

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Format
This pest risk assessment (PRA) is based on the format used by the Exotic Forest Pest Information System for North America. For a description of the evaluation process used, see Step 3- Pest Risk Assessment under Guidelines at: <http://spfnic.fs.fed.us/exfor/download.cfm>

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Date: December 1, 2011