Bering Sea Marine Invasive Species Assessment

Alaska Center for Conservation Science

Scientific Name: *Eusarsiella zostericola*

Common Name *a free-living benthic ostracod*

Phylum	Arthropoda
Class	Ostracod
Order	Myodocopida
Family	Sarsiellidae

Final Rank 33.91

Data Deficiency: 13.75

Species Occurrence by Ecoregion

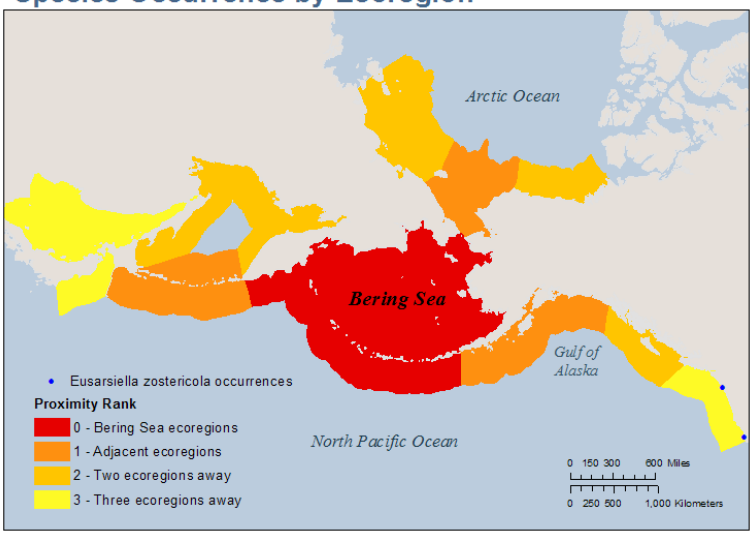

Figure 1. Occurrence records for non-native species, and their geographic proximity to the Bering Sea. Ecoregions are based on the classification system by Spalding et al. (2007). Occurrence record data source(s): NEMESIS and NAS databases.

Category Scores and Data Deficiencies

Category	Score	Total Possible	Data Deficient Points
Distribution and Habitat:	15	26	3.75
Anthropogenic Influence:	4.75	10	0
Biological Characteristics:	9.5	20	10.00
Impacts:	0	30	0
Totals:	29.25	86.25	13.75

General Biological Information

Tolerances and Thresholds

Minimum Temperature (°C)	3	Minimum Salinity (ppt)	18
Maximum Temperature (°C)	33	Maximum Salinity (ppt)	42
Minimum Reproductive Temperature (°C)	NA	Minimum Reproductive Salinity (ppt)	31*
Maximum Reproductive Temperature (°C)	NA	Maximum Reproductive Salinity (ppt)	35*

Additional Notes

Eusarsiella zostericola is a free-living benthic ostracod. It is native to the East Coast of North America (Nova Scotia to Texas) and has been introduced to California, Washington, England, and the Netherlands. The most likely vector for its introduction is historical transplants of Eastern Oysters (Crassostrea virgnica) from East Coast estuaries. It occurs in coastal marine and estuarine habitats including eelgrass beds, oyster beds, and unstructured sediments such as mud and sand. There are no known ecological and economic impacts of this species.

1. Distribution and Habitat

1.1 Survival requirements - Water temperature

Choice: C

Little overlap – A small area (<25%) of the Bering Sea has temperatures suitable for year-round survival

Score: 1.25 **of** 3.75

Ranking Rationale:
Temperatures required for year-round survival occur in a limited area (<25%) of the Bering Sea.

Background Information:
Temperature range required for survival is 3°C to 33ºC (Kornicker 1986).

Sources:
Kornicker 1986 NEMESIS; Fofonoff et al. 2003

1.2 Survival requirements - Water salinity

Choice: A

Considerable overlap – A large area (>75%) of the Bering Sea has salinities suitable for year-round survival

Score: 3.75 **of** 3.75

Ranking Rationale:
Salinities required for year-round survival occur over a large (>75%) area of the Bering Sea.

Background Information:
E. zostericola is a upper mesohaline to upper euhaline species with a salinity tolerance of 18 ppt to 42 ppt (Kornicker 1986).

Sources:
Kornicker 1986 NEMESIS; Fofonoff et al. 2003

1.3 Establishment requirements - Water temperature

Choice: U

Unknown/Data Deficient

Score: **of**

Ranking Rationale:

Background Information:
No information available in the literature.

Sources:
None listed

1.4 Establishment requirements - Water salinity

Choice: A

Considerable overlap – A large area (>75%) of the Bering Sea has salinities suitable for reproduction

Score: 3.75 **of** 3.75

High uncertainty? ☑

Ranking Rationale:
Although salinity thresholds are unknown, this species is a marine organism that does not require freshwater to reproduce. We therefore assume that this species can reproduce in saltwater (31 to 35 ppt). These salinities occur in a large (>75%) portion of the Bering Sea.

Background Information:
No information available in the literature.

Sources:
None listed

1.5 Local ecoregional distribution

Choice: D

Present in an ecoregion greater than two regions away from the Bering Sea

Score: 1.25 **of** 5

Ranking Rationale:
Closest known occurrence is in Washington.

Background Information:
E. zostericola was first observed on the West Coast in the San Francisco Bay, California in 1953 (Kornicker 1967; Kornicker 1975) where it is widespread and abundant (Foss 2009; Peterson and Vaysierres 2010). It has also been discovered in Humboldt Bay, California (California Department of Fish and Wildlife 2014); and in Willapa Bay Washington in 1999 (Wilson and Partidge 2007; Cohen et al. 2001). It is an invader that was probably introduced with the transplant of the Eastern Oyster at the end of the 19th century (Kornicker 1975).

Sources:
NEMESIS; Fofonoff et al. 2003 Kornicker 1967 Kornicker 1975 Foss 2009 Peterson and Vayssieres 2010 California Department of Fish and Wildlife 2014 Wilson and Partridge 2007 Cohen et al. 2001

1.6 Global ecoregional distribution

Choice: B

In a moderate number of ecoregions globally

Score: 3.25 **of** 5

Ranking Rationale:
Distribution is currently limited to North America, England, and the Netherlands.

Background Information:
E. zostericolas native range is the East Coast of North America ranging from Nova Scotia to Texas. At the end of the 19th century the Eastern Oyster (Crassotrea virginica) was transplanted to several locations around the world for aquaculture purposes, bringing E. zostericola with it. It is now found where the Eastern Oyster was transplanted in San Francisco Bay, California; Humboldt Bay, California; Willapa Bay, Washington; the English Channel; and the Netherlands (Kornicker 1975; Cohen et al. 2001; California Department of Fish and Wildlife 2014; Bamber 1987; Faasse 2013).

Sources:
NEMESIS; Fofonoff et al. 2003 Kornicker 1975 Cohen et al. 2001 California Department of Fish and Wildlife 2014 Bamber 1987 Faasse 2013

1.7 Current distribution trends

Choice: C

Established outside of native range, but no evidence of rapid expansion or long-distance dispersal

Score: 1.75 **of** 5

Ranking Rationale:
Small-scale expansion has been observed in localized areas of invasion.

Background Information:
Little potential for long-term dispersal as it has limited swimming ability and is rare in ballast water (Carlton and Geller 1993).

Sources:
NEMESIS; Fofonoff et al. 2003 Carlton and Geller 1993

Section Total - Scored Points:	15
Section Total - Possible Points:	26.25
Section Total -Data Deficient Points:	3.75

2. Anthropogenic Transportation and Establishment

2.1 Transport requirements: relies on use of shipping lanes (hull fouling, ballast water), fisheries, recreation, mariculture, etc. for transport

Choice: B

Has been observed using anthropogenic vectors for transport but has rarely or never been observed moving independent of anthropogenic vectors once introduced

Score: 2 of 4

Ranking Rationale:

Background Information:
Transportation of E. zostericola is likely related to transplants of Eastern Oysters (Crassostrea virgnica), from East Coast estuaries to the West Coast and Europe, in the late 19th and early 20th centuries (Kornicker 1975).

Sources:
Kornicker 1975 NEMESIS; Fofonoff et al. 2003

2.2 Establishment requirements: relies on marine infrastructure, (e.g. harbors, ports) to establish

Choice: B

Readily establishes in areas with anthropogenic disturbance/infrastructure; occasionally establishes in undisturbed areas

Score: 2.75 of 4

High uncertainty? ☑

Ranking Rationale:
Given its limited dispersal ability, this species likely retains a close association with anthropogenic habitats in its introduced range. Information on this distribution and spread of this species is lacking.

Background Information:
This species was likely accidentally introduced to the west coast of North America with the introduction of Eastern Oysters (Crassostrea virginica) for aquaculture (Fofonoff et al. 2003). Habitats include unstructured sediments (e.g. silt, sand), oyster beds, eelgrass, and hydroids (Fofonoff et al. 2003). This species has limited swimming and dispersal ability.

Sources:
NEMESIS; Fofonoff et al. 2003

2.3 Is this species currently or potentially farmed or otherwise intentionally cultivated?

Choice: B

No

Score: 0 of 2

Ranking Rationale:

Background Information:
This species is not currently farmed or intentionally cultivated.

Sources:
None listed

Section Total - Scored Points:	4.75
Section Total - Possible Points:	10
Section Total -Data Deficient Points:	0

3. Biological Characteristics

3.1 Dietary specialization

Choice: U — Unknown

Score: _ of _

Ranking Rationale:

Background Information:
Information on E. zostericola prey and forage is lacking in the literature. It is thought to be a carnivore, as one reported specimen contained a harpacticoid copepod (Wass 1972; Kornicker 1967; Kornicker 1986).

Sources:
Kornicker 1986 NEMESIS; Fofonoff et al. 2003 Wass 1972 Kornicker 1967

3.2 Habitat specialization and water tolerances

Does the species use a variety of habitats or tolerate a wide range of temperatures, salinity regimes, dissolved oxygen levels, calcium concentrations, hydrodynamics, pollution, etc?

Choice: A — Generalist; wide range of habitat tolerances at all life stages

Score: 5 of 5

Ranking Rationale:
Can tolerate a wide range of temperatures and salinities and has been recorded in a variety of habitats.

Background Information:
E. zostericola has a wide range of temperature and salinity tolerances at 3 to 33°C and 18 to 42 ppt (Kornicker 1986). It is also found at a wide range depths of 0.18 to 44.5 m. Its habitats include unstructured sediments, oyster beds, eelgrass, beds, mangroves, and hydroids.

Sources:
Kornicker 1986 NEMESIS; Fofonoff et al. 2003

3.3 Desiccation tolerance

Choice: U — Unknown

Score: _ of _

Ranking Rationale:

Background Information:
No information available in the literature.

Sources:
None listed

3.4 Likelihood of success for reproductive strategy

i. Asexual or hermaphroditic ii. High fecundity (e.g. >10,000 eggs/kg) iii. Low parental investment and/or external fertilization iv. Short generation time

Choice: C — Low – Exhibits none of the above characteristics

Score: 1.75 of 5

Ranking Rationale:
Sexual reproduction, low fecundity, internal fertilization, generation time unknown.

Background Information:
Eusarsiella zostericola has separate sexes and internal fertilization. Females have 5 to 16 eggs that are brooded (Kornicker 1967; Bamber 1987).

Sources:
NEMESIS; Fofonoff et al. 2003 Kornicker 1967 Bamber 1987

3.5 Likelihood of long-distance dispersal or movements

Consider dispersal by more than one method and/or numerous opportunities for long or short distance dispersal e.g. broadcast, float, swim, carried in currents; vs. sessile or sink.

Choice: C — Disperses short (< 1 km) distances

Score: 0.75 of 2.5

Ranking Rationale:

Background Information:
Benthic ostracods have limited swimming ability and dispersal rates (Kornicker 1967).

Sources:
Kornicker 1967

3.6 Likelihood of dispersal or movement events during multiple life stages

i. Can disperse at more than one life stage and/or highly mobile ii. Larval viability window is long (days v. hours) iii. Different modes of dispersal are achieved at different life stages (e.g. unintentional spread of eggs, migration of adults)

Choice: C — Low – Exhibits none of the above characteristics

Score: 0.75 of 2.5

High uncertainty? ☑

Ranking Rationale:
Low mobility, larval viability window is unknown, dispersal is through swimming very short distances.

Background Information:

Sources:
NEMESIS; Fofonoff et al. 2003

3.7 Vulnerability to predators

Choice: D — Multiple predators present in the Bering Sea or neighboring regions

Score: 1.25 of 5

Ranking Rationale:
Numerous predatory, many of which exist in the Bering Sea.

Background Information:
Consumed by fishes and invertebrates (Fofonoff et al. 2003).

Sources:
NEMESIS; Fofonoff et al. 2003

Section Total - Scored Points:	9.5
Section Total - Possible Points:	20
Section Total -Data Deficient Points:	10

4. Ecological and Socioeconomic Impacts

4.1 Impact on community composition

Choice: D — No impact

Score: 0 of 2.5

Ranking Rationale:

Background Information:
There are no known ecological impacts of Eusarsiella zostericola (Fofonoff et al. 2003).

Sources:
NEMESIS; Fofonoff et al. 2003

4.2 Impact on habitat for other species

Choice: D — No impact

Score: 0 of 2.5

Ranking Rationale:

Background Information:
There are no known ecological impacts of Eusarsiella zostericola (Fofonoff et al. 2003).

Sources:
NEMESIS; Fofonoff et al. 2003

4.3 Impact on ecosystem function and processes

Choice: D — No impact

Score: 0 of 2.5

Ranking Rationale:

Background Information:
There are no known ecological impacts of Eusarsiella zostericola (Fofonoff et al. 2003).

Sources:
NEMESIS; Fofonoff et al. 2003

4.4 Impact on high-value, rare, or sensitive species and/or communities

Choice: D — No impact

Score: 0 of 2.5

Ranking Rationale:

Background Information:
There are no known ecological impacts of Eusarsiella zostericola (Fofonoff et al. 2003).

Sources:
NEMESIS; Fofonoff et al. 2003

4.5 Introduction of diseases, parasites, or travelers

What level of impact could the species' associated diseases, parasites, or travelers have on other species in the assessment area? Is it a host and/or vector for recognized pests or pathogens, particularly other nonnative organisms?)

Choice: D — No impact

Score: 0 of 2.5

Ranking Rationale:

Background Information:
The are no known diseases, parasites or travelers associated with E. zostericola (Fofonoff et al. 2003).

Sources:
NEMESIS; Fofonoff et al. 2003

4.6 Level of genetic impact on native species

Can this invasive species hybridize with native species?

Choice: D — No impact

Score: 0 of 2.5

Ranking Rationale:

Background Information:
There are no known genetic impacts associated with E. zostericola (Fofonoff et al. 2003).

Sources:
NEMESIS; Fofonoff et al. 2003

4.7 Infrastructure

Choice: D — No impact

Score: 0 of 3

Ranking Rationale:

Background Information:
There are no documented cases of impact on infrastructure by E. zostericola (Fofonoff et al. 2003).

Sources:
NEMESIS; Fofonoff et al. 2003

4.8 Commercial fisheries and aquaculture

Choice: D — No impact

Score: 0 of 3

Ranking Rationale:

Background Information:
There are no documented cases of impact on commercial fisheries or aquaculture by E. zostericola (Fofonoff et al. 2003).

Sources:
NEMESIS; Fofonoff et al. 2003

4.9 Subsistence

Choice: D — No impact

Score: 0 of 3

Ranking Rationale:

Background Information:
There are no documented cases of impact on subsistence activities by E. zostericola (Fofonoff et al. 2003).

Sources:
NEMESIS; Fofonoff et al. 2003

4.101 Recreation

Choice: D — No impact

Score: 0 of 3

Ranking Rationale:

Background Information:
There are no documented cases of impact on recreation by E. zostericola (Fofonoff et al. 2003).

Sources:
NEMESIS; Fofonoff et al. 2003

4.11 Human health and water quality

Choice: D — No impact

Score: 0 of 3

Ranking Rationale:

Background Information:
There are no documented cases of impact on human health or water quality by E. zostericola (Fofonoff et al. 2003).

Sources:
NEMESIS; Fofonoff et al. 2003

Section Total - Scored Points:	0
Section Total - Possible Points:	30
Section Total -Data Deficient Points:	0

5. Feasibility of prevention, detection and control

5.1 History of management, containment, and eradication

Choice: B — Not attempted

Score: ____ of ____

Ranking Rationale:

Background Information:
There is no indication in the literature that management, containment or eradication efforts exist for E. zostericola.

Sources:
None listed

5.2 Cost and methods of management, containment, and eradication

Choice: U — Unknown

Score: ____ of ____

Ranking Rationale:

Background Information:
Restrictions on oyster farming would be a form of preventative management, however, the cost of these efforts is unknown.

Sources:
None listed

5.3 Regulatory barriers to prevent introductions and transport

Choice: A — Little to no regulatory restrictions

Score: ____ of ____

Ranking Rationale:

Background Information:
Regulations exist restricting the trade and movement of oysters and oyster seed for cultivation, however, no regulations pertaining to E. zostericola in particular exist.

Sources:
None listed

5.4 Presence and frequency of monitoring programs

Choice: A — No surveillance takes place

Score: ____ of ____

Ranking Rationale:

Background Information:
No species-specific monitoring programs exist for E. zostericola.

Sources:
None listed

5.5 Current efforts for outreach and education

Choice: **A** No education or outreach takes place

Score: _____ **of** _____

Ranking Rationale:

Background Information:
No species-specific efforts for outreach or education exist.

Sources:
None listed

Section Total - Scored Points:	
Section Total - Possible Points:	
Section Total -Data Deficient Points:	

Bering Sea Marine Invasive Species Assessment

Alaska Center for Conservation Science

Literature Cited for *Eusarsiella zostericola*

- Bamber, R. N. 1987. Some aspects of the biology of the North American ostracod Sarsiella zostericola Cushman in the vicinity of a British power station. Journal of Micropaleontology 6: 57-62
- Kornicker, L. S. 1967. A study of three species of Sarsiella (Ostracoda: Myodocopa). Proceedings of the United States National Museum 122: 1-46.
- Kornicker, L. S. 1986. Sarsiellidae of the Western Atlantic and northern Gulf of Mexico, and revision of the Sarsiellinae (Ostracoda: Myodocopina). Smithsonian Contributions to Zoology 415:1-217.
- Fofonoff, P. W., G. M. Ruiz, B. Steves, C. Simkanin, and J. T. Carlton. 2017. National Exotic Marine and Estuarine Species Information System. http://invasions.si.edu/nemesis/. Accessed: 15-Sep-2017.
- Peterson, H. A., and Vayssieres, M. 2010. Benthic assemblage variability in the Upper San Francisco Estuary: a 27-year retrospective. San Francisco Estuary and Watershed Science 8(1).
- California Department of Fish and Wildlife. 2014. Introduced aquatic species in California bays and harbors, 2011 survey. Marine Invasive Species Program, Office of Spill Prevention and Response, California Department of Fish and Wildlife, Sacramento, CA.
- Kornicker, L. S. 1975. Spread of ostracodes to exotic environs on transplanted oysters. Bulletins of American Paleontology 65:129-139.
- Wilson, S., and V. Partridge. 2007. Condition of outer coastal estuaries of Washington State, 1999: A statistical summary. Publication No. 07 03-012, Washington State Department of Ecology. 248 pp.
- Cohen, A. N., Berry, H. D., Mills, C. E., Milne, D., Britton-Simmons, K., Wonham, M. J., Secord, D. L., et al. 2001. Washington State exotic expedition 2000: A rapid survey of exotic species in the shallow waters of Elliott Bay, Totten and Eld Inlets, and
- Faasse, M. 2013. The North American ostracod Eusarsiella zostericola (Cushman, 1906) arrives in mainland Europe. BioInvasions Records 2(1):47-50.
- Carlton, J. T., and J. B. Geller. 1993. Ecological roulette: The global transport of nonindigenous marine organisms. Science 261(5117): 78-82.
- Wass, M. L. 1972. A Check List of the Biota of Lower Chesapeake Bay. Special Scientific Report 65, Virginia Institute of Marine Science, University of Virginia, Charlottesville, VA, U.S.A. 290 pp.