WEED RISK ASSESSMENT FORM

Botanical name: *Zostera japonica* Aschers. & Graebn.

Common name: dwarf eelgrass

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Outcome score:

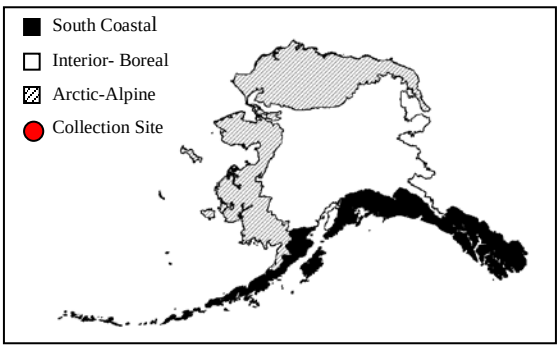
A.	**Climatic Comparison**		
	This species is present or may potentially establish in the following eco-geographic regions:		
1	South Coastal	Yes	
2	Interior-Boreal	Yes	
3	Arctic-Alpine		No

B.	**Invasiveness Ranking**	Total (Total Answered*) Possible	Total
1	Ecological impact	40 (40)	30
2	Biological characteristic and dispersal ability	25 (25)	10
3	Ecological amplitude and distribution	25 (25)	8
4	Feasibility of control	10 (3)	1
	Outcome score	100 (93)[b]	49 [a]
	Relative maximum score†		0.53

* For questions answered "unknown" do not include point value for the question in parentheses for "Total Answered Points Possible."
† Calculated as [a]/[b].

A. CLIMATIC COMPARISON:

	1.1. Has this species ever been collected or documented in Alaska?
	Yes – continue to 1.2
No	No – continue to 2.1
	1.2. Which eco-geographic region has it been collected or documented (see inset map)? *Proceed to Section B. Invasiveness Ranking.*
	South Coastal
	Interior-Boreal
	Arctic-Alpine



Documentation: *Zostera japonica* has not been collected in Alaska (AK Weed Database 2004, Hultén 1968, UAM 2004, Welsh 1974).

Sources of information:

AK Weeds Database. 2004. Database of exotic vegetation collected in Alaska. University of Alaska, Alaska Natural Heritage Program – US Forest Service – National Park Service Database. Available: http://akweeds.uaa.alaska.edu/

Hultén, E. 1968. Flora of Alaska and Neighboring Territories. Stanford University Press, Stanford, CA. 1008 p.

University of Alaska Museum. University of Alaska Fairbanks. 2004. http://hispida.museum.uaf.edu:8080/home.cfm

Welsh, S.L. 1974. Anderson's flora of Alaska and adjacent parts of Canada. Brigham University Press. 724 pp.

2.1. Is there a 40% or higher similarity (based on CLIMEX climate matching) between climates any where the species currently occurs and

a. Juneau (South Coastal Region)?

Yes — Yes – *record locations and similarity; proceed to Section B. Invasiveness Ranking*

No

b. Fairbanks (Interior-Boreal)?

Yes — Yes – *record locations and similarity; proceed to Section B. Invasiveness Ranking*

No

c. Nome (Arctic-Alpine)?

Yes — Yes – *record locations and similarity; proceed to Section B. Invasiveness Ranking*

No – *If "No" is answered for all regions, reject species from consideration*

Documentation: *Zostera japonica* is a native of subtropical to cool seacoasts ranging from Vietnam, East Asia, mainland Russia and the Sakhalin Islands (Miki 1933, Shin and Choi 1998). The CLIMEX matching program indicates the climatic similarity between Juneau, Alaska and Akita, Japan is 55%. The native range of this species includes Vladivostok and Nevel'sk, Russia which have a 60% and 57% climatic match with Anchorage, respectively. Aquatic species are generally less susceptible to variation in terrestrial climates. Dwarf eelgrass is therefore likely to establish in the South Coastal and the coastal portions of the Interior-Boreal regions of Alaska.

Sources of information:

Charkevicz, S.S. 1987. Vascular plants of Soviet Far East.: Lycopodiophyta, Equisetophyta, Polypodiophyta, Pinophyta (Gymnospermae), Magnoliophyta (Angiospermae). Vol. 2. Leningtad "Nauka". 448 p.

CLIMEX for Windows, Version 1.1a. 1999. CISRO Publishing, Australia.

Miki, S. 1933. On the sea-grasses in Japan (I). *Zostera* and *Phyllospadix*, with special reference to morphological and ecological characters. The Botanical Magazine 47: 842-862.

Shin, H. and H. Choi. 1998. Taxonomy and distribution of *Zostera* (*Zosteraceae*) in eastern Asia, with special reference to Korea. Aquatic Botany 60: 49-66.

B. INVASIVENESS RANKING

1. ECOLOGICAL IMPACT

1.1. Impact on Natural Ecosystem Processes

A.	No perceivable impact on ecosystem processes	0
B.	Influences ecosystem processes to a minor degree (e.g., has a perceivable but mild influence on soil nutrient availability)	3
C.	Significant alteration of ecosystem processes (e.g., increases sedimentation rates along streams or coastlines, reduces open water that are important to waterfowl)	7
D.	Major, possibly irreversible, alteration or disruption of ecosystem processes (e.g., the species alters geomorphology; hydrology; or affects fire frequency, altering community composition; species fixes substantial levels of nitrogen in the soil making	10

soil unlikely to support certain native plants or more likely to favor non-native species)

U. Unknown

Score 8

Documentation:

Identify ecosystem processes impacted:

The colonization of sparsely vegetated or bare intertidal flats by dwarf eelgrass represents a drastic modification of habitat. Increased eelgrass coverage slows water flow which increases sedimentation and reduces mean sediment grain size. Eventually eelgrass patches may raise the elevation of mudflats and disrupt ocean currents (Harrison and Bigley 1982, Posey 1988). Significant changes in the ecology of intertidal sediments are predicted as the exotic eelgrass spreads to potential habitat in North America (Harrison and Bigley 1982).

Rational:

Sources of information:

Harrison, P.G. and R. Bigley. 1982. The recent introduction of the seagrass *Zostera japonica* Aschers. and Graebn. to the Pacific coast of North America. Canadian Journal of Fisheries and Aquatic Sciences 39(12): 1642-1648.

Posey, M. H. 1988. Community changes associated with the spread of an introduced seagrass, *Zostera japonica.* Ecology 69(4): 974-983.

1.2. Impact on Natural Community Structure

A.	No perceived impact; establishes in an existing layer without influencing its structure	0
B.	Influences structure in one layer (e.g., changes the density of one layer)	3
C.	Significant impact in at least one layer (e.g., creation of a new layer or elimination of an existing layer)	7
D.	Major alteration of structure (e.g., covers canopy, eradicating most or all layers below)	10
U.	Unknown	

Score 7

Documentation:

Identify type of impact or alteration:

Dwarf eelgrass can form dense mats on previously bare intertidal flats (Harrison and Bigley 1982). Fauna richness and abundance can be higher in patches of introduced eelgrass compared to adjacent unvegetated areas (Posey 1988).

Rational:

Sources of information:

Harrison, P.G. and R. Bigley. 1982. The recent introduction of the seagrass *Zostera japonica* Aschers. and Graebn. to the Pacific coast of North America. Canadian Journal of Fisheries and Aquatic Sciences 39(12): 1642-1648.

Posey, M. H. 1988. Community changes associated with the spread of an introduced seagrass, *Zostera japonica.* Ecology 69(4): 974-983.

1.3. Impact on Natural Community Composition

A.	No perceived impact; causes no apparent change in native populations	0
B.	Influences community composition (e.g., reduces the number of individuals in one or more native species in the community)	3
C.	Significantly alters community composition (e.g., produces a significant reduction in the population size of one or more native species in the community)	7
D.	Causes major alteration in community composition (e.g., results in the extirpation of one or several native species, reducing biodiversity or change the community composition towards species exotic to the natural community)	10
U.	Unknown	

Score 8

Documentation:

Identify type of impact or alteration:

Dwarf eelgrass is not likely to displace native co-occurring eelgrasses (Harrison 1982). Although the introduction of dwarf eelgrass can decrease shrimp and tubeworm populations (Harrison 1987). The richness and number of other species may be increased by the vegetative cover (Posey 1988).

Rational:

Sources of information:
Harrison, P.G. 1982. Seasonal and year-to-year variations in mixed intertidal populations of *Zostera japonica* Aschres. & Graebn. and *Ruppia maritima* L. S.L. Aquatic Botany 14: 357-371.
Harrison, P.G. 1987. Natural expansion and experimental manipulation of seagrass (*Zostera* spp.) abundance and the response of infaunal invertebrates. Estuarine, Coastal and Shelf Science 24(6): 799-812.
Posey, M. H. 1988. Community changes associated with the spread of an introduced seagrass, *Zostera japonica.* Ecology 69(4): 974-983.

1.4. Impact on higher trophic levels (cumulative impact of this species on the animals, fungi, microbes, and other organisms in the community it invades)

A.	Negligible perceived impact	0
B.	Minor alteration	3
C.	Moderate alteration (minor reduction in nesting/foraging sites, reduction in habitat connectivity, interference with native pollinators, injurious components such as spines, toxins)	7
D.	Severe alteration of higher trophic populations (extirpation or endangerment of an existing native species/population, or significant reduction in nesting or foraging sites)	10
U.	Unknown	

Score 7

Documentation:
Identify type of impact or alteration:
Dwarf eelgrass provides habitat and food for invertebrates, fish, and birds, but degrades the quality of habitat for shrimp and tubeworms (Harrison 1987).
Rational:

Sources of information:
Harrison, P.G. 1987. Natural expansion and experimental manipulation of seagrass (*Zostera* spp.) abundance and the response of infaunal invertebrates. Estuarine, Coastal and Shelf Science 24(6): 799-812.

Total Possible 40
Total 30

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2. BIOLOGICAL CHARACTERISTICS AND DISPERSAL ABILITY

2.1. Mode of reproduction

A.	Not aggressive reproduction (few [0-10] seeds per plant and no vegetative reproduction)	0
B.	Somewhat aggressive (reproduces only by seeds (11-1,000/m^2)	1
C.	Moderately aggressive (reproduces vegetatively and/or by a moderate amount of seed, <1,000/m^2)	2
D.	Highly aggressive reproduction (extensive vegetative spread and/or many seeded, >1,000/m^2)	3
U.	Unknown	

Score 2

Documentation:
Describe key reproductive characteristics (including seeds per plant):
Dwarf eelgrass produces an abundance of seeds (Harrison 1979, Harrison and Bigley 1982).
Rational:

Sources of information:
Harrison, P.G. 1979. Reproductive strategies in intertidal populations of two co-occurring seagrasses (*Zostera* spp.). Canadian Journal of Botany 57: 2635-2638.
Harrison, P.G. and R. Bigley. 1982. The recent introduction of the seagrass *Zostera*

japonica Aschers. and Graebn. to the Pacific coast of North America. Canadian Journal of Fisheries and Aquatic Sciences 39(12): 1642-1648.

2.2. Innate potential for long-distance dispersal (bird dispersal, sticks to animal hair, buoyant fruits, wind-dispersal)

A.	Does not occur (no long-distance dispersal mechanisms)	0
B.	Infrequent or inefficient long-distance dispersal (occurs occasionally despite lack of adaptations)	2
C.	Numerous opportunities for long-distance dispersal (species has adaptations such as pappus, hooked fruit-coats, etc.)	3
U.	Unknown	

Score 1

Documentation:
Identify dispersal mechanisms:
Vegetative and flowering plants have been seen uprooted and floating, but it is not known if they can become established. Birds grazing on seeds may act as dispersal vectors (Harrison and Bigley 1982).
Rational:

Sources of information:
Harrison, P.G. and R. Bigley. 1982. The recent introduction of the seagrass *Zostera japonica* Aschers. and Graebn. to the Pacific coast of North America. Canadian Journal of Fisheries and Aquatic Sciences 39(12): 1642-1648.

2.3. Potential to be spread by human activities (both directly and indirectly – possible mechanisms include: commercial sales, use as forage/revegetation, spread along highways, transport on boats, contamination, etc.)

A.	Does not occur	0
B.	Low (human dispersal is infrequent or inefficient)	1
C.	Moderate (human dispersal occurs)	2
D.	High (there are numerous opportunities for dispersal to new areas)	3
U.	Unknown	

Score 2

Documentation:
Identify dispersal mechanisms:
Dwarf eelgrass was apparently introduced to North America with shipments of oysters (Carlton 1989). This plant may be transported inadvertently when entangled with boating or fishing gear (Harrison and Bigley 1982).
Rational:

Sources of information:
Carlton, J.T. 1989. Man's role in changing the face of the ocean: biological invasions and implications for conservation of near-shore environments. Conservation Biology 3(3): 265-273.
Harrison, P.G. and R. Bigley. 1982. The recent introduction of the seagrass *Zostera japonica* Aschers. and Graebn. to the Pacific coast of North America. Canadian Journal of Fisheries and Aquatic Sciences 39(12): 1642-1648.

2.4. Allelopathic

A.	No	0
B.	Yes	2
U.	Unknown	

Score 0

Documentation:
Describe effect on adjacent plants:
No records concerning allelopathy were found.
Rational:

Sources of information:

2.5. Competitive ability

A.	Poor competitor for limiting factors	0
B.	Moderately competitive for limiting factors	1
C.	Highly competitive for limiting factors and/or nitrogen fixing ability	3
U.	Unknown	

Score 0

Documentation:
Evidence of competitive ability:
Zostera japonica grows in the intertidal zone with *Z. marina* in both Japan and North America. Competition from *Zostera marina* may limit the growth of *Z. japonica* (Harrison 1982).
Rational:
Zostera marina usually has well developed rhizomes and roots which penetrate deeper into the sediment than those of *Z. japonica* (Harrison 1982).
Sources of information:
Harrison, P.G. 1982. Seasonal and year-to-year variations in mixed intertidal populations of *Zostera japonica* Aschres. & Graebn. and *Ruppia maritima* L. S.L. Aquatic Botany 14: 357-371.

2.6. Forms dense thickets, climbing or smothering growth habit, or otherwise taller than the surrounding vegetation

A.	No	0
B.	Forms dense thickets	1
C.	Has climbing or smothering growth habit, or otherwise taller than the surrounding vegetation	2
U.	Unknown	

Score 0

Documentation:
Describe grow form:
Dwarf eelgrass is not characterized by climbing or smothering growth habit, and is not taller than the surrounding vegetation (Flora of North America 1993, Hitchcock et al. 1969, Shin and Choi 1998).
Rational:

Sources of information:
Flora of North America. Editorial Committee, eds. 1993. Flora of North America North of Mexico. 7 vols. New York and Oxford.
Hitchcock, C.L., A. Cronquist, and M. Ownbey. 1969. Vascular plants of the Pacific Northwest. Part 1: Vascular Cryptogams, Gymnosperms, and Monocotyledons. Seattle, WA: University of Washington Press. 914 p.
Shin, H. and H. Choi. 1998. Taxonomy and distribution of *Zostera* (*Zosteraceae*) in eastern Asia, with special reference to Korea. Aquatic Botany 60: 49-66.

2.7. Germination requirements

A.	Requires open soil and disturbance to germinate	0
B.	Can germinate in vegetated areas but in a narrow range or in special conditions	2
C.	Can germinate in existing vegetation in a wide range of conditions	3
U.	Unknown	

Score 2

Documentation:
Describe germination requirements:
Dwarf eelgrass requires bare sand or mud for germination and establishment (Harrison and Bigley 1982) but usually does not establish on disturbed areas (Harrison 1987).
Rational:

Sources of information:
Harrison, P.G. 1987. Natural expansion and experimental manipulation of seagrass

(*Zostera* spp.) abundance and the response of infaunal invertebrates. Estuarine, Coastal and Shelf Science 24(6): 799-812.

Harrison, P.G. and R. Bigley. 1982. The recent introduction of the seagrass *Zostera japonica* Aschers. and Graebn. to the Pacific coast of North America. Canadian Journal of Fisheries and Aquatic Sciences 39(12): 1642-1648.

2.8. Other species in the genus invasive in Alaska or elsewhere

A.	No	0
B.	Yes	3
U.	Unknown	

Score 0

Documentation:

Species:

No other *Zostera* species are known as weeds (USDA 2002).

Sources of information:

USDA (United States Department of Agriculture), NRCS (Natural Resource Conservation Service). 2002. The PLANTS Database, Version 3.5 (http://plants.usda.gov). National Plant Data Center, Baton Rouge, LA 70874-4490 USA.

2.9. Aquatic, wetland, or riparian species

A.	Not invasive in wetland communities	0
B.	Invasive in riparian communities	1
C.	Invasive in wetland communities	3
U.	Unknown	

Score 3

Documentation:

Describe type of habitat:

Dwarf eelgrass inhabits the intertidal zone of sandy or muddy coasts (Harrison and Bigley 1982, Hitchcock 1969, Shin and Choi 1998).

Rational:

Sources of information:

Harrison, P.G. and R. Bigley. 1982. The recent introduction of the seagrass *Zostera japonica* Aschers. and Graebn. to the Pacific coast of North America. Canadian Journal of Fisheries and Aquatic Sciences 39(12): 1642-1648.

Hitchcock, C.L., A. Cronquist, and M. Ownbey. 1969. Vascular plants of the Pacific Northwest. Part 1: Vascular Cryptogams, Gymnosperms, and Monocotyledons. Seattle, WA: University of Washington Press. 914 p.

Shin, H. and H. Choi. 1998. Taxonomy and distribution of *Zostera* (*Zosteraceae*) in eastern Asia, with special reference to Korea. Aquatic Botany 60: 49-66.

Total Possible 25

Total 10

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3. DISTRIBUTION

3.1. Is the species highly domesticated or a weed of agriculture

A.	No	0
B.	Is occasionally an agricultural pest	2
C.	Has been grown deliberately, bred, or is known as a significant agricultural pest	4
U.	Unknown	

Score 0

Documentation:

Identify reason for selection, or evidence of weedy history:

Dwarf eelgrass is not an agricultural weed nor is it grown deliberately.

Rational:

Sources of information:

3.2. Known level of impact in natural areas

A.	Not known to cause impact in any other natural area	0
B.	Known to cause impacts in natural areas, but in dissimilar habitats and climate zones than exist in regions of Alaska	1
C.	Known to cause low impact in natural areas in similar habitats and climate zones to those present in Alaska	3
D.	Known to cause moderate impact in natural areas in similar habitat and climate zones	4
E.	Known to cause high impact in natural areas in similar habitat and climate zones	6
U.	Unknown	

Score 3

Documentation:

Identify type of habitat and states or provinces where it occurs:

Colonization of sand flats by native and exotic eelgrasses has reduced the population range of the burrowing shrimp in British Columbia (Harrison 1987). Dense populations of dwarf eelgrass infest approximately 17,000 ha of intertidal flats in Washington (Harrison and Bigley 1982).

Sources of information:

Harrison, P.G. 1987. Natural expansion and experimental manipulation of seagrass (*Zostera* spp.) abundance and the response of infaunal invertebrates. Estuarine, Coastal and Shelf Science 24(6): 799-812.

Harrison, P.G. and R. Bigley. 1982. The recent introduction of the seagrass *Zostera japonica* Aschers. and Graebn. to the Pacific coast of North America. Canadian Journal of Fisheries and Aquatic Sciences 39(12): 1642-1648.

3.3. Role of anthropogenic and natural disturbance in establishment

A.	Requires anthropogenic disturbances to establish	0
B.	May occasionally establish in undisturbed areas but can readily establish in areas with natural disturbances	3
C.	Can establish independent of any known natural or anthropogenic disturbances	5
U.	Unknown	

Score 5

Documentation:

Identify type of disturbance:

Dwarf eelgrass may establish on undisturbed bare sand or mud. Dredging, filling, and erosion associated with dyke or port construction are known to inhibit the establishment and expansion of infestations (Harrison 1987).

Rational:

Sources of information:

Harrison, P.G. 1987. Natural expansion and experimental manipulation of seagrass (*Zostera* spp.) abundance and the response of infaunal invertebrates. Estuarine, Coastal and Shelf Science 24(6): 799-812.

3.4. Current global distribution

A.	Occurs in one or two continents or regions (e.g., Mediterranean region)	0
B.	Extends over three or more continents	3
C.	Extends over three or more continents, including successful introductions in arctic or subarctic regions	5
U.	Unknown	

Score 0

Documentation:

Describe distribution:

Dwarf eelgrass is distributed on sandy and muddy shores of sheltered bays from subtropical Vietnam to East Asia, mainland Russia and the Sakhalin Islands (Shin and Choi 1998). It has been recently introduced to British Columbia, Oregon, and Washington (Harrison and Bigley 1982, Hitchcock 1969).

Rational:

Sources of information:

Harrison, P.G. and R. Bigley. 1982. The recent introduction of the seagrass *Zostera japonica* Aschers. and Graebn. to the Pacific coast of North America. Canadian Journal of Fisheries and Aquatic Sciences 39(12): 1642-1648.
Hitchcock, C.L., A. Cronquist, and M. Ownbey. 1969. Vascular plants of the Pacific Northwest. Part 1: Vascular Cryptogams, Gymnosperms, and Monocotyledons. Seattle, WA: University of Washington Press. 914 p.
Shin, H. and H. Choi. 1998. Taxonomy and distribution of *Zostera* (*Zosteraceae*) in eastern Asia, with special reference to Korea. Aquatic Botany 60: 49-66.

3.5. Extent of the species U.S. range and/or occurrence of formal state or provincial listing

A.	0-5% of the states	0
B.	6-20% of the states	2
C.	21-50%, and/or state listed as a problem weed (e.g., "Noxious," or "Invasive") in 1 state or Canadian province	4
D.	Greater than 50%, and/or identified as "Noxious" in 2 or more states or Canadian provinces	5
U.	Unknown	

Score 0

Documentation:
Identify states invaded:
Dwarf eelgrass has been recently introduced to British Columbia, Oregon, and Washington (Harrison and Bigley 1982, Hitchcock 1969). This plant is not listed in any state as noxious weed (Invaders Database System 2003, USDA 2002).
Rational:

Sources of information:
Harrison, P.G. and R. Bigley. 1982. The recent introduction of the seagrass *Zostera japonica* Aschers. and Graebn. to the Pacific coast of North America. Canadian Journal of Fisheries and Aquatic Sciences 39(12): 1642-1648.
Hitchcock, C.L., A. Cronquist, and M. Ownbey. 1969. Vascular plants of the Pacific Northwest. Part 1: Vascular Cryptogams, Gymnosperms, and Monocotyledons. Seattle, WA: University of Washington Press. 914 p.
Invaders Database System. The University of Montana. 2003. Montana Noxious Weed Trust Fund. Department of Agriculture. http://invader.dbs.umt.edu/
USDA (United States Department of Agriculture), NRCS (Natural Resource Conservation Service). 2002. The PLANTS Database, Version 3.5 (http://plants.usda.gov). National Plant Data Center, Baton Rouge, LA 70874-4490 USA.

Total Possible 25
Total 8

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4. FEASIBILITY OF CONTROL

4.1. Seed banks

A.	Seeds remain viable in the soil for less than 3 years	0
B.	Seeds remain viable in the soil for between 3 and 5 years	2
C.	Seeds remain viable in the soil for 5 years and more	3
U.	Unknown	

Score U

Documentation:
Identify longevity of seed bank:
No records are found concerning seed viability.
Rational:

Sources of information:

4.2. Vegetative regeneration

A.	No resprouting following removal of aboveground growth	0

B.	Resprouting from ground-level meristems	1
C.	Resprouting from extensive underground system	2
D.	Any plant part is a viable propagule	3
U.	Unknown	

Score 1

Documentation:
Describe vegetative response:
Although dwarf eelgrass is capable of resprouting from rhizomes when storms remove the aboveground biomass, resprouting is usually not very vigorous (Harrison 1979).
Rational:

Sources of information:
Harrison, P.G. 1979. Reproductive strategies in intertidal populations of two co-occurring seagrasses (*Zostera* spp.). Canadian Journal of Botany 57: 2635-2638.

4.3. Level of effort required

A.	Management is not required (e.g., species does not persist without repeated anthropogenic disturbance)	0
B.	Management is relatively easy and inexpensive; requires a minor investment in human and financial resources	2
C.	Management requires a major short-term investment of human and financial resources, or a moderate long-term investment	3
D.	Management requires a major, long-term investment of human and financial resources	4
U.	Unknown	

Score U

Documentation:
Identify types of control methods and time-term required:
Control methods for dwarf eelgrass have not been investigated.
Rational:

Sources of information:

Total Possible	3
Total	1
Total for 4 sections Possible	93
Total for 4 sections	49

References:

AK Weeds Database. 2004. Database of exotic vegetation collected in Alaska. University of Alaska, Alaska Natural Heritage Program – US Forest Service – National Park Service Database. Available: http://akweeds.uaa.alaska.edu/

Charkevicz, S.S. 1987. Vascular plants of Soviet Far East.: Lycopodiophyta, Equisetophyta, Polypodiophyta, Pinophyta (Gymnospermae), Magnoliophyta (Angiospermae). Vol. 2. Leningtad “Nauka”. 448 p. In Russian.

CLIMEX for Windows, Version 1.1a. 1999. CISRO Publishing, Australia.

Carlton, J.T. 1989. Man’s role in changing the face of the ocean: biological invasions and implications for conservation of near-shore environments. Conservation Biology 3(3): 265-273.

Flora of North America. Editorial Committee, eds. 1993. Flora of North America North of Mexico. 7 vols. New York and Oxford.

Harrison, P.G. 1979. Reproductive strategies in intertidal populations of two co-occurring seagrasses (*Zostera* spp.). Canadian Journal of Botany 57: 2635-2638.

Harrison, P.G. 1982. Seasonal and year-to-year variations in mixed intertidal populations of *Zostera japonica* Aschres. & Graebn. and *Ruppia maritima* L. S.L. Aquatic Botany 14: 357-371.

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Harrison, P.G. and R. Bigley. 1982. The recent introduction of the seagrass *Zostera japonica* Aschers. and Graebn. to the Pacific coast of North America. Canadian Journal of Fisheries and Aquatic Sciences 39(12): 1642-1648.

Hitchcock, C.L., A. Cronquist, and M. Ownbey. 1969. Vascular plants of the Pacific Northwest. Part 1: Vascular Cryptogams, Gymnosperms, and Monocotyledons. Seattle, WA: University of Washington Press. 914 p.

Hultén, E. 1968. Flora of Alaska and Neighboring Territories. Stanford University Press, Stanford, CA. 1008 p.

Invaders Database System. The University of Montana. 2003. Montana Noxious Weed Trust Fund. Department of Agriculture. http://invader.dbs.umt.edu/

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