Volume III, Chapter 2
Green Sturgeon

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2.0 Green Sturgeon (*Acipenser medirostris*)

Green sturgeon is an anadromous species that spawn in several West Coast rivers but spend most of their life in near-shore marine and estuarine waters from Mexico to southeast Alaska (Houston 1988; Moyle *et al.* 1995). Significant spawning populations of green sturgeon have been identified in the Sacramento, Klamath, and Rogue Rivers. While green sturgeon do not spawn in the Columbia Basin, significant populations of subadults and adults are present in the estuary during summer and early fall. Green sturgeon are occasionally observed as far upriver as Bonneville Dam. Reasons for concentrations in the Columbia River are unclear because no spawning occurs in that system and all of the green sturgeon stomachs examined to date have been empty. These fish may be seeking warmer summer river waters in the northern part of their range.

NOAA Fisheries (formerly know as NMFS) completed a status review for green sturgeon in 2003 and determined that listing under the ESA was not warranted at this time.

2.1 Life History & Requirements

Adult green sturgeon typically migrate into fresh water beginning in late February (Moyle *et al.* 1995). Spawning occurs in deep turbulent river mainstems. Klamath and Rogue River populations appear to spawn within 100 miles of the ocean, while the Sacramento spawning run may travel over 200 miles. Spawning occurs from March–July, with peak activity from April–June (Moyle *et al.* 1995). Confirmed spawning populations in North America are in the Rogue, Klamath, and Sacramento Rivers (Moyle *et al.* 1995).

Specific spawning habitat preferences are unclear, but eggs likely are broadcast over large cobble where they settle into the cracks (Moyle *et al.* 1995). The adhesiveness of green sturgeon eggs is poor compared to white sturgeon (Van Eenennaam *et al.* 2001), which may be explained by the reduced thickness of the outer layer of the chorion of green sturgeon eggs (approximately half the thickness of that in white sturgeon; Deng *et al.* 2001). Optimum flow and temperature requirements for spawning and incubation are unclear, but spawning success in most sturgeons is related to these factors (Dettlaff *et al.* 1993). Temperatures above 68°F (20ºC) were lethal to embryos in laboratory experiments (*Cech et al.* 2000).

Green sturgeon larvae are distinguished from other sturgeon by the absence of a swim-up or post-hatching pelagic stage. They can be distinguished from white sturgeon by their size (longer and larger), light pigmentation, and size and shape of the yolk-sac (Deng *et al.* 2001). Larvae hatched in the laboratory are photonegative, exhibiting hiding behavior (Deng *et al.* 2001), and after the onset of exogenous feeding, green sturgeon larvae and juveniles appear to be

nocturnal (Cech *et al.* 2000). This development pattern and behavior may be an adaptation suited for avoiding downstream displacement.

Juvenile green sturgeon grow rapidly reaching 2 feet within 2–3 years (Nakamoto and Kisanuki 1995). Juveniles appear to spend up from 1–4 years in fresh and estuarine waters and disperse into salt water at lengths of 1-2.5 feet. Green sturgeon are benthic feeders on invertebrates including shrimp and amphipods, small fish, and possibly mollusks (Houston 1988).

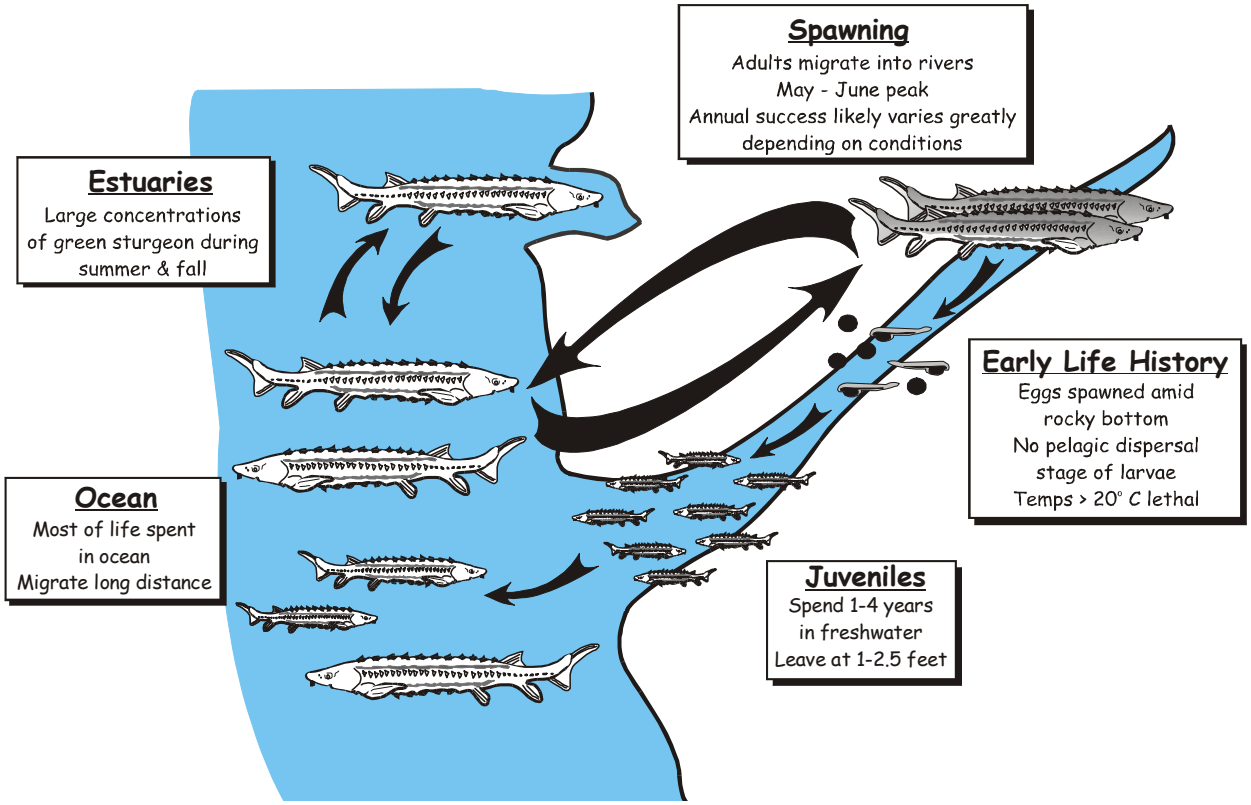

Figure 2-1. Conceptual model of green sturgeon life cycle and limiting factors

2.2 Population Identification

Based on a review of the limited genetic data available for green sturgeon, NMFS identified two distinct population segments. A northern DPS includes Klamath and Rogue spawning populations. A southern DPS includes the Sacramento spawning population. Fish using the Columbia River apparently include individuals from both population segments.

An Asian form of green sturgeon (*A. mikadoi*) also has been described and is known to spawn only in the Tumnin River (Artyukhin and Andronov 1990; Birstein et al 1997 as cited in Birstein and Bemis 1997).

2.3 Status & Abundance Trends

Available time series data were limited, but were not consistent with a modern decline in green sturgeon abundance. Time series data on green sturgeon abundance and size composition are limited to fishery landing statistics; these do not provide a consistent index of green sturgeon abundance. Columbia River harvest per unit effort and size composition data suggest an increasing rather than decreasing trend in green sturgeon abundance. Current data indicate that:

- green sturgeon still spawn in most systems where they were historically present,
- significant numbers of spawners are present in several systems, and
- geographic range of spawning green sturgeon is currently stable or increasing.

The wide distribution of green sturgeon, large numbers seasonally observed in some areas, and projections based on demographic rates suggest that total green sturgeon numbers are at least in the tens of thousands.

2.4 Limiting Factors

Spawning populations of green sturgeon are potentially affected by runoff and water management in natal rivers. Physical factors affecting green sturgeon habitat use in the lower Columbia River and estuary are unclear.

Like all sturgeon, green sturgeon populations are highly susceptible to fishing mortality. Significant catches or concentrations of green sturgeon have been reported in widely-scattered areas throughout the broad distribution of this species. Directed green sturgeon fisheries do not occur anywhere in their range, but small incidental harvest occurs in several areas. Annual harvest data are available from the Columbia River where salmon and white sturgeon fisheries intercept green sturgeon that gather in the estuary in large numbers during late summer and early fall. The majority of the green sturgeon harvest occurs in commercial gill net fisheries. Green sturgeon landings in the Columbia River declined steadily from a peak harvest of 6,400 in 1986, which occurred during expanded salmon fisheries for a very large fall chinook and coho return (Figure 2-2). Rather than an index of green sturgeon abundance, decreases are the direct result of increasing restrictions on white sturgeon and salmon fisheries since 1986.

Like the white sturgeon, green sturgeon probably recovered slowly following collapse of excessive 19th century fisheries. Gradual recovery is consistent with harvest patterns of green sturgeon in Columbia River fisheries: green sturgeon landings were identified beginning in 1938 and they show a generally increasing trend until the 1960s with variable harvest but no obvious trend after 1960. Recent fluctuations in green sturgeon landings likely result from a combination of annual variation in occurrence in the Columbia estuary and in salmon or white sturgeon fisheries. Where total harvest is expressed as catch per unit effort based on fish tickets logged by commercial fish buyers, catch rates have been variable and possibly increasing over the same period that total green sturgeon landings have decreased. Increases might have been even more pronounced but for the fact that the legal-size slot for retention was reduced from 48-72 inches to 48-66 inches TL in 1993. In addition, average size and frequency of large green sturgeon have been increasing.

No supplementation or conservation hatchery programs currently exist for green sturgeon throughout their range (Joel VanEnennaam, University of California, Davis, personal communication).

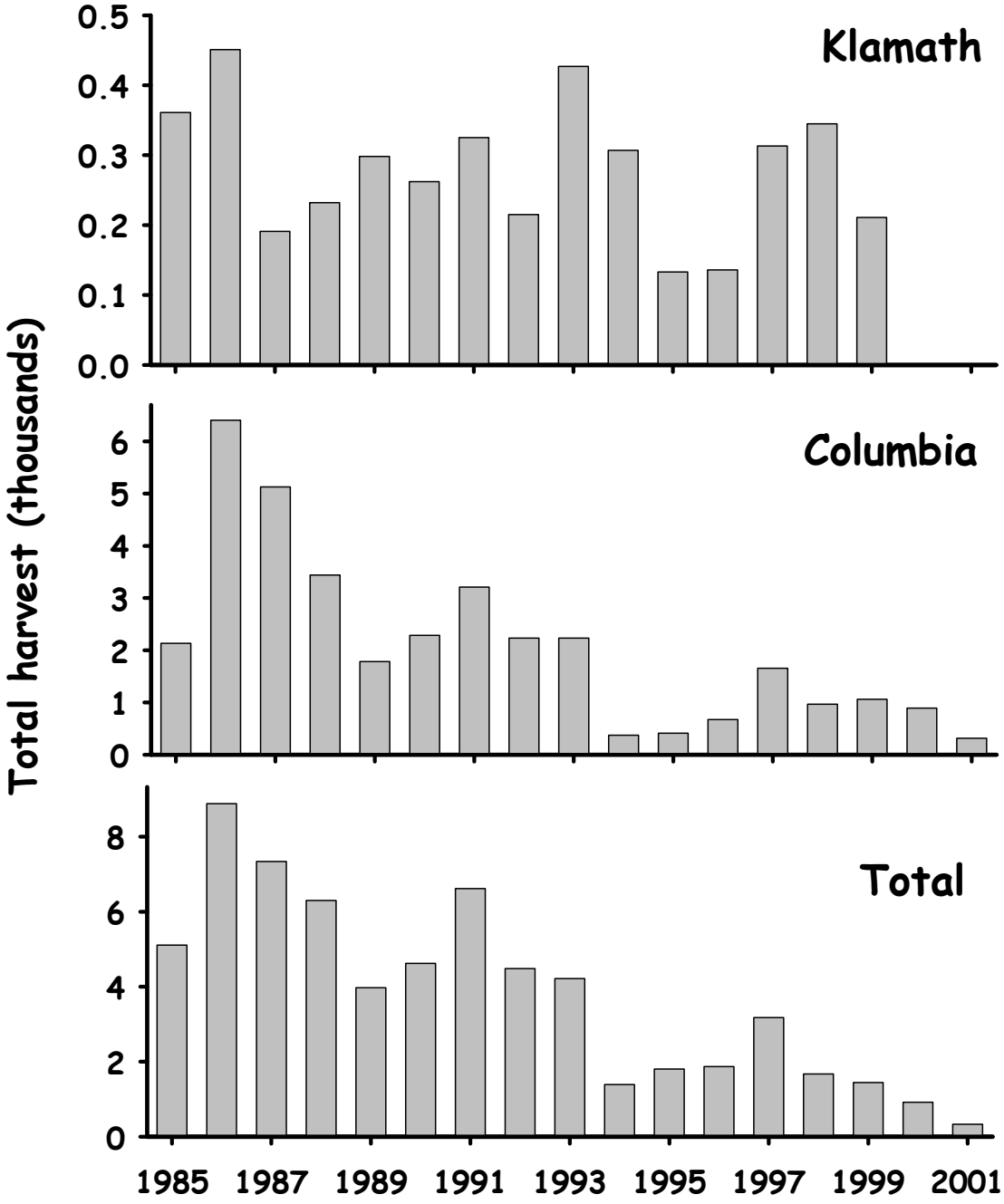

Figure 2-2. Recent annual harvest of green sturgeon as reported by Farr et al. (2002). Columbia includes Oregon and Washington sport and commercial fishery harvests. Klamath includes Yurok and Hoopa subsistence fishery harvests. Total also includes Oregon coastal sport, Washington coastal sport, commercial, Tribal, and Oregon and Washington trawl. The total does not include California sport harvest which is believed to be minor (Schaffter 2000).

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