# Bering Sea Marine Invasive Species Assessment

Alaska Center for Conservation Science

**Scientific Name:** *Cordylophora caspia*

**Common Name** *freshwater hydroid*

| | |
|---|---|
| Phylum | Cnidaria |
| Class | Hydrozoa |
| Order | Anthomedusae |
| Family | Cordylophoridae |

**Final Rank** 46.84

**Data Deficiency:** 5.00

Species Occurrence by Ecoregion

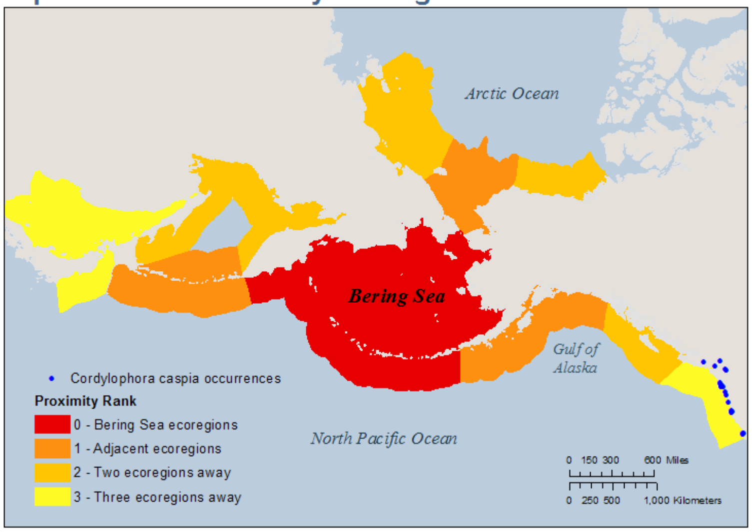


Figure 1. Occurrence records for non-native species, and their geographic proximity to the Bering Sea. Ecoregions are based on the classification system by Spalding et al. (2007). Occurrence record data source(s): NEMESIS and NAS databases.

**Category Scores and Data Deficiencies**

| Category | Score | Total Possible | Data Deficient Points |
|---|---|---|---|
| Distribution and Habitat: | 17 | 30 | 0 |
| Anthropogenic Influence: | 6 | 10 | 0 |
| Biological Characteristics: | 17.75 | 25 | 5.00 |
| Impacts: | 3.75 | 30 | 0 |
| **Totals:** | 44.50 | 95.00 | 5.00 |

## General Biological Information

### Tolerances and Thresholds

| | | | |
|---|---|---|---|
| Minimum Temperature (°C) | -10 | Minimum Salinity (ppt) | 0 |
| Maximum Temperature (°C) | 30 | Maximum Salinity (ppt) | 35 |
| Minimum Reproductive Temperature (°C) | 10 | Minimum Reproductive Salinity (ppt) | 0.2 |
| Maximum Reproductive Temperature (°C) | 28 | Maximum Reproductive Salinity (ppt) | 30 |

### Additional Notes

Cordylophora caspia is a freshwater or brackish hydroid that grows in erect, branching colonies growing from a single stem. A colony may have over a dozen tentacles and 40 or more hydranths. Hydranths are white or pale pink, and the stems are yellowish-brown. Specimens are small (usually a few centimeters tall), but some may measure 15 cm or more. C. caspia is considered native to the Black Sea and Caspian Sea, but has been introduced to tropical and temperate regions worldwide. This species has broad environmental tolerances and can have ecological and economic impacts where it occurs at high densities.

# 1. Distribution and Habitat

## *1.1 Survival requirements - Water temperature*

**Choice:** **A**

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

**Score:** 3.75 **of** 3.75

**Ranking Rationale:**

Because this species has a highly tolerant dormant state, we consider that temperatures required for year-round survival occur over a large (>75%) area of the Bering Sea.

**Background Information:**

This species' temperature tolerance varies across populations. Cold water populations in German had an upper temperature threshold of $24^0$C, whereas individuals from Massachusetts could tolerate temperatures above $30^0$C (qtd. in Fofonoff et al. 2003). Tyler-Walters and Pizzolla (2007) state an upper temperature limit of $35^0$C. A lower temperature threshold of $0^0$C is estimated based on this species' geographic distribution (Fofonoff et al. 2003). However, this species has a dormant state (called menont) that can tolerate temperatures as low as -$10^0$C (Tyler-Walters and Pizzolla 2007).

**Sources:**

NEMESIS; Fofonoff et al. 2003 Tyler-Walters and Pizzolla 2007

## *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:**

C. caspia is usually considered a brackish or freshwater species, but can tolerate salinities up to 35 ppt (based on experimental studies).

**Sources:**

NEMESIS; Fofonoff et al. 2003

## *1.3 Establishment requirements - Water temperature*

**Choice:** **D**

No overlap – Temperatures required for reproduction do not exist in the Bering Sea

**Score:** 0 **of** 3.75

**Ranking Rationale:**

Temperatures required for reproduction occur in a limited area (<25%) of the Bering Sea. However, required salinities that do not occur in the Bering Sea. We therefore ranked this question as "No overlap".

**Background Information:**

This species reproduces at temperatures between 10 and 28°C (Arndt 1989; Tyler-Walters and Pizzolla 2007).

**Sources:**

Tyler-Walters and Pizzolla 2007 Arndt 1989

### *1.4 Establishment requirements - Water salinity*

**Choice:** **D** No overlap – Salinities required for reproduction do not exist in the Bering Sea

**Score:** 0 of 3.75

**Ranking Rationale:**
Salinities required for reproduction do not occur in the Bering Sea.

**Background Information:**
This species can reproduce in nearly freshwater conditions (0.2 ppt; Arndt 1989), but reproduces optimally at ≥ 5 ppt (Ringelband 2001). The upper limit for sexual reproduction was cited as 27 ppt by Kinne (1958, qtd. in Fofonoff et al. 2003), and as low as 20 ppt by Arndt (1989). The upper tolerance for asexual (vegetative) reproduction is 30 ppt (Arndt 1989).

**Sources:**
NEMESIS; Fofonoff et al. 2003 Ringelband 2001 Arndt 1989

### *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:**
This species is found in northern Washington and southern BC.

**Background Information:**
On the west coast of North America, this species occurs from CA to northern WA. It has also been found in Victoria, British Columbia.

**Sources:**
NEMESIS; Fofonoff et al. 2003

### *1.6 Global ecoregional distribution*

**Choice:** **A** In many ecoregions globally

**Score:** 5 of 5

**Ranking Rationale:**
This species has a worldwide distribution including both coasts of North America, Central and South America, western and Mediterranean Europe. In the Pacific, it has been reported in Australia, New Zealand, Hawaii, and Shanghai.

**Background Information:**
This species is native to the Black and Caspian Seas. In North America, it has been introduced on the west coast from CA to BC. On the east coast, it occurs from QC to TX and Panama, and has invaded the Great Lakes region. It has been reported in various countries in South America including Brazil, Uruguay, Argentina, and Chile. It is widespread in Europe, where it is found in Finland and Norway, south to Spain and Italy. It is introduced in New Zealand, Hawaii, Australia, Iraq, and Shanghai.

**Sources:**
NEMESIS; Fofonoff et al. 2003

### *1.7 Current distribution trends*

| | | |
|---|---|---|
| **Choice:** **B** | History of rapid expansion or long-distance dispersal (prior to the last ten years) | **Score:** **3.25** **of** **5** |

**Ranking Rationale:**

This species has spread rapidly throughout Europe and the Great Lakes. Natural long-distance dispersal in this species is unlikely.

**Background Information:**

This species was first introduced to western Europe in the 17th century, where it spread rapidly (Fofonoff et al. 2003). It has also proliferated in the Great Lakes region, where it was first discovered in 1957 (Folino 1999; Darling and Folino-Rorem 2009). This species is sessile and has a short-lived larval stage, which makes long-distance dispersal unlikely (Gili and Hughes 1995).

**Sources:**

NEMESIS; Fofonoff et al. 2003 Darling and Folino-Rorem 2009 Gili and Hughes 1995 Folino 1999

| | |
|---|---|
| **Section Total - Scored Points:** | 17 |
| **Section Total - Possible Points:** | 30 |
| **Section Total -Data Deficient Points:** | 0 |

## 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:**

This species has a limited natural dispersal potential, which only allows for local expansion (on the scale of a few kilometers). The regional and global expansion in its distribution is likely the result of transport via anthropogenic vectors (e.g., ballast water and hull fouling).

**Background Information:**

Most life stages in this species can only disperse short distances; however, dormant stages may be capable of long-distance dispersal (Gili and Hughes 1995). Genetic analyses on populations in the Great Lakes revealed that natural dispersal was highly localized (< 20 km) (Darling and Folino-Rorem 2009). Patterns of regional spread were attributed to anthropogenic vectors (Darling and Folino-Rorem 2009).

**Sources:**

Gili and Hughes 1995 Darling and Folino-Rorem 2009

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

**Choice:** **A**

Readily establishes in areas with anthropogenic disturbance/infrastructure and in natural, undisturbed areas

**Score:** 4 of 4

**Ranking Rationale:**

This species can establish in both disturbed and undisturbed areas.

**Background Information:**

This species has been found on a variety of substrates including vegetation, bivalve shells, rocks, wood, and anthropogenic substrates.

**Sources:**

Tyler-Walters and Pizzolla 2007 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:**

NEMESIS; Fofonoff et al. 2003

| | |
|---|---|
| **Section Total - Scored Points:** | 6 |
| **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:**
This species has a generalized diet and food items are readily available in the Bering Sea.

**Background Information:**
This species is a sit-and-wait carnivore that eats prey that swim into it. Its diet includes zooplankton, larvae, detritus, crustaceans, and other small aquatic invertebrates (Gili and Hughes 1995).

**Sources:**
Gili and Hughes 1995

### *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:**
This species can tolerate a wide range of environmental conditions, but both sexual and asexual reproduction require salinities < 30 ppt, which are not found in the Bering Sea.

**Background Information:**
This species, and especially its dormant state, can tolerate a wide range of environmental conditions, including temperature, salinity, and substrate type (Tyler-Walters and Pizzolla 2007). Folino (1999) attributes the expansion of Cordylophora spp. in the US not only to increased shipping traffic, but also to changes in salt concentrations (as a result of human activity), which favour its establishment. Salinity tolerances for sexual reproduction have been listed as high as 27 ppt (Kinne 1958, qtd. in Fofonoff et al. 2003), but Arndt (1989) suggests a limit of 20 ppt.

**Sources:**
Folino 1999 Tyler-Walters and Pizzolla 2007 NEMESIS; Fofonoff et al. 2003 Arndt 1989

### *3.3 Desiccation tolerance*

**Choice:** **U** Unknown

**Score:** of

**Ranking Rationale:**
The desiccation tolerance of this species unknown.

**Background Information:**
This species produces a dormant state that is capable of tolerating extreme temperatures and perhaps other environmental stressors such as desiccation.

**Sources:**
Tyler-Walters and Pizzolla 2007

### *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:**

This species exhibits asexual reproduction and high fecundity. This species can live for several years, but we consider it to have a short generation time because of its short-lived larval stage and rapid growth rate. These r-selected traits are underscored in colder parts of its range, where this species undergoes seasonal die-offs in the winter.

**Background Information:**

This species is dioecious. Sperm is released in the water column, and eggs are brooded internally by the female. Because this species is colonial, fecundity depends on the size of the colony (Tyler-Walters and Pizzolla 2007). Large colonies may contain upwards of 2000 individuals, and each individual can have several female gonophores. Each female gonophore produces several eggs (~7-16; Fofonoff et al. 2003). Although hydroids can be extremely long-lived, this species has a short larval stage (<24 hours) and an exponential growth rate, with the number of polyps in a colony doubling every 2-4 days (Fulton 1962, qtd. in Tyler-Walters and Pizzolla 2007; Gili and Hughes 1995). In colder parts of its range, it undergoes seasonal die-offs during the winter, returning to an active state as temperatures become warmer (Fofonoff et al. 2003). C. caspia is also capable of asexual reproduction by budding or fragmentation (Gili and Hughes 1995).

**Sources:**

Tyler-Walters and Pizzolla 2007 NEMESIS; Fofonoff et al. 2003 Gili and Hughes 1995

### *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:**

While long-distance dispersal is possible under some conditions, the importance of these dispersal mechanisms is uncertain. In general, this species is considered to have highly limited dispersal abilities.

**Background Information:**

This species has a short-lived (<24 hours), free-swimming larval stage (Folino 1999; Darling and Folino-Rorem 2009). Long-distance dispersal may be achieved by rafting or by the dormant states; however, in general, this species is considered to have very limited dispersal potential (Gili and Hughes 1995). Populations separated by < 21 km were found to have significant genetic differences between each other (Darling and Folino-Rorem 2009). Tyler-Walters and Pizzolla (2007) categorize this species' dispersal potential as <10 m.

**Sources:**

Darling and Folino-Rorem 2009 Gili and Hughes 1995 Folino 1999 Tyler-Walters and Pizzolla 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:** **A** High – Exhibits two or three of the above characteristics

**Score:** 2.5 of 2.5

**Ranking Rationale:**
Although adults are sessile, this species can disperse in several ways and at more than one life stage.

**Background Information:**
This species has a short-lived (< 1 day), but free-swimming larval stage (Folino 1999; Darling and Folino-Rorem 2009). It can disperse naturally in several ways, including by rafting (e.g., on wood or vegetation), by fragmentation, and by dispersal of its highly tolerant dormant stage (Gili and Hughes 1995; Darling and Folino-Rorem 2009).

**Sources:**
Gili and Hughes 1995 Darling and Folino-Rorem 2009

### *3.7 Vulnerability to predators*

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

**Score:** 1.25 of 5

**Ranking Rationale:**
This species is preyed upon by several taxa that occur in the Bering Sea.

**Background Information:**
This species is preyed upon by nudibranchs, amphipods, and fish (Matern and Brown 2005).

**Sources:**
Tyler-Walters and Pizzolla 2007 Matern and Brown 2005

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| **Section Total - Scored Points:** | 17.75 |
| **Section Total - Possible Points:** | 25 |
| **Section Total -Data Deficient Points:** | 5 |

# 4. Ecological and Socioeconomic Impacts

## 4.1 *Impact on community composition*

**Choice:** **C** Limited – Single trophic level; may cause decline but not extirpation

**Score:** 0.75 of 2.5

**Ranking Rationale:**
Studies on this species' impacts are scarce. C. caspia may compete for space with other fouling organism.

**Background Information:**
Because this species is a rapid colonizer and can reach high densities, it may compete with other fouling organisms for space. In field experiments, establishment of C. caspia led to reduced abundances of several species (qtd. in Fofonoff et al. 2003).

**Sources:**
NEMESIS; Fofonoff et al. 2003

## 4.2 *Impact on habitat for other species*

**Choice:** **C** Limited – Has limited potential to cause changes in one or more habitats

**Score:** 0.75 of 2.5

**Ranking Rationale:**
This species' physical structure may create secondary settlement habitat for other aquatic organisms. The impacts from this species are largely restricted to brackish systems, where this species has greater competitive abilities. No impacts have been reported for marine ecosystems.

**Background Information:**
The branching structure of C. caspia has been shown to increase abundance of barnacles, amphipods, and annelids in field experiments (Von Holle and Ruiz 1997, qtd. in Fofonoff et al. 2003). It can also provide habitat for settlement of zebra mussels , but the beneficial impacts may be dampened by C. caspia predation on mussel larvae (Folino-Rorem and Stoeckel 2006).

**Sources:**
NEMESIS; Fofonoff et al. 2003   Folino-Rorem and Stoeckel 2006

## 4.3 *Impact on ecosystem function and processes*

**Choice:** **C** Limited – Causes or potentially causes changes to food webs and/or ecosystem functions, with limited impact and/or within a very limited region

**Score:** 0.75 of 2.5

**Ranking Rationale:**
This species may impact ecosystem functions and food web dynamics through predation, biodeposition, and particle trapping. However, the realized impacts of C. caspia on ecosystems are still unknown.

**Background Information:**
The ecological impacts of C. caspia are still unknown (Darling and Folino-Rorem 2009). In the Baltic Sea, where C. caspia occurs at high densities, it may alter ecosystem processes by contributing to biodeposition and by trapping particles on its branches and stolons. Both of these effects may increase eutrophication (Olenin and Leppäkoski 1999), This species may also impact food web dynamics by preying upon bivalve larvae and other aquatic invertebrates (USGS 2017).

**Sources:**
U.S. Geological Survey; Fuller and Benson 2017   Darling and Folino-Rorem 2009   Olenin and Leppäkoski 1999

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

**Choice:** **D** — No impact

**Score:** 0 of 2.5

**Ranking Rationale:**
No impacts have been reported.

**Background Information:**

**Sources:**
NEMESIS; Fofonoff et al. 2003   U.S. Geological Survey; Fuller and Benson 2017

### *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:**
No impacts have been reported.

**Background Information:**

**Sources:**
NEMESIS; Fofonoff et al. 2003   U.S. Geological Survey; Fuller and Benson 2017

### *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:**
No impacts have been reported.

**Background Information:**

**Sources:**
NEMESIS; Fofonoff et al. 2003   U.S. Geological Survey; Fuller and Benson 2017

### *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:**
This species fouls power plants in freshwater and brackish ecosystems. Severe economic impacts have been reported in some cases. Significant impacts have not been reported from marine systems.

**Background Information:**
This species is known to foul power plants in freshwater and brackish systems in Europe, the U.S., and Brazil (Folino 1999, Grohmann 2008). Fouling by C. caspia has led to decreased efficiency, increased maintenance costs, and even plant closure (Grohmann 2008). Its impacts on ships, buoys, and associated infrastructures are minimal (Fofonoff et al. 2003).

**Sources:**
Folino 1999   Grohmann 2008

### *4.8 Commercial fisheries and aquaculture*

**Choice:** **D** No impact

**Score:** 0 of 3

**Ranking Rationale:**
No impacts have been reported.

**Background Information:**
This species can prey upon bivalve larvae, and can grow on mussel shells, but no negative impacts have been reported.

**Sources:**
NEMESIS; Fofonoff et al. 2003

### *4.9 Subsistence*

**Choice:** **D** No impact

**Score:** 0 of 3

**Ranking Rationale:**
This species is not expected to impact subsistence resources in the Bering Sea.

**Background Information:**
No impacts have been reported.

**Sources:**
NEMESIS; Fofonoff et al. 2003

### *4.101 Recreation*

**Choice:** **D** No impact

**Score:** 0 of 3

**Ranking Rationale:**
This species is not expected to impact recreational opportunities in the Bering Sea.

**Background Information:**
No impacts have been reported.

**Sources:**
NEMESIS; Fofonoff et al. 2003

### *4.11 Human health and water quality*

**Choice:** **D** No impact

**Score:** 0 of 3

**Ranking Rationale:**
This species is not expected to impact human health and water quality in the Bering Sea.

**Background Information:**
No impacts have been reported.

**Sources:**
NEMESIS; Fofonoff et al. 2003

| | |
|---|---|
| **Section Total - Scored Points:** | 3.75 |
| **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:** **C** Attempted; control methods are currently in development/being studied

**Score:** of

**Ranking Rationale:**
Control has been attempted, but unsuccessful. Methods are currently being investigated.

**Background Information:**
Methods of control have focused on eradicating C. caspia from equipment and infrastructure. Chlorine or temperature treatments were not successful, as colonies regenerated within 2 weeks (Folino-Rorem and Indelicato 2005).

**Sources:**
Folino-Rorem and Indelicato 2005

### 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:**
While treatments using chlorine or extreme temperatures ae successful at reducing fouling, colonies regenerate rapidly and treatments must be repeated periodically. For the time being, control of C. caspia requires long-term investment.

**Background Information:**
Chlorine and thermal treatments are the most common control methods used to prevent or reduce biofouling by C. caspia. Of the different treatments that were applied, thermal treatments (> 40˚C) were most effective, and had lower environmental impacts than chlorine (Folino-Rorem and Indelicato 2005). However, colony regeneration occurred in all cases (Folino-Rorem and Indelicato 2005). In Brazil, fouling by C. caspia required maintenance to be performed every four months, instead of every 18 months, which increased overall costs (although no estimates were provided; Grohmann 2008).

**Sources:**
Folino-Rorem and Indelicato 2005 Grohmann 2008

### 5.3 *Regulatory barriers to prevent introductions and transport*

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

**Score:** of

**Ranking Rationale:**
This species is transported by ballast water and ship fouling. No species-specific regulations are currently in place. Although there are federal regulations for both ballast water and hull fouling, compliance with federal fouling regulations remains voluntary.

**Background Information:**

**Sources:**
Hagan et al. 2014 CFR 2017

### *5.4 Presence and frequency of monitoring programs*

**Choice:** **A** No surveillance takes place

**Score:** of

**Ranking Rationale:**
There is no surveillance currently taking place for this species.

**Background Information:**

**Sources:**
None listed

### *5.5 Current efforts for outreach and education*

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

**Score:** of

**Ranking Rationale:**
No education or outreach is taking place for this species.

**Background Information:**

**Sources:**
None listed

**Section Total - Scored Points:**

**Section Total - Possible Points:**

**Section Total -Data Deficient Points:**

## Literature Cited for *Cordylophora caspia*


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