Bering Sea Marine Invasive Species Assessment

Alaska Center for Conservation Science

Scientific Name: *Melita nitida*

Common Name *an amphipod*

Phylum	Arthropoda
Class	Malacostraca
Order	Amphipoda
Family	Melitidae

Final Rank 47.30

Data Deficiency: 21.25

Species Occurrence by Ecoregion

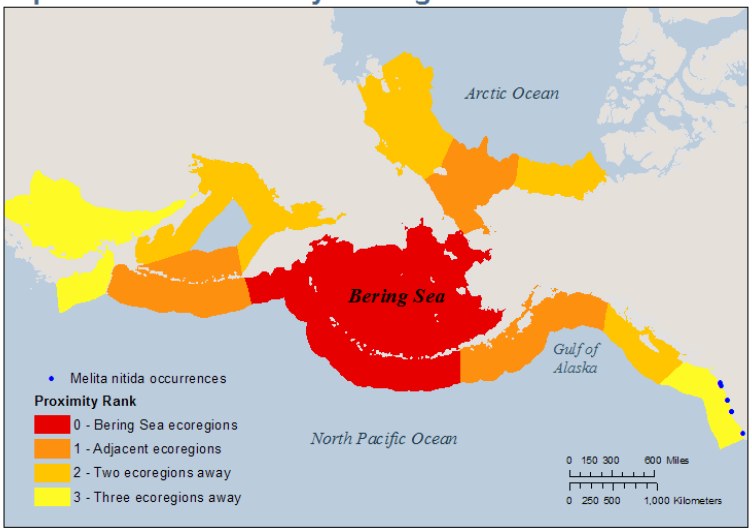

Figure 1. Occurrence records for non-native species, and their geographic proximity to the Bering Sea. Ecoregions are based on the classification system by Spalding et al. (2007). Occurrence record data source(s): NEMESIS and NAS databases.

Category Scores and Data Deficiencies

Category	Score	Total Possible	Data Deficient Points
Distribution and Habitat:	16.25	26	3.75
Anthropogenic Influence:	4.75	10	0
Biological Characteristics:	14.75	23	7.50
Impacts:	1.5	20	10.00
Totals:	37.25	78.75	21.25

General Biological Information

Tolerances and Thresholds

Minimum Temperature (°C)	0	Minimum Salinity (ppt)	0
Maximum Temperature (°C)	32	Maximum Salinity (ppt)	35
Minimum Reproductive Temperature (°C)	NA	Minimum Reproductive Salinity (ppt)	31*
Maximum Reproductive Temperature (°C)	NA	Maximum Reproductive Salinity (ppt)	35*

Additional Notes

Melita nitida is a slender amphipod with a grayish body and a red spot on the head. Males can reach 12 mm and females 9 mm in length. It is Native to east coast of North America and introduced to the West Coast and Europe (Fofonoff et al. 2003). Is very similar to three other Melita species found in the Gulf of Mexico (Sheridan 1979). West Coast populations may not be M. nitida, but another similar or undescribed species (Chapman, in Carlton 2007; Graening et al. 2012).

1. Distribution and Habitat

1.1 Survival requirements - Water temperature

Choice: **B** Moderate overlap – A moderate area (≥25%) of the Bering Sea has temperatures suitable for year-round survival

Score: 2.5 of 3.75

High uncertainty? ✔

Ranking Rationale:
Temperatures required for year-round survival occur in a moderate area (≥25%) of the Bering Sea. Thresholds are based on geographic distribution, which may not represent physiological tolerances; moreover, models disagree with respect to their estimates of suitable area. We therefore ranked this question with "High uncertainty".

Background Information:
The survival temperature threshold for M. nitida is 0 to 32°C (based on geographic distribution; Fofonoff 2003)

Sources:
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:
The salinity range for survival of M. nitida is 0 to 35 ppt (Fofonoff et al. 2003)

Sources:
NEMESIS; Fofonoff et al. 2003

1.3 Establishment requirements - Water temperature

Choice: **U** Unknown/Data Deficient

Score: of

Ranking Rationale:

Background Information:
No information on optimal temperature thresholds for reproduction of M. nitida were available in the literature. A lab study found that an increase in temperature from 17 to 21°C led to quicker embryonic development (10 days vs. 5 days; Borowsky 1980).

Sources:
Borowsky 1980

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 occurrence is British Columbia.

Background Information:
Current occurrence records in the NEMESIS data base include British Columbia and California (Fofonoff et al 2003).

Sources:
NEMESIS; Fofonoff et al. 2003

1.6 *Global ecoregional distribution*

Choice: B In a moderate number of ecoregions globally

Score: 3.25 **of** 5

Ranking Rationale:
Found along East and West coasts of North America and in Europe.

Background Information:
Wide native distribution in eastern North America, from Nova Scotia/PEI to Florida, and from the Gulf of Mexico to Colombia (Caribbean Sea). Introduced to the west coast of North America from California to British Columbia, Canada. In Europe, M. nitida is recorded in France, Germany and the Netherlands.

Sources:
NEMESIS; Fofonoff et al. 2003

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:
Can rapidly colonize and increase in abundance, but evidence exists for declines in introduced ranges.

Background Information:
In 2010, twenty-seven specimens were collected in the Kiel Canal, Germany, near the Baltic Sea entrance in Kiel (Reichert and Beermann 2011). Future establishment and spread of this amphipod in the North Sea and Baltic seems likely (Fofonoff et al. 2003). Although M. nitida can rapidly colonize new habitats and increase local abundance rapidly, colonization experiments found that population growth on clam shells decreased over time and became negative after several months (Munguia et al. 2007). In the Western Scheldt in the Netherlands, M. nitida had a very limited range four years after it was first discovered (Faasse and van Moorsel 2003).

Sources:
Reichert and Beerman 2011 NEMESIS; Fofonoff et al. 2003 Munguia et al. 2007 Faasse and Moorsel 2003

Section Total - Scored Points:	16.25
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

High uncertainty? ✔

Ranking Rationale:
Has been observed using anthropogenic vectors; limited information regarding movements after introduction.

Background Information:
Presumed to have been introduced through anthropogenic vectors, including ballast water and hull fouling, in bait packed in seaweed, or with oyster transplants. Found on the western coast of North America (Fofonoff 2003).

Sources:
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:
Known to use anthropogenic or disturbed sites for establishment; no information on the use of natural sites after introduction.

Background Information:
Introductions in Europe are currently associated with anthropogenic sites (oyster farms, canals), and no follow-up studies have been published on its subsequent spread into natural areas (Faasse and van Moorsel 2003; Reichert and Beermann 2011; Gouillieux et al. 2016). In California, was found in greater densities on non-native tubeworms than on native oysters (Heiman et al. 2008). Has been recorded at many sites throughout the west coast of North America, where it occurs from California to British Columbia, but no genetic analysis has been conducted to determine whether these records are the result of natural dispersal or anthropogenic spread (e.g. primary followed by secondary dispersal).

Sources:
Faasse and Moorsel 2003   Reichert and Beerman 2011   Gouillieux et al. 2016   Heiman et al. 2008

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: A — Generalist at all life stages and/or foods are readily available in the study area

Score: 5 of 5

Ranking Rationale:
Preys on taxa that are readily available in the Bering Sea.

Background Information:
M. nitida is a surface deposit feeder, interface feeder and faculative suspension feeder (Lowrey and Costello 2010; Wildish and Peer 1981). It feeds primarily on epiphytic algae and seagrass debris (Fofonoff 2003).

Sources:
Lowrey and Costello 2010   Wildish and Peer 1981   NEMESIS; Fofonoff et al. 2003

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:
Tolerates wide range of water temperatures and salinities, and uses numerous habitat types.

Background Information:
M. nitida tolerates temperatures of 0°C to 32°C and salinities of 0 PSU to 35 PSU (Bousfield 1973; Sheridan 1979, as qtd. In Fofonoff et al. 2003; Chapman 1988). Habitats include intertidal mudflats, rocks, and debris, clumps of hydroids and bryozoans, floats and pilings, buoys, and crevices created by oysters and bivalves (Bousfield 1973; Sheridan 1979, as qtd. in Fofonoff et al. 2003; Chapman 1988; Munguia et al. 2007). Associated with low-tide to subtidal areas, and with the seafloor, where it burrows and feeds (Borowsky et al. 1997).

Sources:
Bousfield 1973   Chapman 1988   Munguia et al. 2007   Borowsky et al. 1997   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, moderate fecundity, high parental investment, internal fertilization.

Background Information:
Sexual reproduction with internal fertilization. Direct development (no larval stage) and long parental investment. Brood sizes range from 5 - 51 embryos with an average of 30 (Fofonoff et al. 2003). Under controlled conditions, embryos took 10 days to develop at 17°C, and 5 days at 21°C (Borowsky 1980). M. nitida has two generations a year, one in the spring and one in the fall (that overwinters) (Borowsky et al. 1997).

Sources:
NEMESIS; Fofonoff et al. 2003 Borowsky 1980 Borowsky et al. 1997

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: U Unknown

Score: **of**

Ranking Rationale:

Background Information:
No information available in the literature.

Sources:
Munguia et al. 2007

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: B Moderate – Exhibits one of the above characteristics

Score: 1.75 **of** 2.5

Ranking Rationale:
Disperses only as an adult.

Background Information:
Eggs are brooded internally with no external larval stage; individuals hatch as juveniles, which resemble adults. Munguia et al. (2007) found that 97% of M. nitida dispersers were adults, which suggests that the juvenile life stage is not an important dispersal stage.

Sources:
Munguia et al. 2007

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 predators, many of which exist in the Bering Sea.

Background Information:
Likely predators include crabs, shrimps, fishes, and shorebirds (Fofonoff 2003).

Sources:
NEMESIS; Fofonoff et al. 2003

Section Total - Scored Points:	14.75
Section Total - Possible Points:	22.5
Section Total -Data Deficient Points:	7.5

4. Ecological and Socioeconomic Impacts

4.1 *Impact on community composition*

Choice: **D** No impact

Score: 0 of 2.5

Ranking Rationale:
Little to no information in literature suggesting a strong impact of M. nitida on community composition.

Background Information:
In the Netherlands, M. nitida frequently occurs together with M. palmata. A study in 2003 found that the two species exploited different niches: M. palmata occurs mainly higher in the intertidal zone and, unlike M. nitida, was not restricted to the mesohaline part of the estuary (Faasse and van Moorsel 2003). However, as the range of M. nitida was still very limited, it was not possible to predict whether significant competition with M. palmata could occur (Faasse and van Moorsel 2003).

Sources:
Faasse and Moorsel 2003

4.2 *Impact on habitat for other species*

Choice: **U** Unknown

Score: of

Ranking Rationale:

Background Information:
No information available in the literature.

Sources:
NEMESIS; Fofonoff et al. 2003

4.3 *Impact on ecosystem function and processes*

Choice: **U** Unknown

High uncertainty? ☑

Score: of

Ranking Rationale:

Background Information:
No information available in the literature.

Sources:
NEMESIS; Fofonoff et al. 2003

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

Choice: **D** No impact

High uncertainty? ☑

Score: 0 of 2.5

Ranking Rationale:
To date, nor impacts on high-value, rare, or sensitive species have been reported for M. nitida, and given its ecology, none would be expected.

Background Information:
No impacts have been reported in the literature (Fofonoff 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: **U** Unknown

Score: of

Ranking Rationale:

Background Information:
No information available in the literature.

Sources:
None listed

4.6 Level of genetic impact on native species

Can this invasive species hybridize with native species?

Choice: **U** Unknown

Score: of

Ranking Rationale:

Background Information:
No information available in the literature.

Sources:
None listed

4.7 Infrastructure

Choice: **C** Limited – Has limited potential to cause degradation to infrastructure, with limited impact and/or within a very limited region

Score: 0.75 of 3

Ranking Rationale:
Is a fouling species found on ships, dock floats, and pilings.

Background Information:
M. nitida has been found fouling ships, dock floats and pilings (Faase and Moorsel 2003; Reichert and Beermann 2011; Gouillieux et al. 2016), but no economic impacts have been recorded.

Sources:
Faasse and Moorsel 2003   Reichert and Beerman 2011   Gouillieux et al. 2016

4.8 Commercial fisheries and aquaculture

Choice: **C** Limited – Has limited potential to cause degradation to fisheries and aquaculture, and/or is restricted to a limited region

Score: 0.75 of 3

Ranking Rationale:

Background Information:
In its native range, M. nitida is commonly associated with the Eastern oyster, but no economic impacts have been reported.

Sources:
NEMESIS; Fofonoff et al. 2003

4.9 Subsistence

Choice: **D** No impact

Score: 0 of 3

Ranking Rationale:
To date, no impacts on subsistence have been reported for M. nitida, and given its ecology, none would be expected.

Background Information:
No information available in the literature.

Sources:
None listed

4.101 Recreation

Choice: **D** No impact

High uncertainty? ☑

Score: 0 of 3

Ranking Rationale:
To date, no impacts on recreation have been reported for M. nitida, and given its ecology, none would be expected.

Background Information:
No information available in the literature.

Sources:
NEMESIS; Fofonoff et al. 2003

4.11 Human health and water quality

Choice: **D** No impact

High uncertainty? ☑

Score: 0 of 3

Ranking Rationale:
To date, no impacts on human health or water quality have been reported for M. nitida, and given its ecology, none would be expected.

Background Information:
No information available in the literature.

Sources:
NEMESIS; Fofonoff et al. 2003

Section Total - Scored Points:	1.5
Section Total - Possible Points:	20
Section Total -Data Deficient Points:	10

5. Feasibility of prevention, detection and control

5.1 History of management, containment, and eradication

Choice: **C**

Attempted; control methods are currently in development/being studied

Score:

of

Ranking Rationale:

Effective methods of managing ballast water and hull fouling are currently being developed.

Background Information:

Although regulations for ballast water and hull fouling exist in Alaska, this species is transported by numerous vectors and no species-specific regulations are currently in place. Management of both ballast water and hull fouling is currently being developed (Hagan et al. 2014; Ruiz and Reid 2007).

Sources:

Hagan et al. 2014   Ruiz and Reid 2007

5.2 Cost and methods of management, containment, and eradication

Choice: **B**

Major short-term and/or moderate long-term investment

Score:

of

Ranking Rationale:

Current hull fouling technologies that address invasive species require purchasing of specialized equipment and regular cleaning.

Background Information:

Current hull fouling technologies that address invasive species require purchasing of specialized equipment and regular cleaning. To comply with ballast water regulations, vessels will have to equip themselves with an onboard ballast water treatment system. These systems represent a major short-term cost for vessel owners (up to $3 million), with additional costs over time to maintain and replace equipment (e.g. chemicals, filters, UV light bulbs).

Sources:

Zagdan 2010   Hagan et al. 2014

5.3 *Regulatory barriers to prevent introductions and transport*

Choice: **B** Regulatory oversight, but compliance is voluntary

Score: of

Ranking Rationale:
Compliance with fouling regulations are voluntary. Alaska does not have state regulations on ballast water management, but two federal regulations (USCG and EPA) require mandatory reporting and either exchange or treatment of ballast water.

Background Information:
Hull fouling: In the U.S., Coast Guard regulations require masters and ship owners to clean vessels and related infrastructure on a “regular” basis (CFR 33 § 151.2050). Failure to remove fouling organisms is punishable with a fine (up to $27 500). However, because the word “regular” is not defined, regulations are hard to enforce and compliance remains largely voluntary (Hagan et al. 2014). Cleaning of recreational vessels is also voluntary, although state and federal programs are in place to encourage owners to clean their boats. Boat inspection is mandatory on some lakes (e.g. Lake Tahoe in CA/NV, Lake George in NY). In summer 2016, state and federal agencies conducted voluntary inspections for aquatic invasive species on trailered boats entering the state of Alaska (Davis 2016).

Ballast Water: State regulations: Alaska does not have a state regulations related to the management of aquatic invasive species in discharged ballast water. It relies on the U.S. Coast Guard (USCG) to enforce national standards. In Alaska, data from 2009-2012 show moderate to high compliance with USCG reporting requirements (Verna et al. 2016).

Federal regulations: In the U.S., ballast water management (treatment or exchange) and record-keeping is mandatory and regulated by the USCG, with additional permitting by the Environmental Protection Agency (EPA). Certain vessels (e.g. small vessels or those traveling within 1 Captain of the Port Zone) are exempt from USCG and EPA regulations.

Sources:
CFR 2017   Hagan et al. 2014   Davis 2016   Verna et al. 2016   EPA 2013

5.4 *Presence and frequency of monitoring programs*

Choice: **A** No surveillance takes place

Score: of

Ranking Rationale:

Background Information:
No information available in the literature to suggest that there are monitoring programs in place for M. nitida.

Sources:
None listed

5.5 *Current efforts for outreach and education*

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

Score: of

Ranking Rationale:
Information on M. nitida is scarce, and no evidence of outreach taking place was present in the literature.

Background Information:
M. nitida was mentioned in an educational brochure on aquatic invasive species (100th Meridian Initiative 2009). Listed on a few invasive/nonnative species “checklists” (e.g. in CA and OR), but with little information provided beyond that.

Sources:
Behrens Yamada 1982

Section Total - Scored Points:

Section Total - Possible Points:

Section Total -Data Deficient Points:

Literature Cited for *Melita nitida*

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