Bering Sea Marine Invasive Species Assessment

Alaska Center for Conservation Science

Scientific Name: *Paracorophium spp.*

Common Name *an amphipod*

Phylum Arthropoda
Class Malacostraca
Order Amphipoda
Family Corophiidae

Final Rank 29.15
Data Deficiency: 26.25

Species Occurrence by Ecoregion

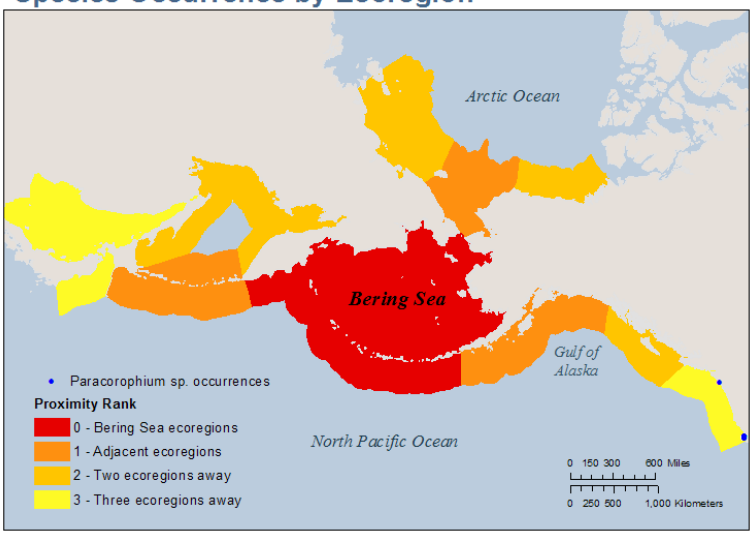

Figure 1. Occurrence records for non-native species, and their geographic proximity to the Bering Sea. Ecoregions are based on the classification system by Spalding et al. (2007). Occurrence record data source(s): NEMESIS and NAS databases.

Category Scores and Data Deficiencies

Category	Score	Total Possible	Data Deficient Points
Distribution and Habitat:	6.75	14	16.25
Anthropogenic Influence:	2	10	0
Biological Characteristics:	12	23	7.50
Impacts:	0.75	28	2.50
Totals:	21.50	73.75	26.25

General Biological Information

Tolerances and Thresholds

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

Additional Notes

Paracorophium sp. is a tube-building amphipod endemic to warm and temperate waters in the Southern Hemisphere. In North America, it has been introduced to California. The taxonomic identity of this introduced population is unknown.

1. Distribution and Habitat

1.1 Survival requirements - Water temperature

Choice: U — Unknown/Data Deficient

Score: [ ] of [ ]

High uncertainty? ☑

Ranking Rationale:
Temperatures requirements for survival are unknown.

Background Information:
Paracorophium spp. occur in warm temperate to cold temperate environments (Fofonoff et al. 2003). Occurrence records are available for Paracorophium species in Eureka (NAS database) which has an average water temperature that ranges from 10 to 11.1 C (Trinidad CA; NOAA 2017).

Sources:
NEMESIS; Fofonoff et al. 2003 NAS database, USGS 2017 NOAA 2017

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

High uncertainty? ☑

Ranking Rationale:
Surival has been observed in a variety of salinities from 0 ppt to full salinity.

Background Information:
Tolerant of a wide range of salinities. Has been observed in water ranging from 0 ppt to full salinity (Boyd et al. 2002; Chapman et al. 2002; Stevens et al. 2002; Chapman 2007 as qtd. In Fofonoff et al. 2003; Southern California Association of Marine Invertebrate Taxonomists 2008).

Sources:
Boyd et al. 2002 Chapman et al. 2002 Stevens et al. 2002 NEMESIS; Fofonoff et al. 2003 Southern California Association of Marine Invertebrate Taxonomists 2008

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: U — Unknown/Data Deficient

Score: [ ] of [ ]

Ranking Rationale:

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:
Present in an ecoregion three regions away from the Bering Sea.

Background Information:
Occurrences for Paracorophium spp. have been reported in Humboldt Bay, Tomales Bay, Morro Bay, and Elkhorn Slough CA (Boyd et al. 2002; Southern California Association of Marine Invertebrate Taxonomists 2008; Graening et al. 2012; California Department of Fish and Wildlife 2014).

Sources:
Boyd et al. 2002 Southern California Association of Marine Invertebrate Taxonomists 2008 Graening et al. 2012 California Department of Fish and Wildlife 2014 NEMESIS; Fofonoff et al. 2003

1.6 Global ecoregional distribution

Choice: C — In few ecoregions globally

Score: 1.75 of 5

High uncertainty? ☑

Ranking Rationale:
Paracorophium spp. are present to numerous locations in the Southern Hemisphere, however, these results are for three species; the species located in California may be more limited in its distribution.

Background Information:
Paracorophium spp. is known from its introduced range: Humboldt Bay, Tomales Bay, Elkhorn Slough, and Morro Bay, CA (Chapman 2007 as qtd. In Fofonoff et al. 2003; Southern California Association of Marine Invertebrate Taxonomists 2008; Graening et al. 2012; California Department of Fish and Wildlife 2014). It is an unknown amphipod that may actually be one or more species. Other paracorophium species are mainly known in the Southern Hemisphere with specific species occurring in New Zealand, Australia, Chile, Palau, and Thailand (Gonzalez 1986, as qtd. in Fofonoff et al. 2003; Barnard and Karaman 1991; Fenwick 2001; Myers 2009; Wongkamhaeng et al. 2015).

Sources:
NEMESIS; Fofonoff et al. 2003 Southern California Association of Marine Invertebrate Taxonomists 2008 Graening et al. 2012 California Department of Fish and Wildlife 2014 Barnard and Karaman 1991 Fenwick 2001 Myers 2009 Wongkamhaeng et al. 2015

1.7 Current distribution trends

Choice: U — Unknown/Data Deficient

Score: of

High uncertainty? ☑

Ranking Rationale:
Data deficient. The only non-native records for Paracorophium spp. are in California (2011; NAS, USGS 2017). No information available regarding recent spread in non-native range.

Background Information:
No information available in the literature.

Sources:
NAS database, USGS 2017

Section Total - Scored Points:	6.75
Section Total - Possible Points:	13.75
Section Total -Data Deficient Points:	16.25

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:

Reported as using ballast water and hull fouling as a transportation vector. Has not been observed moving naturally outside of areas of introduction.

Background Information:

Paracorophium spp. is considered native to New Zealand and South America. The lumber trade with New Zealand and Brazil could have introduced this species to California through hull fouling, dry ballast, and ballast water (Boyd et al. 2002; NAS database, USGS 2017). Ballast water and hull fouling are listed as potential transportation vectors for Paracorophium sp. in the NAS database (NAS database, USGS 2017).

Sources:

Boyd et al. 2002 NAS database, USGS 2017 NEMESIS; Fofonoff et al. 2003

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

Choice: **D**

Does not use anthropogenic disturbance/infrastructure to establish

Score: **0** **of** **4**

Ranking Rationale:

Establishes in natural habitat; has not been observed establishing on marine infrastructure.

Background Information:

Paracorophium spp. in CA is found in muddy intertidal areas and salt marshes. Does not require marine infrastructure to establish.

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:

NEMESIS; Fofonoff et al. 2003

Section Total - Scored Points:	2
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 numerous taxa readily available in the Bering Sea.

Background Information:
If Paracorophium spp. are like other corophiid amphipods, it probably consumes phytoplankton, detritus, benthic microalgae, and filamentous epiphytic algae (Bousfield 1973).

Sources:
Bousfield 1973 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: B — Requires specialized habitat for some life stages (e.g., reproduction)

Score: 3.25 of 5

Ranking Rationale:

Background Information:
Near shore species, restricted to muddy intertidal habitats, salt marshes, and shallow channels, often with freshwater input. Tolerant of a variety of habitats (intertidal and freshwater), temperatures and salinity regimes.

Sources:
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, high parental investment, internal fertilization.

Background Information:
Paracorophium spp. are not asexual or hermaphroditic. Females brood small broods of eggs and sexual maturity is achieved at approximately 6 months of age.

Sources:
NEMESIS; Fofonoff et al. 2003

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:
Dispersal is limited to crawling, swimming or rafting (Fofonoff 2003). Distances are not mentioned in the literature.

Sources:
NEMESIS; Fofonoff et al. 2003

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

Ranking Rationale:

Background Information:
There is no larval stage for Paracorophium spp. and adults have low mobility with dispersal being limited to crawling, swimming and rafting (Fofonoff et al. 2003).

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

High uncertainty? ☑

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

Background Information:
Likely predators include fish and shrimp.

Sources:
NEMESIS; Fofonoff et al. 2003

Section Total - Scored Points:	12
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

High uncertainty? ☑

Ranking Rationale:
To date, no impacts on community composition have been reported for Paracorophium spp., and given its ecology, none would be expected.

Background Information:
No information available in the literature.

Sources:
None listed

4.2 Impact on habitat for other species

Choice: D — No impact

Score: 0 of 2.5

High uncertainty? ☑

Ranking Rationale:
To date, no impacts on habitat for other species have been reported for Paracorophium spp., and given its ecology, none would be expected.

Background Information:
No information available in the literature.

Sources:
NEMESIS; Fofonoff et al. 2003

4.3 Impact on ecosystem function and processes

Choice: D — No impact

Score: 0 of 2.5

High uncertainty? ☑

Ranking Rationale:
To date, no impacts on ecosystems functions and processes have been reported for Paracorophium spp., and given its ecology, none would be expected.

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

Score: 0 of 2.5

High uncertainty? ☑

Ranking Rationale:
To date, no impacts on high-value, rare, or sensitive species have been reported for Paracorophium spp., and given its ecology, none would be expected.

Background Information:
No information available in the literature.

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: C — Limited – Has limited potential to spread one or more organisms, with limited impact and/or within a very limited region

Score: 0.75 of 2.5

High uncertainty? ☑

Ranking Rationale:
A closely related species was found to be a host to a nematode species.

Background Information:
Paracorophium excavatum, a closely related species found in New Zealand, was found to be a host for a previously undescribed fourth-stage larvae of anisakid nematodes. The impacts of this parasite are unknown and it has not been studied in introduced populations (Luque et al. 2007).

Sources:
Luque et al. 2007 NEMESIS; Fofonoff et al. 2003

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: D — No impact

Score: 0 of 3

Ranking Rationale:

Background Information:
Paracorophium spp. have not been observed interacting with marine infrastructure and no impacts on infrastructure are predicted.

Sources:
NEMESIS; Fofonoff et al. 2003

4.8 Commercial fisheries and aquaculture

Choice: D — No impact

Score: 0 of 3

High uncertainty? ☑

Ranking Rationale:
To date, no impacts on commercial fisheries an aquaculture have been reported for Paracorophium spp., and given its ecology, none would be expected.

Background Information:
No information available in the literature.

Sources:
None listed

4.9 Subsistence

Choice: D — No impact

Score: 0 of 3

Ranking Rationale:
To date, no impacts on subsistence have been reported for Paracorophium spp., 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

Score: 0 of 3

Ranking Rationale:
To date, no impacts on recreation have been reported for Paracorophium spp., 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

Score: 0 of 3

High uncertainty? ☑

Ranking Rationale:
To date, no impacts on human health or water quality have been reported for Paracorophium spp., and given its ecology, noe would be expected.

Background Information:
No information available in the literature.

Sources:
NEMESIS; Fofonoff et al. 2003

Section Total - Scored Points:	0.75
Section Total - Possible Points:	27.5
Section Total -Data Deficient Points:	2.5

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:
No species-specific management, containment or eradication exists for Paracorophium spp. Management and control methods do exist for ballast water and hull fouling in general.

Background Information:
Ballast water exchange is the method currently used by most ships to reduce the spread of species by ballast water. However, it is considered a short-term or "stop-gap" option until more effective, technology-based methods become available e.g., ballast water treatment systems (Ruiz and Reid 2007). The treatment of ballast water is an active area of research as vessels are forced to comply with new regulations. Hull fouling technologies that treat and/or safely dispose of marine organisms, without being toxic to the environment, are currently being studied.

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

Background Information:
No species specific methods have been reported in the literature. However, methods to deal with ballast water and hull fouling have been tested.

The costs associated with purchasing a ballast water treatment system depend on the volume of the water that needs to be treated. Systems with a pump capacity of 200-250 m3/h can cost form $175,000 to $490,000. The estimated price for larger systems with a pump capacity of around 2000 m3/h range from $650,000 to nearly $3 million.

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

Sources:
FUSP 2013 Zagdan 2010

5.3 Regulatory barriers to prevent introductions and transport

Choice: B — Regulatory oversight, but compliance is voluntary

Score: _____ of _____

Ranking Rationale:
Regulatory barriers and preventative measures for general biofouling and ballast water discharge apply to this species but nothing specific could be found in the literature. Compliance with general fouling regulations are voluntary.

Background Information:
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).

Sources:
CFR 2017 Hagan et al. 2014 Davis 2016

5.4 Presence and frequency of monitoring programs

Choice: A — No surveillance takes place

Score: _____ of _____

Ranking Rationale:

Background Information:
No monitoring programs currently exist for Paracorophium spp.

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:
Education and outreach efforts are limited to more general invasive awareness and prevention methods such as ballast water discharge reduction.

Sources:
None listed

Section Total - Scored Points:

Section Total - Possible Points:

Section Total -Data Deficient Points:

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Literature Cited for *Paracorophium spp.*

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