Appendix A
Southern DPS Green Sturgeon Recovery Plan
Threats Assessment Methodology and References

Background and Definitions

This Appendix describes the threats assessment process and methodology. The threats assessment is to determine, to the extent possible, why the species is declining. For the purposes of this recovery plan, a threat is defined as any factor that could represent an impediment to recovery. Understanding of current and potential future threats to sDPS green sturgeon is essential in developing effective recovery actions and criteria.

The threats assessment was separated into habitat units and conducted by recovery team members who had experience with a particular habitat unit as follows:

Sacramento River Basin (SRB): 1) upstream extent of the Sacramento-San Joaquin Delta on the Sacramento River (I Street Bridge; defined by California Water Code section 12220) to Keswick Dam, including the Sutter and Yolo bypasses; 2) the Feather River from its confluence with the Sacramento River upstream to Fish Barrier Dam; 3) the Yuba River from its confluence with the Feather River upstream to Daguerre Point Dam; and 4) the American River from its confluence with the Sacramento River upstream to the Highway 160 bridge (Recovery Team members: Corwin, Poytress, Seesholtz).

San Francisco Bay Delta and Estuary (SFBDE): estuarine areas up to the top of high tide from the Golden Gate Bridge to the upstream extent of the Sacramento-San Joaquin Delta (excluding flood control bypasses) (Recovery Team members: Gingras, Israel).

Coastal Bays and Estuaries (CBE): coastal bays and estuaries up to top of high tide including: 1) Humboldt Bay in California; 2) Coos, Winchester, Yaquina, and Nehalem bays in Oregon; 3) Willapa Bay and Grays Harbor in Washington; and 4) the lower Columbia River estuary from the mouth to river kilometer 74 (Recovery Team members: Erickson, Moser, Parsley).

Nearshore Marine (NM): nearshore waters within the 60 fathom (110 meters) isobath from the Monterey Bay north to the U.S./Canada border (including the Strait of Juan de Fuca) (Recovery Team members: Erickson, Moser, Parsley).

With the exception of the CBE and NM habitat units, each threats assessment was conducted independently.

The assessments were also conducted for each life stage present in a habitat unit (Table A-1).

Table A-1. Target life stage by habitat unit. Life stages were defined as follows: Eggs: fertilization to hatch; Larvae: hatch to size at metamorphosis (1 to 6 centimeters [cm] total length [TL]); Juveniles: metamorphosed juveniles to size at first ocean entry (6 to 65 cm TL); Subadults: first ocean entry to size at sexual maturity (65 to 150 cm TL); Adults: sexually mature adults (greater than 150 cm TL).

Habitat Unit	Life Stage				
	Adult	Subadult	Juveniles	Larvae	Eggs
SRB	X		X	X	X
SFBDE	X	X	X		
CBE	X	X			
NM	X	X			

Specific threats were organized with respect to each of the four geographic habitat units by Listing Factor and threat category as follows:

A. Habitat Destruction, Modification, or Curtailment: threat categories Altered Water Flow, Altered Prey Base, Altered Water Temperature, Contaminants, Altered Sediment, Barriers to Migration, Water Depth Modification, Loss of Wetland Function, and Altered Turbidity.
B. Overutilization for Recreational, Commercial, Scientific, or Educational Purposes: threat categories Take (harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct) and Reduced Genetic Diversity.
C. Disease and Predation: threat categories Disease and Predation.
D. Inadequacy of Existing Regulatory Mechanisms: addressed in other listing factors and threat categories[1].
E. Other Natural or Man-made Factors: Competition for Habitat and Take.

The recovery team met and developed a list of current and potential future threats to the sDPS of green sturgeon. The team members determined the life stages, threat categories, and specific threats that would be assessed in their respective habitat unit. The following threat definitions were used:

Anthropogenic light: sources of anthropogenic light include but are not limited to construction sites (urban or industrial), bridges, boats, buoys, marinas, docks, and dams. Anthropogenic light may increase predation on all sizes of green sturgeon or alter behavior and migration.

Anthropogenic underwater sound: sources of underwater sound include but are not limited to cars or trains travelling over bridges, pile driving, blasting, boat engines, water pumps, air guns and hydrokinetic equipment. Effects on green sturgeon range from delayed and/or altered migration to stress, injuries, or death depending on the size of the fish and the amount of explosive, size of pile/hammer, or size/number of air guns.

[1] Regulatory mechanisms were considered when ranking the threats under Listing Factors A through C and E.

Aquaculture: cultivation of aquatic organisms such as fish, crustaceans, and mollusks. Toxic contaminants may be linked to aquaculture activities occurring in bays, estuaries, and the nearshore marine environment. For example, pesticides are directly applied within intertidal areas of coastal bays to control burrowing shrimp or non-native grasses in an effort to promote shellfish culture.

Artificial propagation of green sturgeon: artificial propagation and release of green sturgeon for enhancement or research purposes. Addition of hatchery fish to the wild green sturgeon population may affect natural genotype frequencies and later population equilibrium. This could result in reduced levels of genetic diversity compared to the natural equilibrium. The overrepresentation of a particular genotype may lead to reduced resilience in the face of bottlenecks should population numbers continue to decline.

Augmentation: active and passive addition of gravel and other materials to enhance salmonid spawning habitat or promote shellfish habitat or culture. Gravel augmentation has the potential to affect depth structure and bottom composition, potentially affecting green sturgeon spawning habitat. Gravel and oyster shell placement occurs in some estuaries for sediment stabilization and to promote shellfish culture, thus altering substrates.

Beach renourishment: relocation of sands (usually as beneficial re-use of dredged material) on beaches for renourishment. Beach renourishment activities may alter sediment composition and transport in estuaries, reduce wetland function, and temporarily increase turbidity in nearshore marine waters.

Bottom trawling: trawling in groundfish and non-groundfish fisheries (e.g., shrimp, California halibut, ridgeback prawn, sea cucumber). Bottom trawling may affect habitat and cause prey to relocate. Discard of dead bycatch may affect the prey base and remove competing predators (potential prey base enhancements).

Bypasses: large flood control areas adjacent to the Sacramento River. The two major bypasses are Sutter and Yolo. Bypasses operate when flood waters in the Sacramento River overtop weirs located along the Sacramento River upstream of the Feather River and alter flood flows in the mainstem Sacramento River. Because bypasses are large shallow areas that can allow greater equilibration of water and air temperatures than adjacent river channels, the return water from the bypasses may be warmer or cooler than the receiving river water. Bypass weirs and other associated structures may delay or prevent green sturgeon migration. Adult green sturgeon are also stranded and exposed to dewatered areas and vulnerable to poaching around bypass weirs.

Channel control structures: structures used to control channel position including but not limited to levees, rip-rap, hard points, boulder weirs (e.g., Sunset Pumps), gradient control facilities (e.g., Glenn Colusa Irrigation District structures), wing dams, and pile dikes. Their presence alters water flow velocity and direction, channel migration and morphology, and sediment transport. These structures may also cause aggradation and degradation of channels (alteration of channel depths) used by green sturgeon for holding and spawning.

Derelict fishing gear: abandoned fishing gear (e.g., derelict gill nets in Puget Sound). Green sturgeon may be injured or killed through exposure to derelict fishing gear.

Diversions: major diversions include the south Delta pumping plants, Sacramento River facilities (Red Bluff Diversion Pumping Plant, Anderson Cottonwood Irrigation District, and Glenn Colusa Irrigation District), as well as facilities associated with Sunset Pumps and Daguerre Point Dam on the Feather and Yuba rivers respectively. Many unscreened smaller diversions are also operated throughout the system. Diversions reduce flow volume below facilities and potentially affect the magnitude of river hydraulics and stage in green sturgeon migration and spawning habitat, including flow into the San Francisco Bay-Delta/Estuary. This may affect migration (e.g., altering hydrology cues), water temperatures, and sediments. For example, reduced downstream flows may result in increased downstream water temperature and affect channel morphology and the potential scouring process of deep pool formation. Increased flows upstream of the diversion may result in decreased upstream water temperature (Also see "Upstream diversions").

Dredging and disposal of dredged material: sediment removal and/or disposal associated with maintaining navigable waters (e.g., marinas and boat ramps), construction projects (e.g., building bridges), and gold mining. Dredging can remove substrates important for spawning and rearing, alter benthic communities by removing benthic prey organisms or disrupting habitat, alter water depth, increase contaminant availability through exposure of sediment layers with elevated contaminant concentrations and dispersal of dredged material into the water column, and potentially result in suspension and release of fine-grain sediments (3-5% of total volume dredged by clamshell equipment) into the water column. The magnitude of this effect depends on sediment type and dredging objectives. Dredging has also been found to reduce the ability of sediments to remove phosphorous, nitrogen, and pesticides from the water column and releases phosphorous, nitrogen, and pesticides to clean water more quickly than sediments taken prior to dredging. Redistribution of mercury or mercury byproducts or other toxic legacy elements (e.g., arsenic, benzene, copper, and zinc) can occur from excavation activities. California has recently proposed to not permit suction gold mining dredging in the mainstem Sacramento River or its tributaries. Recovery of an area from dredging has been found to be variable dependent on sediment type. In-water disposal of dredged material can bury benthic communities, alters depth and bottom characteristics (further altering benthic communities), and disperses potentially contaminated sediments or fine grain material into the water column. For example, a disposal site near Alcatraz Island in central San Francisco Bay is no longer a deep depression. Dredged material was historically used to create levees in the Delta and thus contributed to the loss of wetlands. Currently, disposal of some dredged material is used beneficially and to a large extent for wetland creation (i.e., salt pond restoration). Temporary increases in turbidity could occur and depends upon the amount and type of material being disposed per event, the time between events, and the conditions (e.g., current) at the disposal site.

Electromagnetic field: electromagnetic fields generated by structures or facilities including but not limited to buried electrical cables, overhead power lines, and hydrokinetic projects. The presence of electromagnetic fields may delay or alter green sturgeon migration or affect their ability to forage, hold in pools, and/or spawn.

Entrainment and/or impingement at water diversion intakes: movement or transport of green sturgeon along with the flow of water (entrainment) and/or significant contact with diversion apparatus (impingement) at power plants and water diversion facilities. Larval and juvenile green sturgeon may suffer injury or mortality when they are entrained in unscreened or inadequately screened diversions and impinged on screened diversions. Attraction flows from large diversion facilities may alter migration or attract green sturgeon into suboptimal habitats (e.g., areas with increased predation or poor water quality). Mortality also may occur during collection, handling, and transport of salvaged green sturgeon (e.g., CVP and SWP pumping facilities). In marine waters, green sturgeon may be entrained at water intakes (e.g., at the Moss Landing power plant intake).

Entrainment from dredging: entrainment of green sturgeon associated with hydraulic dredging. White sturgeon have been entrained during hydraulic dredging in the Columbia River. Recent studies have shown that white sturgeon can be entrained during hydraulic dredging in the Delta.

Entrainment from hydrokinetic projects: entrainment of green sturgeon by turbines and other apparatus associated with hydrokinetic projects.

Fisheries: incidental capture of green sturgeon in fisheries. Incidental capture of adult green sturgeon occurs in several fisheries, including but not limited to the white sturgeon and salmonid recreational fisheries in the Sacramento and Feather rivers and Bay-Delta and bottom trawl fisheries (e.g., groundfish, California halibut) along the coast. Juvenile green sturgeon are incidentally captured in recreational fisheries in the lower Sacramento River and in shrimp trawl and commercial herring gillnet fisheries in the Bay-Delta. Although green sturgeon must be released, delayed migration of the adults and over-exertion by playing the fish could result in stress, injury, or immediate or delayed mortality from injury caused from the hooking or mishandling the fish. Some fish may be retained accidentally due to misidentification with white sturgeon and some may have increased predation risk by pinnipeds upon release. As of March 1, 2010, CDFW regulations prohibit fishing for any sturgeon species in the upper Sacramento River above Butte Bridge (Hwy 162).

Global climate change: large-scale changes to air and water temperature, precipitation, snow pack, and timing, frequency and magnitude of weather events. Climate change is expected to result in changes in precipitation from snow to rainfall, higher water temperatures, and increased frequency of high or low flow events. These changes could result in elevated river water temperatures that exceed the tolerable and/or optimal spawning and rearing temperatures for green sturgeon. Changing weather patterns, increased and fluctuating water temperature, and other changes may affect prey abundance, distribution, and community structure.

Harvest of prey species: legal and illegal harvest of prey species (e.g., crayfish and lamprey). Harvest may affect prey abundance and community structure. Additional prey species such as burrowing shrimp are actively eliminated to promote shellfish culture.

Hatcheries: artificial fish propagation facilities. The release of artificially propagated fish from hatcheries could introduce disease to wild green sturgeon populations.

Impoundments: impoundments created by dams (defined as rim, diversion, or low-head). In addition to dams delaying migration or blocking access to spawning habitat, impoundments can have several effects on in-river conditions. Impoundment outflows may be managed for power generation, flood control, water delivery, and water quality (e.g., saltwater intrusion). This can alter the natural hydrograph in the rivers, altering water temperatures and sediment composition and distribution. For example, impoundment outflows may be warmer (from the lake surface) or cooler (from the lake bottom) than unmanaged temperatures downstream of the dams. Sediment-depleted conditions downstream of impoundments cause channel adjustment in the form of bank erosion, bed erosion, substrate coarsening, and channel planform change. Impoundments reduce or eliminate spring turbidity levels that may be beneficial to sturgeon spawning behavior, egg adhesion, egg development, and egg/larval camouflage from predators. Impoundments result in changes to channel morphology and pool structure by reducing sediment recruitment and transport magnitude and duration, minimizing flooding effects and natural redistribution of sediments and woody debris recruitment. Impoundments also affect conditions further downstream in bays, estuaries, and nearshore marine waters. For example, impoundments reduce sediment recruitment and transport magnitude and duration, minimize flooding effects and natural redistribution of sediments recruitment, and reduce turbidity by holding back sediment and acting as nutrient traps. This can result in changes to the bathymetry of bays and estuaries and nearshore habitats.

In-water construction: maintenance and construction of in-water structures including bridge piers and abutments, boat docks and marinas, diversions, and habitat restoration features. In-water construction activities may result in the release of fine to medium sized sediments and hazardous materials into the water column, such as fuels, oils, hydraulic fluids, chemicals, and contaminants in sediments (e.g., mercury or mercury byproducts). Sediment and contaminants released from in-water construction can affect egg survival and larval development, spawning and rearing habitat, water depth and bathymetry, and wetland and ecosystem function.

In-water structures: in-water structures include but are not limited to the Sacramento Deep Water Ship Channel locks and Delta Cross Channel gates, which may alter green sturgeon migration and/or be complete or partial migration barriers depending on operations. In-water structures in marine waters, like hydrokinetic projects and oil rigs, may alter prey availability by altering benthic communities.

Marine mammals: Steller and California sea lions and harbor seals. California sea lions have been observed preying on green sturgeon in the Columbia River and move upstream as far as Knights Landing (rkm 142) in the Sacramento River.

Mitigation and restoration: channel, floodplain, and tidal wetland habitat restoration projects. Restoration of channel and floodplain areas could alter geomorphology in green sturgeon spawning or holding habitat and restoration of tidal function in diked baylands could potentially modify the depth of foraging habitat in estuaries.

Native species: native fish (e.g., Sacramento suckers and pikeminnow), birds, and mammals. Native species can prey on green sturgeon eggs, larvae, and juveniles as well as compete with green sturgeon for rearing habitat and food.

Non-native species: non-native fish (e.g., striped and largemouth bass), crustaceans (e.g., red swamp crayfish and Siberian prawn), bivalves (e.g., Asian calm and overbite clam), and subaquatic vegetation (e.g., Brazilian waterweed and Japanese eelgrass). Non-native species can prey on green sturgeon eggs, larvae, and juveniles (e.g., striped bass); compete with green sturgeon for habitat and food; or compete with prey species and replace prey items of greater nutritional value. Some species may affect habitat quality, such as invasive subaquatic vegetation (e.g., *Egeria*, *Spartina alterniflora*, *Zostera japonica*) that alters wetland function and species composition in the Delta. Non-native species may also introduce disease to wild sturgeon populations, for example, through the introduction of non-native parasites or diseases, or the introduction of new host species.

Oil and chemical spills: oil and chemical spills associated with vessel accidents, railway transport of chemicals and subsequent derailment, or other activities that occur near water or in adjacent areas (e.g., vehicle fueling or heavy equipment operation). Exposure of green sturgeon to oil and chemicals could result in stress, injury, or death.

Poaching: the intentional and illegal harvest of subadult and adult green sturgeon for meat or roe. Poaching includes targeted harvest and intentional retention of incidentally caught fish.

Point and non-point source contaminants: point source contaminants include effluents from sewage treatment plants, timber mills, industrial facilities (e.g., power plants, LNG facilities, and desalination plants), and small fuel and chemical spills in and around water (e.g., riverbank docks, marinas, and other infrastructure). Non-point sources contaminants include runoff from urban areas (e.g., roads, building sites, domestic sewage, gardens, lawns, and parking lots), forests, agricultural areas, nurseries, landfills, livestock, and mining operations. Exposure of green sturgeon to contaminants could result in stress (reproductive or hormonal), injuries, and/or mortality. Contaminants also impact macroinvertebrate population and community structure (species presence/absence and overall numbers), affecting benthic prey resources for green sturgeon.

Point and non-point source sediment: point source sediments include but are not limited to fine-grain sediment from sewage treatment plants, timber mills, industrial discharges, riverbank docks, and marinas. Non-point source sediments include fine-grain sediment from urban and agricultural runoff, logging operations, burned areas, mining operations, and grazed lands. Input of fine grain material alters turbidity, substrate composition, and water depth/bathymetry. Removal of riparian vegetation also results in increased erosion and input of fine grain material into the water.

Point and non-point source thermal effluence: water inputs that increase ambient water temperatures. Point sources include Thermalito Afterbay Outlet, industrial and sewage treatment facility effluents, and power plants. Non-point sources include runoff from agricultural and urban areas (excluding bypasses).

Point and non-point source turbidity: temporary or ongoing sources of turbidity. Point source turbidity inputs include but are not limited to sewage treatment plants, timber mills, industrial discharges, riverbank docks, and marinas. Non-point turbidity sources include but are not limited to runoff from urban and agricultural areas, forests, irrigated lands, landfills, livestock, mining operations, nurseries, orchards, and algal blooms.

Sacramento River temperature management: management of water temperature below Keswick Dam on the Sacramento River for species such as Chinook salmon. Reduced water temperature in the Sacramento River may influence green sturgeon spawning distribution (including spatial and temporal), egg incubation/development, and larval growth.

Sand/gravel mining: mining of aggregate material in channels of Suisun Bay, central San Francisco Bay, rivers and tributaries, adjacent riparian corridors, or off-site (e.g., at mine tailings along the Sacramento, Feather, and Yuba rivers). Mining activities may release fine-grain sediments into the water column and remove substrates that are used by green sturgeon for spawning. The removal of sand and gravel may also alter the prey base (similar to dredging activities), temporarily or permanently modify depth/bathymetry, and reduce sediment input to downstream areas.

Scientific research activities: scientific research activities including egg and larval sampling (e.g., egg mats, rotary screw traps, and D-nets), and capture and tagging of adults and juveniles (e.g., hook and line and gillnet). Collection, handling, and release of green sturgeon associated with research activities could cause stress, injuries, or mortality (i.e., exposure to pathogens during tagging, physiological stress due to handling, and suboptimal conditions during transport).

Shoreline development: activities include but are not limited to construction and short-term impacts of land clearing or excavation work and bank armoring to protect property adjacent to the river (e.g., waterfront homes, recreation areas, and agriculture). These activities result in erosion and release of sediments, loss or alteration of wetland function (e.g., by filling in the margins of bays for development or constructing/maintaining levees within the estuary/delta), or changes in sediment dynamics and turbidity (e.g., shoreline armoring).

Upstream diversions: diversions occurring upstream or outside of a given habitat unit. In the Sacramento River, the out of basin (i.e., Trinity River) transfer of water may increase flows. In other cases, diverting water upstream reduces the flow in the river and subsequently into estuaries and bays, altering channel hydraulics and sediment transport processes. Reduced flow may also result in increased water temperatures downstream of the diversion and ultimately influence water temperature in the nearshore marine environment.

Vessel propeller strikes: vessel propellers hitting green sturgeon and causing death or injury.

Water quality: water quality measures include but are not limited to temperature, turbidity, and dissolved oxygen. Poor water quality causes stress to green sturgeon, which may lead to reduced immune function and resilience and increased risk of disease or physiological stress. Poor water quality associated with low dissolved oxygen, contaminants, and temperature, may create migratory barriers (e.g., plumes of low dissolved oxygen, such as observed at the mouth of the Columbia River).

Threat Analysis

Each recovery team member assessing a habitat unit received the same instructions, criteria, and relevant threat definition to conduct a detailed analysis of the current and potential future threats, following guidelines developed under Conservation Measures Partnership and Benetech's Miradi program (https://miradi.org/). Miradi utilizes categorical criteria (Very High, High, Medium, Low, or Not Applicable) for *Scope*, *Severity*, *Permanence*, and *Data Sufficiency*, and (Historical, Current, and Future) for *Threat Persistence* for each target (life stage) present as defined below. In addition to providing a score for each assessed parameter, each recovery team member was instructed to include a statement describing their rationale, including available reference citations that supported their decision. Each recovery team member conducted this initial assessment independently. The references considered by the recovery team members in conducting their assessment are included in this document and organized by habitat unit.

Following this initial assessment, the recovery team members assigned to each habitat unit met as a group to discuss their individual ratings and reach consensus on a final rating for each assessed parameter (*Scope*, *Severity*, *Permanence*, and *Data Sufficiency*). Once consensus was reached, the rankings for each assessed parameter was input into the "Miradi" software to derive an overall rating (Very High, High, Medium, or Low) for each specific threat for each life stage present in the habitat unit. Specifically, Miradi averaged the ratings for *Scope* and *Severity*, and that rating was then used with the *Permanence* rating to derive an overall rating for each specific threat (Figure 1). *Data Sufficiency* scores were not used to derive a final ranking for each threat. Although Miradi also created a *summary rating* across all life stages for each specific threat, this was not used as we felt that it was important to consider the threat ratings for each life stage. Finally, the recovery team members met a final time to review the Miradi output and make any changes (which were few) to the final threats rankings.

Definitions and Rating Criteria for Scope, Severity, Permanence, Data Sufficiency, and Threat Persistence

Scope: defined spatially as the proportion of the target that can reasonably be expected to be affected by the threat within fifty years given the continuation of current circumstances and trends. Two hierarchical methodologies can be used to reach this ranking. The primary approach rates the proportion of the population or life stage affected (% of fish). When these data are not known, a secondary approach can be used that rates the proportion of the habitat affected (% of habitat).

> **Very High:** very widespread or pervasive in its scope, affecting the target across all or most (71-100%) of a designated ecosystem and life stage.
>
> **High:** widespread in its scope, affecting the target across much (31-70%) of a designated ecosystem and life stage.
>
> **Medium:** restricted in its scope, affecting the target across some (11-30%) of a designated ecosystem and life stage.

Low: very narrow in its scope, affecting the target across a small proportion (1-10%) of a designated ecosystem and life stage.

Severity: Within the scope, the level of damage to the target from the threat that can reasonably be expected given the continuation of current circumstances and trends. For green sturgeon, severity was estimated as the degree of reduction of life stage or habitat present within the designated region.

Very High: destroy or eliminate the target or reduce its population by 71-100% within fifty years.

High: seriously degrade habitat or reduce the population by 31-70% within fifty years.

Medium: moderately degrade habitat or reduce the population by 11-30% within fifty years.

Low: only slightly degrade habitat or reduce the population by 0-10% within fifty years.

Permanence: The degree to which the effects of a threat can be reversed and the target affected by the threat restored. Permanence refers to the effects of the threat on the target, not the threat itself. In other words, it is not a measure of how difficult it is to stop the threat, but rather to undo the stress caused by the threat on the target.

Very High: cannot be reversed and it is very unlikely the target can be restored, and/or it would take more than 100 years to achieve this (i.e., wetlands converted to a shopping center).

High: can technically be reversed and the target restored, but it is not practically affordable and/or it would take 21-100 years to achieve this (i.e., wetland converted to agriculture).

Medium: can be reversed and the target restored with a reasonable commitment of resources and/or within 6-20 years (i.e., ditching and draining of wetland).

Low: are easily reversible and the target can be easily restored at a relatively low cost and/or within 0-5 years (i.e., off-road vehicles trespassing in wetland).

Note: the permanence rating as specified incorporates both a temporal and irreversibility aspect with respect to prioritizing potential threats. For example, if a threat is imminent that will cause irreversible damage then it makes sense to prioritize that threat to avoid the impact. However, if the threat has already occurred and the irreversible damage has already taken place, then it may receive a lower priority.

Data Sufficiency: Data sufficiency refers to the quality of data available upon which to assign a ranking.

> **High:** An abundance of data is available for the species and effects, and the scorer has no reservations in reaching a ranking decision.
>
> **Medium:** Specific data are available for the species and effects, and a ranking decision can be assigned, but additional data are desired.
>
> **Low:** Ranking decision is based on expert opinion, hypotheses, or suspicions based on biological concepts or inferences from data or information on other species or areas.

Threat Persistence: Is the threat historic, current, or future.

> **Historica**l: threats that occurred in the past and may or may not be occurring presently.
>
> **Current:** threats occurring now.
>
> **Future:** threats likely to affect green sturgeon over the next fifty years.

Definitions for Overall Ratings

The overall ratings for each threat were derived using the Miradi software, based on the consensus scores for Scope, Severity, and Permanence (Figure A-1). The overall ratings are defined below. Each overall rating level could result from several combinations of scores for the three parameters. A Very High or High score for scope/severity (together, called the "magnitude") or for permanence had a large influence on the overall rating.

Very High: Threats with an overall rating of Very High had
> Very High scope/severity and Very High, High, or Medium permanence; or
> High scope/severity and Very High permanence.

High: Threats with an overall rating of High had
> Very High scope/severity and Low permanence;
> High scope/severity and High or Medium permanence; or
> Medium scope/severity and Very High permanence.

Medium: Threats with an overall rating of Medium had
> High scope/severity and Low permanence;
> Medium scope/severity and High or Medium permanence; or
> Low scope/severity and Very High permanence.

Low: Threats with an overall rating of Low had
> Medium scope/severity and Low permanence; or
> Low scope/severity and High, Medium, or Low permanence.

(a)

		Scope			
		Very High	**High**	**Medium**	**Low**
Severity	**Very High**	Very High	High	Medium	Low
	High	High	High	Medium	Low
	Medium	Medium	Medium	Medium	Low
	Low	Low	Low	Low	Low

(b)

		Permanence			
		Very High	**High**	**Medium**	**Low**
Magnitude	**Very High**	Very High	Very High	Very High	High
	High	Very High	High	High	Medium
	Medium	High	Medium	Medium	Low
	Low	Medium	Low	Low	Low

Figure A-1. Miradi's rule-based system for deriving an overall rating for each threat based on Scope, Severity, and Permanence. (a) First, Miradi combines the ratings for scope and severity to get the overall threat magnitude rating for each threat. (b) Miradi then combines this overall threat magnitude rating from the first step with the permanence rating. Figure adapted from Appendix B in Foundations of Success. 2009. Conceptualizing and Planning Conservation Projects and Programs: A Training Manual. Foundations of Success, Bethesda, Maryland, USA (available at: http://www.fosonline.org/resource/conceptualizing-and-planning-manual).

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