Bering Sea Marine Invasive Species Assessment

Alaska Center for Conservation Science

Scientific Name: *Watersipora subtorquata complex*

Common Name *red-rust bryozoan*

Phylum	Bryozoa
Class	Gymnolaemata
Order	Cheilostomatida
Family	Watersiporidae

Final Rank 58.51

Data Deficiency: 16.25

Species Occurrence by Ecoregion

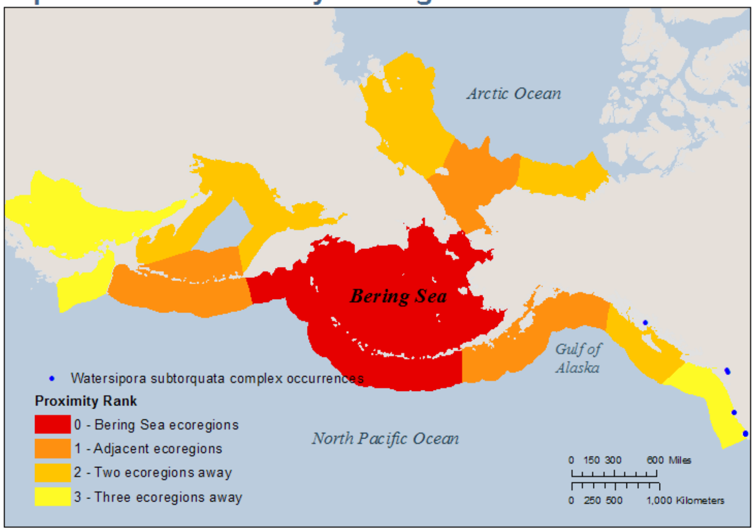

Figure 1. Occurrence records for non-native species, and their geographic proximity to the Bering Sea. Ecoregions are based on the classification system by Spalding et al. (2007). Occurrence record data source(s): NEMESIS and NAS databases.

Category Scores and Data Deficiencies

Category	Score	Total Possible	Data Deficient Points
Distribution and Habitat:	20	26	3.75
Anthropogenic Influence:	3.25	10	0
Biological Characteristics:	19	25	5.00
Impacts:	6.75	23	7.50
Totals:	49.00	83.75	16.25

General Biological Information

Tolerances and Thresholds

Minimum Temperature (°C)	6.7	Minimum Salinity (ppt)	25
Maximum Temperature (°C)	30.6	Maximum Salinity (ppt)	40
Minimum Reproductive Temperature (°C)	NA	Minimum Reproductive Salinity (ppt)	31*
Maximum Reproductive Temperature (°C)	NA	Maximum Reproductive Salinity (ppt)	35*

Additional Notes

Colonial bryozoan that is red or orange in color. Its native range is unknown. Watersipora subtorquata is a species complex that has not been taxonomically resolved.

Reviewed by Linda McCann, Research Technician, Smithsonian Environmental Research Center, Tiburon, CA

Review Date: 12/15/2017

1. Distribution and Habitat

1.1 Survival requirements - Water temperature

Choice: D — No overlap – Temperatures required for survival do not exist in the Bering Sea

Score: 0 of 3.75

Ranking Rationale:
Year-round temperature requirements do not exist in the Bering Sea.

Background Information:
The temperature range for survival is 6.7°C to 30.6°C (Zerebecki and Sorte 2011).

Sources:
Zerebecki and Sorte 2011   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:
This species has a salinity range of 25 to 40 ppt (Cohen 2011; Wyatt et al. 2005).

Sources:
Cohen 2011   Wyatt et al. 2005

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

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: C Present in an ecoregion two regions away from the Bering Sea (i.e. adjacent to an adjacent ecoregion)

Score: 2.5 of 5

Ranking Rationale:
Present in Southeast Alaska.

Background Information:
Discovered in Ketchikan, AK in 2010 (Ashton et al. 2014).

Sources:
Ashton et al. 2014

1.6 Global ecoregional distribution

Choice: A In many ecoregions globally

Score: 5 of 5

Ranking Rationale:
Wide global distribution.

Background Information:
Globally distributed. In North America, it is widely distributed in California; it also occurs in OR and WA, and north to Ketchikan, AK. Also found in Florida, Jamaica, Puerto Rico, Hawaii, and Brazil. In Europe, has been found in England and France. Also reported in the Middle East (Egypt, Lebanon). In Asia, found along the coasts of Japan, Korea, and China, including the Sea of Japan and East China Sea. In the Southern Hemisphere, it is found in South Africa, Australia, and New Zealand.

Sources:
NEMESIS; Fofonoff et al. 2003

1.7 Current distribution trends

Choice: A Recent rapid range expansion and/or long-distance dispersal (within the last ten years)

Score: 5 of 5

Ranking Rationale:
Recent documentation of range expansion and long-distance dispersal.

Background Information:
Where introduced, is able to become a dominant species in a relatively short period of time. In 1970-1971 was listed as one of seven rare non-native species off the coast of California. In 2006 it was listed as one of the eight most abundant species with potential for rapid growth and expansion (Lonhart 2012).

Sources:
Lonhart 2012 NEMESIS; Fofonoff et al. 2003

Section Total - Scored Points:	20
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:
Readily transported via fouling, but natural dispersal is limited.

Background Information:
Long-distance dispersal is likely due to fouling as W. subtorquata has a short mobile life stage (Ryland et al. 2009). Marine debris, including tsunami debris, is also a potential transport vector (L. McCann, pers. comm.).

Sources:
Ryland et al. 2009   NEMESIS; Fofonoff et al. 2003

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

Choice: C — Uses anthropogenic disturbance/infrastructure to establish; never observed establishing in undisturbed areas

Score: 1.25 of 4

Ranking Rationale:
Typically associated with anthropogenic substrates.

Background Information:
W. subtorquata establishes itself on hard substrates. It has been observed on several anthropogenic structures such as pilings, floats, oil platforms, ships' hulls, and fouling plates (Mackie et al. 2006; Page et al. 2006; Cohen and Zabin 2009; Ryland et al. 2009).

Sources:
Mackie et al. 2006   Page et al. 2006   Cohen and Zabin 2009   Ryland et al. 2009   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:
This species is not farmed or cultivated.

Background Information:

Sources:
None listed

Section Total - Scored Points:	3.25
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:
Feeds on taxa readily available in the Bering Sea.

Background Information:
Larvae are lecithotrophic, adults are suspension feeders consuming primarily phytoplankton (Fofonoff et al. 2003).

Sources:
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 a wide range of temperatures and uses numerous habitat types. Can enter a dormancy during periods of poor conditions.

Background Information:
Requires hard substrates to establish itself. Has been observed on pilings, rocks, shells, floats, oil platforms, ships' hulls, and fouling plates (Mackie et al. 2006; Page et al. 2006; Cohen and Zabin 2009; Ryland et al. 2009).
Can lie dormant in toxic conditions and recover as conditions improves (Piola and Johnston 2006).
Has a wide temperature range and moderate salinity range

Sources:
Mackie et al. 2006   Page et al. 2006   Cohen and Zabin 2009   Ryland et al. 2009   Piola and Johnston 2006   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: A High – Exhibits three or four of the above characteristics

Score: 5 of 5

Ranking Rationale:
Asexual and hermophroditic with low parental investment.

Background Information:
Asexual reproduction through budding. Colonies are hermaphroditic, and capable of sexual reproduction. Eggs are brooded and released once mature. No parental care exists beyond that. Lifespan and age at maturity is unknown. Able to lie dormant in unsuitable (e.g. toxic) conditions and recover as conditions improve.

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: C Disperses short (< 1 km) distances

Score: 0.75 of 2.5

Ranking Rationale:
Natural dispersal only occurs at one life stage that lasts a short time.

Background Information:
Larvae is free-swimming, but shorted live (≤1 day). Adult is sessile and attached to a hard substrate.

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:
Has only one short mobile phase as a larvae.

Background Information:
Larvae are free-swimming, but short-lived, settling on substrate within a day or less. Adults are sessile.

Sources:
NEMESIS; Fofonoff et al. 2003

3.7 Vulnerability to predators

Choice: **C** Few predators suspected present in the Bering Sea and neighboring regions, and/or multiple predators in native range

Score: 2.5 **of** 5

High uncertainty? ✔

Ranking Rationale:
Expected to have few predators in the Bering Sea.

Background Information:
Predators include sea slugs and sea spiders, and occasionally sea urchins and chitons. However, calcareous crusts are not readily eaten by most predators (O'Clair and O'Clair 1998).

Sources:
O'Clair and O'Clair 1998

Section Total - Scored Points:	19
Section Total - Possible Points:	25
Section Total -Data Deficient Points:	5

4. Ecological and Socioeconomic Impacts

4.1 *Impact on community composition*

Choice: B Moderate – More than one trophic level; may cause declines but not extirpation

Score: 1.75 of 2.5

Ranking Rationale:
By creating habitat for other species, is known to cause changes in community composition in warm-temperate climates.

Background Information:
Displaces local Watersipora species to become dominant species as seen in New Zealand (Gordon and Mawatari 1992), Australia (Keough and Ross 1999 as qtd. in Fofonoff et al. 2003), and Southern California (Geller et al. 2008 as qtd. in Fofonoff et al. 2003; Banta 1969).

W. subtorquata has a sessile three dimensional growth form that increases species richness by providing a habitat for other species (Sellheim et al. 2010).

Sources:
Gordon and Mawatari 1992 Banta 1969 Sellheim et al. 2010 NEMESIS; Fofonoff et al. 2003

4.2 *Impact on habitat for other species*

Choice: B Moderate – Causes or has potential to cause changes to one or more habitats

Score: 1.75 of 2.5

Ranking Rationale:
Because of its colonial habitat and leaf-like growth structure, W. subtorquata spp. creates habitat for other species to settle on.

Background Information:
Can grow in large colonies on hard substrates providing habitat for other organisms. Often grows leaf-like folds above the substrate creating additional habitat space. Due to its resistance to heavy metals found in anti-fouling plates, it provides habitat for more sensitive species to settle (Floerl et al. 2004).

Sources:
Floerl et al. 2004 NEMESIS; Fofonoff et al. 2003

4.3 *Impact on ecosystem function and processes*

Choice: U Unknown

Score: of

Ranking Rationale:

Background Information:
No information available in the literature.

Sources:
None listed

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

Choice: U Unknown

Score: of

Ranking Rationale:

Background Information:
No information available in the literature.

Sources:
None listed

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: B Moderate – Spreads or has potential to spread one or more organisms, with moderate impact and/or within only a portion of region

Score: 1.75 of 2.5

Ranking Rationale:
Because it provides habitat for other species to settle on, it may introduce "hitchhikers" into new areas.

Background Information:
Facilitates spread of other invasive species by providing a non-toxic surface settle on (Wisely 1958; Allen 1959 as qtd in GISD 2016).

Sources:
GISD 2016

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: B Moderate – Causes or has the potential to cause degradation to infrastructure, with moderate impact and/or within only a portion of the region

Score: 1.5 of 3

Ranking Rationale:
Grows on infrastructure but is not destructive.

Background Information:
Fouls ship hulls, docks, and pilings (Fofonoff et al. 2003). Its resistance to copper-based antifouling paints makes it hard to control (Fofonoff et al. 2003; Piola and Johnston 2006). Once established, it provides a relatively non-toxic surface for other organisms to establish. Hull foulers have negative impacts on ship speed and efficiency (Floerl et al. 2004).

Sources:
NEMESIS; Fofonoff et al. 2003   Floerl et al. 2004

4.8 Commercial fisheries and aquaculture

Choice: **D** No impact

Score: 0 of 3

Ranking Rationale:
No impacts have been reported. Given its ecology, we do not expect this species to impact recreational opportunities in the Bering Sea.

Background Information:
No information found.

Sources:
NEMESIS; Fofonoff et al. 2003

4.9 Subsistence

Choice: **D** No impact

Score: 0 of 3

Ranking Rationale:
No impacts have been reported. Given its ecology, we do not expect this species to impact recreational opportunities in the Bering Sea.

Background Information:
No information available in the literature.

Sources:
NEMESIS; Fofonoff et al. 2003

4.101 Recreation

Choice: **D** No impact

Score: 0 of 3

Ranking Rationale:
No impacts have been reported. Given its ecology, we do not expect this species to impact recreational opportunities in the Bering Sea.

Background Information:
No information found.

Sources:
NEMESIS; Fofonoff et al. 2003

4.11 Human health and water quality

Choice: **D** No impact

Score: 0 of 3

Ranking Rationale:
No impacts have been reported. Given its ecology, we do not expect this species to impact human health or water quality in the Bering Sea.

Background Information:
No information available in the literature.

Sources:
None listed

Section Total - Scored Points:	6.75
Section Total - Possible Points:	22.5
Section Total -Data Deficient Points:	7.5

5. Feasibility of prevention, detection and control

5.1 History of management, containment, and eradication

Choice: **A** Attempted; control methods are not successful

Score: of

Ranking Rationale:
Methods of control have been performed and were unsuccessful.

Background Information:
Tolerant of copper and mercury in antifouling paint, making it difficult to control or eliminate (Allen 1953; Ryland 1971 as qtd. in Fofonoff et al. 2003; Piola and Johnston 2006). Since its populations are usually fairly widespread, local population control using are deemed ineffective (Hayes et al. 2005). Physical removal or chemical treatment options are not yet cost-effective.

Sources:
Allen 1953   NEMESIS; Fofonoff et al. 2003   Piola and Johnston 2006   Hayes et al. 2005

5.2 Cost and methods of management, containment, and eradication

Choice: **A** Major long-term investment, or is not feasible at this time

Score: of

Ranking Rationale:
Current technologies to prevent the transport of marine invasive species are being developed, and require major long-term investments. Resistant to copper-based anti-fouling paints.

Background Information:
This species can be transported via several anthropogenic vectors, including fouling, hitchhiking, and marine debris. Methods to control the spread of marine invasive species are being studied, and currently require major long-term investments (Zagdan 2010; Hagan et al. 2014). This species is resistant to anti-fouling paints (Hayes et al. 2005).

Sources:
Hayes et al. 2005   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.

Background Information:
In the U.S., Coast Guard regulations require masters and ship owners to engage in practices that will reduce the spread of invasive species, including cleaning ballast tanks and removing fouling organisms from hulls, anchors, and other infrastructure on a “regular” basis (CFR 33 § 151.2050). Failure to remove fouling organisms is punishable with a fine (up to $27 500). However, the word “regular” is not defined, which makes the regulations hard to enforce. As a result of this technical ambiguity, compliance with ship fouling regulations 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: B — Surveillance takes place, but is largely conducted by non-governmental environmental organizations (e.g., citizen science programs)

Score: of

Ranking Rationale:
Monitoring for invasive tunicates is conducted by Plate Watch and KBNERR, which are non-governmental agencies.

Background Information:
In Alaska, Plate Watch and Kachemak Bay National Estuarine Research Reserve (KBNERR) conduct monitoring for non-native tunicates and other invasive or harmful species. These programs involve teachers, students, outdoor enthusiasts, environmental groups and professional biologists to detect invasive species. W. subtorquata is listed as a species to look for, and has an ID fact sheet.

Sources:
iTunicate Plate Watch 2016

5.5 *Current efforts for outreach and education*

Choice: C — Educational materials are available and outreach occurs only sporadically in the Bering Sea or adjacent regions

Score: 0 of

Ranking Rationale:
Identification guides are available, but outreach activities occur sporadically.

Background Information:
Plate Watch and the Kachemak Bay National Estuarine Research Reserve (KBNERR) provide training opportunities for identifying and detecting non-native fouling organisms, and public education events on coastal and marine ecosystems more generally. "Bioblitzes" were held in Southeast AK in 2010 and 2012; these events engage and educate the public on marine invasive species. Outreach activities were conducted on the Pribilof Islands for Bering Sea Days in 2017. Field identification guides for native and non-native tunicates, as well as common fouling organisms, are readily available.

Sources:
iTunicate Plate Watch 2016

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

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