Bering Sea Marine Invasive Species Assessment

Alaska Center for Conservation Science

Scientific Name: *Alosa sapidissima*

Common Name *American shad*

Phylum	Chordata
Class	Actinopterygii
Order	Clupeiformes
Family	Clupeidae

Final Rank 49.25

Data Deficiency: 0.00

Species Occurrence by Ecoregion

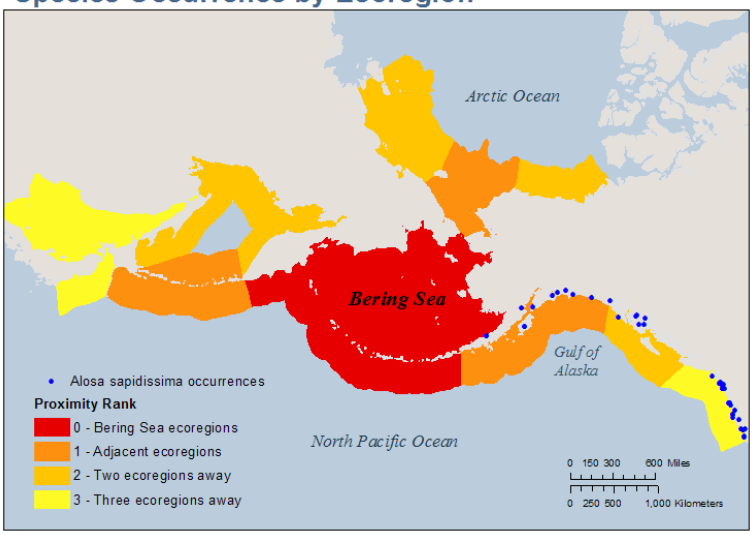

Figure 1. Occurrence records for non-native species, and their geographic proximity to the Bering Sea. Ecoregions are based on the classification system by Spalding et al. (2007). Occurrence record data source(s): NEMESIS and NAS databases.

Category Scores and Data Deficiencies

Category	Score	Total Possible	Data Deficient Points
Distribution and Habitat:	13.75	30	0
Anthropogenic Influence:	10	10	0
Biological Characteristics:	20.75	30	0
Impacts:	4.75	30	0
Totals:	49.25	100.00	0.00

General Biological Information

Tolerances and Thresholds

Minimum Temperature (°C)	2	Minimum Salinity (ppt)	5
Maximum Temperature (°C)	26	Maximum Salinity (ppt)	33
Minimum Reproductive Temperature (°C)	8	Minimum Reproductive Salinity (ppt)	0
Maximum Reproductive Temperature (°C)	26	Maximum Reproductive Salinity (ppt)	7.6

Additional Notes

The American Shad has a silver, metallic body with a deeply forked tail fin and iridescent coloring that can vary from greenish to dark blue. Its large dark shoulder spot may be followed by several paler spots. It is an anadromous, schooling fish that spends most of its life at sea. Adults enter freshwater in the spring to spawn, and many return to their natal river. A thorough risk assessment for this species must therefore consider compatibility with freshwater as well as marine conditions. However, in keeping with the scope of this project (i.e. the Bering Sea ecosystem), we assess this species' impacts and establishment potential only with respect to its marine life phase. American Shad is a species of concern in its native range along the Atlantic Coast of North America, where populations are declining.

Reviewed by Peter Westley, Assistant Professor, College of Fisheries and Ocean Sciences, UAF, Fairbanks AK

Review Date: 9/6/2017

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:
Optimal sea surface temperatures are between 13 to 18°C (Pearcy and Fisher 2011; Hasselman et al. 2012a). On the East Coast, A. sapidissima has been caught in waters with surface temperatures as low as 2°C (Neves and Depres 1978).

Sources:
FishBase 2016 Pearcy and Fisher 2011 Hasselman et al. 2012a Neves and Depres 1978 Greene et al. 2009

1.2 Survival requirements - Water salinity

Choice: B

Moderate overlap – A moderate area (≥25%) of the Bering Sea has salinities suitable for year-round survival

Score: 2.5 **of** 3.75

High uncertainty? ☑

Ranking Rationale:
Salinities required for year-round survival occur in a moderate area (≥25%) of the Bering Sea. We ranked this question with "High Uncertainty" to indicate disagreements in model estimates.

Background Information:
While in the ocean, American shad will live in seawater that is approximately 33 ppt.

Sources:
Greene et al. 2009

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:
This species requires freshwater to spawn.

Background Information:
Spawning has been reported from 8 to 26°C, and generally occurs between 12 and 21°C.

Sources:
Greene et al. 2009 Morrow 1980

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:
This species requires freshwater to spawn.

Background Information:
Spawning and embryos require freshwater. Juveniles can tolerate a wide range of salinities (5 to 33 ppt).

Sources:
Greene et al. 2009

1.5 Local ecoregional distribution

Choice: A — Present in the Bering Sea

Score: 5 of 5

Ranking Rationale:
This species has been found in the Bering Sea.

Background Information:
American Shad have been documented northeast of Port Moller (Aleutians East), and in the Gulf of Alaska (Mecklenburg et al. 2002). Individuals have been found in Alaska as far back as 1891 (Smith 1896, qtd. in Mecklenburg et al. 2002). American Shad are considered "strays" in Alaska and there are no established populations in the state (Morrow 1980).

Sources:
Morrow 1980 Mecklenburg et al. 2002

1.6 Global ecoregional distribution

Choice: C — In few ecoregions globally

Score: 1.75 of 5

Ranking Rationale:
With the exception of records off the Russian coast, does not occur outside of North America.

Background Information:
American Shad are native to the Atlantic coast of North America from Labrador (Canada) to Florida. They were introduced to San Francisco Bay in 1871, and rapidly spread northward along the Pacific Coast. Spawning has been reported at least as far north as the Columbia River (WA) (Cohen and Carlton 1995). Feeding adults have been caught as far south as Baja California (Mexico), and as far north as Cook Inlet and the Kamchatka Peninsula (Center for Aquatic Resource Studies 2005).

Sources:
Ruiz et al. 2006 Hasselman et al. 2012a

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:
No evidence of rapid range expansion has been reported in the past 10 years. Rapid range expansion via natural long-distance dispersal was documented along the Pacific Coast after this species' initial introduction to California in 1871.

Background Information:
American shad are capable of long-distance dispersal. This species underwent a rapid northward expansion following its introduction in California in 1871 (Hasselman et al. 2012a). By 1891, it had spread all along the Pacific coast, north to AK. Reports of shad from Russia and Alaska are sporadic (Mecklenburg et al. 2002). There are currently no established populations in Alaska.

Sources:
Hasselman et al. 2012a Hasselman et al. 2012b Mecklenburg et al. 2002

Section Total - Scored Points:	13.75
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: A

Has been observed using anthropogenic vectors for transport and transports independent of any anthropogenic vector once introduced

Score: 4 **of** 4

Ranking Rationale:
Intentionally stocked as a sport fish, and can disperse naturally once introduced.

Background Information:
American Shad have been intentionally stocked as a sport fish. Following its introduction to California in 1871, American Shad dispersed naturally along the Pacific Coast, north to AK (Ruiz et al. 2006).

Sources:
Animal Diversity Web 2017 U. S. Geological Survey 2017 Ruiz et al. 2006

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:
Lives in open water and does not require anthropogenic vectors to establish. Human disturbance may facilitate establishment by providing access to more spawning habitat.

Background Information:
This species does not require anthropogenic vectors to establish. Human disturbance (e.g. construction of dams) in the Columbia River may have allowed the American Shad to enter previously inaccessible spawning habitat (Hasselman et al. 2012a)

Sources:
Hasselman et al. 2012a

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

Choice: A

Yes

Score: 2 **of** 2

Ranking Rationale:
This species supports commercial, subsistence, and sport fisheries.

Background Information:
American Shad have been introduced for forage, food, sport and commercial fishing. In its native range, American Shad are being reared in hatcheries to boost local populations; but there are no hatchery programs outside the native range (although one did operate in Oregon from 1906 to 1920; Hasselman et al. 2012a).

Sources:
ASFMC 2007 U. S. Geological Survey 2017 Hasselman et al. 2012a

Section Total - Scored Points:	10
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:
Generalist diet across all life stages. Prey items are readily available in the Bering Sea.

Background Information:
At sea, American Shad feed on plankton, crustaceans and small fish. Adults are believed to stop feeding once they begin their upstream spawning migration; however, a recent stomach content analysis found freshwater copepods and crustaceans in adults that had just spawned (Walters and Olney 2003, qtd. in Greene et al. 2009). Juveniles feed on zooplankton, copepods, adults and immature insects (both aquatic and terrestrial).

Sources:
Greene et al. 2009

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:
American Shad require freshwater for spawning.

Background Information:
American Shad spend most of their adult life in the open sea, at average water depths of 125 m (range: 0 to 375 m). They require well-oxygenated waters throughout their life history, but adults appear to be tolerant to turbid water conditions (Greene et al. 2009). Larvae and adults can tolerate a wide range of salinities between 5 to 33 ppt (Greene et al. 2009). Spawning typically occurs in freshwater.

Sources:
Greene et al. 2009 Animal Diversity Web 2017

3.3 Desiccation tolerance

Choice: C

Little to no tolerance (<1 day) of desiccation during its life cycle

Score: 1.75 of 5

Ranking Rationale:
American Shad cannot survive out of water for extended periods of time.

Background Information:
A. sapidissima is a ray-finned fish that requires water for respiration.

Sources:
Randall 1970

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: **B**

Moderate – Exhibits one or two of the above characteristics

Score: **3.25** **of** **5**

Ranking Rationale:

American Shad exhibit high fecundity, external fertilization and low parental investment, but time to sexual maturity is long. Sexes are separate.

Background Information:

Dioecious, sexual reproduction. Fertilization is external, and adults do not provide any care for the eggs or larvae after fertilization. American Shad spawn in rivers during late winter or early spring. Most return to their natal rivers and tributaries to spawn, but some populations exhibit low site fidelity (e.g. Cumberland Basin population; Melvin et al. 1986). On average, larvae hatch in 10 days. Fecundity estimates vary from 116,000 to >600,000 eggs per female (Morrow 1980). Estimates of egg production in York River, Virginia, are 20,000 to 70,000 eggs per kg of somatic weight, spawned every four days (Olney et al. 2001, qtd. in Greene et al. 2009). American Shad breed once a year, but exhibit regional differences in lifetime spawning frequency. Some populations are iteroparous (repeat spawners), while others are semelparous (die after one spawning season) (Leggett and Carscadden 1978).

Average lifespan: 9 years
Sexual maturity: 3 to 7 years for females

Sources:

Greene et al. 2009 Melvin et al. 1986 Animal Diversity Web 2017 Morrow 1980 Leggett and Carscadden 1978

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: **A**

Disperses long (>10 km) distances

Score: **2.5** **of** **2.5**

Ranking Rationale:

While eggs and larvae may only disperse a few metres within a waterway, adults can undergo extensive migrations, travelling hundreds to thousands of kilometers in one season.

Background Information:

Larvae, eggs, and juveniles can be passively dispersed by water currents. Eggs have been observed traveling a distance of 5 to 35 m downstream before sinking (qtd. in Greene et al. 2009). Bilkovic et al. (2002) found that larvae were transported throughout a larger portion of the water body than eggs. The oceanic Davidson Current may have enabled juvenile shad to move northwards from Sacramento at a rate of 24.9 km/day (Burt and Wyatt 1964, qtd. in Hasselman et al. 2012a). Hasselman et al. (2012a) propose that this mechanism was responsible for the rapid northward expansion of American shad at the end of the 19th century. Adults undergo extensive ocean migrations of sometimes thousands of kilometers in one season (Pearcy and Fisher 2011). Leggett (1977, qtd in. Melvin et al. 1986) determined a maximum migration rate of 25 km/day for adult shad during their spring coastal movements. Most American Shad populations return to their natal river to spawn (Melvin et al. 1986).

Sources:

Greene et al. 2009 Melvin et al. 1986 Bilkovic et al. 2002 Animal Diversity Web 2017 Pearcy and Fisher 2011 Hasselman et al. 2012a

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:

All life stages (eggs, larvae, juveniles, and adults) can disperse. Juveniles and adults are highly mobile and free-swimming. Eggs and larvae can be passively dispersed by water currents.

Background Information:

Sources:

Hasselman et al. 2012a Greene et al. 2009

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**

Ranking Rationale:

Several taxa including birds, fishes, and marine mammals prey upon adult American Shad. Predators known to eat eggs and larvae are not present in the Bering Sea.

Background Information:

Adults are eaten by seals, double-crested cormorant, dolphins, otters, and herons. Eggs and larvae are preyed upon primarily by American eel and fish including striped bass, king mackerel, and catfish.

Sources:

Greene et al. 2009

Section Total - Scored Points:	20.75
Section Total - Possible Points:	30
Section Total -Data Deficient Points:	0

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:

A negative correlation between American Shad and zooplankton abundances has been reported in the Columbia River, where shad occurs at large densities. At high densities, American Shad may also affect salmon behaviour by blocking their migratory movement. However, population-level effects of shad on salmon (or other fish species) have not yet been documented.

Background Information:

Shad have been reported from several rivers in the Pacific Northwest that contain evolutionarily significant populations of salmon and steelhead. Although some authors have suggested that shad may negatively affect Pacific coastal ecosystems and native salmon populations, this hypothesis has not been empirically tested (Hasselman et al. 2012b).

Shad may compete with indigenous taxa for space and impede the migration of other anadromous fishes (Hasselman et al. 2012b). Accumulations of large numbers of adult shad have impeded the migration of salmon at fish ladder entrances on the Columbia River (Monk et al. 1989, qtd. in Hasselman et al. 2012b).

Competition for zooplankton by young: In the Columbia River, where shad occur at high densities, larval and juvenile shad feed primarily on zooplankton. Haskell et al. (2013) observed strong predation by shad on zooplankton, and concomitant decreases in the abundance and size of Daphnia spp. Through their effect on zooplankton, American shad may have negative consequences on native fish such as Pacific salmon that also rely on this resource (Haskell et al. 2013).

Sources:

Hasselman et al. 2012b Haskell et al. 2013 U. S. Geological Survey 2017

4.2 Impact on habitat for other species

Choice: D

No impact

Score: 0 of 2.5

Ranking Rationale:

No impacts have been reported. Given its ecology, we do not expect American Shad to impact habitat in the Bering Sea.

Background Information:

No information found.

Sources:

Hasselman et al. 2012b U. S. Geological Survey 2017

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:

Ecosystem effects are largely speculative, or restricted to areas where American Shad occur at high densities.

Background Information:

Apparent competition: Shad may indirectly affect native salmon through apparent competition. In areas where American Shad occur at high densities, larvae and juveniles may provide an important food source for double-crested cormorants, and fishes such as northern pike minnow, smallmouth bass, and walleye. The population of these fish species may increase as a result, which may in turn lead to increased predation on juvenile salmon (Hasselman et al. 2012b).

In south Atlantic coastal rivers, where most individuals die after spawning, shad carcasses may contribute significant nutrient input from marine to freshwater ecosystems (ASMFC 1999, qtd. in Greene et al. 2009).

Sources:

Hasselman et al. 2012b Greene et al. 2009

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

Choice: C

Limited – Has limited potential to cause degradation of one more species or communities, with limited impact and/or within a very limited region

Score: 0.75 **of** 2.5

High uncertainty? ☑

Ranking Rationale:

Although this species has the potential to affect native Pacific salmon populations, effects have not yet been documented.

Background Information:

Shad have been reported from several rivers in the Pacific Northwest that contain evolutionarily significant populations of salmon and steelhead. Although some authors have suggested that shad may negatively affect Pacific coastal ecosystems and native salmon populations, this hypothesis has not been empirically tested (Hasselman et al. 2012b).

Sources:

Hasselman et al. 2012b

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:

American Shad is host to several parasites, some of which affect other fish species and/or can be transmitted to higher trophic levels. The introduction or increased abundance of American Shad has been linked to the outbreak and spread of Ichthyophonus and Anisakis simplex parasites.

Background Information:

American Shad are hosts to a variety of parasites, including nematodes (Anisakis simplex, Hysterothylacium aduncum), cestodes (Scolex pleuronectis), and trematodes (Genitocotyle atlantica). Anisakis simplex was historically restricted to marine environments and its native herring (Clupea harengus) host. The introduction of American shad has enabled A. simplex to expand into freshwater systems. A. simplex can be transmitted to mammalian predators including otters and humans. American shad are also hosts to Ichthyophonus spp., a parasite of wild marine fishes. Ichthyophonus is native to the Pacific Northwest and infects salmon, which then introduce the parasite into freshwater systems. However, an outbreak of this parasite in the Columbia River in 2007 was linked to the high abundance of shad in the river.

Sources:

Hasselman et al. 2012b

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 instances of hybridization between American Shad and other fish species have been reported. There are no native Clupeidae species in Alaska.

Background Information:

No information found to suggest that A. sapidissima hybridizes with native species. Instances of hybridization have been reported between other Alosa species (A. alosa × A. fallax in Jolly et al. 2011; A. pseudoharengus × A. aestivalis in Hasselman et al. 2014).

Sources:

Jolly et al. 2011 Hasselman et al. 2014

4.7 Infrastructure

Choice: **D**

No impact

Score: **0** **of** **3**

Ranking Rationale:

No impacts have been reported. Given its ecology, we do not expect American Shad to impact infrastructure in the Bering Sea.

Background Information:

No information found.

Sources:

Hasselman et al. 2012b

4.8 Commercial fisheries and aquaculture

Choice: D — No impact

Score: 0 of 3

High uncertainty? ☑

Ranking Rationale:
Some authors have suggested that American Shad may compete with native Pacific salmon species, but this assertion has not yet been supported by empirical data.

Background Information:
No impacts have been reported.

Sources:
Hasselman et al. 2012b U. S. Geological Survey 2017

4.9 Subsistence

Choice: D — No impact

Score: 0 of 3

High uncertainty? ☑

Ranking Rationale:
Some authors have suggested that American Shad may compete with native Pacific salmon species, but this assertion has not yet been supported by empirical data.

Background Information:
No impacts have been reported.

Sources:
Hasselman et al. 2012b U. S. Geological Survey 2017

4.101 Recreation

Choice: D — No impact

Score: 0 of 3

High uncertainty? ☑

Ranking Rationale:
Some authors have suggested that American Shad may compete with native Pacific salmon species, but this assertion has not yet been supported by empirical data.

Background Information:
No impacts have been reported.

Sources:
Hasselman et al. 2012b U. S. Geological Survey 2017

4.11 Human health and water quality

Choice: C — Limited – Has limited potential to pose a threat to human health, with limited impact and/or within a very limited region

Score: 0.75 of 3

Ranking Rationale:
To prevent anisakiasis, the CDC recommends avoiding to eat raw or undercooked fish. Anisakiasis is most commonly found in areas where eating raw fish is popular. Japan has the greatest number of reported cases of anisakiasis, with over 1000 cases reported per year (Beaudry 2012).

Background Information:
American shad are hosts to the nematode Anisakis simplex. Anisakis simplex is not specific to American Shad, and can also infect herring, cod, salmon, and cephalopods (e.g., squid, cuttlefish). This parasite can pose a health risk to humans if humans consume undercooked, infected fish. Because Anisakis larvae cannot survive in humans, larvae will eventually die. In extreme cases, ingesting A. simplex can trigger severe allergic reactions, and treating an Anisakis infection may require surgery. This infection cannot be transmitted from human to human.

Sources:
CDC 2017 U. S. Geological Survey 2017 Beaudry 2012

Section Total - Scored Points:	4.75
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: B — Not attempted

Score: [ ] of [ ]

Ranking Rationale:
There have been no attempts to control or eradicate American shad.

Background Information:
There have been no attempts to control or eradicate American shad, but intentional introductions to the Pacific coast have stopped (Hasselman et al. 2012a). In the Atlantic states where American shad is native, management efforts are hoping to increase population size (ASFMC 2007).

Sources:
ASFMC 2007 Hasselman et al. 2012a

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:
Although few estimates are available, control or eradication of American Shad would likely require millions of dollars over several years.

Background Information:
Few management plans discuss the control or eradication of American Shad. However, Huppert and Fluharty (1995, qtd. in Petersen et al. 2003) estimated that removing American Shad from the Snake River would cost $1 million per year over five years.

Sources:
Petersen et al. 2003

5.3 Regulatory barriers to prevent introductions and transport

Choice: C — Regulatory oversight and/or trade restrictions

Score: [ ] of [ ]

Ranking Rationale:
The transport and trade of live fish is regulated in Alaska.

Background Information:
According to the Alaska Administrative Code, "No person may transport, possess, export from the state, or release into the waters of the state, any live fish unless the person holds a fish transport permit […] and the person is in compliance with all conditions of the permit and the provisions of this chapter." Permits are issued by the Alaska Department of Fish & Game and are project- and time-specific.

Sources:
AAC 2017

5.4 Presence and frequency of monitoring programs

Choice: **A** No surveillance takes place

Score: _____ **of** _____

Ranking Rationale:
Although monitoring of American Shad population is being conducted in its native range (where the goal is to increase populations), no monitoring is being conducted in Alaska or in states where it is invasive.

Background Information:
State monitoring programs exist in this species' native range, where management efforts are underway to increase populations. In its invasive range, no monitoring plans are in place. In its introduced range, counts are conducted at some dams on the Columbia River during migration. Management plans for the Columbia River basin do not mention American Shad as a potential threat to salmon or to the ecosystem (Petersen et al. 2003).

Sources:
Greene et al. 2009 Petersen et al. 2003

5.5 Current efforts for outreach and education

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

Score: _____ **of** _____

Ranking Rationale:
No outreach or education is being conducted for this species.

Background Information:
An online search returned no results for outreach and education programs on the invasive status of American Shad.

Sources:
None listed

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

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Literature Cited for *Alosa sapidissima*

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