



# Endangered Species Act Biennial Report to Congress

October 1, 1996 - September 30, 1998



Prepared by:  
**U.S. DEPARTMENT OF COMMERCE**  
**National Oceanic and Atmospheric Administration**  
National Marine Fisheries Service  
Office of Protected Resources



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## Introduction

The 1978 amendments of the Endangered Species Act of 1973 (ESA) contained a requirement that the U.S. Fish and Wildlife Service (FWS) and the National Marine Fisheries Service (NMFS) develop and implement recovery plans for species under their jurisdiction. During the 1988 reauthorization of the ESA, an amendment was added to the ESA requiring the Secretaries of Commerce and the Interior to prepare a biennial report “on the status of efforts to develop and implement recovery plans for all species listed pursuant to this section and on the status of all species for which such plans have been developed.”

To satisfy this reporting requirement, a summary of recovery efforts for species under NMFS jurisdiction for the period October 1, 1996 and September 30, 1998 has been prepared. Included in this report is the most current species status and trends information available. Recovery plans can be obtained by writing to:

Endangered Species Division - Recovery Plans  
Office of Protected Resources - F/PR3  
National Marine Fisheries Service  
1315 East-West Highway, 13th Floor  
Silver Spring, MD 20910-3226

This report is available on-line via the NMFS-Office of Protected Resources Website at:  
[http://www.nmfs.noaa.gov/prot\\_res/readingrm/ESABiennial/98bien.pdf](http://www.nmfs.noaa.gov/prot_res/readingrm/ESABiennial/98bien.pdf).

Recovery plans are also available electronically at:  
[http://www.nmfs.noaa.gov/prot\\_res/PR3/recovery.html](http://www.nmfs.noaa.gov/prot_res/PR3/recovery.html).

NMFS manages an information database that tracks: (1) the status of endangered or threatened marine species; and (2) the development and implementation of recovery plans to promote survival of species. This report was generated from the data in that system.

The ESA requires development and implementation of recovery plans unless such plans will not promote the conservation of the species. Although the ESA does not differentiate between domestic and foreign species in this regard, specific management actions are often not feasible for species whose range is either totally or primarily outside of U.S. jurisdiction. The range of a number of listed marine species is totally outside U.S. jurisdiction. In other cases, the range in areas under the jurisdiction of the United States is limited, and management actions in the U.S. portion of their range are not likely to contribute to recovery. Therefore, NMFS has focused recovery plans to those species primarily under U.S. jurisdiction.

NMFS believes that local efforts and initiatives are key to restoring environmental health and fisheries resources. It is our view that collaboration between Federal, state, tribal, and local

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authorities, and private entities, has the greatest chance of ensuring the recovery of listed species. Aggressive initiatives in habitat, hatcheries, and harvest have the potential to restore species to levels such that listing under ESA is unwarranted. In perhaps the most complex and controversial program ever attempted under the ESA, the Pacific Northwest, under NMFS leadership, is moving ahead with significant actions to improve overall environmental health and recover listed Pacific salmon and trout. NMFS is also investing substantial funding, technical expertise, and policy guidance in support of state, tribal, and local initiatives to restore salmon, steelhead, and cutthroat trout populations in California, Oregon, Washington and Idaho.

Listing Actions occurring during the report period:

<u>Common Name</u>	<u>Population Name</u>	<u>Status</u>	<u>Listing Date</u>	<u>FR Notice</u>
<b>Coho Salmon</b>				
Central California Coast		Threatened	10/31/1996	61 FR 56138
Oregon Coast		Threatened	8/10/1998	63 FR 42587
Southern Oregon-Northern California		Threatened	5/6/1997	62 FR 24588
<b>Steelhead Trout</b>				
California Central Valley		Threatened	3/19/1998	63 FR 11346
Central California Coast		Threatened	8/18/1997	62 FR 43937
Lower Columbia River		Threatened	3/19/1998	63 FR 11346
Snake River Basin		Threatened	8/18/1997	62FR 43974
South Central Coast		Threatened	8/18/1997	62 FR 43937
Southern California		Endangered	8/18/1997	62 FR 43937
Upper Columbia River		Endangered	8/18/1997	62 FR 43937
<b>Johnson's seagrass</b>		Threatened	9/18/1998	63 FR 49035

Included in this report is information on species proposed for listing under the ESA. During the period of this report, the following species were also proposed for listing:

<u>Common Name</u>	<u>Population Name</u>	<u>Status</u>	<u>Proposed Rule Date</u>	<u>FR Notice</u>
<b>Chinook Salmon</b>				

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Lower Columbia River	Proposed Threatened	3/9/1998	63 FR 11481
Puget Sound	Proposed Threatened	3/9/1998	63 FR 11481
Upper Columbia River, spring-run	Proposed Endangered	3/9/1998	63 FR 11481
Upper Willamette River	Proposed Threatened	3/9/1998	63 FR 11481
Central Valley California, spring-run	Proposed Endangered	3/9/1998	63 FR 11481
Central Valley California, fall/late-fall run	Proposed Threatened	3/9/1998	63 FR 11481
Southern Oregon & California Coast	Proposed Threatened	3/9/1998	63 FR 11481
Snake River fall-run	Proposed Endangered - extension	3/10/1998	63 FR 11798
<b>Chum Salmon</b>			
Columbia River	Proposed Threatened	3/10/1998	63 FR 11773
Hood Canal summer-run	Proposed Threatened	3/10/1998	63 FR 11773
<b>Sockeye Salmon</b>			
Ozette Lake	Proposed Threatened	3/10/1998	63 FR 11750
<b>Steelhead Trout</b>			
Middle Columbia River	Proposed Threatened	3/10/1998	63 FR 11798
Upper Willamette River	Proposed Threatened	3/10/1998	63 FR 11798

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The following species have also had critical habitat designated or proposed during the reporting period:

<i>Common Name</i>	<i>Population Name</i>	<i>Designation/ Proposal Date</i>	<i>FR Notice</i>	<i>CH Status</i>
<b>Chinook Salmon</b>				
	Lower Columbia River	3/9/1998	63 FR 11481	Proposed
	Puget Sound	3/9/1998	63 FR 11481	Proposed
	Upper Columbia River, spring-run	3/9/1998	63 FR 11481	Proposed
	Upper Willamette River	3/9/1998	63 FR 11481	Proposed
	Central Valley California, spring-run	3/9/1998	63 FR 11481	Proposed
	Central Valley California, fall/late-fall run	3/9/1998	63 FR 11481	Proposed
	Southern Oregon & California Coast	3/9/1998	63 FR 11481	Proposed
	Snake River fall-run (range extension)	3/9/1998	63 FR 11481	Designated
<b>Chum Salmon</b>				
	Columbia River	3/9/1998	63 FR 11481	Proposed
	Hood Canal summer-run	3/9/1998	63 FR 11481	Proposed
<b>Sockeye Salmon</b>				
	Ozette Lake	3/9/1998	63 FR 11481	Proposed
<b>Coho Salmon</b>				
	Central California Coast	11/25/1997	62 FR 62741	Proposed
	Southern Oregon-Northern California Coast	11/25/1997	62 FR 62741	Proposed
	Snake River fall-run (range extension)	3/9/1998	63 FR 11481	Proposed
<b>Green and Hawksbill Turtle</b>				
	Culebra, Mona, and Monito Islands, Puerto Rico	9/02/98	63 FR 46693	Designated

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Also included in this report is information on species designated as candidates under the ESA .

<u>Common Name</u>	<u>Area of Concern</u>	<u>Designation Date</u>	<u>FR Notice</u>
Nassau Grouper	Atlantic, Caribbean and Gulf of Mexico	6/11/1991	56 FR 26797
Warsaw Grouper	Atlantic and Gulf of Mexico	7/14/1997	62 FR 134
Speckled Hind	Atlantic and Gulf of Mexico	7/14/1997	62 FR 134
Jewfish	Atlantic, Caribbean and Gulf of Mexico	6/11/1991	56 FR 26797
Opossum Pipefish	Eastern Florida	7/14/1997	62 FR 134
Mangrove Rivulus	Eastern Florida	7/14/1997	62 FR 134
Atlantic Salmon <sup>1</sup>	Gulf of Maine DPS	12/18/1997	62 FR 66325
Alabama Shad	Gulf of Mexico	7/14/1997	62 FR 134
Dusky Shark	Atlantic, Pacific and Gulf of Mexico	7/14/1997	62 FR 134
Sand Tiger Shark	Atlantic and Gulf of Mexico	7/14/1997	62 FR 134
Night Shark	Atlantic and Caribbean	7/14/1997	62 FR 134
Key Silverside	Florida Keys	6/11/1991	56 FR 26797
Atlantic Sturgeon	Atlantic, anadromous	1988	
Saltmarsh topminnow	Gulf of Mexico	7/14/1997	62 FR 134
White Abalone	California	7/14/1997	62 FR 134
Sockeye Salmon	Baker River	3/10/1998	63 FR 11750
Steelhead Trout	Klamath Mountains Province	3/19/1998	63 FR 11346
	Northern California	3/19/1998	63 FR 11346
	Oregon Coast	3/19/1998	63 FR 11346

<sup>1</sup>Previously proposed for listing. Proposal withdrawn in December, 1997 (62 FR 66342).

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All species currently under NMFS jurisdiction (domestic and foreign), including proposed and candidate species, are listed in the Appendix.

For the sake of efficiency, information on marine mammals is not included in this Biennial Report. Detailed information on status and recovery programs for marine mammals is available in a separate publication, the Marine Mammal Protection Act of 1972 (MMPA) Annual Report. This report is available electronically at:

[http://www.nmfs.noaa.gov/prot\\_res/PR2/MMPA\\_Annual\\_Report/annualreport.html](http://www.nmfs.noaa.gov/prot_res/PR2/MMPA_Annual_Report/annualreport.html)

# Recovery Plans



A Sea Turtle Successfully Escapes a Turtle Excluder Device

**Plan Title:     Green Turtle - Atlantic Population**

<b>Planning Stage:</b>	Final
<b>Plan Approval Date:</b>	10/29/91

**Species Covered**

<b>Common Name</b>	<b>Population Name</b>	<b>NMFS Status</b>
Turtle, green	Florida Breeding Population	Endangered
	Range-wide	Threatened

**Plan Status**

NMFS approved and distributed a final recovery plan for green turtles in the Atlantic Ocean in 1991.

**Recovery Actions**

1.     Protect and manage nesting habitat.
  - a.     Evaluate current laws on beach armoring, and strengthen laws if necessary.
  - b.     Ensure laws regulating construction and beach armoring are enforced.
  - c.     Acquire in fee-title all undeveloped nesting beaches between Melbourne and Wabasso Beach, Florida.
2.     Protect and manage populations on nesting beaches.
  - a.     Monitor trends in nesting activity by means of standardized surveys.
  - b.     Evaluate nest success and implement appropriate nest protection measures.
  - c.     Protect and manage populations in the marine environment.
  - d.     Determine seasonal distribution, abundance and status of sea turtles in the nearshore marine environment.
  - e.     Determine etiology of sea turtle fibropapillomas and monitor mortality of those turtles affected.
3.     NMFS has made a major effort to reduce green turtle mortality in shrimp trawl fisheries by improving the regulations that require the use of Turtle Excluder Devices (TEDs).
4.     NMFS has provided resources for the collection of basic sea turtle biological information.
5.     NMFS funded projects are being conducted to determine species composition, relative abundance, and seasonal distribution in important nearshore waters of the southeastern U.S. Historically, Cedar Key, Florida, supported large numbers of green turtles.
6.     NMFS is sponsoring a project to determine distribution and species composition in this area.
7.     The agency is also conducting research to determine similar information about turtles during their pelagic life stages. NMFS laboratories are conducting research on sea turtle

habitat utilization in the Gulf of Mexico. The project focuses on known sea turtle developmental habitats. Analyses of sea turtle strandings have been conducted to monitor the level of strandings and possible causes of mortality.

8. Research has been conducted on the effects of pollutants on sea turtles.
9. NMFS is currently conducting research on the etiology and epidemiology of fibropapillomas in green turtles from Hawaiian waters and the Atlantic. In addition, NMFS is developing an integrated health assessment plan for sea turtles in coastal southeastern U.S. waters.

### **Recovery Goals**

The Atlantic population of the green turtle in the United States can be delisted if, over a period of 25 years, the following conditions are met:

1. The level of nesting in Florida has increased to an average of 5000 nests per year for at least 6 years;
2. At least 25% (105km) of all available nesting beaches (420km) is in public ownership and encompasses greater than 50% of the nesting activity;
3. A reduction in mortality is reflected in higher counts of individuals on foraging grounds; and
4. All priority 1 tasks have been successfully implemented.

Six major actions are needed to achieve recovery:

1. Provide long-term protection to important nesting beaches;
2. Ensure at least 60% success on major nesting beaches;
3. Implement effective lighting ordinances or lighting plans on nesting beaches;
4. Determine distribution and seasonal movements for all life stages in marine environment;
5. Minimize mortality from commercial fisheries; and
6. Reduce threats to population and habitat from marine pollution.

**Plan Title: Green Turtle - Pacific Population**

<b>Planning Stage:</b>	Final
<b>Plan Approval Date:</b>	1/12/98

**Species Covered**

<b>Common Name</b>	<b>Population Name</b>	<b>NMFS Status</b>
Turtle, green	Range-wide	Threatened

**Plan Status**

The green turtle is listed as Threatened under the Endangered Species Act (ESA) throughout its Pacific Range, except for the Endangered population nesting on the Pacific coast of Mexico which is covered under the Recovery Plan for the East Pacific green turtle. In reviewing this species' current status, the Recovery Team found that, outside of Hawaii, the green turtle populations have seriously declined and should probably be classified as Endangered. By far, the most serious threat to these stocks is from direct take of turtles and eggs, both within U.S. jurisdiction and on shared stocks that are killed when they migrate out of U.S. jurisdiction (e.g., nesting turtles from American Samoa migrate to Fiji and French Polynesia to feed). In Hawaii, green turtle populations appear to have a somewhat less dire status, probably due to effective protection at the primary nesting areas of the Northwest Hawaiian Islands and better enforcement of regulations prohibiting take of the species. However, the relatively recent increase in the incidence of fibropapillomatosis, a disease associated with tumors, in the Hawaiian green turtle threatens to eliminate improvements in the status of the stock. Another serious threat to green turtle populations throughout the Pacific is associated with increasing human populations and development. In particular, human development is having an increasingly serious impact on green nesting beaches.

Significant progress is being made in the monitoring of Hawaiian green turtles by the NMFS and the USFWS. A 5-year series of saturation surveys, completed in 1992, led to the development of rigorous quantitative methods to estimate the nesting population. Progress is also being made in monitoring juvenile and subadult Hawaiian green turtles in their nearshore habitat.

**Recovery Actions**

Actions Needed: Eight major actions are needed to achieve recovery (not in order of priority).

1. All regional stocks that use U.S. waters have been identified to source beaches based on reasonable geographic parameters.
2. Each stock must average 5,000 (or a biologically reasonable estimate based on the goal of maintaining a stable population in perpetuity) females estimated to nest annually (FENA)

- over six years.
3. Nesting populations at "source beaches" are either stable or increasing over a 25-year monitoring period.
  4. Existing foraging areas are maintained as healthy environments.
  5. Foraging populations are exhibiting statistically significant increases at several key foraging grounds within each stock region.
  6. All Priority #1 tasks have been implemented.
  7. A management plan to maintain sustained populations of turtles is in place.
  8. International agreements are in place to protect shared stocks.

### **Recovery Goals**

Goal: The recovery goal is to delist the species.

Recovery Criteria: To consider de-listing, all of the following criteria must be met:

1. Stop the direct harvest of green turtles and eggs, through education and law enforcement actions.
2. Eliminate the threat of fibropapillomas to green turtle populations.
3. Reduce incidental harvest of green turtles by commercial and artisanal fisheries.
4. Determine population size and status through regular nesting beach and in-water censuses.
5. Identify stock home ranges using DNA analysis.
6. Support conservation and biologically viable management of green turtle populations in countries that share U.S. green turtle stocks.
7. Eliminate adverse effects of development on green turtle nests and foraging habitats.
8. Control non-native predators of eggs and hatchlings, (e.g., mongoose, feral cats, pigs) in the Hawaiian population.

**Plan Title: Green Turtle - East Pacific Population**

<b>Planning Stage:</b>	Final
<b>Plan Approval Date:</b>	1/12/98

**Species Covered**

<b>Common Name</b>	<b>Population Name</b>	<b>NMFS Status</b>
Turtle, green	Mexican Breeding Population	Endangered

**Plan Status**

The East Pacific green turtle is listed as Endangered throughout its range. This regionally important population of the green turtle (*Chelonia mydas* although see Taxonomy), has exhibited an extreme decline over the last 30 years. This decline was undoubtedly caused by the massive overharvest of wintering turtles in the Sea of Cortez between 1950 and 1970, and the intense collection of eggs between 1960 and the early 1980s on mainland beaches of Mexico. Primary threats to the species in U.S. waters are from entanglement in debris and boat collisions. The Primary threat in Mexico is the (illegal) harvest of turtles and eggs.

**Recovery Actions**

1. Minimize boat collision mortalities, particularly within San Diego County, California.
2. Minimize incidental mortalities of turtles by commercial fishing operations.
3. Support the efforts of Mexico and the countries of Central America to census and protect nesting East Pacific green turtles, their eggs and nesting beaches.
4. Determine population size and status in U.S. waters through regular surveys.
5. Identify stock home range(s) using DNA analysis.
6. Identify and protect primary foraging areas in U.S. jurisdiction.

**Recovery Goals**

1. All regional stocks that use U.S. waters have been identified to source beaches based on reasonable geographic parameters.
2. Each stock must average 5,000 (or a biologically reasonable estimate based on the goal of maintaining a stable population in perpetuity) females estimated to nest annually (FENA) over six years.
3. Nesting populations at "source beaches" are either stable or increasing over a 25-year monitoring period.
4. Existing foraging areas are maintained as healthy environments.
5. Foraging populations are exhibiting statistically significant increases at several key foraging grounds within each stock region.
6. All priority #1 tasks have been implemented.

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7. A management plan to maintain sustained populations of turtles is in place.
8. International agreements are in place to protect shared stocks.

**Plan Title: Hawksbill Turtle - Atlantic Population**

<b>Planning Stage:</b>	Final
<b>Plan Approval Date:</b>	11/24/93

**Species Covered**

<b>Common Name</b>	<b>Population Name</b>	<b>NMFS Status</b>
Turtle, hawksbill	Range-wide	Endangered

**Plan Status**

NMFS approved and distributed a final recovery plan for hawksbill turtles in the Atlantic Ocean in 1993.

**Recovery Actions**

The major points outlined in the recovery plan are:

1. Identify important nesting beaches.
2. Ensure long-term protection of important nesting beaches.
3. Ensure long-term protection of marine habitat.
4. Prevent degradation or destruction of marine habitats from upland erosion and siltation.
5. Prevent degradation of reef habitat from oil, sewage, and other pollutants.
6. Monitor trends in nesting activity.
7. Evaluate nest success and implement nest protection measures.
8. Ensure law enforcement activities prevent poaching on nesting beaches.
9. Determine nesting beach origins for juvenile and adult populations.
10. Quantify threats to adults and juveniles on foraging grounds.
11. Increase law enforcement to reduce poaching in U.S. waters.
12. To eliminate commercial trade in hawksbill turtles, the Secretaries of Commerce and the Interior certified Japan under the Pelly Amendment to the Fishermen's Protective Act of 1967 for engaging in activities that diminish the effectiveness of CITES. The Pelly amendment provides that the President may prohibit the importation of wildlife products from the offending country. After negotiations with the U.S. government, Japan announced on June 19, 1991, that it would end all trade in hawksbill turtles by the end of 1992 and withdraw its CITES reservation for hawksbills on July 1, 1994.
13. NMFS is involved with protecting nesting beaches and conducting surveys on primary hawksbill nesting areas in the Caribbean. NMFS has also made a major effort to reduce hawksbill turtle mortality in shrimp fisheries by implementing regulations requiring the use of turtle excluder devices (TEDs). Analyses of sea turtle strandings have been conducted to monitor the level of strandings and possible causes of mortality.

**Recovery Goals**

The Atlantic population of the hawksbill turtle in the United States can be delisted, if over a period of 23 years, the following goals are met:

1. The adult female population is increasing, as evidenced by a statistically significant trend in the annual number of nests five index beaches, including Mona Island and BIRNM.
2. Habitat for at least 50 percent of the nesting activity that occurs in the USVI and Puerto Rico is protected in perpetuity.
3. Numbers of adults, subadults, and juveniles are increasing, as evidenced by a statistically significant trend on at least five key foraging areas within Puerto Rico, USVI, and Florida.
4. All priority one tasks have been successfully implemented.

**Plan Title: Hawksbill Turtle - Pacific Population**

<b>Planning Stage:</b>	Final
<b>Plan Approval Date:</b>	1/12/98

**Species Covered**

<b>Common Name</b>	<b>Population Name</b>	<b>NMFS Status</b>
Turtle, hawksbill	Range-wide	Endangered

**Plan Status**

The hawksbill turtle is listed as Endangered throughout its range. In the Pacific, this species is rapidly approaching extinction due to a number of factors, but the intentional harvest of the species for meat, eggs and the tortoiseshell and stuffed curio trade is of greatest impact. Increasing human populations and the concurrent destruction of the habitat are also of major concern for the Pacific hawksbill populations. In a review of the status of the species the members of Recovery Team (which is made up of biologists with extensive experience in the insular Pacific) were surprised and concerned at how few hawksbills are left in areas of once-high (or at least much greater) abundance.

NMFS believed that a lack of regular quantitative surveys of species distribution and population status contributed to the Team being previously unaware of how seriously depleted hawksbill populations had become in the Pacific. The status of this species is clearly of a highest concern for the Pacific and it is recommended that immediate actions be taken to prevent its extinction.

**Recovery Actions**

Eight major actions are needed to achieve recovery (not in order of priority):

1. Stop the direct harvest of hawksbill turtles and eggs, through education and law enforcement actions.
2. Reduce incidental mortalities of hawksbills by commercial and artisanal fisheries
3. Determine population size, status and trends through long-term regular nesting beach and in-water censuses.
4. Identify stock home ranges using DNA analysis.
5. Support conservation and biologically viable management of hawksbill populations in countries that share U.S. hawksbill stocks.
6. Identify and protect primary nesting and foraging areas for the species.
7. Eliminate adverse effects of development on hawksbill nesting and foraging habitats.
8. Control non-native predators of eggs and hatchlings, e.g., mongoose, feral cats, and pigs, in the Hawaiian population.

**Recovery Goals**

The recovery goal is to delist the species.

Recovery Criteria: To consider de-listing, all of the following criteria must be met:

1. All regional stocks that use U.S. waters have been identified to source beaches based on reasonable geographic parameters.
2. Each stock must average 1,000 females estimated to nest annually (FENA) (or a biologically reasonable estimate based on the goal of maintaining a stable population in perpetuity) over six years.
3. All females estimated to nest annually (FENA) at "source beaches" are either stable or increasing for 25 years.
4. Existing foraging areas are maintained as healthy environments.
5. Foraging populations are exhibiting statistically significant increases at several key foraging grounds within each stock region.
6. All Priority #1 tasks have been implemented.
7. A management plan designed to maintain sustained populations of turtles is in place.
8. Ensure formal cooperative relationship with regional sea turtle management programs (South Pacific Regional Environment Program [SPREP]).
9. International agreements are in place to protect shared stocks.

**Plan Title: Kemp's ridley Turtle**

<b>Planning Stage:</b>	Final
<b>Plan Approval Date:</b>	8/21/92

**Species Covered**

<b>Common Name</b>	<b>Population Name</b>	<b>NMFS Status</b>
Turtle, Kemp's ridley	Range-wide	Endangered

**Plan Status**

NMFS approved and distributed a final recovery plan for Kemp's ridley turtles in 1992. Significant progress has also been made in collaboration with Mexico and the USFWS to establish and maintain more comprehensive nesting beach surveys for Kemp's ridleys.

**Recovery Actions**

The major points outlined in the recovery plan are:

1. Encourage Mexico to expand and codify the Kemp's Ridley Natural Reserve at Rancho Nuevo.
2. Redefine and codify regulations for better reserve protection.
3. Encourage Mexico to restrict development that may degrade the nesting habitat.
4. Identify important marine habitat.
5. Protect nesting females at Rancho Nuevo.
6. Protect nests and increase hatchling protection at Rancho Nuevo.
7. Monitor population trends at Rancho Nuevo.
8. Determine juvenile and subadult nearshore habitat use.
9. Determine migration routes and foraging areas of adults.
10. Enforce and expand TED regulations.
11. Enforce the trawling prohibitions near Rancho Nuevo.
12. Promote TED use in Mexico.

NMFS has made a major effort to reduce Kemp's ridley mortality in shrimp trawl fisheries by implementing regulations requiring the use of turtle excluder devices (TEDs). In addition, NMFS has provided technical assistance to the Government of Mexico on TED utilization and provided funding support for protection of the Kemp's ridley at the major nesting beach in Mexico.

Projects are being conducted to determine species composition, relative abundance, and seasonal distribution in Atlantic and Gulf of Mexico waters. A continuing project to determine

distribution and species composition is being carried out in the Cedar Key area of Florida's west coast. Historically, this area supported large numbers of Kemp's ridleys.

NMFS laboratories are conducting research on sea turtle habitat utilization in the Gulf of Mexico. The project focuses on known sea turtle developmental habitats. Kemp's ridleys are tracked with radio and sonic transmitters to determine their temporal and spacial utilization of these areas.

Analyses of sea turtle strandings have been conducted to monitor the level of strandings and possible causes of mortality. Physiological research has been conducted on the effects of forced submergence on Kemp's ridleys.

### **Recovery Goals**

Because of Kemp's ridleys' aggregated nesting behavior, restricted breeding range, and increasing threats from the expanding global human population and general environmental degradation, complete recovery (delisting) may not be achievable. Since the principal nesting beach is in Mexico, continued, long-term cooperation between the U.S. and Mexico is necessary to recover the species.

The goal of this recovery plan is to upgrade the species from endangered to threatened status. Criteria for delisting will be addressed in future revisions of the recovery plan. Criteria for upgrading the status are as follows:

1. Continue complete and active protection of the known nesting habitat, and the waters adjacent to the nesting beach (concentrating on the Rancho Nuevo area) and continue the bi-national protection project.
2. Eliminate mortality from incidental catch in commercial shrimping in the United States and Mexico through use of TEDs and achieve full compliance with the regulations requiring TED use.
3. Attain a population of at least 10,000 nesting females per year.
4. Successfully implement all priority 1 recovery tasks.

The major actions necessary for recovery are to:

1. Assist Mexico to ensure long-term protection of the major nesting beach and its environs, including the protection of adult breeding stock and enhanced production/survival of hatching turtles.
2. Continue TED regulation enforcement in U.S. waters, expanding the areas and seasonality of required TED use to reflect the distribution of the species. Encourage and assist Mexico to incorporate TEDs in their Gulf of Mexico shrimp fleet.
3. Fill in gaps in knowledge of Kemp's ridley life history that will result in better management decisions. In order to minimize threats and maximize recruitment we should: determine distribution and habitat use for all life stages, determine critical mating/reproductive behaviors and physiology, determine survivorship and recruitment.

**Plan Title:      Leatherback Turtle - Atlantic Population**

<b>Planning Stage:</b>	Final
<b>Plan Approval Date:</b>	4/6/92

**Species Covered**

<b>Common Name</b>	<b>Population Name</b>	<b>NMFS Status</b>
Turtle, leatherback	Range-wide	Endangered

**Plan Status**

NMFS approved and distributed a final recovery plan for leatherback turtles in the Atlantic Ocean in 1992.

**Recovery Actions**

The major points outlined in the recovery plan are:

1. Identify and ensure long-term protection of important nesting beaches.
2. Identify important marine habitat.
3. Monitor trends in nesting activity on important nesting beaches with standardized surveys.
4. Evaluate nest success and implement appropriate nest protection measures.
5. Implement measures to reduce capture and mortality in the shrimp trawl fishery.
6. Evaluate extent of entanglement in and ingestion of marine debris.
7. Implement and enforce MARPOL.
8. Analyses of sea turtle strandings have been conducted to monitor the levels of strandings and possible causes of mortality.

**Recovery Goals**

The goal of the recovery plan is to delist the U.S. population of leatherback turtles. Delisting would be considered when the following conditions are met:

1. The adult female population increases over the next 25 years, as evidenced by a statistically significant increase in the number of nests at Culebra, Puerto Rico; St. Croix, USVI; and along the east coast of Florida.
2. Nesting habitat encompassing at least 75% of nesting activity in the U.S. Virgin Islands, Puerto Rico and Florida is in public ownership.
3. All priority 1 tasks have been successfully implemented.

**Plan Title: Leatherback Turtle - Pacific Population**

<b>Planning Stage:</b>	Final
<b>Plan Approval Date:</b>	1/12/98

**Species Covered**

<b>Common Name</b>	<b>Population Name</b>	<b>NMFS Status</b>
Turtle, leatherback	Range-wide	Endangered

**Plan Status**

The leatherback turtle is listed as Endangered throughout its range. In the Pacific, leatherback populations are in severe decline and recovery actions must be given the highest priority. Primary threats to the species are incidental take in coastal and high seas fisheries, and the killing of nesting females and collecting of eggs at the nesting beaches. The United States does not have any nesting of leatherbacks in its jurisdiction in the Pacific, but has important foraging areas on the continental U.S. west coast and near the Hawaiian Islands. It is likely that stocks in U.S. waters originate in Mexico and Central America, though some may originate from Southeast Asia as well. While not directly classified as a threat, the lack of information on the movement patterns and habitat needs of this pelagic species severely hampers recovery efforts and must be addressed as a high priority.

**Recovery Actions**

Five major actions are needed to achieve recovery (not in order of priority):

1. Eliminate incidental take of leatherbacks in U.S. and international commercial fisheries.
2. Support the efforts of Mexico and the countries of Central America to census and protect nesting leatherbacks, their eggs, and nesting beaches.
3. Determine movement patterns, habitat needs and primary foraging areas for the species throughout its range.
4. Determine population size and status in U.S. waters through regular aerial or on-water surveys.
5. Identify stock home ranges using DNA analysis.

**Recovery Goals**

The recovery goal is to delist the species.

Recovery Criteria: To consider de-listing, all of the following criteria must be met:

1. All regional stocks that use U.S. waters have been identified to source beaches based on reasonable geographic parameters.
2. Each stock must average 5,000 (or a biologically reasonable estimate based on the goal of maintaining a stable population in perpetuity) females estimated to nest annually (FENA) over six years.

3. Nesting populations at "source beaches" are either stable or increasing over a 25-year monitoring period.
4. Existing foraging areas are maintained as healthy environments.
5. Foraging populations are exhibiting statistically significant increases at several key foraging grounds within each stock region.
6. All Priority #1 tasks have been implemented.
7. A management plan designed to maintain sustained populations of turtles is in place.

**Plan Title: Loggerhead Turtle - Atlantic Population**

<b>Planning Stage:</b>	Final
<b>Plan Approval Date:</b>	12/26/91

**Species Covered**

<b>Common Name</b>	<b>Population Name</b>	<b>NMFS Status</b>
Turtle, loggerhead	Range-wide	Threatened

**Plan Status**

NMFS approved and distributed a final recovery plan for loggerhead turtles in the Atlantic Ocean in 1991.

**Recovery Actions**

The major points outlined in the recovery plan are:

1. Evaluate current laws on beach armoring.
2. Enforce laws regarding coastal construction.
3. Acquire nesting beaches between Melbourne and Wabasso Beach, FL.
4. Monitor trends in nesting activity.
5. Evaluate nest success and implement nest protection measures.
6. Determine seasonal distribution, abundance, population characteristics, and status in inshore and nearshore waters. Implement and enforce TED regulations. NMFS has made a major effort to reduce loggerhead turtle mortality in shrimp fisheries by implementing regulations requiring the use of TEDs. Analyses of sea turtle strandings have been conducted to monitor the level of strandings and possible causes of mortality.

**Recovery Goals**

The southeastern United States population of the loggerhead turtle can be delisted if, over a period of 20 years, the following conditions are met:

1. The adult female population in Florida is increasing and in North Carolina, South Carolina and Georgia, it has returned to prelisting nesting levels (NC = 800 nests/season; SC = 10,000 nests per season; GA = 2,000 nests/season).
2. At least 25 percent (560 km) of all available nesting beaches (2240 km) is in public ownership, is distributed over the entire nesting range and encompasses greater than 50 percent of the nesting activity.
3. All priority one tasks have been successfully implemented.

**PlanTitle: Loggerhead Turtle - Pacific Population**

<b>Planning Stage:</b>	Final
<b>Plan Approval Date:</b>	1/12/98

**Species Covered**

<b>Common Name</b>	<b>Population Name</b>	<b>NMFS Status</b>
Turtle, loggerhead	Range-wide	Threatened

**Plan Status**

The loggerhead turtle is listed as a Threatened species throughout its range. In the Pacific, threatened status is consistent with population levels and trends. The stocks found in U.S. jurisdiction most likely originate from Japanese nesting areas and thus activities in Japan which impact nesting success or foraging turtles in coastal waters are of concern. The United States and Mexico (primarily Baja California South) support important developmental habitats for juvenile loggerheads. A primary threat to the species in the Pacific is from the incidental mortalities associated with commercial fisheries, particularly longline and net fisheries. This threat must be minimized for recovery of this species.

**Recovery Actions**

Five primary actions are needed to achieve recovery (not in order of priority):

1. Reduce incidental capture of loggerheads by coastal and high seas commercial fishing operations.
2. Establish bilateral agreements with Japan and Mexico to support their efforts to census and monitor loggerhead populations and to minimize impacts of coastal development and fisheries on loggerhead stocks.
3. Identify stock home ranges using DNA analysis.
4. Determine population size and status (in U.S. jurisdiction) through regular aerial or on-water surveys.
5. Identify and protect primary foraging areas for the species.

**Recovery Goals**

The recovery goal is to delist the species.

To consider de-listing, all of the following criteria must be met:

1. To the best extent possible, reduce the take in international waters (have and enforce agreements).
2. All regional stocks that use U.S. waters have been identified to source beaches based on reasonable geographic parameters.
3. All females estimated to nest annually (FENA) at "source beaches" are either stable or increasing for over 25 years.

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4. Each stock must average 5,000 FENA (or a biologically reasonable estimate based on the goal of maintaining a stable population in perpetuity) over six years.
5. Existing foraging areas are maintained as healthy environments.
6. Foraging populations are exhibiting statistically significant increases at several key foraging grounds within each stock region.
7. All Priority #1 tasks have been implemented.
8. A management plan designed to maintain stable or increasing populations of turtles is in place.
9. Ensure formal cooperative relationship with a regional sea turtle management program (SPREP).
10. International agreements are in place to protect shared stocks (e.g., Mexico and Japan).

**Plan Title: Olive Ridley Turtle - Pacific Population**

<b>Planning Stage:</b>	Final
<b>Plan Approval Date:</b>	1/12/98

**Species Covered**

<b>Common Name</b>	<b>Population Name</b>	<b>NMFS Status</b>
Turtle, olive ridley	Range-wide	Threatened
	Mexican Breeding Population	Endangered

**Plan Status**

The olive ridley turtle is listed as Threatened in the Pacific, except for the Mexican nesting population, which is classified as Endangered. This latter classification was based on the extensive over-harvesting of olive ridleys in Mexico, which caused a severe population decline. Since the ban on the harvest of turtles in Mexico, the primary threat to the Mexican nesting population has been reduced and the population appears to be stabilizing. Downlisting to Threatened status may be feasible. The primary threats to the olive ridley appear to be incidental take in fisheries and boat collisions while in U.S. waters (or by U.S.-based fishing fleets), and the harvest of turtles and eggs on Mexican and Central American nesting beaches.

**Recovery Actions**

Three major actions are needed to achieve recovery (not in order of priority):

1. Minimize incidental mortalities of turtles by commercial fishing operations.
2. Support the efforts of Mexico and the countries of Central America to census and protect nesting olive ridleys, their eggs and nesting beaches.
3. Identify stock home ranges using DNA analysis.

**Recovery Goals**

The recovery goal is to delist the species.

Recovery Criteria: To consider delisting all of the following recovery criteria must be met:

1. All regional stocks that use U.S. waters have been identified to source beaches based on reasonable geographic parameters.
2. Foraging populations are statistically significantly increasing at several key foraging grounds within each stock region.
3. All females estimated to nest annually (FENA) at "source beaches" are either stable or increasing for over 10 years.
4. A management plan based on maintaining sustained populations for turtles is in effect.
5. International agreements are in place to protect shared stocks.

**Plan Title: Sacramento River Winter-Run Chinook Salmon**

<b>Planning Stage:</b>	Draft
<b>Notice of Availability Date:</b>	8/7/97

**Species Covered**

<b>Common Name</b>	<b>Population Name</b>	<b>NMFS Status</b>
Salmon, Chinook	Sacramento River Winter-run	Endangered

**Plan Status**

The Sacramento River winter-run chinook salmon was listed as threatened on an emergency basis on August 4, 1989, and was listed as threatened on November 30, 1990. In response to a petition received in June 1991, NMFS reclassified this species as endangered in January 1994. A recovery team has been appointed to prepare a recovery plan. A draft recovery plan was made available for public review and comment on August 7, 1997 (62 FR 42508). A final version of the plan should be available at the end of 1999.

**Recovery Actions**

Most of the recovery actions for the winter-run chinook salmon involve consultations under section 7 of the ESA with Federal agencies that either control the diversion of water in the river or permit activities by other water users (i.e. the Bureau of Reclamation and the U.S. Army Corps of Engineers). This species depends on an adequate flow of water at a specific temperature in the Sacramento River.

NMFS is a member of the Bureau of Reclamation's Temperature Advisory Committee, and is working with the Bureau on temperature management strategies to attract winter-run as far up the Sacramento River as possible and increase the amount of spawning in the reach of the river that the Bureau can manage with available water. NMFS is also working with the State of California by reviewing impacts of state actions on winter-run chinook.

In 1988, NMFS, the State of California, the Fish and Wildlife Service, and the Bureau of Reclamation signed a cooperative agreement to restore Sacramento River winter-run chinook. The Ten-Point Winter-Run Restoration Plan includes actions such as raising the gates at the Bureau's Red Bluff Diversion Dam from December 1 through April 1 to allow free passage of adult winter-run chinook to suitable spawning habitat and maintaining water temperatures at levels below lethal limits in the reach of river above Red Bluff Dam that is used for spawning. A biological opinion issued in 1993 to the Bureau of Reclamation on the operation of its Central Valley Project, and the State Water Project controls activities in most of the species' important habitats.

In June 1991, NMFS issued a biological opinion to the Army Corps of Engineers stating that issuance of a permit to the Glenn-Colusa Irrigation District (GCID) would likely jeopardize the continued existence of the Sacramento River winter-run chinook because GCID did not plan to install new fish screens that would exclude fish when water is diverted from the Sacramento River. NMFS requested that GCID take immediate action to prevent a take of juvenile winter-run chinook before they would pass GCID's pumping station. NMFS requested the Department of Justice move to enjoin the operation of the pumping plant when the fish are likely to be taken. A Federal District Court Judge issued a temporary restraining order against GCID which was effective on August 19, 1991, and cuts diversion of water by about 50 percent. GCID currently operates under a court-approved plan that protects winter-run chinook salmon. They are building a new fish screen to reduce entrainment of juvenile salmonids.

NMFS has consulted under section 7 with the Pacific Fishery Management Council. Because a direct take of Sacramento River winter-run chinook salmon by sport or commercial fishermen is not allowed, the biological opinion includes measures in the incidental take statement to decrease the potential incidental take of the species. These measures include not approving an early opening of the commercial fishery south of Point Arena, California, and delaying the recreational fishery for 2 weeks and closing it 2 weeks early south of Point Arena. Fishing regulations in 1996 include increased size limits in California recreational and commercial ocean salmon fisheries to further reduce impacts on winter-run chinook salmon.

The Bureau of Reclamation recently re-initiated section 7 consultation with NMFS for impacts of the Central Valley Project to winter-run chinook salmon and other listed/proposed species, including Central Valley steelhead (listed threatened), Central Valley fall/late-fall chinook (proposed threatened), and Central Valley spring-run chinook (proposed endangered). This consultation, along with restoration actions implemented pursuant to the Central Valley Project Improvement Act and Cal-Fed initiatives, should result in further improvements to winter-run chinook salmon habitat conditions in the Sacramento River and Delta.

**Plan Title: Snake River Salmon**

<b>Planning Stage:</b>	Draft
<b>Notice of Availability Date:</b>	1995

**Species Covered**

<b>Common Name</b>	<b>Population Name</b>	<b>NMFS Status</b>
Salmon, Chinook	Snake River Spring/Summer Run	Threatened
	Snake River Fall Run	Threatened
Salmon, Sockeye	Snake River	Endangered

**Plan Status**

A Snake River Salmon Recovery Team was formed in 1991; it submitted recommendations for a NMFS recovery plan in June of 1994. The NMFS reviewed and re-worked these recommendations and in March of 1995 a draft recovery plan was released for public comment. Many of the recovery actions being taken in the Columbia River basin are based upon the recommendations made in that draft Plan. A working draft of what was intended to be the Final Recovery Plan was released in August of 1997, but by that time, broad-based recovery efforts underway in other venues had made redundant the NMFS-driven recovery planning process in the Snake and Columbia River basins. This report details some of the ongoing measures instituted by the 1995 Draft Plan and summarizes the recovery efforts being generated in other forums.

**Recovery Actions Initiated by the 1995 Proposed Plan**

*Institutional Structure, Accountability, and Monitoring*

The 1995 Proposed Plan determined that the decision-making process for ESA concerns in the Columbia and Snake River basins needed to be improved. The Plan’s framers felt that because there are so many (sometimes conflicting) jurisdictions and authorities in the Region, it was vital to make profound institutional changes in order to prevent further listings and achieve recovery as rapidly and economically as possible. As a result, the very first recommendation made in the Proposed Recovery Plan was to “Create and implement a coordinated institutional structure to ensure a unified approach to recovery of ESA-listed stocks.” The second main section of this report—Multi-species Recovery Efforts—details how this recommendation is being carried out.

**Delisting Criteria**

One of the ESA-mandated requirements of any recovery plan is the establishment of objective and measurable criteria by which it can be deemed that the listed species in question no longer requires ESA protection. NMFS established these criteria for Snake River salmon in 1995; they

fall into two major categories: (1) Remedying the environmental (and other) factors that have reduced the stocks to levels which are in danger of extinction; and (2) rebuilding populations to levels where there is evidence of improved productivity, even when considering the potential impacts of severe stochastic environmental events (e.g., protracted drought, oceanic El Niño effects, etc.). Both of these categories must be achieved in order to consider delisting. To determine (2) above, NMFS proposed to use cohort replacement rates and numeric delisting criteria.

The natural cohort replacement rate describes the rate at which each subsequent cohort, or generation, replaces the previous one. When this rate is exactly 1.0, a population is neither increasing nor decreasing. If the ratio remains less than 1.0 for extended periods, a population is in decline, and could continue into extinction--a risk which originally led to listing Snake River salmon. For population rebuilding, the natural cohort replacement rate must be greater than 1. For delisting to be considered, the eight-year geometric mean cohort replacement rate of a listed species must exceed 1.0. For Snake River spring/summer chinook salmon, this goal must also be met for 80% of the index areas available for estimating cohort replacement rates.

For sockeye salmon, the numerical escapement goal is an eight-year (approximately two-generation) geometric mean of at least 1,000 natural spawners returning annually to Redfish Lake and 500 naturally-produced spawners in each of two other Snake River Basin lakes. The numerical escapement goal for Snake River fall chinook salmon is an eight-year geometric mean of at least 2,500 naturally-produced spawners in the mainstem Snake River annually. Snake River spring/summer chinook salmon have two numeric delisting criteria; both must be met for delisting to be considered. The first numerical escapement goal for Snake River spring/summer chinook salmon is an eight-year geometric mean corresponding to at least 60% of the pre-1971 brood year average redd counts for 80% of the available index areas. The second numerical escapement goal for spring/summer chinook salmon is an eight-year geometric mean equal to 60% of the 1962-1967 brood year average count of naturally-produced spawners past Ice Harbor Dam (goal is equal to 31,440 natural spawners).

### **Tributary Ecosystem**

Land and water management actions, including water withdrawals, unscreened water diversions, stream channelization, road construction, timber harvest, livestock grazing, mining, and outdoor recreation have degraded important salmon spawning and rearing habitats. To protect tributary ecosystem health, NMFS proposes a three part approach: (1) Protect remaining high quality habitat by ceasing activities that would degrade ecosystem functions and values that listed fish need, (2) restore degraded habitats, and (3) provide connectivity between high quality habitats. Federal lands and Federal actions should bear, as much as possible, the burdens of recovering listed salmon species and their habitat. NMFS' March, 1995 biological opinion on eight Land and Resource Management Plans in the Snake River Basin established guidelines to maintain or improve aquatic habitats. These guidelines are in effect until geographically specific environmental impact statements for ecosystem management are completed. The U.S. Forest Service adopted standards collectively called "PACFISH" in February, 1995; these standards sunset in August, 1996, and were extended by the Forest Service until the East Side EIS's are completed. However, non-Federal lands constitute approximately 35 percent of the Snake River

salmon critical habitat. Therefore, an ecosystem approach that emphasizes integrated Federal and non-Federal land management is needed. To achieve this, all stakeholders in a subbasin or watershed are encouraged to participate in management partnerships. The Recovery Plan also proposes actions that will reduce the loss of listed species at water withdrawal sites, rebuild salmon populations by providing adequate instream flows and improving fish passage at barriers, reduce losses of listed salmon associated with poor water quality, and reduce impacts on salmon resulting from recreational activities.

### **Mainstem and Estuarine Ecosystem**

In the mainstem and estuarine ecosystem, salmon face problems associated with their downstream and upstream migrations. The journey through the lower Snake and Columbia Rivers has become more hazardous since eight hydroelectric dams were built and their reservoirs created. Each dam delays juvenile fish in their transition to the ocean environment and exacts additional losses. Seventy percent of the 482 miles between the mouth of the Columbia River and Lewiston/Clarkston on the Snake River has been converted from free-flowing river into reservoirs. This change has slowed the rate of downstream travel for smolts and increased the amount of habitat favorable to predator species. Hatchery fish and exotic species compete with and prey on the listed salmon in the mainstem ecosystem.

The plan prescribed immediate actions to improve mainstem survival and called for a new and rapid set of evaluations to determine the efficacy of these actions, and evaluations to determine the feasibility and likely biological benefits of major structural modifications of dams. Management actions already taken to improve river conditions include drawdown of reservoirs behind the dams to minimum operating pool, increased river flows, and increased spill at dams. Structural changes implemented to improve fish survival past the dams include installation of extended length screens, construction of bypass systems (seven of the eight dams these fish must pass now have bypasses), and design and installation of a prototype surface diversion structure.

The main evaluation set up by the Proposed Plan was a process to determine whether surface diversion—in combination with improved river conditions (i.e., increased flow and spill)—and barge transportation would sufficiently improve survival to achieve recovery, or whether major structural modification of dams (i.e., drawdowns below minimum operating pool) would be necessary. The decision on which route to recommend to Congress and to the system managers has been termed “The ‘99 Decision,” as it is intended to be completed in June of 2000. The primary program for modeling and evaluating the possible options are the Plan for Analyzing and Testing Hypotheses, or PATH and NMFS’ Cumulative Risk Initiative (CRI). PATH and NMFS scientists have been laboring intensively for the past three years to deliver the best possible science to the decision makers. Their final recommendations for operating the Columbia River hydropower system will be out in late summer of 2000.

To minimize predation and competition problems in the migration corridor, the Proposed Recovery Plan contains actions to control predation by squawfish, birds, marine mammals, and non-native fishes such as smallmouth bass, walleye, and channel catfish. Measures are also proposed to reduce American shad populations in the Columbia River because they both prey on

and compete with juvenile salmon.

Environmental conditions in the Columbia River estuary and nearshore ocean environments are factors that influence juvenile salmonid survival. The Proposed Recovery Plan calls for improvement in the estuarine ecosystem through better management of dredging and water quality issues.

### **Harvest Management**

Snake River salmon are not directly targeted for harvest, but they are incidentally caught by commercial, recreational, and tribal fisheries in the ocean and in the Columbia and Snake Rivers. Incidental harvest in the ocean of Snake River sockeye salmon and Snake River spring/summer chinook salmon is minimal. However, fall chinook salmon are caught incidentally in commercial and sport fisheries from Southeast Alaska to California, in non-treaty inriver sport and commercial fisheries, and in treaty fisheries above Bonneville Dam. In each of these fisheries, listed Snake River fall chinook are mixed with a number of other natural and hatchery-origin stocks. At present, these fisheries are managed through a complex system of interrelated forums.

The draft Recovery Plan recommends amending the existing inriver harvest management rules so that they incorporate explicit management criteria to protect Snake River salmon. To minimize the number of fall chinook caught in ocean fisheries, NMFS proposes to implement a management strategy that is consistent with the Pacific Salmon Commission's management objectives for adult chinook. These goals are established for a number of stocks and are based on a chinook rebuilding program that was fully implemented in 1984. This approach takes a broad view of stock protection and focuses on the coastwide status of chinook stocks including those from Puget Sound, the Washington and Oregon coasts, and the Columbia River.

### **Artificial Propagation**

Artificial propagation of salmon in the Columbia River Basin has successfully contributed to ocean and inriver commercial, sport, and tribal fisheries. In some cases, hatchery production has slowed the decline of natural salmon populations or helped preserve them. However, effects from intensive hatchery production (such as supporting harvest rates in excess of what the natural populations can withstand, using natural fish for hatchery broodstock, and causing introgression into natural gene pools) have also contributed to the continued decline of some natural salmon populations. Ecological interactions between hatchery fish and natural fish such as competition, predation, displacement, and disease transfer need to be minimized.

Under the draft recovery plan, captive broodstocks are being maintained to conserve remaining sockeye and spring/summer chinook salmon gene pools. Other supplementation efforts designed to support listed salmon recovery are also underway in the Snake River Basin.

The draft Recovery Plan also suggests protecting listed species from excessive genetic introgression, minimizing impacts on listed salmon resulting from interactions between Columbia River Basin hatchery salmon and natural salmon, improving the quality of fish

released from hatcheries, reducing predation and competition interactions between listed salmon and steelhead and hatchery trout, restoring listed chinook by reintroducing them to historic habitat, and conducting research for the purpose of optimizing production and conserving natural populations.

### **Multi-species Recovery Efforts**

As stated earlier, one of the draft Recovery Plan's primary recommendations was to bring recovery planning under a centralized institutional structure in order to avoid conflict and wasted effort. While this work was underway, other species in the basin were listed under the ESA and still others were determined to be in failing health. This state of affairs pointed up the necessity to centralize regional recovery efforts, not just for salmon, but for all the imperiled species in the basin. This regional effort is being coordinated through the Multi-Species Framework project and the Columbia Basin Forum. Participants include state governments, Tribal governments and Federal agencies, with a management committee representing all three entities. Participants hope that this effort will help to identify areas of consensus, and ultimately lead to broader regional agreement on the future management direction for the Columbia Basin.

### **The Columbia Basin Forum**

Formerly known as the Three Sovereigns, the Columbia Basin Forum is made up of representatives from the four Northwest states, the 13 Columbia Basin Tribes, and the Federal agencies involved in the Columbia River. Its purpose is to provide a high-level policy forum to coordinate the use of its members' respective authorities in addressing fish and wildlife management and related habitat issues in the Columbia Basin. The Forum can provide a place for regional governments and interested parties in the region to discuss alternative management approaches being developed in the Framework Project and test regional agreement on the various alternatives. The Forum also will provide an opportunity for public participation.

Through the Forum, each management entity will engage in regional discussion of the available alternatives in each of the four "Hs" (habitat, harvest, hatcheries, and hydropower). The Federal agencies, for example, will specifically discuss a draft "All-H" paper and a draft Biological Assessment. The states and Tribes will do the same, bringing any particular management or recovery plans forward for discussion. Other regional interests will also be invited to participate.

### **The Multi-species Framework**

The Framework project is an effort to develop the fundamental options and outcomes necessary to make informed management decisions. The project solicited alternative management proposals from stakeholders in the region and consolidated those 27 alternatives into seven. The Framework created two workgroups to analyze the alternatives for their biological, social, and economic effects. Regional input and comments are being solicited on the alternatives and analysis through outreach activities throughout the summer. Federal, state, and Tribal representatives will participate in those outreach activities together. Members of the Forum (see below) will also discuss these alternatives. A draft report will be available for public review in the fall.

At the same time, the Corps of Engineers has since 1995 been conducting a feasibility study on alternative actions for the lower Snake River dams. The Environmental Impact Statement being prepared by the Corps examines a number of alternatives that are somewhat different from those being considered in the Framework. (This is because the Corps' process was set up to examine actions only on the Snake River.) To aid in this effort, the National Marine Fisheries Service used the output from the PATH and CRI process (mentioned above) to analyze the ecological effects likely to result from the various alternatives. The Corps intends to release a draft of the EIS for public comment this fall.

Many in the region are optimistic that the Framework project and Forum process will be able to identify areas of consensus within the region to guide Columbia Basin fish and wildlife restoration. Implementation of any regional plans requires more detail than either the Framework or the Forum can provide. Accordingly, Federal, state and Tribal implementation plans can be expected in the future. For example, Federal agencies with specific responsibilities under the Endangered Species Act, Indian treaties, and other authorities need to produce a management plan for the Federal hydropower system well before the end of 1999. For this reason, the Federal agencies are developing a detailed proposal for operation and configuration of the FCRPS, which they will put forward in the fall.

A plan for managing the Federal hydropower system only makes sense in the context of all the human activities that affect fish and wildlife. Therefore, as stated above, the Federal agencies are developing a All-H Paper that explains how the proposed hydropower management plan can fit into an overall recovery strategy. The Federal agencies intend to work within the Framework to develop alternatives that can be incorporated into the All-H paper. In addition, harvest and hatchery regimes for many Columbia River fisheries are currently being discussed in negotiations over a new Columbia River Fish Management Plan within the U.S. v. Oregon process. The Federal agencies have stated their intention that any agreement that comes out of that process would form the harvest and hatchery pieces of the All-H Paper.

### **Recovery Goals**

By working to improve survival in every segment of the salmon's life history, the ongoing recovery efforts necessarily address the effects of a broad range of activities on many of the region's ecological components. When these efforts are added to the basinwide forums, a mechanism for bringing about the recovery of the ecosystem as a whole emerges. This is vastly preferable to concentrating on limited numbers of actions in geographically disparate areas. The salmon are, or were, pervasive in the region. In recovering them, the basin managers will have gone a long way toward restoring the resources upon which they depend. Moreover, they will have taken a major step toward bringing back many of the region's other species that now exhibit badly depleted numbers.

**Plan Title: Gulf Sturgeon**

<b>Planning Stage:</b>	Final
<b>Plan Approval Date:</b>	9/22/95

**Species Covered**

<b>Common Name</b>	<b>Population Name</b>	<b>NMFS Status</b>
Sturgeon, Gulf	Range-wide	Threatened

**Plan Status**

During this report period, increased interest in Gulf sturgeon by government and non-government agencies and institutions have accomplished much toward its recovery. Genetic analyses of Gulf sturgeon indicate the population is divided into five genetically distinct stocks, each occupying a unique watershed or geographical unit. Also, Gulf sturgeon spawning and resting habitat have been documented and characterized in three river systems. Population surveys and freshwater and marine movement and migratory behavior have been studied in six watersheds. In addition, Gulf sturgeon outreach activities have contributed much toward public education.

**Recovery Actions**

NMFS, U.S. Fish & Wildlife Service and the Gulf Coast Fishery management Council published a recovery plan for the Gulf sturgeon. The major actions recommended in the plan are:

1. Conduct and refine field investigations to locate important habitats.
2. Characterize riverine, estuarine, and neritic essential habitat. Develop and implement population sampling and monitoring techniques.
3. Eliminate potential for introductions of non-native stock or other sturgeon.
4. Conduct life history studies on the requirements of little-known life stages.
5. Identify potential harmful chemical and water quantity and quality changes associated with surface water restrictions.
6. Identify and eliminate point and non-point sources of chemical contaminants.
7. Seek resolution of conflict between authorized projects and restoration of fish populations.
8. Reduce or eliminate incidental mortality.
9. Restore natural riverine habitats. Utilize existing authorities to protect habitat, and where inadequate, enact new laws and regulations.
10. Identify dam and lock sites which offer the greatest flexibility for successful restoration of essential habitats.
11. Modify specific navigation projects which alter riverine habitats or modify thermal or substrate characteristics of those habitats.
12. Implement projects or actions which will achieve recovery plan objectives. Increase

- effectiveness and enforcement of state and federal take prohibitions.
13. Seek funding for recovery actions. Identify and eliminate known and potential impacts to water quantity and quality associated with existing and proposed uses and water diversions. Assess the relationship between groundwater pumping and reduction of groundwater flows and quantify loss of riverine habitat related to reduced groundwater inflows.

### **Recovery Goals**

The primary short-term recovery objective is to prevent further reduction of existing wild populations of Gulf sturgeon within the subspecies` range. The long-term recovery objective is to establish population levels that would allow delisting of the Gulf sturgeon in discrete management units. Delisting could be considered within 30 years, if recovery criteria are met. Following delisting, a long-term fishery management objective is to establish a self-sustaining population that could withstand directed fishing pressure within discrete management units.

**Plan Title: Shortnose Sturgeon**

<b>Planning Stage:</b>	Draft
<b>Plan Approval Date:</b>	December, 1998

**Species Covered**

<b>Common Name</b>	<b>Population Name</b>	<b>NMFS Status</b>
Sturgeon, Shortnose	Range-wide	Endangered

**Plan Status**

In December 1998, NMFS will finalize and distribute the final recovery plan for shortnose sturgeon.

**Recovery Actions**

Actions Needed:

1. Establish Listing Criteria for Shortnose Sturgeon Population Segments
2. Protect Shortnose Sturgeon and their Habitats
3. Rehabilitate Shortnose Sturgeon Populations and Habitats
4. Implement Recovery Tasks

Cost of Recovery Tasks: The costs of recovery are undeterminable at this time. Refer to the Implementation Schedule for cost estimates for individual tasks. Cost estimates were not available for some tasks because the actual actions needed are not known (for example: costs of restoring access to spawning areas located above dams will vary depending on the type of fish passage implemented). In addition, some tasks are a high priority for a large number of population segments. If these tasks are conducted on several rivers concurrently, costs may be significantly reduced. Therefore, accurate cost estimates were impossible to predict.

Date of Recovery: There is evidence that some population segments are already starting to recover. Delisting of all population segments could be initiated by 2024, if all recovery criteria are met.

**Recovery Goals**

Recovery Goal: To delist shortnose sturgeon populations throughout their range.

Recovery Objective and Criteria: To recover populations to levels of abundance at which they no longer require protection under the ESA. For each population segment, the minimum population size will be large enough to maintain genetic diversity and avoid extinction.

## **Status Discussions for Species Listed under the Endangered Species Act of 1973.**



**Spawning Sockeye salmon**

***Listed Species Status***

**Green Turtle: *Chelonia mydas***

Listing Date: July 28, 1978



The green turtle was listed under the U.S. Endangered Species Act (ESA) on July 28, 1978. The species is listed as threatened throughout its range except for the Florida and Pacific Mexico breeding populations which are listed as endangered. Historically, the greatest cause of decline for green turtles has been commercial harvest for eggs and meat. This threat is still a major cause of decline outside the U.S.

**Species Biology:**

Adult green turtles are the largest of the hard-shelled turtles. Average carapace length and mass of nesting females range from 92 cm and 110 kg to 109 cm and 182 kg. The carapace is smooth and colored grey, green, brown and black. The plastron is yellowish white. An adult male can be easily differentiated from an adult female in that the male has a thick prehensile tail that extends far beyond the posterior margin of its carapace. Green turtle hatchlings weigh approximately 25 g and measure approximately 50 mm in length. The hatchling carapace is colored blue-black and the plastron is creamy-white. Green turtles are distinguished from other sea turtle species by the presence of a single pair of large prefrontal scales between the eyes, and a strongly serrated lower jaw. The common name “green turtle” specifically refers to the color of the animal’s fat.

**Distribution and Abundance:**

In the southeastern United States, green turtles are found in waters around the U.S. Virgin Islands, Puerto Rico, and the continental U.S. from Texas to Massachusetts. Important feeding grounds in Florida include the Indian River Lagoon, the Southeast Florida coastline, the Florida Keys, Florida Bay, Homosassa, Crystal River and Cedar Key. The primary nesting sites in the U.S. Atlantic are along the east coast of Florida, with additional sites in the U.S. Virgin Islands and Puerto Rico.

Green turtles are found throughout the North Pacific, occasionally ranging as far north as Eliza Harbor, Admiralty Island, Alaska, and Ucluelet, British Columbia. In the eastern North Pacific, green turtles have been sighted from Baja California to southern Alaska. In the central Pacific, green turtles can be found at most tropical islands. In U.S. Hawaiian waters, green turtles are found around most of the islands in the Hawaiian Archipelago. The primary nesting site is at French Frigate Shoals in the northwestern Hawaiian island chain.

Total population size for the green turtle is not known, and trends are particularly difficult to assess because of wide year-to-year fluctuations in numbers of nesting females, difficulties of

conducting research on early life stages, and long generation time. Present estimates of females nesting each year in the U.S. average 675 in Florida and 500 in Hawaii. Nesting in Florida is likely reduced from historical levels and has been greatly reduced in the Dry Tortugas; however, recent data (1989-1998) indicate that nesting may now be stable or increasing. In Hawaii, nesting numbers are lower than historical levels, but have increased substantially in the past 20 years. Populations in Surinam, Ascension Island, and Tortuguero, Costa Rica, appear to be stable, but other populations including Seychelles; Europa, Reunion; Indonesia; Peninsular, Malaysia; and Ogaswara Island, Japan continue to decline.

There are several principal threats to green turtles in the U.S. and these include loss of habitat, fibropapilloma disease, boat and ship strikes, and incidental capture in gill nets. Worldwide, commercial harvest and egg poaching are the primary causes of population decline. Turtles are harvested for food, leather and jewelry, and small turtles are sometimes stuffed for curios.

**Major Impacts/Threats in the Nesting Environment:**

- In the United States, harvesting of nesting green turtles and egg poaching is infrequent. However, in other parts of the world, harvesting of nesting turtles and egg poaching is a serious threat. Animal predation of eggs and hatchlings is also a concern in some areas.
- Artificial lighting can cause disorientation or misorientation of both adults and hatchlings. Green turtle hatchlings are attracted to artificial light, which disrupts their natural sea-finding behavior and can result in increased predation and mortality. In addition, adult females are discouraged from nesting in highly developed areas with intense artificial lighting.
- Beach armoring (seawalls, revetments, riprap, sandbags and sand fences) to protect property from erosion can cause the loss of dry nesting beach and/or interfere with access to suitable nesting sites. However, natural processes of beach erosion are not generally a significant threat.
- Beach nourishment results in heavy machinery, pipelines, increased human activity and artificial lighting on a project beach, and can cause the burial of nests and disturbance of nesting turtles if not regulated properly to occur outside the nesting season. Beach nourishment can result in alteration of beach or sand characteristics which can affect nesting and nest success.
- Repeated mechanical raking of nesting beaches by heavy machinery can result in compacting sand and cause tire ruts which may hinder or trap hatchlings. Rakes can penetrate the surface and disturb or uncover a nest. Disposing of the raked debris on the high beach can cover nests and may alter nest temperature affecting temperature dependent sex determination mechanisms.
- Human disturbance of nesting females is a serious concern. Also, heavy utilization of nesting beaches by humans may result in lowered hatchling success due to sand compaction.
- The placement of physical obstacles (e.g. beach chairs, recreational beach equipment) on a beach can hamper or deter nesting attempts as well as interfere with the incubation of eggs and the emergence of hatchlings.
- The use of vehicles on beaches is a serious problem in certain areas. It may result in

decreased hatchling success due to sand compaction, or directly kill hatchlings and adults. Tire ruts may also interfere with the ability of hatchlings to get to the ocean. The use of vehicles at night on nesting beaches can deter nesting females and misorient hatchlings.

- The invasion of nesting sites by non-native beach vegetation can lead to increased erosion and degradation of nesting habitat. Trees shading a beach can also change nest temperatures, altering the natural sex ratio of the hatchlings.

**Major Impacts/Threats in the Marine Environment:**

- It is estimated that before the implementation of turtle excluder device (TED) requirements, the U.S. commercial shrimp fleet captured approximately 925 green turtles each year; approximately 225 of those captures were fatal. With TED regulations in place the incidental capture and mortality of green turtles has been greatly reduced. Non-shrimp bottom and mid-water trawl fisheries also capture and can kill green turtles and efforts are underway by NMFS to address these threats. Turtles are taken by purse seine fisheries in the Atlantic and Gulf of Mexico, but the magnitude of the take is not currently known. Several thousand commercial vessels and an extensive recreational fishery are involved in hook and line fishing for various coastal species. The capture of turtles in this fishery is believed to be common, but the number is not known.
- Throughout the late 1980's and early 1990's, significant numbers of green turtles were killed by gill and trammel net fisheries off the eastern coast of central Florida. However, in 1995, gill and trammel net fisheries were banned from operating in Florida state waters. Gill nets fished in other areas of the species range remain a serious threat. Pound net fisheries are primarily a problem in Virginia waters, where turtles become entangled in the gear and can drown. In North Carolina, live turtles are often released from pound nets. Green turtles are incidentally taken by the U.S. pelagic longline fisheries in the Western North Atlantic, Eastern Pacific, and Hawaii when they are hooked and/or become entangled with the mainline or buoy line. Traps, commonly used to capture crabs, lobster and reef fish result in incidental takes of green turtles when they become entangled in the trap lines and drown. The impact of trap line gear on green turtle populations has not been quantified.
- Green turtles can consume a wide variety of marine debris such as plastic and styrofoam pieces, tar balls, balloons, plastic bags, and plastic pellets. Effects of consumption include interference in metabolism or gut function, even at low levels of ingestion, as well as absorption of toxic byproducts. Discarded monofilament fishing line and abandoned netting can entangle turtles, causing injury and/or death.
- A disease, known as fibropapillomatosis (FP), originally identified in green turtles, but now affecting loggerhead, Kemp's ridley, and olive ridley turtles as well, has emerged as a serious threat to sea turtle recovery. In the U.S., the disease is most notably present in green turtles of Hawaii, Florida, and the Caribbean, but is found at other sites around the world as well. FP is expressed as tumors which occur primarily on the skin and eyes, and the disease can be fatal. In Hawaii, green turtles afflicted with FP have a high incidence of tumors in the oral cavity, whereas oral tumors have not been reported from Florida or other areas. The cause of the disease remains unknown, however, a viral etiology is suspected. The expression of the disease has been systematically monitored in several locales in Hawaii. At a study site on southern Molokai, for example, where tumors were

virtually unknown before 1988, the prevalence of tumored turtles ranged from 42-56% during the 1995-1997 surveys. In Florida, up to 50% of the juvenile green turtles captured in the Indian River Lagoon are infected, and there are similar reports from other sites in Florida, including Florida Bay, as well as from Puerto Rico, and the U.S. Virgin Islands. In Florida, the disease has been documented affecting up to 13% of loggerheads inhabiting Florida Bay. Fibropapillomatosis is considered the primary impediment to the full recovery of the Hawaii green turtle population and the disease may hinder the recovery of green turtle populations elsewhere as well. Research to determine the cause of this disease is a high priority and is underway at federal, state, and private institutions.

- Illegal harvesting of green turtles is uncommon in the mainland U.S. Illegal take of green turtles in the Caribbean, particularly near Puerto Rico, is a more significant problem; however, no estimates of take exist. Legislation and treaties to protect and conserve green turtles are more extensive than they have been in the past, although laws are often poorly enforced, especially among developing nations and smaller islands where resources and geography limit implementation.
- Green turtles are at risk when encountering marine pollution such as oil spills. Respiration, skin, blood chemistry and salt gland functions are affected. Pesticides, heavy metals, and PCB's have been detected in turtles and eggs, but the effects are unknown.
- Dredging can result in habitat destruction by degrading nesting sites and/or foraging grounds. Hopper dredges can also kill turtles caught in dragheads. NMFS has implemented restrictions on hopper dredging activities in the Gulf and Atlantic to reduce the likelihood of dredges encountering turtles.
- In areas where recreational boating and ship traffic is intense, propeller and collision injuries are common and likely play a significant role in hampering recovery. This is a particularly difficult issue to address, given the number of registered vessels and their wide-ranging activities.
- Marina and dock construction result in the degradation and/or destruction of green turtle foraging habitat. This development also leads to increased boat traffic, increasing the risk of propeller and vessel collision injuries.
- Coastal power plants which draw their cooling water from nearshore and estuarine waters can entrain sea turtles and cause mortality. Measures have been put in place to reduce the risk to sea turtles and studies are ongoing to develop additional measures.
- Underwater explosions (e.g. gas and oil structure removal and testing using explosives) can kill or injure turtles, and may destroy or damage habitat. NMFS closely monitors oil rig removals and has instituted measures to minimize this threat.

**Conservation Activities:**

- In 1998, NOAA Fisheries and the U.S. Fish and Wildlife Service (USFWS) published recovery plans for five species of Pacific sea turtles, including one distinct nesting population of the green turtle. Plans are underway to revise some of the U.S. Atlantic recovery plans which were completed in the early 1990s. These plans describe and prioritize actions which are necessary to conserve and recover the species.
- NMFS oversees a national sea turtle stranding program. This program consists of state and Federal biologists and private citizens who respond when a sea turtle strands injured

- or dead on coastal beaches. The program has increased our knowledge of turtle biology and the human-related impacts to the turtle populations.
- To address the impact of incidental capture in the shrimp trawl fishery, TEDs were developed and, in 1992, were required in all shrimp trawlers (with a few exceptions) from North Carolina through Texas. Additionally, TED requirements were amended, effective March 1997, to enhance protection of sea turtles by establishing Shrimp Fishery Sea Turtle Conservation Areas (SFSTCAs) in the western Gulf and in the Atlantic along the coast of Georgia and South Carolina.
  - A multi-disciplinary research program is underway to study the cause and effects of the disease fibropapillomatosis (FP). Research has been initiated on the possible etiologies of the disease, including viruses, parasites, and environmental pollutants. In addition to field and laboratory research, statistical analyses and modeling studies are underway to link fibropapilloma incidence and severity to key aspects of green turtle population dynamics and assess impacts of the disease on population recovery.
  - Progress has been made in the study of migratory movements of post-nesting sea turtles, to elucidate routes of travel and identify resident foraging grounds. NOAA Fisheries scientists have conducted highly successful satellite telemetry studies with post-nesting Hawaiian and Florida green turtles.
  - On September 2, 1998, NMFS designated the coastal waters surrounding Culebra Island, Puerto Rico, critical habitat for green turtles. Critical habitat designations highlight the areas that are essential to the recovery of the species and alerts Federal agencies that these areas will be given special consideration during consultations under section 7 of the ESA.
  - Significant progress is being made in the monitoring of Hawaiian green turtles by the NMFS Honolulu Laboratory and the USFWS. A 5-year series of saturation surveys at East Island, French Frigate Shoals, completed in 1992, led to the development of rigorous quantitative methods that are now applied routinely to estimate the nesting population at East Island from annual partial-season surveys. Progress is also being made in monitoring juvenile and subadult Hawaiian green turtles in their nearshore habitat.
  - In the Hawaii and Atlantic pelagic longline fishery for tuna and swordfish, the incidental take of turtles is being monitored through a logbook and observer program. Workshops have been held to formulate research techniques to assess the population level effects of hooking and entanglement and to identify ways to reduce or mitigate incidental capture. In related research, satellite transmitters have been deployed on turtles hooked incidentally in the longline fishery to track post-release movements to better understand the long-term effects of hooking. Linkages between turtle movements and oceanographic processes are also being studied.
  - In the last decade considerable efforts have been expended to elucidate sea turtle management units through the use of genetic tools. There is a high degree of genetic structuring within ocean basins for all species except the leatherback. These genetically distinct management units arose as a result of genetic isolation facilitated by the species' natal homing. While the animals do appear to segregate when nesting, they commingle on the foraging grounds, sometimes thousands of miles away from their natal beach (where they hatched). The analyses of genetic material from turtles incidentally taken in various fisheries can tell us which populations are being impacted. The Hawaii-based longline fishery interacts with loggerheads from Japan, green turtles from Hawaii and

Mexico, and leatherbacks from both the eastern Pacific (Mexico or Costa Rica) and the southwestern Pacific (Irian Jaya, Malaysia, or Solomon Islands). Collection and analysis of genetic specimens from Mexican nesting beaches is just one facet of a broad collaboration between NMFS and Mexican scientists with the objective of monitoring and assessing turtle nesting along Mexico's Pacific coast. Green turtles inhabiting foraging habitats along the east coast of the U.S. come from nesting sites in Florida, the Caribbean, and the South Atlantic Ocean (east and west).

- The Inter-American Convention for the Protection and Conservation of Sea Turtles was concluded on September 5, 1996 in Salvador, Brazil. This is the first international agreement devoted solely to the protection of sea turtles. The Convention will come into force when 8 countries have ratified it. The Convention establishes national sea turtle conservation programs in the signatory countries. These programs will include prohibiting intentional take (except for subsistence take as allowed under the convention), domestic or international sale of turtle parts or products, conservation and restoration of habitat and nesting beaches, and the promotion of efforts to enhance sea turtle populations. All commercial shrimp trawl vessels operating in waters regulated by the Parties will use TEDs to reduce the incidental capture of sea turtles. Some exceptions to the TED requirement are allowed. All Parties will establish a monitoring and observation program to verify that these measures are being applied. The convention is open only to States in the Americas or States with territories in the Americas, but it does call upon Parties to negotiate complementary protocols with non-Party states.
- U.S. Public Law 101-162, Section 609 requires the U.S. to embargo shrimp harvested with commercial fishing technology which may adversely affect sea turtles. The import ban does not apply to nations that have adopted comparable sea turtle protection programs (i.e., require the use of TEDs) to that of the U.S. or those nations whose fishing environment does not pose a threat of incidental take of sea turtles. The Department of State (DOS) is the principal implementing agency of this law, with NMFS serving as technical advisor. NMFS has provided training in the installation and use of TEDs to many countries in Latin America, and more recently in Asia.

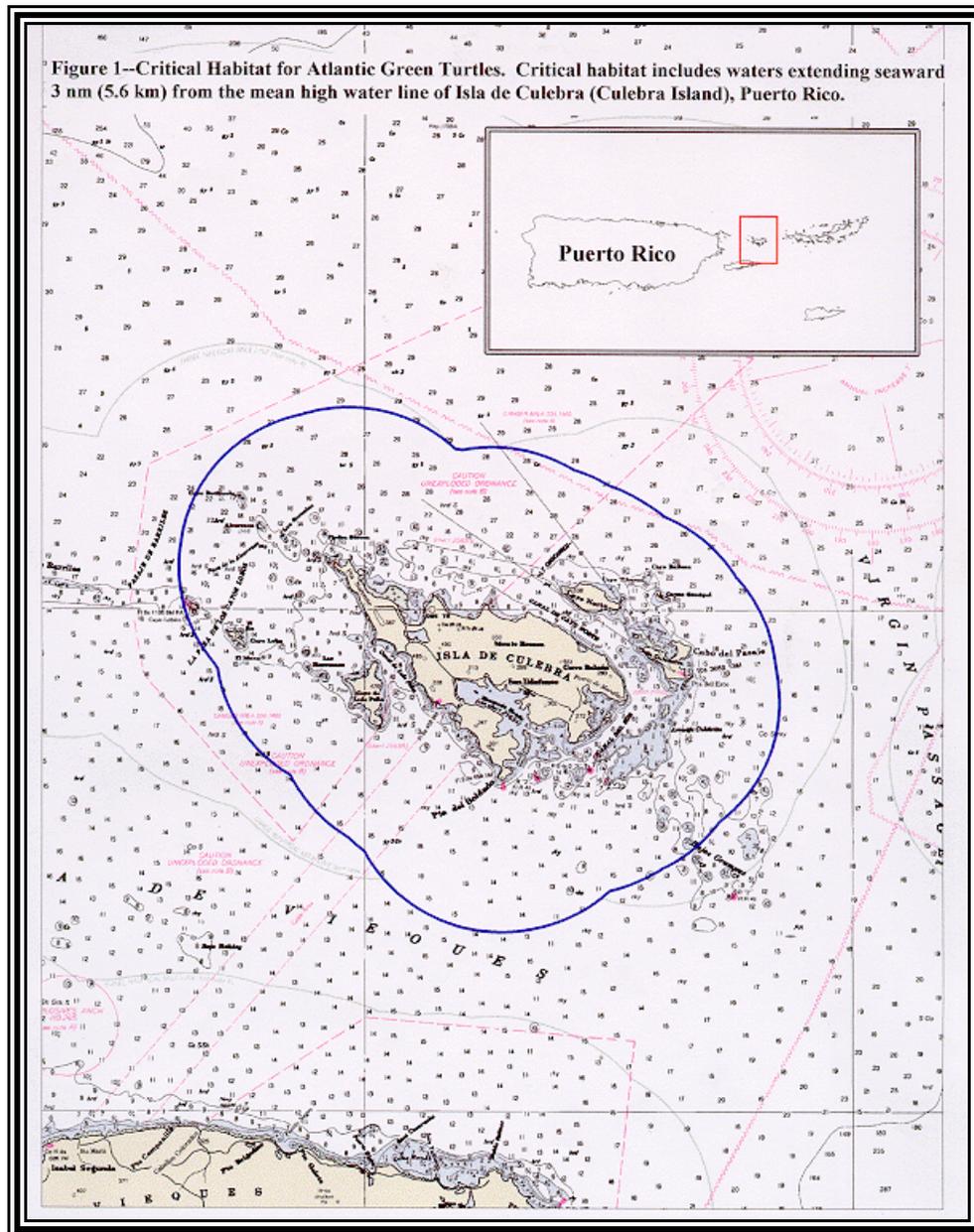
### *Population Status*

<b>Population Name</b>	<b>Status</b>	<b>Population Trend</b>	<b>Population Estimate</b>	<b>Critical Habitat</b>
Range-wide	Threatened	Increasing	unknown	Designated
Florida Breeding population	Endangered	Increasing	675 nesting females <sup>2</sup>	
Mexican Breeding population	Endangered	Decreasing	470 nesting females <sup>3</sup>	

<sup>2</sup>Average number of females nesting annually based on 3.5 nests/female/year for 1993-1997.

<sup>3</sup>Michoacan nesting populations 1994-1995 (Alvarado et al., 1995).

*Designated Critical Habitat for Atlantic Green Turtles*



*Listed Species Status*

**Hawksbill Turtle: *Eretmochelys imbricata***

Listing Date: June 2, 1970

The hawksbill turtle's status has not changed since it was listed as endangered in 1970. It is a solitary nester, and thus, population trends or estimates are difficult to determine. The decline of nesting populations is accepted by most researchers. In 1983, the only known apparently stable populations were in Yemen, northeastern Australia, the Red Sea, and Oman. Commercial exploitation is the major cause of the continued decline of the hawksbill turtle. There is a continuing demand for the hawksbill's shell as well as other products including leather, oil, perfume, and cosmetics. Prior to being certified under the Pelly Amendment, Japan had been importing about 20 metric tons of hawksbill shell per year, representing approximately 19,000 turtles. A negotiated settlement was reached regarding this trade on June 19, 1992. The hawksbill shell commands high prices (currently \$225/kilogram), a major factor preventing effective protection.



**Species Biology**

The hawksbill is a small to medium-sized sea turtle. In the U.S. Caribbean, nesting females average about 62-94cm in straight carapace length. Weight is typically to 80 kg in the wider Caribbean, with a record weight of 127 kg. Hatchlings average about 42 mm straight carapace length and range in weight from 13.5-19.5 g. The following characteristics distinguish the hawksbill from other sea turtles: two pairs of prefrontal scales; thick, posteriorly overlapping scutes on the carapace; four pairs of coastal scutes; two claws on each flipper; and a beak-like mouth. The carapace is heart-shaped in very young turtles, and becomes more elongate or subovate with maturity. Its lateral and posterior margins are sharply serrated in all but very old individuals. The epidermal scutes that overlay the bones of the shell are the tortiseshell of commerce. They are unusually thick, and overlap posteriorly on the carapace in all but hatchlings and very old individuals. Carpacial scutes are often richly patterned with irregularly radiating streaks of brown or black on an amber background. The scutes of the plastron of Atlantic hawksbills are usually clear yellow, with little or no dark pigmentation. The soft skin on the ventral side is cream or yellow, and may be pinkish-orange in mature individuals. The scales of the head and forelimbs are dark brown or black with sharply defined yellow borders. There are typically four pairs of inframarginal scales. The head is elongate and tapers sharply to a point. The lower jaw is V-shaped.

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Hawksbills utilize different habitats at different stages of their life cycle. Posthatchling hawksbills occupy the pelagic environment, taking shelter in weedlines that accumulate at convergence points. Hawksbills reenter coastal waters when they reach approximately 20-25 cm carapace length. Coral reefs are widely recognized as the resident foraging habitat of juveniles, subadults and adults. This habitat association is undoubtedly related to their diet of sponges, which need solid substrate for attachment. The ledges and caves of the reef provide shelter for resting both during the day and night. Hawksbills are also found around rocky outcrops and high energy shoals, which are also optimum sites for sponge growth. Hawksbills are also known to inhabit mangrove-fringed bays and estuaries, particularly along the eastern shore of continents where coral reefs are absent. In Texas, juvenile hawksbills are associated with stone jetties.

Hawksbills utilize both low- and high-energy nesting beaches in tropical oceans of the world. Both insular and mainland nesting sites are known. Hawksbills will nest on small pocket beaches, and, because of their small body size and great agility, can traverse fringing reefs that limit access by other species. They exhibit a wide tolerance for nesting substrate type. Nests are typically placed under vegetation.

It is estimated that hawksbills recruited into the reef environment at 35 cm in length would begin breeding 31 years later. However, the time required to reach 35 cm in length is unknown. As a result, actual age at sexual maturity is not known.

### **Distribution and Abundance:**

The hawksbill occurs in tropical and subtropical seas of the Atlantic, Pacific and Indian Oceans. The species is widely distributed in the Caribbean Sea and western Atlantic Ocean, with representatives of at least some life history stages regularly occurring in southern Florida and the northern Gulf of Mexico (especially Texas); in the Greater and Lesser Antilles; and along the Central American mainland south to Brazil. Within the United States, hawksbills are most common in Puerto Rico and its associated islands, and in the U.S. Virgin Islands. In the continental U.S., the species is recorded from all the gulf states and from along the eastern seaboard as far north as Massachusetts, with the exception of Connecticut, but sightings north of Florida are rare.

Hawksbills are observed in Florida with some regularity on the reefs off Palm Beach County, where the warm Gulf Stream current passes close to shore, and in the Florida Keys. Texas is the only other state where hawksbills are sighted with any regularity. Most sightings involve posthatchlings and juveniles. These small turtles are believed to originate from nesting beaches in Mexico.

Nesting within the southeastern United States occurs principally in Puerto Rico and the U.S. Virgin Islands, the most important sites being Mona Island and Buck Island. Nesting also occurs on other beaches of St. Croix, and on Culebra Island, Vieques Island, mainland Puerto Rico, St.

John and St. Thomas. Within the continental United States, nesting is restricted to the southeast coast of Florida and Florida Keys.

In the U.S. Pacific Ocean, there have been no hawksbill sightings off the west coast. Hawksbills have been observed in the Gulf of California as far as 29°N, throughout the northwestern states of Mexico, and south along the Central and South American coasts to Columbia and Ecuador. In the Hawaiian Islands, nesting occurs in the main islands, primarily on several small sand beaches on the Islands of Hawaii and Molokai. Two of these sites are at a remote location in the Hawaii Volcanos National Park.

**Major Impacts/Threats in the Nesting Environment:**

- The greatest threat on nesting beaches is poaching. Poaching of hawksbill eggs is a serious problem in Puerto Rico, and also occurs at lower levels in St. Thomas and St. Croix. Adult females are still butchered for their tortiseshell, but the practice is decreasing with better enforcement.
- Erosion of nesting beaches can result in loss of nesting habitat. However, natural processes of beach erosion are not generally a significant threat.
- Fortification of beachfronts to protect property from erosion can cause the loss of a dry nesting beach. It can also prevent females from getting to nesting sites and wash out nests. Beach nourishment buries nests and disturbs nesting turtles. Nourishment also results in heavy machinery, pipelines, increased human activity and artificial lighting on a project beach. This can create barriers for nesting sea turtles emerging from the ocean, preventing them from building nests, and it also disturbs nesting turtles on the beach.
- Removal of sand for construction aggregate or renourishment of other beaches is a serious threat throughout the Caribbean. Sand removed from above the tide line is replaced very slowly from subtidal areas, a process which can take decades. Subtidal sand removal results in beach sand moving offshore.
- Most nesting beaches are in private hands, and many of these have been developed. Development and landscaping of these nesting beaches can create impediments for nesting turtles. In addition, exotic plants such as sea oats can damage or destroy nests through root action.
- Artificial lighting can cause disorientation or misorientation of both adults and hatchlings. Turtle hatchlings are attracted to light, ignoring or coming out of the ocean to go towards a light source, increasing their chances of death or injury. In addition, as nesting females avoid areas with intense lighting, highly developed areas may cause problems for turtles trying to nest.
- Mechanical raking can result in heavy machinery repeatedly moving across a nest and compacting sand as well as causing tire ruts which may hinder or trap hatchlings. Rakes can penetrate the surface and disturb or uncover a nest. Disposing of debris on the high beach can cover nests and may alter nest temperature.
- The most serious threat of nighttime use of a beach is the disturbance of nesting females.

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Heavy utilization of nesting beaches by humans may also result in lowered hatchling success due to sand compaction.

- The use of off-road vehicles on beaches is a serious problem in many areas. It may result in decreased hatchling success due to sand compaction, or directly kill hatchlings. Tire ruts may also interfere with the ability of hatchlings to get to the ocean.
- A variety of natural and introduced predators such as hogs, mongooses, ghost crabs and ants prey on hawksbill eggs and hatchlings.

### **Major Impacts/Threats in the Marine Environment :**

- The extent to which hawksbills are killed or debilitated after becoming entangled in marine debris are unknown, but it is believed to be a serious and growing problem. Hawksbills have been reported entangled in monofilament gill nets, "fish nets", fishing line and rope.
- Hawksbill turtles eat a wide variety of debris such as plastic bags, plastic and styrofoam pieces, tar balls, balloons and plastic pellets. Effects of consumption include interference in metabolism or gut function, even at low levels of ingestion, as well as absorption of toxic byproducts.
- Incidental catch during fishing operations is an unquantified and potentially significant source of mortality. Gill nets, longlines and shrimp trawls all take turtles in Gulf of Mexico waters. In Puerto Rico, hawksbills are captured by a variety of fishing gear, including driftnets, gillnets, seines and spearguns. Gillnets and seines are widely deployed and are a particularly serious problem; these nets are sometimes set specifically for turtles.
- In areas where recreational boating and ship traffic is intense, propeller and collision injuries are not uncommon.
- In Puerto Rico, damage to coral reefs and other shallow water benthic systems from sedimentation and siltation has not been assessed as yet, but is known to be a serious problem in some areas, with some coral reefs completely destroyed by siltation.
- Pesticides, heavy metals and PCB's have been detected in turtles and eggs, but their effect is unknown.
- Raw sewage in Puerto Rico and the U.S. Virgin Islands has been released directly into nearshore waters. While a regional treatment plant has just been completed in Puerto Rico, monitoring has not been initiated.
- The illegal take of hawksbills at sea has not yet been fully quantified, but it is a continuing problem.
- Marine turtles are at risk when encountering an oil spill. Respiration, skin, blood chemistry and salt gland functions are affected.
- The hawksbill's dependence on coral reefs for shelter and food link its well-being to the condition of reefs. Destruction of reefs from vessels anchoring, striking or grounding is a growing problem. Cruiseships and yachts are destroying portions of coral reefs with their anchors and anchor chains in the US Virgin Islands, Puerto Rico, the British Virgin

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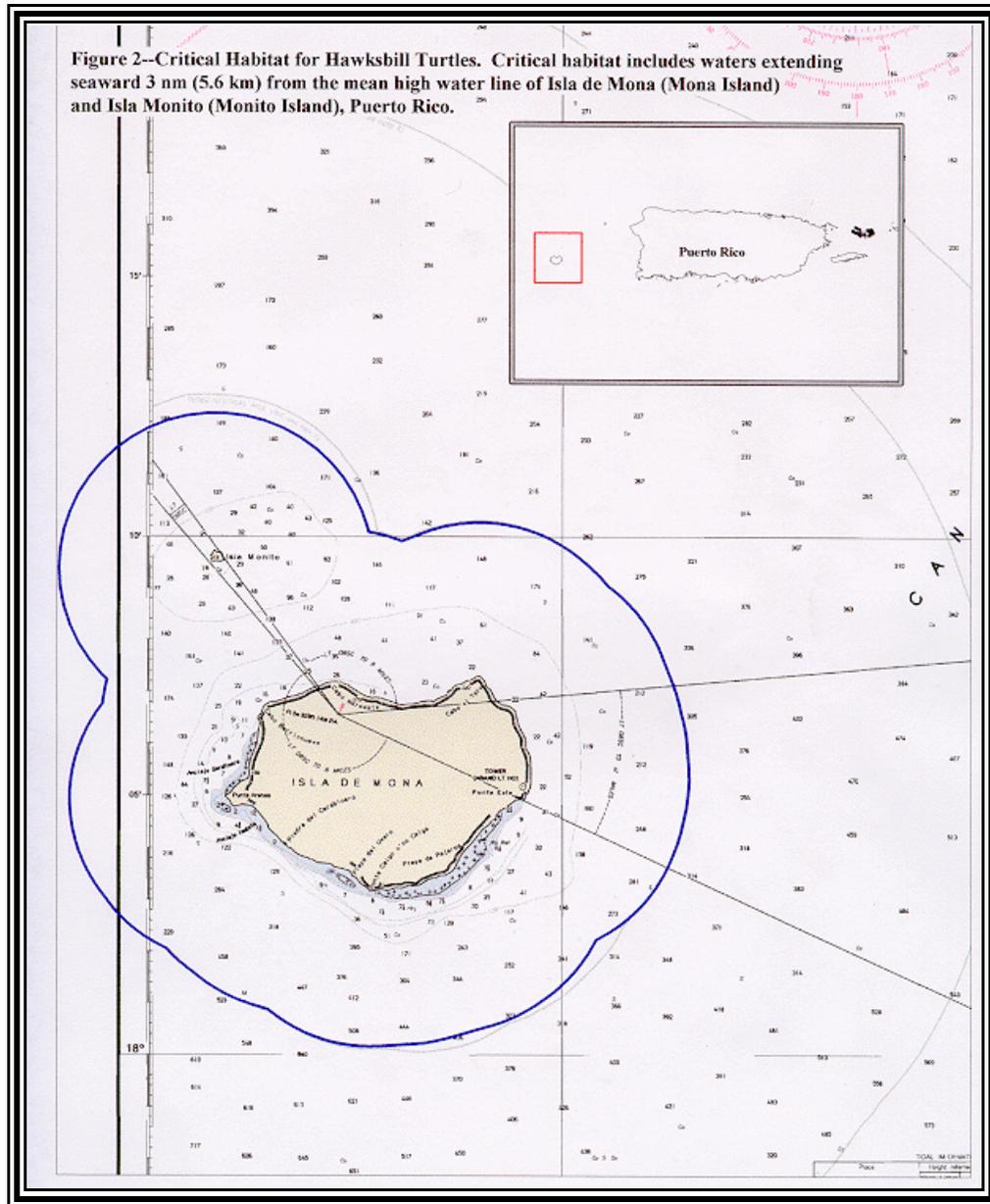
Islands, Belize and elsewhere. There is also damage from recreational, diving and fishing boats anchoring indiscriminately on reefs.

- International commerce in hawksbill shell (bekko) is the single most significant factor endangering hawksbill populations around the world. Japanese imports of raw bekko between 1970 and 1989 totalled 713,850 kg, representing more than 670,000 turtles; more than half the imports originated in the Caribbean and Latin America. While hawksbills are protected under CITES, trade continues for several reasons:
  - a. Not all countries have ratified CITES;
  - b. Some treaty signatories participate in trade by falsifying documents of origin;
  - c. Some treaty signatories ignore the treaty and trade openly in hawksbills and hawksbill products; and
  - d. Some treaty signatories have exercised their right to take exemption to treaty provisions as they affect sea turtles.
- In nearshore waters, hawksbills are periodically captured in the cooling water intakes of industrial facilities. In addition, illegal use of explosives for fishing is a concern, especially off the southeast coast of Puerto Rico.

***Population Status***

<b>Population Name</b>	<b>Status</b>	<b>Population Trend</b>	<b>Population estimate</b>	<b>Critical Habitat</b>
Rangewide	Endangered	Decreasing	Unknown	Designated

*Designated Critical Habitat for Atlantic Hawksbill Turtles*



*Listed Species Status*

**Kemp's Ridley Turtle:**  
*Lepidochelys kempii*

Listing Date: December 12, 1970



The Kemp's ridley was listed as endangered throughout its range on December 2, 1970, and its status has remained unchanged. The Kemp's ridley population has declined since 1947 when an estimated 42,000 females nested in one day to a nesting population of approximately 1000 in the mid 1980's. The decline of this species was primarily due to human activities including collection of eggs, fishing for juveniles and adults, killing adults for meat and other products, and direct take for indigenous use. In addition to these sources of mortality, Kemp's ridleys have been subject to high levels of incidental take by shrimp trawlers. Today, under strict protection, the population appears to be in the earliest stages of recovery. The increase can be attributed to two primary factors: full protection of nesting females and their nests in Mexico, and the requirement to use turtle excluder devices (TEDs) in shrimp trawls both in the United States and Mexico.

**Species Biology**

The Kemp's ridley and olive ridley turtles are the smallest of all extant sea turtles, with the weight of an adult generally being less than 45 kg and the straight carapace length around 65 cm. Adult Kemp's ridleys' shells are almost as wide as long. Coloration changes significantly during development from the grey-black carapace and plastron of hatchlings to the lighter grey-olive carapace and cream-white or yellowish plastron of adults. There are two pairs of prefrontal scales on the head, five vertebral scutes, five pairs of coastal scutes and generally twelve pairs of marginals on the carapace. In each bridge adjoining the plastron to the carapace, there are four scutes, each of which is perforated by a pore. This is the external opening of Rathke's gland which secretes a substance of unknown (possibly a pheromone) function. Males resemble the females in size and coloration. Secondary sexual characteristics of male sea turtles include a longer tail, more distal vent, recurved claws and, during breeding, a softened mid-plastron. Eggs are 34-45 mm in diameter and 24-40 g in weight. Hatchlings range from 42-48 mm in straight line carapace length, 32-44 mm in width and 15-20 g in weight.

Neonatal Kemp's ridleys feed on the available sargassum and associated infauna or other epipelagic species found in the Gulf of Mexico. In post-pelagic stages, the ridley is largely a crab-eater, with a preference for portunid crabs. Age at sexual maturity is not known, but is

believed to be approximately 7-15 years, although other estimates of age at maturity range as high as 35 years.

**Distribution and Abundance:**

The major nesting beach for Kemp's ridleys is on the northeastern coast of Mexico. This location is near Rancho Nuevo in southern Tamaulipas. The species occurs mainly in coastal areas of the Gulf of Mexico and the northwestern Atlantic Ocean.

**Major Impacts/Threats in the Nesting Environment:**

- Threats to the nesting beach in Mexico are presently few, but potentially serious. Human population growth and increasing developmental pressure will result in increased threats to the nesting beach. Only the central part of the prime nesting area is protected by Mexican presidential decree. A primary concern is human encroachment and access along the entire nesting area. However, the wording of the Mexican decree is vague and construction of commercial fishing facilities proceeded in 1987 immediately adjacent to the main turtle camp at Rancho Nuevo. Occasionally plans for massive expansion of La Pesca (just to the north of the nesting area) as a fishing center or dredging of the Gulf Intercoastal Waterway from Brownsville, Texas to Barra del Tordo (in the south part of the nesting beach) are reported. These plans are alarming because of the assuredly detrimental and possibly disastrous effects that they could have on the nesting population if they were to be completed.
- A threat resulting from management practices at Ranch Nuevo is relocating all of the nests in one corral to prevent poaching and predation. This concentration makes the eggs more susceptible to reduced viability from the manipulation, disease vectors and inundation.

**Major Impacts/Threats in the Marine Environment**

- It is estimated that before the implementation of TEDs, the commercial shrimp fleet killed 500-5000 Kemp's ridleys each year. Besides shrimp trawls, Kemp's ridleys have been taken in pound nets, trawls, gill nets, hook and line, crab traps, and longlines. Beginning in 1976, the U.S. and Mexican governments agreed to phase out U.S. shrimping in Mexican waters by 1979. U.S. shrimp vessels continued to illegally operate off Mexico through the mid 1980s. The Mexican shrimp fleet has declined and consists of only approximately 600 vessels, many of which do not operate. Also since 1978, Mexico has closed the nearshore waters off Rancho Nuevo to fishing during the nesting season. However, this closure has not been strictly enforced.
- The Gulf of Mexico is an area of high density offshore oil extraction with chronic low-level spills and occasional massive spills. The two primary feeding grounds for adult Kemp's ridley turtles in the northern and southern Gulf of Mexico are both near major areas of near shore and offshore oil exploration and production. The nesting beach at

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Rancho Nuevo is also vulnerable and has been affected by oil spills.

- The vast amount of floating debris in the Gulf of Mexico constitutes an increasingly serious threat to Kemp's ridley turtles of all ages. Plastics, monofilament, discarded netting and many other waste items are either eaten by Kemp's ridleys or become death traps when the turtles become entangled. Ingestion of plastic, rubber, fishing line and hooks, tar, cellophane, rope and string, wax, styrofoam, charcoal, aluminum cans and cigarette filters has occurred in sea turtles.
- NMFS is currently analyzing stranding data and available necropsy information to determine the magnitude of debris ingestion and entanglement.
- Dredging operations affect Kemp's ridley turtles through incidental take and by degrading the habitat. Incidental take of ridleys has been documented with hopper dredges. In addition to direct take, channelization of the inshore and nearshore areas can degrade foraging and migratory habitat through spoil dumping, degraded water quality/clarity and altered current flow.

***Population Status***

<b>Population Name</b>	<b>Status</b>	<b>Population Trend</b>	<b>Population estimate</b>	<b>Critical Habitat</b>
Rangewide	Endangered	Increasing	954 nesting females <sup>4</sup>	

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<sup>4</sup>Number of females nesting in 1997 based on 2.5 nests/female/year.

*Listed Species Status*

**Leatherback Turtle: *Dermochelys coriacea***

Listing Date: 06/02/70

The leatherback turtle was listed as endangered throughout its range on June 2, 1970. Nesting populations of leatherback turtles are especially difficult to discern because the females frequently change beaches. However, current estimates are that 20,000-30,000 female leatherbacks exist worldwide.



Leatherbacks do not nest frequently enough in the United States to assess an accurate trend. The recovery plan for the leatherback turtle concludes that nesting trends in the United States appear stable, but the population faces significant threats from incidental take in commercial fisheries and marine pollution.

Populations have declined in Mexico, Costa Rica, Malaysia, India, Sri Lanka, Thailand, Trinidad, Tobago, and Papua New Guinea. Leatherbacks are seriously declining at all major nesting beaches throughout the Pacific. The decline is dramatic along the Pacific coasts of Mexico and Costa Rica and coastal Malaysia. Nesting along the Pacific coast of Mexico declined at an annual rate of 22% over the last 12 years, and the Malaysian population represents 1% of the levels recorded in the 1950s. The collapse of these nesting populations was precipitated by a tremendous overharvest of eggs, direct harvest of adults, and incidental mortality from fishing. In the Atlantic and Caribbean, the largest nesting assemblages are found in the U.S. Virgin Islands, Puerto Rico, and Florida. Nesting data for these locations have been collected since the early 1980's and indicate that the annual number of nests is likely stable; however, information regarding the status of the entire leatherback population in the Atlantic is lacking. Nesting activity has also declined in French Guiana due to erosion of nesting beaches, the population appears to have shifted to Surinam, where annual numbers of nests have risen from less than 100 in 1967 to 5,565 in 1977 and 9,816 in 1987. Habitat destruction, incidental catch in commercial fisheries, the harvest of eggs and flesh are the greatest threats to the survival of the leatherback.

**Species Biology**

The leatherback is the largest living turtle, and is so distinctive as to be placed in a separate taxonomic family, Dermochelyidae. The carapace is distinguished by a rubber-like texture, about 4 cm thick, and made primarily of tough, oil-saturated connective tissue. No sharp angle is formed between the carapace and the plastron, resulting in the animal being somewhat barrel-

shaped. The average curved carapace length for adult turtles is 155 cm and weight ranges from 200-700 kg. Hatchlings are dorsally mostly black and are covered with tiny scales; the flippers are margined in white, and rows of white scales appear as stripes along the length of the back. Hatchlings average 61.3 mm long and 45.8 g in weight. In the adult, the skin is black and scaleless. The undersurface is mottled pinkish-white and black. The front flippers are proportionally longer than in any other sea turtle, and may span 270 cm in an adult. In both adults and hatchlings, the upper jaw bears two tooth-like projections at the premaxillary-maxillary sutures. Age at sexual maturity is unknown.

### **Distribution and Abundance**

The leatherback turtle's range extends from Cape Sable, Nova Scotia, south to Puerto Rico and the U.S. Virgin Islands. Critical habitat for the leatherback includes the waters adjacent to Sandy Point, St. Croix, U.S. Virgin Islands, up to and inclusive of the waters from the hundred fathom curve shoreward to the level of mean high tide with boundaries at 17°42'12" N and 64°50'00" W. Nesting occurs from February - July with sites located from Georgia to the U.S. Virgin Islands. Leatherbacks migrate from southern nesting beaches along the Atlantic coast in the Spring to nutrient rich waters in the Gulf of Maine and Canada and conversely migrate south in the late Fall.

Leatherbacks are commonly seen by fishermen in Hawaiian offshore waters, generally beyond the 100-fathom curve but within sight of land. Sightings often take place off the north coast of Oahu and the Kona coast of Hawaii. North of the Hawaiian Islands, a high seas aggregation of leatherbacks is known to occur at 35°-45°N, 175°-180°W.

### **Major Impacts/Threats in the Nesting Environment**

- Historically, leatherback turtles were rarely taken for their meat. However, a few have been killed in recent years. In Puerto Rico, adults are occasionally taken for meat and oil. In addition, the poaching of eggs from nests continues at low levels in the U.S. Virgin Islands and is widespread in Puerto Rico.
- Leatherback turtles prefer to nest on open beaches. However, these beaches are prone to erosion, causing egg loss. Nests are also lost to hurricanes.
- Development of beachfronts results in fortification to protect property from erosion, resulting in loss of a dry nesting beach. It can also prevent females from getting to nesting sites and wash out nests.
- Beach nourishment impacts turtles by burial of nests, disturbance to nesting turtles, and changes sand compaction and temperature which may affect embryo development.
- Artificial lights can cause disorientation or misorientation of both adults and hatchlings. Turtles are attracted to light, ignoring or coming out of the ocean to go towards a light source. This increases their chances of death or injury. In addition, as nesting females avoid areas with intense lighting, highly developed areas may cause problems for turtles trying to nest.

- Mechanical raking can result in heavy machinery repeatedly moving across a nest and compacting sand as well as causing tire ruts which may hinder or trap hatchlings. Rakes can penetrate the surface and disturb or uncover a nest. Disposing of debris on the high beach can cover nests and may alter nest temperature.
- The most serious threat of nighttime use of a beach is the disturbance of nesting females. Heavy utilization of nesting beaches by humans may also result in lowered hatchling success due to sand compaction.
- The placement of physical obstacles on a beach can hamper or deter nesting attempts as well as interfere with incubating eggs and the movement of hatchlings to the sea.
- The use of off-road vehicles on beaches is a serious problem in many areas. It may result in decreased hatchling success due to sand compaction, or directly kill hatchlings. Tire ruts may also interfere with the ability of hatchlings to get to the ocean.

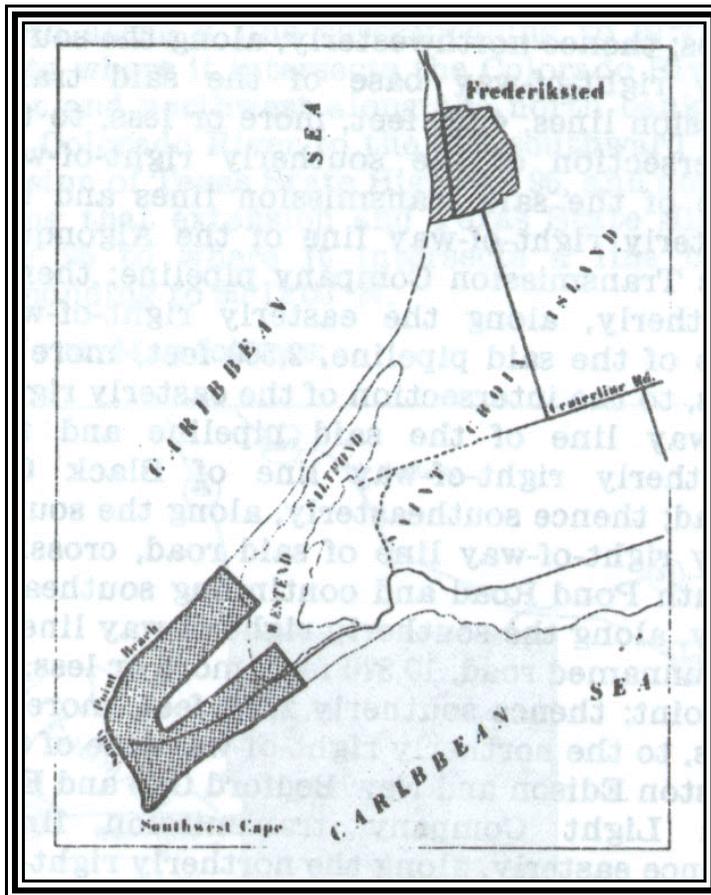
### **Major Impacts/Threats in the Marine Environment**

- Leatherbacks become entangled in longlines, fish traps, buoy anchor lines and other ropes and cables. This can lead to serious injuries and/or death by drowning. The setting of "large mesh nets suitable for turtling" is common in the waters of Puerto Rico. Although the practice was outlawed in 1984, it still continues. The nets are intended for hawksbills and green turtles, but leatherbacks occasionally become entangled.
- Leatherback turtles eat a wide variety of marine debris such as plastic bags, plastic and styrofoam pieces, tar balls, balloons and plastic pellets. Effects of consumption include interference in metabolism or gut function, even at low levels of ingestion, as well as absorption of toxic byproducts. NMFS is currently analyzing stranding data and available necropsy information to determine the magnitude of debris ingestion.
- It is estimated that even with TEDs, the offshore commercial shrimp fleet is anticipated to capture about 640 leatherbacks a year. The use of TEDs is not expected to reduce leatherback captures and mortality significantly, because TEDs are generally incapable of passing adult leatherbacks through the exit opening. However, beginning in 1995, NMFS established a Leatherback Conservation Zone to restrict shrimp trawl activities from off the coast of Cape Canaveral, Florida, to the North Carolina/Virginia border. This provides for short-term closures when high concentrations of normally pelagically distributed leatherbacks are recorded in more coastal waters where the shrimp fleet operates. This measure is necessary because, due to their size, adult leatherbacks are larger than the escape openings of most NMFS-approved TEDs.
- Leatherbacks are vulnerable to boat collisions and strikes, particularly when in waters near shore. It is not known if open ocean collisions with large ships occur.
- Marine turtles are at risk when encountering an oil spill. Respiration, skin, blood chemistry and salt gland functions are affected.

**Population Status**

Population Name	Status	Population Trend	Population estimate	Critical Habitat
Rangewide	Endangered	Decreasing	unknown <sup>5</sup>	Designated

**Designated Critical Habitat for Atlantic Leatherback Turtles**



<sup>5</sup>Population trend for the Pacific leatherback is declining, while the Atlantic leatherback are stable.

## *Listed Species Status*

### **Loggerhead Turtle: *Caretta caretta***

Listing Date: 06/02/70

The loggerhead turtle was listed as threatened throughout its range on June 2, 1970, and its status has not changed. Most recent evidence suggests that the number of nesting females in South Carolina and Georgia may be declining, while the number of nesting females in Florida appears to be stable.



Four nesting subpopulations of loggerheads in the western North Atlantic have been identified based on genetic research: (1) the Northern Subpopulation, producing approximately 6,200 nests/year from North Carolina to Northeast Florida; (2) the South Florida Subpopulation, occurring from just north of Cape Hatteras on the east coast of Florida and extending up to Naples on the west coast. The Northern Subpopulation declined through the mid 1980s and thereafter a trend is not detected. Recent surveys of South Carolina nesting beaches (where more than 30% of the nesting of the Northern Subpopulation occurs) indicate a downward trend and thus the subpopulation is stable or declining. The South Florida Subpopulation appears to have shown significant increases over the last 25 years, suggesting the population is recovering, although the trend could not be detected over the most recent 7 years of nesting. An increase in the numbers of adult loggerheads has been reported in recent years in Florida waters without a concomitant increase in benthic immatures. These data may forecast limited recruitment to South Florida nesting beaches in the future. Since loggerheads take approximately 20-30 years to mature, the effects of decline in immature loggerheads might not be apparent on nesting beaches for decades. The recovery team concluded that nesting trends for the loggerhead are generally declining. The most significant threats to the loggerhead populations is coastal development, commercial fisheries, and pollution.

Loggerhead populations in Honduras, Mexico, Colombia, Israel, Turkey, Bahamas, Cuba, Greece, Japan, and Panama have been declining. This decline continues and is primarily attributed to shrimp trawling, coastal development, increased human use of nesting beaches, and pollution. Loggerheads are the most abundant species in U.S. coastal waters, and are often captured incidental to shrimp trawling. Shrimping is thought to have played a significant role in the population declines observed for the loggerhead.

### **Species Biology**

Adults and sub-adults have a reddish-brown carapace. Scales on the top and sides of the head and top of the flippers are also reddish-brown, but have yellow borders. The neck, shoulders and limb bases are dull brown on top and medium yellow on the sides and bottom. The plastron is also medium yellow. Adult average size is 92 cm straight carapace length; average weight is 115 kg. Hatchlings are dull brown in color. Average size at hatching is 45 mm long; average weight is 20 g. Maturity is reached at between 16-40 years. Mating takes place in late March-early June, and eggs are laid throughout the summer.

### **Distribution and Abundance**

Loggerheads are circumglobal, inhabiting continental shelves, bays, estuaries, and lagoons in temperate, subtropical, and tropical waters. In the Atlantic, the loggerhead turtle's range extends from Newfoundland to as far south as Argentina. During the summer, nesting occurs in the lower latitudes, but not in the tropics. The primary Atlantic nesting sites are along the east coast of Florida, with additional sites in Georgia, the Carolinas, and the Gulf Coast of Florida. In the eastern Pacific, loggerheads are reported as far north as Alaska, and as far south as Chile. Occasional sightings are also reported from the coast of Washington, but most records are of juveniles off the coast of California. Southern Japan is the only known breeding area in the North Pacific.

### **Major Impacts/Threats in the Nesting Environment**

- In the United States, killing of nesting loggerheads is infrequent. However, in a number of areas, egg poaching is common.
- Erosion of nesting beaches can result in loss of nesting habitat.
- Development of beachfronts results in fortification to protect property from erosion, resulting in loss of a dry nesting beach. It can also prevent females from getting to nesting sites and wash out nests.
- Beach nourishment impacts turtles by burial of nests, disturbance to nesting turtles, and changes in sand compaction and temperature which may affect embryo development.
- Artificial lighting can cause disorientation or misorientation of both adults and hatchlings. Turtles are attracted to light, ignoring or coming out of the ocean to go towards a light source, increasing their chances of death or injury. In addition, as nesting females avoid areas with intense lighting, highly developed areas may cause problems for turtles trying to nest.
- Repeated mechanical raking of nesting beaches by heavy machinery can result in compact sand and causes tire ruts which may hinder or trap hatchlings. Rakes can penetrate the surface and disturb or uncover a nest. Disposing of debris on the high beach can cover nests and may alter nest temperature.
- A serious threat of nighttime use of a beach is the disturbance of nesting females. Heavy utilization of nesting beaches by humans may also result in lowered hatchling success due

to sand compaction.

- The placement of physical obstacles on a beach can hamper or deter nesting attempts as well as interfere with incubating eggs and the sea approach of hatchlings.
- The use of off-road vehicles on beaches is a serious problem in many areas. It may result in decreased hatchling success due to sand compaction, or directly kill hatchlings. Tire ruts may also interfere with the ability of hatchlings to get to the ocean.
- The invasion of a nesting site by non-native beach vegetation can lead to increased erosion and destruction of a nesting habitat. Trees shading a beach can also change nest temperatures, altering the natural sex ratio of the hatchlings.

### **Major Impacts/Threats in the Marine Environment**

- Dredging can destroy resting or foraging habitats. The use of hopper dredges can also kill turtles caught in dragheads.
- Loggerhead turtles eat a wide variety of marine debris such as plastic bags, plastic and styrofoam pieces, tar balls, balloons and raw plastic pellets. Effects of consumption include interference in metabolism or gut function, even at low levels of ingestion, as well as absorption of toxic byproducts. NMFS is currently analyzing stranding data and available necropsy information to determine the magnitude of debris ingestion and entanglement.
- Commercial Fishing:
  - 5,000-50,000 loggerheads each year. Most turtles killed are juveniles and sub-adults. Inshore catch and mortality for shrimp trawlers is not known, but is thought to be significant. Bluefish, croaker and flounder trawl fishing are also a serious threat.
  - Turtles are taken by gillnet fisheries in the Atlantic and Gulf of Mexico, but the number is currently not known.
  - Several thousand vessels are involved in hook and line fishing for various coastal species. The capturing of turtles is not uncommon, but the number is currently not known.
  - Pound net fisheries are primarily a problem in waters off of Virginia and North Carolina, however generally turtles are released alive.
  - From 1978-1981, 330 turtles were captured in the Atlantic and Gulf of Mexico EEZ in the Japanese tuna longline fishery. Due to expansion of this fishery, it may have a large impact on turtle recovery.
  - Loggerhead turtles are vulnerable to entanglement in trap fishery lines, and subsequent drowning. The impact on the population has not been determined.
- In areas where recreational boating and ship traffic is intense propeller and collision injuries are not uncommon.
- Sea turtles are at risk when encountering an oil spill. Respiration, skin, blood chemistry

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and salt gland functions are affected.

- Pesticides, heavy metals and PCB's have been detected in turtles and eggs, but the effect on them is unknown.
- Marina and dock development can cause foraging habitat to be destroyed or damaged. It also leads to increased boat traffic, increasing the risk of turtle/vessel collisions.
- Turtles have been caught in saltwater intake systems of coastal power plants. The mortality rate is estimated at 2%.
- Underwater explosions can kill or injure turtles, and may destroy or damage habitat.
- The effects of offshore lights are not known. They may attract hatchlings and interfere with proper offshore orientation, increasing the risk from predators.
- Turtles get caught in discarded fishing gear. The number affected is unknown, but potentially significant.
- Illegal harvesting of loggerhead turtles is uncommon in the U.S. and Caribbean. No estimates of take exist.

***Population Status***

<b>Population Name</b>	<b>Status</b>	<b>Population Trend</b>	<b>Population Estimate</b>	<b>Critical Habitat</b>
Range-wide	Threatened	Decreasing	unknown	

*Listed Species Status*

**Olive Ridley Turtle: *Lepidochelys olivacea***

Listing Date: 07/28/78



The olive ridley turtle was listed as endangered for the "Mexican nesting population" and threatened for all other populations on July 28, 1978. Since listing, there has been a decline in abundance of this species, and it has been recommended that the olive ridley for the Western Atlantic be reclassified as endangered. The need for this classification is based on continued direct and incidental take, particularly in shrimp trawl nets. The western North Atlantic (Surinam and adjacent areas) nesting population has declined more than 80 percent since 1967. Declines are also documented for Playa Nancite, Costa Rica, however other nesting populations along the Pacific coast of Mexico and Costa Rica appear stable or increasing. In the Indian Ocean, Gahirmatha located in the Bhitarkanika Wildlife Sanctuary, India, supports perhaps the largest nesting population with an average of 398,000 females nesting in a given year. This population continues to be threatened by nearshore trawl fisheries. Direct harvest of adults and eggs, incidental capture in commercial fisheries and loss of nesting habitat are main concerns regarding the recovery of this species.

**Species Biology**

The olive ridley is a small, hard-shelled marine turtle, one of the two species of the genus *Lepidochelys*, and a member of the family Cheloniidae. The species may be identified by the uniquely high and variable numbers of vertebral and costal scutes. Although some individuals have only five pairs of costals (the number shown by almost all individuals of the congener *Lepidochelys kempii*), in nearly all cases some division of costal scutes occurs, so that as many as six to nine pairs may be present. Division of the "standard" scutes occurs from the rear of the carapace, so that a specimen with, say, seven pairs of costals shows division of the homologs of costals IV and V. Asymmetry in the number of costal scutes is frequent.

In addition to the division of the costal scutes, the vertebral scutes also show frequent division, as do the scales on the dorsal surface of the head. The prefrontal scales, however, typically number two pairs. The carapace is wide in subadults and adults, although less so than that of *L. kempii*. In anterior profile it is typically elevated and flat-topped, with flat, sloping sides. The plastron is large, with the usual six pairs of large scutes and sometimes a small intergular and interanal also. The inframarginals typically number four on each side, each of which is perforated by a pore

located towards its posterior margin. The head is relatively large, as compared with that of *Chelonia* or *Eretmochelys*, but is smaller than that of adult *Caretta*, and slightly smaller than that of *L. kempii*.

The skull of *L. olivacea* differs from that of *L. kempii* in many ways. The orbit is consistently larger, the width across the pterygoids is consistently less, and the alveolar ridges are sharp and are only evident on the rhamphothecae, not on the underlying maxillary-palatine sutural area.

There are also numerous differences between the lower jaws of the two species, as follows:

1. the entire bony alveolar surface of *L. olivacea* is flat (rather strongly concave in *L. kempii*)
2. the overall depth of the jaw of *L. olivacea* is somewhat less than that of *L. kempii*
3. The tip of the coronoid bone, that provides attachment for the temporal muscle closing the jaw, is rounded off in *L. olivacea* (bluntly pointed in *L. kempii*)
4. the dorsal mandibular vacuity is relatively larger in *L. olivacea* than in *L. kempii*
5. the articular surfaces of the mandible of *L. olivacea* tend to be directed upward (directed more posteriorly in *L. kempii*)
6. the bones comprising the articular surfaces (the articular, pre-articular, and angular) are loosely sutured in adult *L. olivacea*.

In size, female olive ridleys in Surinam range in carapace length from 62 to 74 cm; in Pacific Honduras from 58 to 74 cm; and in Pacific Mexico from 56 to 78 cm.

Geographic variation in olive ridleys is subtle, and no subspecies are currently recognized. However, the number of costal scutes apparently varies from one area to another, specimens with only five pairs of costals being somewhat more abundant in the eastern Pacific than elsewhere. In addition, overall carapace coloration is typically somewhat lighter in the western Atlantic than in the eastern Pacific, and the shell is typically more elevated in the eastern Pacific than elsewhere.

The most dramatic aspect of the life history of the olive ridley is the habit of forming great nesting aggregations, generally known as "arribadas," sometimes as "arribazones" or "morrias". Although not every adult olive ridley participates in these arribadas, the vast majority of them do. Formerly these nesting concentrations occurred at several beaches along the Pacific coast of Mexico, including Piedra del Tlacoyunque, Bahia Chacahua, and El Playon de Mismaloya, but in recent years the Mexican arribadas have been largely restricted to La Escobilla, although smaller nesting concentrations have been reported from Morro Ayuta. In Costa Rica, a major nesting aggregation is found at Ostional, on the Nicoya Peninsula, and smaller arribadas occur at Nancite, in the Santa Rosa National Park. Smaller arribadas also occur in Nicaragua at La Flor and Chacocente and at several localities in Panama. In the Indian Ocean, four arribada sites have

been reported in the Indian State of Orissa, the most important being Gahirmatha Beach. In the Atlantic, only small arribadas, numbering at most a few hundred animals per night, have been reported from a single locality.

Arribadas may be precipitated by such climatic events as a strong offshore wind, or by certain phases of the moon and tide, but there is a major element of unpredictability at all arribada sites. This unpredictability, and the apparent ability of gravid females to wait for weeks while holding fully-shelled eggs, may be an important aspect of the survival advantage of arribada-formation, a phenomenon usually interpreted as one that evolved as a predator-saturation device.

Individual olive ridleys may nest one, two or three times per season, typically producing 100-110 eggs on each occasion. The internesting interval is variable, but for most localities it is approximately 14 days for solitary nesters and 28 days for arribada nesters. The genus is also unique in that ridleys of both species commonly, and probably typically, nest each year, without intervening non-breeding seasons as shown by dermochelyids and other cheloniids. The ridleys nesting in an arribada could not be sustained by the productivity of immediately adjacent marine ecosystems, and the species is indeed migratory. Recent investigations show that olive ridleys reside in oceanic habitats of the eastern Pacific Ocean during the non-reproductive portion of its life cycle.

The overall distribution of the olive ridley shows interesting parallels with that of the utterly different leatherback turtle (*Dermochelys coriacea*). Both occupy oceanic habitats and both nest primarily on Pacific shores of the American tropics and in the Guianas, in moderate numbers in tropical West Africa, and in relatively small numbers elsewhere, both being extremely rare, for example, throughout Australia, or Pacific oceanic islands.

Despite its abundance, there are surprisingly few data relating to the feeding habits of the olive ridley. However, those reports that do exist suggest that the diet in the western Atlantic and eastern Pacific includes crabs, shrimp, rock lobsters, jellyfish, and tunicates. In some parts of the world, it has been reported that the principal food is algae.

### **Distribution and Abundance**

The range of the olive ridley is essentially tropical. In the eastern Pacific nesting takes place from southern Sonora, Mexico, south at least to Colombia. Non-nesting individuals occasionally are found in waters of the southwestern United States. They occur abundantly in Pacific Colombia and Ecuador, but only in small numbers in Peru and Chile.

The olive ridley has been recorded occasionally from Galapagos waters, but it is essentially very rare throughout the islands of the Pacific, and indeed even in the western Pacific it is scarce everywhere, although widespread low-density nesting occurs. In the Indian Ocean it only

achieves abundance in eastern India and Sri Lanka, although minor nesting occurs alongside the green turtles at Hawke's Bay, Pakistan, and some nesting also occurs in New Britain, Mozambique, Madagascar, peninsular Malaysia, and various other localities.

In the Atlantic Ocean, the olive ridley occurs widely, but probably not in great abundance, in waters of West Africa, from about Mauritania southward at least to the Congo. In the western Atlantic, nesting formerly occurred abundantly in eastern Surinam, as well as in western French Guiana and northwestern Guyana. Non-nesting individuals occur regularly as far west as Isla Margarita and Trinidad, but they rarely penetrate any further into the Caribbean than this. The species occurs in Brazil, and nests in the states of Bahia and Sergipe, but it seems to be rare.

### **Population Status**

Because of the continued existence of several large arribadas, it is probable that the olive ridley is, in terms of absolute numbers of adult individuals in existence, the most abundant sea turtle species in the world. Nevertheless, there is evidence of downward trends at several arribada beaches. The various populations are under considerable stress, and the concentration of such a large proportion of the reproductive animals into a few arribadas may be a liability, not only in that such aggregation facilitates industrial-scale exploitation, as it has in Mexico as well as on the feeding grounds in Ecuador, but also because arribadas do not seem to be an efficient method of guaranteeing maximum reproductive efficiency. Indeed, at the relatively undisturbed arribada beach of Nancite, within Santa Rosa National Park, Costa Rica, it has been estimated that only about 5 % of eggs laid actually produce hatchlings.

The number of ridleys nesting during an arribada is difficult to count, although methodologies to estimate arribada size have been developed that are useful if nesting is well supervised by competent biologists. On the other hand, estimates by laymen of numbers of turtles in a given arribada are probably so inaccurate as to be useless. Because nesting in successive years is commonplace for olive ridleys, and may well be the norm for the species, the erratic nesting population trend lines often shown by loggerhead or green turtle populations, that very rarely nest in successive years, are not shown by olive ridley populations. It is thus much easier and more justified to draw conclusions about overall ridley population trends from a few years of comprehensive nest counts than it is for those species with multi-year nesting cycles.

### **Major Impacts/Threats to Olive Ridley Turtles**

- Pesticides, heavy metals and PCB's have been detected in turtles and eggs, but the effect on them is unknown.
- Marine turtles are at risk when encountering an oil spill. Respiration, skin, blood chemistry and salt gland function are affected.
- Olive ridley turtles eat a wide variety of marine debris such as plastic bags, plastic and styrofoam pieces, tar balls, balloons and raw plastic pellets. Effects of consumption

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include interference in metabolism or gut function, even at low levels of ingestion, as well as absorption of toxic byproducts.

- In areas where recreational boating and ship traffic is intense, propeller and collision injuries are not uncommon.

***Population Status***

<b>Population Name</b>	<b>Status</b>	<b>Population Trend</b>	<b>Population Estimate</b>	<b>Critical Habitat</b>
Range-wide	Threatened	Decreasing	unknown	
Mexican Breeding population	Endangered	Increasing	>350,000 <sup>6</sup>	

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<sup>6</sup>Estimated number of nesting females at La Escobilla beach, Oaxaca, Mexico in 1996.

*Listed Species Status*

**Chinook Salmon: *Oncorhynchus tshawytscha***



Along the U.S. West Coast, there are 17 distinct groups, or evolutionarily significant units (ESUs), of chinook salmon, from southern California to the Canadian border and east to the Rocky Mountains. Snake River spring/summer chinook and Snake River fall chinook were listed as threatened species in 1992.

In 1994, Sacramento River winter-run chinook were listed as endangered. In March 1998, two ESUs were proposed as endangered, five proposed as threatened, and the Snake River fall-run ESU was proposed to include fall chinook salmon populations in the Deschutes River. Details about these proposed ESUs are summarized below by population.

**Species Biology**

Chinook salmon belong to the family Salmonidae and are one of eight species of Pacific salmonids in the genus *Oncorhynchus*. Chinook salmon are easily the largest of any salmon, with adults often exceeding 40 pounds; individuals over 120 pounds have been reported. Chinook salmon are very similar to coho salmon in appearance while at sea (blue-green back with silver flanks), except for their large size, small black spots on both lobes of the tail, and black pigment along the base of the teeth. Chinook salmon are anadromous (adults migrate from a marine environment into the fresh water streams and rivers of their birth) and semelparous (spawn only once and then die).

Chinook salmon stocks exhibit considerable variability in size and age of maturation, and at least some portion of this variation is genetically determined. The relationship between size and length of migration may also reflect the earlier timing of river entry and the cessation of feeding for chinook salmon stocks that migrate to the upper reaches of river systems. Body size, which is correlated with age, may be an important factor in migration and redd construction success. Roni and Quinn (1995) reported that under high density conditions on the spawning ground, natural selection may produce stocks with exceptionally large-sized returning adults.

There are different seasonal “runs” (ie., spring, summer, fall, or winter) or modes in the migration of chinook salmon from the ocean to freshwater. These runs have been identified on the basis of when adult chinook salmon enter freshwater to begin their spawning migration. However, distinct runs also differ in the degree of maturation at the time of river entry, the

thermal regime and flow characteristics of their spawning site, and their actual time of spawning. Freshwater entry and spawning timing are believed to be related to local temperature and water flow regimes.

Adult female chinook will prepare a spawning bed, called a redd, in a stream area with suitable gravel composition, water depth and velocity. The adult female chinook may deposit eggs in 4 to 5 “nesting pockets” within a single redd. After laying eggs in a redd, adult chinook will guard the redd from 4 to 25 days before dying. Chinook salmon eggs will hatch, depending upon water temperatures, between 90 to 150 days after deposition. Eggs are deposited at a time to ensure that young salmon fry emerge during the following spring when the river or estuary productivity is sufficient for juvenile survival and growth. Juvenile chinook may spend from 3 months to 2 years in freshwater after emergence and before migrating to estuarine areas as smolts, and then into the ocean to feed and mature. Coastwide, chinook salmon remain at sea for 1 to 6 years (more commonly 2 to 4 years), with the exception of a small proportion of yearling males (called jack salmon) which mature in freshwater or return after 2 or 3 months in salt water.

Among chinook salmon, two distinct races have evolved. One race, described as a “stream-type” chinook, is found most commonly in headwater streams. Stream-type chinook salmon have a longer freshwater residency, and perform extensive offshore migrations before returning to their natal streams in the spring or summer months. Stream-type juveniles are much more dependent on freshwater stream ecosystems because of their extended residence in these areas. A stream-type life history may be adapted to areas that are more consistently productive and less susceptible to dramatic changes in water flow. At the time of saltwater entry, stream-type (yearling) smolts are much larger, averaging 73-134 mm depending on the river system, than their ocean-type (subyearling) counterparts and are therefore able to move offshore relatively quickly. Stream-type chinook salmon are found migrating far from the coast in the central North Pacific.

The second race is called the “ocean-type” chinook, which is commonly found in coastal streams in North America. Ocean-type chinook typically migrate to sea within the first three months of emergence, but they may spend up to a year in freshwater prior to emigration. They also spend their ocean life in coastal waters. Ocean-type chinook salmon return to their natal streams or rivers as spring, winter, fall, summer, and late-fall runs, but summer and fall runs predominate. Ocean-type chinook salmon tend to utilize estuaries and coastal areas more extensively for juvenile rearing. The development of the ocean-type life history strategy may have been a response to the limited carrying capacity of smaller stream systems and unproductive watersheds, or a means of avoiding the impact of seasonal floods. Ocean-type chinook salmon tend to migrate along the coast. Populations of chinook salmon south of the Columbia River drainage appear to consist predominantly of ocean-type fish.

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**Distribution and Abundance**

Chinook salmon are found from the Bering Strait south to Southern California. Historically, they ranged as far south as the Ventura River, California.

**Major Threats and Impacts**

See section entitled "Major Threats and Impacts to Pacific Salmonids" as well as more specific information under each population summary.

***ESU Status***

<b>ESU Name</b>	<b>Status</b>	<b>Listing Date</b>	<b>Population Trend Last 5 years</b>	<b>Population Estimate Mean # 1994-1998</b>	<b>Critical Habitat</b>
Central Valley California, spring-run	Proposed Endangered	3/1998			Proposed
Snake River Fall run	Endangered	4/1992	stable	565	Designated
Sacramento River Winter-run	Endangered	1/1994			Designated
Snake River Spring/Summer run	Threatened	4/1992	decreasing	3,300	Designated
Central Valley, fall/late fall-run	Proposed Threatened	3/1998	mixed	200,000	Proposed
Southern Oregon & California Coastal	Proposed Threatened	3/1998	mixed	132,000 in Oregon	Proposed
Puget Sound	Proposed Threatened	3/1998	mixed	71,000 (spawning escapement)	Proposed
Lower Columbia River	Proposed Threatened	3/1998	decreasing	2,000 <1% historic abundance <sup>7</sup>	Proposed
Upper Willamette River	Proposed Threatened	3/1998	decreasing	1,800 <sup>8</sup>	Proposed
Upper Columbia River, Spring run	Proposed Endangered	3/1998	decreasing	740 <sup>9</sup>	Proposed

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<sup>7</sup>No data update since 1994

<sup>8</sup>Updates through 1996-1998

<sup>9</sup>Sum of escapement to tributaries; mean for 1991-1995

**Population Name:** *Central Valley, California, Spring run*

**Species Status:** Proposed Endangered

**Trend:** Declining

**Estimate:** Average recent abundance is 2,000 fish, compared with 40,000 in 1940s

ESU Distribution/Description:

This ESU encompasses all naturally spawned populations of chinook (and their progeny) in the Sacramento River and its tributaries in California. Also included are river reaches and estuarine areas of the Sacramento-San Joaquin Delta, all waters from Chipps Island westward to Carquinez Bridge, including Honker Bay, Grizzly Bay, Suisun Bay, and Carquinez Strait, all waters of San Pablo Bay westward of the Carquinez Bridge, and all waters of San Francisco Bay (north of the San Francisco/Oakland Bay Bridge) from San Pablo Bay to the Golden Gate Bridge. Excluded are areas above specific dams or above longstanding, naturally impassable barriers. This ESU includes chinook salmon entering the Sacramento River from March to July and spawning from late August through early October, with a peak in September. Spring-run fish in the Sacramento River exhibit an ocean-type life history, emigrating as fry, subyearlings, and yearlings.

Critical Habitat:

A designation of critical habitat was proposed for this ESU in March 1998 and is expected to be finalized in March 1999. Proposed critical habitat includes all river reaches accessible to chinook salmon in the Sacramento River and its tributaries in California, all river reaches and estuarine areas of the Sacramento-San Joaquin Delta, all waters from Chipps Island westward to Carquinez Bridge, including Honker Bay, Grizzly Bay, Suisun Bay, and Carquinez Strait, all waters of San Pablo Bay westward of the Carquinez Bridge, and all waters of San Francisco Bay (north of the San Francisco/Oakland Bay Bridge) from San Pablo Bay to the Golden Gate Bridge. Excluded are areas above specific dams or above longstanding, naturally impassable barriers (i.e., natural waterfalls in existence for at least several hundred years).

Major Impacts:

Habitat problems are the most important source of ongoing risk to this ESU. Spring-run fish cannot access most of their historical spawning and rearing habitat in the Sacramento and San Joaquin River Basins (which is now above impassable dams), and current spawning is restricted to the mainstem and a few river tributaries in the Sacramento River. The remaining spawning habitat accessible to fish is severely degraded. Collectively, these habitat problems greatly reduce the resiliency of this ESU to respond to additional stresses in the future. The general degradation of conditions in the Sacramento River Basin (including elevated water temperatures, agricultural and municipal diversions and returns, restricted and regulated flows, entrainment of migrating fish into unscreened or poorly screened diversions, and the poor quality and quantity of remaining habitat) has severely impacted important juvenile rearing habitat and migration corridors.

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There is also serious concern for threats to genetic integrity posed by hatchery programs in the Central Valley. Most of the spring-run chinook salmon production in the Central Valley is of hatchery origin, and naturally spawning populations may be interbreeding with both fall/late fall- and spring-run hatchery fish. In addition, hatchery strays are considered to be an increasing problem due to the management practice of releasing a larger proportion of fish into the Sacramento River delta and San Francisco Bay to avoid adverse river conditions.

**Population Name:** *Central Valley, California, fall/late fall-run*

**Species Status:** Proposed Threatened

**Trend:** Mixed; long term trends generally stable

**Estimate:** Average recent natural escapement above 200,000 fish

### ESU Distribution/Description:

This ESU encompasses all naturally spawned populations of chinook salmon (and their progeny) in the Sacramento and San Joaquin River Basins and their tributaries, east of Carquinez Strait, California. Fall and late-fall chinook salmon enter the Sacramento and San Joaquin Rivers from July through April and spawn from October through February. Both runs are ocean-type chinook salmon, emigrating predominantly as fry and subyearlings and remaining off the California coast during their ocean migration.

### Critical Habitat:

A designation of critical habitat was proposed for this ESU in March 1998 and is expected to be finalized in March 1999. Proposed critical habitat includes all river reaches accessible to chinook salmon in the Sacramento and San Joaquin Rivers and their tributaries in California, all river reaches and estuarine areas of the Sacramento-San Joaquin Delta, all waters from Chipps Island westward to Carquinez Bridge, including Honker Bay, Grizzly Bay, Suisun Bay, and Carquinez Strait, all waters of San Pablo Bay westward of the Carquinez Bridge, and all waters of San Francisco Bay (north of the San Francisco/Oakland Bay Bridge) from San Pablo Bay to the Golden Gate Bridge. Excluded are areas upstream of the Merced River and areas above specific dams or above longstanding, naturally impassable barriers.

### Major Impacts

A large proportion of the historic range of this ESU is severely degraded. Since most of fall/late fall-run spawning habitat is below dams, habitat blockage is not as severe for fall/late fall-run chinook as it is for winter- and spring-run chinook salmon in this region. However, there has been a severe degradation of the remaining habitat, especially due to agricultural and municipal water use activities in the Central Valley (which result in point and non-point pollution, elevated water temperatures, diminished flows, and smolt and adult entrainment into poorly screened or unscreened diversions). Additionally, stray rates are high because many hatchery fish are released into the Sacramento River delta and San Francisco Bay to avoid adverse river

conditions, resulting in a much larger proportion of hatchery chinook salmon present in the natural spawning population.

A mitigating factor for the overall risk to the ESU is that a few of the Sacramento and San Joaquin River Basin tributaries have shown recent, short-term increases in abundance. Total population abundance in this ESU is relatively high, perhaps near historical levels, however, the streams supporting natural runs considered to be the least influenced by hatchery fish have the lowest abundance and the most consistently negative trends of all populations in the ESU. In general, high hatchery production combined with infrequent monitoring of natural production make assessing the sustainability of natural production problematic, resulting in substantial uncertainty in assessing the status of this ESU.

Another concern facing chinook salmon in this ESU is the high ocean and freshwater harvest rates in recent years, which may be higher than is sustainable by natural populations given the productivity of the ESU under present habitat conditions. The mixed stock ocean salmon fisheries off California are managed to achieve certain spawning escapement goals for two main indicator stocks: Sacramento River fall chinook and Klamath River fall chinook. Since 1993, the need to address Indian fishing rights in the Klamath River Basin has required significant reductions in the ocean harvest rate on Klamath River fall chinook. The ocean harvest rates are currently 71-79 percent and recent freshwater harvest is 25 percent.

**Population Name:** *Southern Oregon & California Coastal*

**Species Status:** Proposed Threatened

**Trend:** Mixed

**Estimate:** Average recent escapement about 132,000 in Oregon; few estimates for California

ESU Distribution/Description:

This ESU includes all naturally spawned coastal spring and fall chinook salmon spawning from Cape Blanco (inclusive of the Elk River) to the southern extent of the current range for chinook salmon at Point Bonita (the northern landmass marking the entrance to San Francisco Bay). Chinook salmon in this ESU exhibit an ocean-type life-history; ocean distribution is predominantly off of the California and Oregon coasts.

Critical Habitat:

A designation of critical habitat was proposed for this ESU in March 1998 and is expected to be finalized in March 1999. Proposed critical habitat includes all river reaches and estuarine areas accessible to chinook salmon in the drainages of San Francisco and San Pablo Bays, westward to the Golden Gate Bridge, and includes all estuarine and river reaches accessible to proposed chinook salmon on the California and southern Oregon coast to Cape Blanco (inclusive).

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Excluded are the Klamath and Trinity Rivers upstream of their confluence. Also excluded are areas above specific dams or above longstanding, naturally impassable barriers.

### Major Impacts:

Habitat loss and/or degradation is widespread throughout the range of the ESU. Habitat blockages and fragmentation, logging and agricultural activities, urbanization, and water withdrawals are reported as the most predominant problems for anadromous salmonids in California's coastal basins. Such problems also occur in Oregon streams within the ESU. The Rogue River Basin, in particular, has been affected by mining activities and unscreened irrigation diversions in addition to the problems resulting from logging and dam construction. Approximately one-third of spring chinook salmon spawning habitat in the Rogue River was inaccessible following the construction of Lost Creek Dam (River Kilometer 253) in 1977. Recent major flood events (February 1996 and January 1997) have probably affected habitat quality and survival of juveniles within this ESU.

Artificial propagation programs in this ESU are less extensive than those in other ESUs.- Current hatchery contribution to overall abundance is relatively low except for the Rogue River spring-run. The hatchery-to-total run ratio of Rogue River spring chinook salmon, as measured at Gold Ray Dam (Rkm 201), has exceeded 60% in some years.

**Population Name:** *Puget Sound*

**Species Status:** Proposed Threatened

**Trend:** Mixed

**Estimate:** Average current abundance 71,000 (spawning escapement)

### ESU Distribution/Description:

This ESU encompasses all naturally spawned populations of chinook salmon from rivers and streams flowing into Puget Sound including the Straits of Juan De Fuca from the Elwha River eastward, including rivers and streams flowing into Hood Canal, South Sound, North Sound and the Strait of Georgia in Washington. Chinook salmon in this area all exhibit an ocean-type life history.

### Critical Habitat:

A designation of critical habitat was proposed for this ESU in March 1998 and is expected to be finalized in March 1999. Proposed critical habitat includes all marine, estuarine and river reaches accessible to chinook salmon in Puget Sound. Puget Sound marine areas include South Sound, Hood Canal, and North Sound to the international boundary at the outer extent of the Strait of Georgia, Haro Strait and the Straits of Juan De Fuca to a straight line extending north from the west end of Freshwater Bay, inclusive. Excluded are areas above specific dams or

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above longstanding, naturally impassable barriers (i.e., natural waterfalls in existence for at least several hundred years).

### Major Impacts:

Habitat throughout the ESU has been blocked or degraded. In general, upper tributaries have been impacted by forest practices and lower tributaries and mainstem rivers have been impacted by agriculture and/or urbanization. Diking for flood control, draining and filling of freshwater and estuarine wetlands, and sedimentation due to forest practices and urban development are problems throughout the ESU. Blockages by dams, water diversions, and shifts in flow regime due to hydroelectric development and flood control projects are major habitat problems in several basins.

Nearly 2 billion fish have been released into Puget Sound tributaries since the 1950s. The preponderance of hatchery production throughout the ESU may mask trends in natural populations and makes it difficult to determine whether they are self-sustaining. This difficulty is compounded by the dearth of data pertaining to proportion of naturally-spawning fish that are of hatchery origin.

Harvest impacts on Puget Sound chinook salmon stocks are quite high. Ocean exploitation rates on natural stocks averaged 56-59%; overall harvest rates average 68-83% (1982-89). Total exploitation rates on some stocks have exceeded 90%.

**Population Name:** *Lower Columbia River*

**Species Status:** Proposed Threatened

**Trend:** Mixed

**Estimate:** Recent natural spawning average about 40,000, with large hatchery component

### ESU Distribution/Description:

This ESU encompasses all naturally spawned populations of chinook salmon (and their progeny) from the Columbia River and its tributaries from its mouth at the Pacific Ocean upstream to a transitional point between Washington and Oregon east of the Hood River and the White Salmon River, and includes the Willamette River to Willamette Falls, Oregon. Populations in this ESU are considered ocean type.

### Critical Habitat:

A designation of critical habitat was proposed for this ESU in March 1998 and is expected to be finalized in March 1999. Proposed critical habitat includes all river reaches accessible to chinook salmon in Columbia River tributaries between the Grays and White Salmon Rivers in Washington and the Willamette and Hood Rivers in Oregon, inclusive. Also included are river

reaches and estuarine areas in the Columbia River from a straight line connecting the west end of the Clatsop jetty (south jetty, Oregon side) and the west end of the Peacock jetty (north jetty, Washington side) upstream to The Dalles Dam. Excluded are areas above specific dams or above longstanding, naturally impassable barriers (i.e., natural waterfalls in existence for at least several hundred years).

**Major Impacts:**

All basins are affected (to varying degrees) by habitat degradation. Major habitat problems are primarily related to blockages, forest practices, urbanization in the Portland and Vancouver areas, and agriculture in floodplains and low-gradient tributaries.

Hatchery programs to enhance chinook salmon fisheries abundance in the lower Columbia River began in the 1870s, expanded rapidly, and have continued throughout this century. Although the majority of the stocks have come from within this ESU, over 200 million fish from outside the ESU have been released since 1930. The large numbers of hatchery fish in this ESU make it difficult to determine the proportion of naturally produced fish.

Harvest rates on fall-run stocks are moderately high; recent average total harvest rate was 65 percent (1982-89 brood years). The average ocean exploitation rate for this period was 46 percent, while the freshwater harvest rate on the fall run has averaged 20 percent. Harvest rates are somewhat lower for spring run stocks.

**Population Name:** *Upper Willamette River*

**Species Status:** Proposed Threatened

**Trend:** Declining

**Estimate:** Recent total escapement averaged 26,000; however, naturally-spawning escapement may average 3,900 fish, of which only 1,300 are naturally produced.

**ESU Distribution/Description:**

This ESU includes naturally spawned spring-run populations of chinook salmon (and their progeny) in the Willamette River, and its tributaries, above Willamette Falls, Oregon. The ocean distribution is consistent with an ocean-type life history, and recoveries occur in considerable numbers in the Alaskan and British Columbian coastal fisheries.

**Critical Habitat:**

A designation of critical habitat was proposed for this ESU in March 1998 and is expected to be finalized in March 1999. Proposed critical habitat includes all river reaches accessible to chinook salmon in the Willamette River and its tributaries above Willamette Falls. Also included are river reaches and estuarine areas in the Columbia River from a straight line

connecting the west end of the Clatsop jetty (south jetty, Oregon side) and the west end of the Peacock jetty (north jetty, Washington side) upstream to and including the Willamette River in Oregon. Excluded are areas above specific dams or above longstanding, naturally impassable barriers (i.e., natural waterfalls in existence for at least several hundred years).

Major Impacts:

While the abundance of Willamette River spring chinook salmon has been relatively stable over the long term, and there is evidence of some natural production, it is apparent that at present production and harvest levels the natural population is not replacing itself. With natural production accounting for only 1/3 of the natural spawning escapement, it is questionable whether natural spawners would be capable of replacing themselves even in the absence of fisheries. While hatchery programs in the Willamette River Basin have maintained broodlines that are relatively free of genetic influences from outside the Willamette basin, they may have homogenized the population structure within the ESU. The introduction of fall-run chinook salmon into the basin and laddering of Willamette Falls have increased the potential for genetic introgression between wild spring-and hatchery fall-run chinook salmon, but there is no direct evidence of hybridization (other than an overlap in spawning times and spawning location) between these two runs. Prolonged artificial propagation of the majority of the production from this ESU may also have had deleterious effects on the ability of Willamette River spring chinook salmon to reproduce successfully in the wild.

Habitat blockage and degradation are significant problems in this ESU. Available habitat has been reduced by construction of dams in the Santiam, McKenzie, and Middle Fork Willamette River Basins, and these dams have probably adversely affected remaining production via thermal effects. Agricultural development and urbanization are the main activities that have adversely affected habitat throughout the basin.

Another concern for this ESU is that commercial and recreational harvests are high relative to the apparent productivity of natural populations. The average total harvest mortality rate was estimated to be 72 percent in 1982-89, with a corresponding ocean exploitation rate of 24 percent. This estimate does not fully account for escapement, and ODFW is in the process of revising harvest rate estimates for this stock; revised estimates may average 57 percent total harvest rate, with 16 percent ocean and 48 percent freshwater components. The inriver recreational harvest rate (Willamette River sport catch/estimated run size) for the period from 1991 through 1995 was 33 percent.

**Population Name:** *Upper Columbia River, spring-run*

**Species Status:** Proposed Endangered

**Trend:** Declining

**Estimate:** Recent average escapement fewer than 5,000; recent run sizes are lowest in 60 years

ESU Distribution/Description:

This ESU includes all naturally spawned populations of chinook (and their progeny) spawning above Rock Island Dam--that is, those in the Wenatchee, Entiat, and Methow Rivers. These upper Columbia River populations exhibit classical stream-type life-history strategies.

Critical Habitat:

A designation of critical habitat was proposed for this ESU in March 1998 and is expected to be finalized in March 1999. Proposed critical habitat includes all river reaches accessible to chinook salmon in Columbia River tributaries upstream of the Rock Island Dam and downstream of Chief Joseph Dam in Washington, excluding the Okanogan River. Also included are river reaches and estuarine areas in the Columbia River from a straight line connecting the west end of the Clatsop jetty (south jetty, Oregon side) and the west end of the Peacock jetty (north jetty, Washington side) upstream to Chief Joseph Dam in Washington. Excluded are areas above specific dams or above longstanding, naturally impassable barriers (i.e., natural waterfalls in existence for at least several hundred years).

Major Impacts:

Access to a substantial portion of historical habitat was blocked by Chief Joseph and Grand Coulee Dams. There are local habitat problems related to irrigation diversions and hydroelectric development, as well as degraded riparian and instream habitat from urbanization and livestock grazing. Mainstem Columbia River hydroelectric development has resulted in a major disruption of migration corridors and affected flow regimes and estuarine habitat. Some populations in this ESU must migrate through nine mainstem dams.

Artificial propagation efforts have had a significant impact on spring-run populations in this ESU, either through hatchery-based enhancement or the extensive trapping and transportation activities. It is probable that the majority of returning spring-run adults trapped at Rock Island Dam for use in hatchery-based enhancement were probably not native to the Wenatchee, Entiat, and Methow Rivers. Naturally spawning populations in tributaries upstream of hatchery release sites have apparently undergone limited introgression by hatchery stocks. Artificial propagation efforts have recently focused on supplementing naturally spawning populations in this ESU, although it should be emphasized that these naturally spawning populations were probably founded by the same homogenized stock. Furthermore, the potential for hatchery-derived non-native stocks to genetically impact naturally spawning populations exists, especially given the recent low numbers of fish returning to rivers in this ESU. Risks associated with interactions

between wild and hatchery chinook salmon are a concern.

Harvest rates are low for this ESU, with very low ocean and moderate instream harvest. Harvest rates have been declining recently.

**Population Name:** *Snake River fall*

**Species Status:** Threatened; redefined ESU proposed as threatened

**Trend:** Declining

**Estimate:** Total natural escapement averages about 6,500

ESU Distribution/Description:

This ESU is now believed to include additional fall-run populations; genetic analysis links fall chinook from the Deschutes River to the existing Snake River fall-run ESU. Populations in mainstem Columbia, John Day, Umatilla, and Walla Walla rivers are extinct, in addition to loss of populations that historically spawned above Hells Canyon Dam Complex.

This ESU includes all natural population(s) of fall chinook in the mainstem Snake River and any of the following subbasins: Tucannon River, Grande Ronde River, Imnaha River, Salmon River, and Clearwater River. Snake River fall chinook salmon spawn in October and November in the mainstem Snake River from the upper limit of the Lower Granite Dam Reservoir to Hells Canyon Dam and the lower reaches of the Imnaha, Grande Ronde, Clearwater, and Tucannon Rivers or the lower parts of tributaries in October and November. This ESU includes ocean-type fish.

Critical Habitat:

Final critical habitat was designated for this ESU in December 1993. In March 1998, critical habitat was proposed to be revised to include all naturally spawned populations of chinook salmon (and their progeny) from the Columbia River and its tributaries upstream from a transitional point between Washington and Oregon east of the Hood River and the White Salmon River, to its confluence with the Snake River, and also includes the Snake River and its tributaries upstream to Hells Canyon Dam. These tributaries include the lower Grande Ronde, Imnaha, lower Salmon and lower Clearwater Rivers in parts of Oregon, Washington, and Idaho. Critical habitat is expected to be finalized in March 1999.

Major Impacts:

Almost all historical Snake River fall-run chinook salmon spawning habitat in the Snake River Basin was blocked by the Hells Canyon Dam complex; other habitat blockages have also occurred in Columbia River tributaries. Hydroelectric development on the mainstem Columbia

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and Snake Rivers continues to affect juvenile and adult migration. Remaining habitat has been reduced by inundation in the mainstem Snake and Columbia Rivers, and the ESU's range has also been affected by agricultural water withdrawals, grazing, and vegetation management.

The continued straying by non-native hatchery fish into natural production areas is an additional source of risk to the Snake River chinook salmon.

Management changes have significantly reduced ocean harvest rates in the last six years.

### *Listed Species Status*

## **Chum Salmon: *Oncorhynchus keta***



Along the U.S. West Coast, there are 4 distinct groups, or evolutionarily significant units (ESUs), of chum salmon. Two of these ESUs, Hood Canal summer-run and Columbia River, were proposed as threatened under the ESA in March 1998. Details about these proposed ESUs are summarized below by population.

### **Species Biology**

Chum salmon belong to the family Salmonidae and are one of eight species of Pacific salmonids in the genus *Oncorhynchus*. Chum salmon are anadromous (adults migrate from a marine environment into the fresh water streams and rivers of their birth), semelparous (spawn only once and then die), and spawn primarily in fresh water. Chum salmon grow to be among the largest of Pacific salmon, second only to chinook salmon in adult size, with individuals reported up to 108.9 cm in length and 20.8 kg in weight. Average size for the species is around 3.6 to 6.8 kg. The species is best known for the enormous canine-like fangs and striking body color (a calico pattern, with the anterior two-thirds of the flank marked by a bold, jagged, reddish line and the posterior third by a jagged black line) of spawning males. Females are less flamboyantly colored and lack the extreme dentition of the males. Chum salmon may historically have been the most abundant of all salmonids.

Chum salmon spawn in the lowermost reaches of rivers and streams, typically within 100 km of the ocean. They migrate almost immediately after hatching to estuarine and ocean waters, in contrast to coho, chinook, sockeye and pink salmon, and steelhead and cutthroat trout, which migrate to sea after months or even years in fresh water. This means that survival and growth in juvenile chum salmon depend less on freshwater conditions (unlike stream-type salmonids which depend heavily on freshwater habitats) than on favorable estuarine and marine conditions. Another behavioral difference between chum salmon and most species that rear extensively in fresh water is that chum salmon form schools, presumably to reduce predation. Age at maturity appears to follow a latitudinal trend in which a greater number of older fish occur in the northern portion of the species' range. Most chum salmon mature between 3 and 5 years of age, with 60 to 90 percent of the fish maturing at 4 years of age. The species has only a single form (sea-run) and does not reside in fresh water.

### **Distribution and Abundance**

The species has the widest natural geographic and spawning distribution of any Pacific salmonid, primarily because its range extends farther along the shores of the Arctic Ocean than that of the other salmonids. Historically, chum salmon were distributed throughout the coastal regions of western Canada and the United States, as far south as Monterey, California. Presently, major

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spawning populations are found only as far south as Tillamook Bay on the northern Oregon coast.

**Major Threats and Impacts**

See section entitled "Major Threats and Impacts to Pacific Salmonids" as well as more specific information under each population summary.

**ESU Status**

ESU Name	Status	Listing Date	Population Trend Last 5 years	Population Estimate Mean # 1994-1998	Critical Habitat
Lower Columbia River	Proposed Threatened	3/1999	Decreasing	<1% historic levels	Proposed
Hood Canal Summer-run	Proposed Threatened	3/1999	Decreasing	4,000 <sup>10</sup>	Proposed

**Population Name:** *Columbia River*

**Status:** Proposed Threatened

**Trend:** Stable

**Estimate:** Recent annual returns between 1,500 and 4,000 fish, compared to as many as 500,000 before 1994

ESU Distribution/Description:

Historically, chum salmon were abundant in the lower reaches of the Columbia River and may have spawned as far upstream as the Walla Walla River (over 500 km inland); at least one ESU of chum salmon occurred in the Columbia River. Today only remnant chum salmon populations exist, all in the lower Columbia River. They are few in number, low in abundance, and of uncertain stocking history. The Columbia River ESU extends only to the mouth of the river.

Critical Habitat:

A designation of critical habitat was proposed for this ESU in March 1998 and is expected to be finalized in March 1999. Proposed critical habitat includes all naturally spawned populations of chum salmon (and their progeny) in the Columbia River and its tributaries in Washington and Oregon.

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<sup>10</sup>Mean for 1992-1996

Major Impacts:

The Columbia River historically contained large runs of chum salmon that supported a substantial commercial fishery in the first half of this century. Current abundance is probably less than 1 percent of historical levels, and the ESU has undoubtedly lost some of its original genetic diversity. Many spill dams and other small hydropower facilities have been constructed in lower river areas, and Bonneville Dam presumably continues to impede recovery of upriver populations. Substantial habitat loss in the Columbia River estuary and associated areas presumably was an important factor in the decline and also represents a significant continuing risk for this ESU.

**Population Name:** *Hood Canal Summer-run*

**Status:** Proposed Threatened

**Trend:** Mixed

**Estimate:** Recent annual returns of approximately 9,500 fish

ESU Distribution/Description:

This ESU includes summer-run chum salmon populations in Hood Canal in Puget Sound and in Discovery and Sequim Bays on the Strait of Juan de Fuca. It may also include summer-run fish in the Dungeness River, but the existence of that run is uncertain.

Critical Habitat:

A designation of critical habitat was proposed for this ESU in March 1998 and is expected to be finalized in March 1999. Proposed critical habitat includes all naturally spawned populations of summer-run chum salmon (and their progeny) in Hood Canal and its tributaries as well as populations in Olympic Peninsula rivers between Hood Canal and Sequim Bay, Washington.

Major Impacts:

Hood Canal summer-run chum salmon have disappeared from several streams, and many other streams have experienced severe declines over the past twenty years. Historically, summer chum salmon have not been a primary fishery target in Hood Canal, as harvests have focused on other salmonids. However, summer chum salmon have a run timing that overlaps with those of chinook and coho salmon, and they have been incidentally harvested in fisheries directed at those species. Exploitation rates on summer-run chum salmon in Hood Canal have been greatly reduced since 1991 as a result of closures of the coho salmon fishery and of efforts to reduce the harvest of summer chum salmon. Threats to this population include degradation of spawning habitat, low water flows, and incidental harvest in salmon fisheries in the Strait of Juan de Fuca and coho salmon fisheries in Hood Canal. In addition, summer chum salmon populations have shown a great deal of variability in productivity and run size in recent years, and this extreme variability can itself be a significant risk factor.

## Listed Species Status

### **Coho Salmon: *Oncorhynchus kisutch***

Along the U.S. West Coast, there are 6 distinct groups, or evolutionarily significant units (ESUs), of chum salmon. Three of these ESUs, Central California, Southern Oregon/Northern California Coasts, and Oregon Coasts, were listed as threatened under the ESA in October 1996, May 1997, and August 1998, respectively. Details about these proposed ESUs are summarized below by population.



#### **Species Biology**

Coho salmon belong to the family Salmonidae and are one of eight species of Pacific salmonids in the genus *Oncorhynchus*. Coho salmon are anadromous (adults migrate from a marine environment into the fresh water streams and rivers of their birth) and semelparous (spawn only once and then die). Coho spend approximately the first half of their life cycle rearing in streams and small freshwater tributaries. The remainder of the life cycle is spent foraging in estuarine and marine waters of the Pacific Ocean prior to returning to their stream of origin to spawn and die. Most adults are three-year old fish, however, some precocious males known as "jacks" return as two-year old spawners. A returning adult may measure more than two feet in length and weigh an average of eight pounds.

#### **Distribution and Abundance**

The species was historically distributed throughout the North Pacific Ocean from central California to Point Hope, Alaska, through the Aleutian Islands, and from the Anadyr River, Russia, south to Hokkaido, Japan. Historically, this species probably inhabited most coastal streams in Washington, Oregon, and central and northern California. Some populations, now considered extinct, are believed to have migrated hundreds of miles inland to spawn in tributaries of the upper Columbia river in Washington, and the Snake river in Idaho.

#### **Major Threats and Impacts**

See section entitled "Major Threats and Impacts to Pacific Salmonids" as well as more specific information under each population summary.

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**ESU Status**

ESU Name	Status	Listing Date	Population Trend (Last 5 years)	Population Estimate	Critical Habitat
Oregon Coast	Threatened	8/1998	declining	38,600 <sup>11</sup>	
Southern Oregon/Northern California Coast	Threatened	5/1997	unknown	8,500 <sup>12</sup>	Proposed
Central California Coast	Threatened	10/1996	declining	<6,000	Proposed
Puget Sound/Straights of Georgia	Candidate	7/1995			
Lower Columbia River/ SW Washington	Candidate	7/1995			

**Population Name:** *Central California Coast*

**Status:** Threatened

**Trend:** Declining

**Estimate:** <6,000

ESU Distribution/Description:

In the 1940s, estimated abundance of coho salmon in the Central California Coast ESU ranged from 50,000 to 125,000 natural spawning adults. Today, it is estimated that there are probably less than 6,000 naturally-reproducing coho salmon, and the vast majority of these fish are considered to be of non-native origin (either hatchery fish or from streams stocked with hatchery fish). The ESU consists of all coho salmon naturally reproduced in streams between Punta Gorda, Humboldt County, California and the San Lorenzo River, Santa Cruz County, California.

Critical Habitat:

A designation of critical habitat was proposed for this ESU in November 1997 and is expected to be finalized in November 1998. Proposed critical habitat encompasses accessible reaches of all rivers (including estuaries and tributaries) south of Punta Gorda in northern California up to and

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<sup>11</sup>Mean for 1990-1993; updated data not available

<sup>12</sup>Data current through 1997 & 1998; Rogue and Trinity Dam counts

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including California's San Lorenzo River. Also included are two rivers entering San Francisco Bay: Mill Valley Creek and Corte Madera Creek.

### Major Impacts:

The present depressed condition is the result of several human caused factors such as habitat degradation, harvest, water diversions, and artificial propagation that exacerbate the adverse effects of natural environmental variability from drought and poor ocean conditions.

**Population Name:** *Oregon Coast*

**Status:** Threatened

**Trend:** Declining

**Estimate:** 39,000

### ESU Distribution/Description:

This ESU includes coho salmon from Oregon coastal streams between Cape Blanco and the Columbia River

### Critical Habitat:

Critical habitat was not determinable at the time of listing; proposed critical habitat is expected to be designated by August 1999.

### Major Impacts:

The current abundance of coho salmon in this ESU is substantially less than it was historically. Population levels for Oregon coast coho have declined to approximately 5-10% of historic levels. In addition, habitat degradation and inadequate regulatory mechanisms have posed continued threats to this species' survival.

**Population Name:** *Southern Oregon/Northern California Coast*

**Status:** Threatened

**Trend:** Declining

**Estimate:** < 10,000 naturally-produced adults

### ESU Distribution/Description:

This ESU is composed of coho salmon populations between Punta Gorda, California, and Cape Blanco, Oregon. In the 1940's, estimated abundance in this ESU ranged from 150,000 to 400,000 naturally spawning fish. Today, coho populations in this ESU are very depressed, currently numbering approximately 10,000 naturally produced adults.

### Critical Habitat:

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A designation of critical habitat was proposed for this ESU in November 1997 and is expected to be finalized in November 1998. Proposed critical habitat encompasses for the Southern Oregon/Northern California Coasts ESU encompasses accessible reaches of all rivers (including estuaries and tributaries) between the Mattole River in California and the Elk River in Oregon, inclusive.

### Major Impacts:

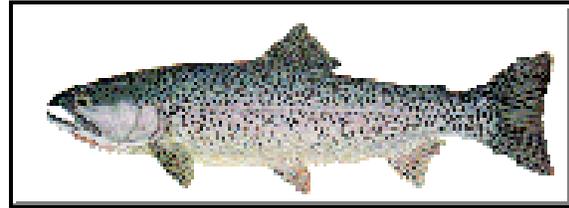
Population levels of Southern Oregon/Northern California coast coho are substantially below historical levels. In the California portion of this ESU, about 36% of coho streams no longer have spawning runs. There has been widespread habitat degradation, and much of the remaining populations are hatchery-derived populations which may be genetically divergent from native strains.

### *Listed Species Status*

## **Coastal Cutthroat Trout: *Oncorhynchus clarki clarki***

### **Species Biology**

Coastal cutthroat trout differ from all other trout by their profusion of small to medium-size spots of irregular shape. In addition, they do not develop the brilliant colors associated with inland cutthroat trout (a separate subspecies). In the sea-run (anadromous) form of the coastal cutthroat trout, spots and colors are further obscured by the silvery skin deposit common to anadromous salmonids. Non-anadromous (resident) fish tend to be darker, with a "coppery or brassy" sheen.



The life history of this subspecies is probably the most complex and flexible of any Pacific salmonid. Unlike other anadromous salmonids, sea-run forms of the coastal cutthroat trout do not overwinter in the ocean and only rarely make long extended migrations across large bodies of water. They migrate in the nearshore marine habitat and usually remain within 10 km of land. While most anadromous cutthroat trout enter seawater as 2- or 3- year olds, some may remain in fresh water up to 5 years before entering the sea. Other cutthroat trout may never outmigrate at all, but remain as residents of small headwater tributaries. Still other cutthroat trout may migrate only into rivers and lakes, even when they have access to the ocean. In the Umpqua River, anadromous, resident, and potamodromous (river-migrating) life-history forms have been reported. Details of the coastal cutthroat trout life history and ecology, including aspects particular to the various life forms, can be found in published reviews.

### **Abundance and Distribution**

The Umpqua River cutthroat trout is a "distinct population segment" under the ESA (hereinafter referred to as an Evolutionarily Significant Unit or ESU (56 FR 58612; November 20, 1991)) of the coastal cutthroat trout (*Oncorhynchus clarki clarki*). The coastal cutthroat trout subspecies is native to western North America and is found in the coastal temperate rainforests from southeast Alaska to northern California. The Umpqua River cutthroat trout ESU inhabits a large coastal basin (drainage area over 12,200 square km) in the southwestern Oregon coast. Spawning sites are located in the North and South Umpqua Rivers and their tributaries, of which Smith River and Calapooya, Elk, and Scholfield Creeks are major tributaries. The estuary of the Umpqua River is one of the largest on the Oregon coast.

### **Major Threats and Impacts**

See section entitled "Major Threats and Impacts to Pacific Salmonids" as well as more specific information under each population summary.

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*ESU Status*

<b>ESU Name</b>	<b>Status</b>	<b>Listing Date</b>	<b>Population Trend (Last 5 years)</b>	<b>Population Estimate</b>	<b>Critical Habitat</b>
Umpqua River	Endangered	8/1996	Decreasing	unknown	Designated

### *Listed Species Status*

## **Sockeye Salmon: *Oncorhynchus nerka***

Along the U.S. West Coast, there are 7 distinct groups, or evolutionarily significant units (ESUs), of sockeye salmon. One of these ESUs, Snake River, was listed as endangered in November 1991. In March 1998, the Ozette Lake ESU was proposed as threatened and the Baker River ESU was designated as a candidate species. Details about the proposed and candidate ESUs are summarized below by population.



### **Species Biology**

Sockeye salmon belong to the family Salmonidae and are one of seven species of Pacific salmonids in the genus *Oncorhynchus*. Sockeye salmon are anadromous, meaning they migrate from the ocean to spawn in fresh water. They are the third most abundant of the seven species of Pacific salmon, after pink and chum salmon. Unique in their appearance, the adult spawners typically turn bright red, with a green head, hence "red" salmon, as commonly called in Alaska. During the ocean and adult migratory phase sockeye often have a bluish back and silver sides, giving rise to another common name, "bluebacks." The name "sockeye" is thought to have been a corruption of the various Indian tribes' word "sukkai."

Sockeye salmon exhibit a wide variety of life history patterns that reflect varying dependency on the fresh water environment. With the exception of certain river-type and sea-type populations, the vast majority of sockeye salmon spawn in or near lakes, where the juveniles rear for 1 to 3 years prior to migrating to sea. For this reason, the major distribution and abundance of large sockeye salmon stocks are closely related to the location of rivers that have accessible lakes in their watersheds for juvenile rearing. There are also *O. nerka* life forms that are non-anadromous, meaning that most members of the form spend their entire lives in freshwater. Non-anadromous *O. nerka* in the Pacific Northwest are known as kokanee. Occasionally, a proportion of the juveniles in an anadromous sockeye salmon population will remain in their rearing lake environment throughout life and will be observed on the spawning grounds together with their anadromous siblings. Taxonomically, the kokanee and sockeye salmon do not differ.

### **Distribution and Abundance**

On the Pacific coast, sockeye salmon inhabit riverine, marine, and lake environments from the Columbia River and its tributaries north and west to the Kuskokwim River in western Alaska .

**Major Threats and Impacts**

See section entitled "Major Threats and Impacts to Pacific Salmonids" as well as more specific information under each population summary.

***ESU Status***

<b>ESU Name</b>	<b>Status</b>	<b>Listing Date</b>	<b>Population Trend (Last 5 years)</b>	<b>Population Estimate</b>	<b>Critical Habitat</b>
Snake River	Endangered	11/1991	Decreasing	2 <sup>13</sup>	Designated
Ozette Lake	Proposed Threatened	3/1998	Decreasing	700 <sup>14</sup>	Proposed
Baker River	Candidate		Stable	2,700	

**Population Name:** *Ozette Lake*

**Species Status:** Proposed Threatened

**Trend:** Declining

**Estimate:** Recent average annual escapement was 700 fish

**ESU Distribution/Description:**

This ESU consists of sockeye salmon that return to Ozette Lake through the Ozette River and currently spawn primarily in lakeshore upwelling areas in Ozette Lake (particularly at Allen's Bay and Olsen's Beach). Minor spawning may occur below Ozette Lake in the Ozette River or in Coal Creek, a tributary of the Ozette River. Sockeye salmon do not presently spawn in tributary streams to Ozette Lake, although they may have spawned there historically.

Kokanee are very numerous in Ozette Lake and spawn in inlet tributaries, whereas sockeye salmon spawn on lakeshore upwelling beaches. Sockeye have not been observed on the inlet spawning grounds of kokanee in Ozette Lake, although there are no physical barriers to prevent their entry into these tributaries. On the other hand, kokanee-sized *O. nerka* are observed together with sockeye salmon on the sockeye salmon spawning beaches at Allen's Bay and Olsen's Beach.

Based on the very large genetic difference between Ozette Lake kokanee that spawn in tributaries and Ozette Lake sockeye salmon that spawn on shoreline beaches, Ozette Lake kokanee are not

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<sup>13</sup>1992-1996

<sup>14</sup>Mean for 1992-1996

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included in this sockeye salmon ESU. However, if "kokanee-sized" *O. nerka* observed spawning with sockeye salmon on sockeye salmon spawning beaches in Ozette Lake are identified as resident sockeye salmon, they are to be considered as part of the Ozette Lake sockeye salmon ESU.

### Critical Habitat:

A designation of critical habitat was proposed for this ESU in March 1998 and is expected to be finalized in March 1999. Proposed critical habitat includes all lake areas and river reaches accessible to listed sockeye salmon in Ozette Lake, located in Clallam county, Washington.

### Major Impacts:

The ESU is presently near the lower end of its historical abundance range. Current escapements averaging below 1,000 adults per year imply a moderate degree of risk from small-population genetic and demographic variability, with little room for further declines before abundances would be critically low. Other concerns include siltation of beach spawning habitat, very low abundance compared to harvest in the 1950s, and potential genetic effects of present hatchery production and past interbreeding with genetically dissimilar kokanee.

**Population Name:** *Baker River*

**Species Status:** Candidate

**Trend:** Stable

**Estimate:** Recent average annual escapement was about 2,700 adults

### ESU Distribution/Description:

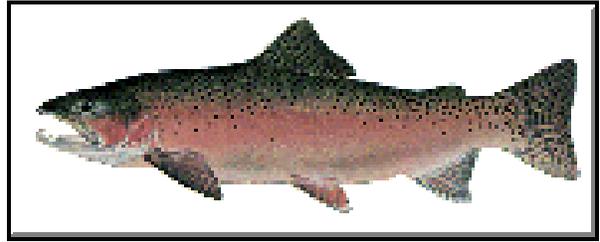
This ESU consists of sockeye salmon that return to the barrier dam and fish trap on the lower Baker River after migrating through the Skagit River. They are trucked to one of three artificial spawning beaches above either one or two dams on the Baker River and are held in these enclosures until spawning.

### Major Impacts:

The recent average abundance is probably near the lower end of the historical abundance range for this ESU. Concerns are focused on high fluctuations in abundance, lack of natural spawning habitat, and the vulnerability of spawning beaches to water quality problems. Large fluctuations in abundance were a substantial concern. It is also likely that this stock would go extinct if present human intervention were halted and problems related to that intervention pose some risk to the population. This ESU bears close monitoring and its status should be reconsidered if abundance remains low.

*Listed Species Status*

**Steelhead Trout:**  
*Oncorhynchus mykiss*



**Species Biology**

Steelhead has the greatest diversity of life history patterns of any Pacific salmonid species, including varying degrees of anadromy, differences in reproductive biology, and plasticity of life history between generations. Within the range of west coast steelhead, spawning migrations occur throughout the year, with seasonal peaks of activity. In any given river basin there may be one or more peaks of migration activity; since these *runs* are generally named for the season in which they occur, some rivers may have runs known as winter, spring, summer, or fall steelhead. For example, large rivers such as the Columbia, Rogue, and Klamath have migrating adult steelhead at all times of year. Through time, the names of seasonal runs have generally been simplified- in the Pacific Northwest, winter and summer steelhead runs are commonly identified. In northern California, some biologists have retained the terms spring and fall steelhead to name what others would call summer steelhead.

North American steelhead commonly spend 2 years in the ocean before entering freshwater to spawn. Summer steelhead enter fresh water up to a year prior to spawning. Steelhead may spawn more than once. In some cases, the separation between anadromous steelhead and resident rainbow or redband trout is obscure (i.e., they look and behave similarly in freshwater).

**Distribution and Abundance**

West coast steelhead are presently distributed across about 15 degrees of latitude, from approximately 49°N at the U.S.-Canada border south to 34°N at the mouth of Malibu Creek, California. In some years steelhead may be found as far south as the Santa Margarita River in San Diego County. Climatic and geological features vary greatly across this area.

**Major Threats and Impacts**

Hydropower development; water withdrawal, conveyance, storage, and flood control; land use activities such as logging, road construction, urban development, grazing, mining, agriculture; loss of large woody debris, riparian habitat, and increased sedimentation; commercial, recreational, and tribal harvest; ocean conditions; and artificial propagation activities are all factors for the decline of steelhead throughout its range. See section entitled "Major Threats and Impacts to Pacific Salmonids" as well as more specific information under each population summary.

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***ESU Status***

<b>ESU Name</b>	<b>Status</b>	<b>Listing Date</b>	<b>Population Trend (Last 5 years)</b>	<b>Population Estimate</b>	<b>Critical Habitat</b>
Snake River	Threatened	8/1997	Decreasing	9,400 <sup>15</sup>	
Upper Columbia River	Endangered	8/1997	Decreasing	7,600 <sup>16</sup>	
Southern California	Endangered	8/1997	Decreasing		
Middle Columbia River	Proposed Threatened	3/1998	Decreasing	14,000 <sup>17</sup>	
Lower Columbia River	Threatened	3/1998	Decreasing	10,700 <sup>18</sup>	
Upper Willamette River	Proposed Threatened	3/1998	Decreasing	5,400 <sup>19</sup>	
Oregon Coast	Candidate	3/1998	Increasing	7,800	
Klamath Mountains Province	Candidate	3/1998	Decreasing	26,000 <sup>20</sup>	
Northern California	Candidate	3/1998	Decreasing		
South Central California Coast	Threatened	8/1997	Decreasing		
Central	Threatened	8/1997	Decreasing		

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<sup>15</sup>Data current through 1998

<sup>16</sup>Includes mixed hatchery & natural stocks

<sup>17</sup>Includes mixed Deschutes stock (~1,300 fish)

<sup>18</sup>Data current through 1997

<sup>19</sup>Data current through 1997

<sup>20</sup>Includes mixed stocks

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California Central Valley	Threatened	3/1998	Decreasing		
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**Population Name:** *Snake River*

**Species Status:** Threatened

**Trend:** Decreasing

**Estimate:** 9,400

ESU Distribution/Description

This inland steelhead ESU occupies the Snake River Basin of southeast Washington, northeast Oregon and Idaho. While total runs size (hatchery plus natural) has increased since the mid-1970s, there has been a severe decline in natural run size. Downward trends and low parr densities indicate severe problems for “B-run” steelhead, the loss of which would substantially reduce life history diversity within the ESU. Genetic introgression from hatcheries is a major concern, with hatchery fish comprising as much as 86% of spawners. Degradation of freshwater habitat from grazing, irrigation diversions, and hydroelectric dams is also a major concern.

The Snake River flows through terrain that is warmer and drier on an annual basis than the upper Columbia Basin or other drainages to the north. Geologically, the land forms are older and much more eroded than most other steelhead habitat. The eastern portion of the basin flows out of the granitic geological unit known as the Idaho Batholith. The western Snake River Basin drains sedimentary and volcanic soils of the Blue Mountains complex. Collectively, the environmental factors of the Snake River Basin result in a river that is warmer and more turbid, with higher pH and alkalinity, than is found elsewhere in the range of inland steelhead.

Snake River Basin steelhead are summer steelhead (as are most inland steelhead) and comprise 2 groups, A-run and B-run, based on migration timing, ocean-age, and adult size. Snake River Basin steelhead enter fresh water from June to October and spawn the following spring from March to May. A-run steelhead are thought to be predominately 1-ocean, while B-run steelhead are thought to be 2-ocean (IDFG, 1994). Snake River Basin steelhead usually smolt at age-2 or -3 years (Whitt, 1954; BPA, 1992; Hassemer, 1992).

The steelhead population from Dworshak National Fish Hatchery (NFH) is the most divergent single population of inland steelhead based on genetic traits determined by protein electrophoresis. Additionally, steelhead returning to Dworshak NFH are considered to have a distinctive appearance and are the one steelhead population that is consistently referred to as B-run. NMFS considered the possibility that Dworshak NFH steelhead should be in their own ESU. However, little specific information was available regarding the characteristics of this population's native habitat in the North Fork Clearwater River, which is currently unavailable to anadromous fish due to blockage by Dworshak Dam.

**Population Name:** *Upper Columbia River*

**Species Status:** Endangered

**Trend:** Decreasing

**Estimate:** 7,600

ESU Distribution/Description

This inland steelhead ESU occupies the Columbia River Basin upstream from the Yakima River, WA, to the United States/Canada Border. Although total abundance of these populations have been relatively stable or even increasing, this is due to major hatchery supplementation programs. Hatchery fish make up 65% and 81% of spawning escapement in the Wenatchee and Methow/Okanogan Rivers, respectively. Ongoing impacts include habitat degradation from grazing, irrigation diversions, and hydroelectric dams; high harvest rates on steelhead smolts in rainbow trout fisheries; and genetic introgression from hatchery production.

The geographic area occupied by this ESU forms part of the larger Columbia Basin Ecoregion (Omernik, 1987). The Wenatchee and Entiat Rivers are in the Northern Cascades Physiographic Province, and the Okanogan and Methow Rivers are in the Okanogan Highlands Physiographic Province. The geology of these provinces is somewhat similar and very complex, developed from marine invasions, volcanic deposits, and glaciation (Franklin & Dyrness, 1973). The river valleys in this region are deeply dissected and maintain low gradients except in extreme headwaters. The climate in this area includes extremes in temperatures and precipitation, with most precipitation falling in the mountains as snow. Streamflow in this area is provided by melting snowpack, groundwater, and runoff from alpine glaciers. Mullan et al. (1992) described this area as a harsh environment for fish and stated that "it should not be confused with more studied, benign, coastal streams of the Pacific Northwest."

Life history characteristics for Upper Columbia River Basin steelhead are similar to those of other inland steelhead ESUs; however, some of the oldest smolt ages for steelhead, up to 7 years, are reported from this ESU. This may be associated with the cold stream temperatures (Mullan et al., 1992). Based on limited data available from adult fish, smolt age in this ESU is dominated by 2-year-olds. Steelhead from the Wenatchee and Entiat Rivers return to fresh water after 1 year in salt water, whereas Methow River steelhead are primarily 2-ocean residents (Howell et al., 1985).

In 1939, the construction of Grand Coulee Dam on the Columbia River (Rkm 956) blocked anadromous fish access to over 1,800 km of river (Mullan et al., 1992). In an effort to preserve fish runs affected by Grand Coulee Dam, all anadromous fish migrating upstream were trapped at Rock Island Dam (Rkm 729) from 1939 through 1943 and either released to spawn in tributaries between Rock Island and Grand Coulee Dams or spawned in hatcheries and the offspring released in that area (Peven, 1990; Mullan et al., 1992; Chapman et al., 1994). Through this process, stocks of all anadromous salmonids, including steelhead, which historically were native to several separate subbasins above Rock Island Dam, were randomly redistributed among tributaries in the Rock Island-Grand Coulee reach. Exactly how this has affected stock composition of steelhead is unknown.

**Population Name:** *Southern California*

**Species Status:** Endangered

**Trend:** Declining

**Estimate:** unknown

ESU Distribution/Description

This coastal steelhead ESU occupies rivers from (and including) the Santa Maria River to the southern extent of the species range which is presently considered to be Malibu Creek, in Los Angeles County (McEwan & Jackson, 1996). Steelhead have been extirpated from much of their historical range, primarily due to widespread degradation, destruction, and blockage of freshwater habitat from flood control, water development, land use, road-building, and other activities. Water allocation and habitat destruction continues in many areas, and there may be harmful genetic impacts from widespread stocking of rainbow trout.

Migration and life history patterns of southern California steelhead depend more strongly on rainfall and streamflow than is the case for steelhead populations farther north (Moore, 1980; Titus et al., in press). River entry ranges from early November through June, with peaks in January and February. Spawning primarily begins in January and continues through early June, with peak spawning in February and March. Average rainfall is substantially lower and more variable in this ESU than regions to the north, resulting in increased duration of sand berms across the mouths of streams and rivers and, in some cases, complete dewatering of the marginal habitats.

Environmental conditions in marginal habitats may be extreme (e.g., elevated water temperatures, droughts, floods, and fires) and presumably impose selective pressures on steelhead populations. The species use of warm southern California streams and rivers with elevated temperatures by steelhead suggests that populations within this ESU are able to withstand higher temperatures than those to the north. The relatively warm and productive waters of the Ventura River resulted in more rapid growth of juvenile steelhead than occurs in northerly populations. However, relatively little life history information exists for steelhead from this ESU.

Genetic data show large differences between steelhead populations within this ESU as well as between these and populations to the north. Steelhead populations between the Santa Ynez River and Malibu Creek show a predominance of a mtDNA type that is rare in populations to the north. Allozyme data indicate that two samples from Santa Barbara County are genetically among the most distinctive of any natural populations of coastal steelhead yet examined. Among the remaining questions regarding this ESU are the distribution and abundance of steelhead south of Malibu Creek. For example, in years of substantial rainfall there have been reports of steelhead in some coastal streams as far south as the Santa Margarita River, San Diego County (Hubbs, 1946; Barnhart, 1986; Higgins, 1991; McEwan & Jackson, 1996; Titus et al., in press).

**Population Name:** *Middle Columbia River*

**Species Status:** Proposed Threatened

**Trend:** Decreasing

**Estimate:** 14,000

ESU Distribution/Description

This inland steelhead ESU occupies the Columbia River Basin and tributaries from above (and excluding) the Wind River in Washington and the Hood River in Oregon, upstream to, and including, the Yakima River, in Washington. Steelhead of the Snake River Basin are excluded.

Total steelhead abundance in the ESU appears to have been increasing recently, but the majority of natural stocks for which data is available have been declining, including those in the John Day River, which is the largest producer of wild, natural steelhead. There is pervasive opportunity for genetic introgression from hatchery stocks. Habitat degradation due to grazing and water diversions has been documented throughout the ESU. The status of populations in the Yakima River and winter steelhead are of particular concern.

Franklin and Dyrness (1973) placed the Yakima River Basin in the Columbia Basin Physiographic Province, along with the Deschutes, John Day, Walla Walla, and lower Snake River Basins. Geology within this intermontane region is dominated by the Columbia River Basalt formation, and includes some of the driest areas of the Pacific Northwest, generally receiving less than 40 cm of rainfall annually (Jackson, 1993). Vegetation is of the shrub-steppe province, reflecting the dry climate and harsh temperature extremes.

Genetic differences between inland and coastal steelhead are well established, although some uncertainty remains about the exact geographic boundaries of the two forms in the Columbia River. Electrophoretic and meristic data show consistent differences between steelhead from the middle Columbia and Snake Rivers. No recent genetic data exist for natural steelhead populations in the upper Columbia River, but recent WDFW data show that the Wells Hatchery stock from the upper Columbia River does not have a close genetic affinity to sampled populations from the middle Columbia River. All steelhead in the Columbia River Basin upstream from The Dalles Dam are summer-run, inland steelhead (Schreck et al., 1986; Reisenbichler et al., 1992; Chapman et al., 1994). Steelhead in Fifteen Mile Creek, OR, are genetically allied with inland *O. mykiss*, but are winter-run. Winter steelhead are also found in the Klickitat and White Salmon Rivers, WA. Life history information for this ESU indicates that most middle Columbia River steelhead smolt at 2 years and spend 1 to 2 years in salt water (i.e., 1-ocean and 2-ocean fish, respectively) prior to re-entering fresh water, where they may remain up to a year prior to spawning (Howell et al., 1985; Bonneville Power Association (BPA), 1992). Within this ESU, the Klickitat River is unusual in that it produces both summer and winter steelhead, and the summer steelhead are dominated by 2-ocean steelhead (whereas most other rivers in this region produce about equal numbers of both 1-and 2-ocean steelhead).

**Population Name:** *Lower Columbia River*

**Species Status:** Threatened

**Trend:** Decreasing

**Estimate:** 10,700

ESU Distribution/Description

This coastal steelhead ESU occupies tributaries to the Columbia River between the Cowlitz and Wind Rivers in Washington and the Willamette and Hood Rivers in Oregon. Excluded are steelhead in the upper Willamette River Basin above Willamette Falls, and steelhead from the Little and Big White Salmon Rivers in Washington. Similar to Willapa Bay and Grays Harbor in southwest Washington, the lower Columbia River has extensive intertidal mud and sand flats and differs substantially from estuaries to the north and south. This similarity results from the shared geology of the area and the transportation of Columbia River sediments northward along the Washington coast. Rivers draining into the Columbia River have their headwaters in increasingly drier areas, moving from west to east. Columbia River tributaries that drain the Cascade Mountains have proportionally higher flows in late summer and early fall than rivers on the Oregon coast.

This ESU is composed of winter steelhead and summer steelhead. The majority of populations for which data is available have been declining in the recent past, although some populations have shown increases. However, the strongest upward trends are for non-native stocks (Lower Willamette and Clackamas River summer steelhead) or stocks that are recovering from major habitat disruption and are still at low abundance (mainstem and North Fork Toutle River). There is pervasive opportunity for genetic introgression from hatchery stocks- there is widespread hatchery production, and several stocks have more than 50% hatchery fish in natural escapement. Concerns about hatchery influence are particularly great for summer steelhead and Oregon winter steelhead stocks, where there appears to be substantial overlap in spawning among hatchery and natural fish.

Steelhead populations in this ESU are of the coastal genetic group (Schreck et al., 1986; Reisenbichler et al., 1992; Chapman et al., 1994), and a number of genetic studies have shown that they are part of a different ancestral lineage than inland steelhead from the Columbia River Basin. Genetic data also show steelhead from this ESU to be distinct from steelhead from the upper Willamette River and coastal streams in Oregon and Washington. WDFW data showed genetic affinity between the Kalama, Wind, and Washougal River steelhead. The data show differentiation between the Lower Columbia River ESU and the Southwest Washington and Middle Columbia River Basin ESUs.

**Population Name:** *Upper Willamette River*

**Species Status:** Proposed Threatened

**Trend:** Decreasing

**Estimate:** 5,4000

ESU Distribution/Description

This coastal steelhead ESU occupies the Willamette River and its tributaries, upstream from Willamette Falls near Portland, OR.. Native winter steelhead within this ESU have been declining since 1971, and have exhibited large fluctuations in abundance. The main production of native (late-run) winter steelhead is in the North Fork Santiam River, where estimates of hatchery proportion in natural spawning range from 14% to 54%. There is strong potential for genetic and ecological impacts from widespread production of hatchery steelhead within the range of this ESU, predominantly of non-native summer and early-run winter steelhead.

The Willamette River Basin is zoogeographically complex. In addition to its connection to the Columbia River, the Willamette River historically has had connections with coastal basins through stream capture and headwater transfer events (Minckley et al., 1986).

Steelhead from the upper Willamette River are genetically distinct from those in the lower river. Reproductive isolation from lower river populations may have been facilitated by Willamette Falls, which is known to be a migration barrier to some anadromous salmonids. For example, winter steelhead and spring chinook salmon (*O. tshawytscha*) occurred historically above the falls, but summer steelhead, fall chinook salmon, and coho salmon did not (Pacific Gas and Electric (PGE), 1994).

The native steelhead of this basin are late-migrating winter steelhead, entering fresh water primarily in March and April (Howell et al., 1985), whereas most other populations of west coast winter steelhead enter fresh water beginning in November or December. As early as 1885, fish ladders were constructed at Willamette Falls to aid the passage of anadromous fish. The ladders have been modified and rebuilt, most recently in 1971, as technology has improved (Bennett, 1987; PGE, 1994). These fishways facilitated successful introduction of Skamania stock summer steelhead and early-migrating Big Creek stock winter steelhead to the upper basin. Another effort to expand the steelhead production in the upper Willamette River was the stocking of native steelhead in tributaries not historically used by that species. Native steelhead primarily used tributaries on the east side of the basin, with cutthroat trout predominating in streams draining the west side of the basin. Nonanadromous *O. mykiss* are known to occupy the Upper Willamette River Basin; however, most of these nonanadromous populations occur above natural and manmade barriers (Kostow, 1995).

Historically, spawning by Upper Willamette River steelhead was concentrated in the North and Middle Santiam River Basins (Fulton, 1970). These areas are now largely blocked to fish passage by dams, and steelhead spawning is now distributed throughout more of the Upper Willamette River Basin than in the past (Fulton, 1970). Due to introductions of non-native steelhead stocks and translocation of native stocks within the basin, it is difficult to formulate a clear picture of the present distribution of native Upper Willamette River steelhead, and their relationship to nonanadromous and possibly residualized *O. mykiss* within the basin.

**Population Name:** *Oregon Coast*

**Species Status:** Candidate

**Trend:** Increasing

**Estimate:** 7,800

ESU Distribution/Description

This coastal steelhead ESU occupies river basins on the Oregon coast north of Cape Blanco, excluding rivers and streams that are tributaries of the Columbia River. Most steelhead populations in this ESU have been declining in the recent past, with increasing trends restricted to the southernmost portion of the ESU, south of Siuslaw Bay. There is strong potential for adverse genetic and ecological impacts from extensive and widespread hatchery production, largely based on out-of-basin stocks. Approximately half the streams are estimated to have more than 50% hatchery fish in natural spawning escapements.

Most rivers in this area drain the Coast Range Mountains, have a single peak in flow in December or January, and have relatively low flow during summer and early fall. The coastal region receives fairly high precipitation levels, and the vegetation is dominated by Sitka spruce and western hemlock. Upwelling off the Oregon coast is much more variable and generally weaker than areas south of Cape Blanco. While marine conditions off the Oregon and Washington coasts are similar, the Columbia River has greater influence north of its mouth, and the continental shelf becomes broader off the Washington coast.

Recent genetic data from steelhead in this ESU are limited, but they show a level of differentiation from populations from Washington, the Columbia River Basin, and coastal areas south of Cape Blanco. Ocean migration patterns also suggest a distinction between steelhead populations north and south of Cape Blanco. Steelhead (as well as chinook and coho salmon) from streams south of Cape Blanco tend to be south-migrating rather than north-migrating (Everest, 1973; Nicholas & Hankin, 1988; Pearcy et al., 1990; Pearcy, 1992). The Oregon Coast ESU primarily contains winter steelhead; there are only two native stocks of summer steelhead. Summer steelhead occur only in the Siletz River, above a waterfall, and in the North Umpqua River, where migration distance may prevent full utilization of available habitat by winter steelhead. Alesea River winter steelhead have been widely used for steelhead broodstock in coastal rivers as compared with other areas. Populations of nonanadromous *O. mykiss* are relatively uncommon on the Oregon coast, occurring primarily above migration barriers and in the Umpqua River Basin (Kostow, 1995). Little information is available regarding migration and spawn timing of natural steelhead populations within this ESU. Age structure appears to be similar to other west coast steelhead, dominated by 4-year-old spawners. Iteroparity (multiple spawning runs) is more common among Oregon coast steelhead than populations to the north.

**Population Name:** *Klamath Mountains Province*

**Species Status:** Candidate

**Trend:** Decreasing

**Estimate:** 26,000

ESU Distribution/Description

This coastal steelhead ESU occupies river basins from the Elk River in Oregon to the Klamath and Trinity Rivers in California, inclusive. Although historical abundance trends are not clearly known, there has been substantial replacement of naturally-produced fish with hatchery fish. While absolute abundance remains fairly high, since about 1970 trends in abundance have been downward in most steelhead populations for which data is available, and some populations are considered to be at risk of extinction. Declines in summer steelhead populations are of particular concern. After accounting for the contribution of hatchery fish, NMFS is unable to identify any remaining populations that are naturally self-sustaining.

Geologically, this region includes the Klamath Mountains Province, which is not as erosive as the Franciscan formation terrains south of the Klamath River Basin. Dominant vegetation along the coast is redwood forest, while some interior basins are much drier than surrounding areas and are characterized by many endemic species. Elevated stream temperatures are a factor affecting steelhead and other species in some of the larger river basins. With the exception of major river basins such as the Rogue and Klamath, most rivers in this region have a short duration of peak flows. Strong and consistent coastal upwelling begins at about Cape Blanco and continues south into central California, resulting in a relatively productive nearshore marine environment.

Protein electrophoretic analyses of coastal steelhead have indicated genetic discontinuities between the steelhead of this region and those to the north and south (Hatch, 1990; Busby et al., 1993, 1994). Chromosomal studies have also identified a distinctive karyotype that has been reported only from populations within this ESU. Steelhead within this ESU include both winter and summer steelhead as well as the unusual "half-pounder" life history (characterized by immature steelhead that return to fresh water after only 2 to 4 months in salt water, overwinter in rivers without spawning, then return to salt water the following spring).

Among the remaining questions regarding this ESU is the relationship between *O. mykiss* below and above Klamath Falls, OR. Behnke (1992) has proposed that the two groups are in different subspecies, and that the upper group, a redband trout (*O. m. newberrii*), exhibited anadromy until blocked by the Copco dams in the early 1900's. However, Moyle (1976) stated that Klamath Falls was the upstream barrier to anadromous fish prior to construction of the dams.

**Population Name:** *Northern California*

**Species Status:** Candidate

**Trend:** Declining

**Estimate:** unknown

ESU Distribution/Description

This coastal steelhead ESU occupies river basins from Redwood Creek in Humboldt County, CA south to the Gualala River, inclusive. Current population levels are very low compared to historic counts (1930s dam counts), and recent trends are downward where data is available. There is particular concern regarding sedimentation and channel restructuring due to floods, apparently due at least in part from poor land management practices. The abundance of Sacramento pikeminnow (Sacramento squawfish) (*Ptychocheilus grandis*) as a predator in the Eel River is also a concern. Hatcheries, such as the Mad River hatchery, have the potential cause genetic introgression and other adverse impacts to natural spawning stocks.

Dominant vegetation along the coast is redwood forest, while some interior basins are much drier than surrounding areas and are characterized by many endemic species. This area includes the extreme southern end of the contiguous portion of the Coast Range Ecoregion (Omernick, 1987). Elevated stream temperatures are a factor in some of the larger river basins (greater than 20 deg.C), but not to the extent that they are in river basins farther south. Precipitation is generally higher in this geographic area than in regions to the south, averaging 100-200 cm of rainfall annually (Donley et al., 1979). With the exception of major river basins such as the Eel, most rivers in this region have peak flows of short duration. Strong and consistent coastal upwelling begins at about Cape Blanco and continues south into central California, resulting in a relatively productive nearshore marine environment.

There are life history similarities between steelhead of the Northern California ESU and the Klamath Mountains Province ESU. The latter ESU includes both winter and summer steelhead, (including what is presently considered to be the southernmost population of summer steelhead), in the Middle Fork Eel River. Half-pounder juveniles also occur in this geographic area, specifically in the Mad and Eel Rivers. Snyder (1925) first described the half-pounder from the Eel River; however, Cramer et al. (1995) suggested that adults with the half-pounder juvenile life history may not spawn south of the Klamath River Basin. As with the Rogue and Klamath Rivers, some of the larger rivers in this area have migrating steelhead year-round, and seasonal runs have been named. River entry ranges from August through June and spawning from December through April, with peak spawning in January in the larger basins and late February and March in the smaller coastal basins.

**Population Name:** *South Central California Coast*

**Species Status:** Threatened

**Trend:** Declining

**Estimate:** unknown

ESU Distribution/Description

This coastal steelhead ESU occupies rivers from the Pajaro River, located in Santa Cruz County, CA, to (but not including) the Santa Maria River. Total abundance of steelhead in this ESU is extremely low, and most stocks for which data is available show recent downward trends. Habitat degradation from water development, poor land use practices, and floods are of particular concern. There is also concern about genetic effects of widespread stocking of rainbow trout.

Most rivers in this ESU drain the Santa Lucia Range, the southernmost of the California Coast Ranges. The climate is drier and warmer than in the north, which is reflected in the vegetational change from coniferous forest to chaparral and coastal scrub. Another biological transition at the north of this area is the southern limit of the distribution of coho salmon (*O. kisutch*). The mouths of many of the rivers and streams in this area are seasonally closed by sand berms that form during periods of low flow in the summer. The southern boundary of this ESU is near Point Conception, a well-known transition area for the distribution and abundance of marine flora and fauna.

Mitochondrial DNA data provide evidence for a genetic transition in the vicinity of Monterey Bay. Both mtDNA and allozyme data show large genetic differences between populations in this area, but do not provide a clear picture of population structure. Only winter steelhead are found in this ESU. River entry ranges from late November through March, with spawning from January through April. Little other life history information exists for steelhead in this ESU. The relationship between anadromous and nonanadromous *O. mykiss*, including possibly residualized fish upstream from dams, is unclear, but likely to be important.

**Population Name:** *Central California Coast*

**Species Status:** Threatened

**Trend:** Declining

**Estimate:** unknown

ESU Distribution/Description

This coastal steelhead ESU occupies river basins from the Russian River in Sonoma County to Soquel Creek, Santa Cruz County (inclusive), and the drainages of San Francisco and San Pablo Bays; excluded is the Sacramento-San Joaquin River Basin of the Central Valley of California. This area is characterized by very erosive soils in the coast range mountains; redwood forest is the dominant coastal vegetation for these drainages. Precipitation is lower here than in areas to the north, and elevated stream temperatures (greater than 20 deg.C) are common in the summer. Coastal upwelling in this region is strong and consistent, resulting in a relatively productive nearshore marine environment.

Analysis of mtDNA data suggests that genetic transitions occur north of the Russian River and north of Monterey, California. Allozyme data show large genetic differences between steelhead populations from the Eel and Mad Rivers and those to the south. Only winter steelhead are found in this ESU and those to the south. River entry ranges from October in the larger basins to late November in the smaller coastal basins, and continues through June. Steelhead spawning begins in November in the larger basins, December in the smaller coastal basins, and can continue through April, with peak spawning generally in February and March. Little other life history information exists for steelhead in this ESU.

Historical abundance estimates are available for some stocks within this ESU, but no overall estimates are available prior to 1961, when Hallock et al. (1961) estimated a total run size of 40,000 steelhead in the Sacramento River, including San Francisco Bay. In the mid-1960s, CDFG estimated steelhead spawning populations for the rivers in this ESU, totaling almost 27,000 fish. We have limited data on recent abundance for this ESU, but its present total run size (based on dam counts, hatchery returns, and past spawning surveys) is probably less than 10,000 fish. Both natural and hatchery runs have declined since the 1960s.

**Population Name:** *California Central Valley*

**Species Status:** Threatened

**Trend:** Declining

**Estimate:** unknown

#### ESU Distribution/Description

Central Valley steelhead are in danger of extinction. They have already been extirpated from most of their historical range. Habitat concerns are principally the widespread degradation, destruction, and blockage of freshwater habitat, and the potential impacts of continuing habitat destruction and water diversion. There is also the potential for genetic impacts from hatchery steelhead production within the area of the ESU.

In the mid-1960s, CDFG (1965) estimated 94,000 steelhead spawning in many rivers of this ESU, but adequate adult escapement information is not available to compute trends for any individual stocks. However, general trends can be inferred from the comparison of 1960s and 1990s abundance estimates, and these indicate substantial rates of decline in the two largest steelhead stocks (Russian and San Lorenzo Rivers). These data indicate that recent total abundance in these two rivers is probably less than 15% of their abundance 30 years ago. In addition, McEwan and Jackson (1996) noted that steelhead in most streams tributary to San Francisco and San Pablo Bays have been extirpated, although small "fair to good" runs of steelhead reportedly occur in coastal Marin County tributaries.

This coastal steelhead ESU occupies the Sacramento and San Joaquin Rivers and their tributaries. The Sacramento and San Joaquin Rivers offer the only migration route to the drainages of the Sierra Nevada and southern Cascade mountain ranges for anadromous fish. The distance from the Pacific Ocean to spawning streams can exceed 300 km, providing unique potential for reproductive isolation among steelhead. The Central Valley is much drier than the coastal regions to the west, receiving on average only 10-50 cm of rainfall annually. Steelhead

within this ESU have the longest freshwater migration of any population of winter steelhead. There is essentially one continuous run of steelhead in the upper Sacramento River. River entry ranges from July through May, with peaks in September and February. Spawning begins in late December and can extend into April.

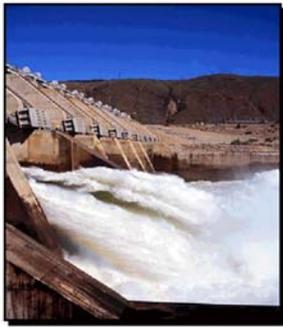
Steelhead ranged throughout the tributaries and headwaters of the Sacramento and San Joaquin Rivers prior to dam construction, water development, and watershed perturbations of the 19th and 20th centuries. Present steelhead distribution in the central valley drainages has been greatly reduced (McEwan & Jackson, 1996), particularly in the San Joaquin basin.

Among the remaining questions regarding this ESU are the current presence, distribution, and abundance of steelhead in the San Joaquin River and its main tributaries (Stanislaus, Tuolumne, and Merced Rivers), and whether these steelhead stocks historically represented a separate ESU from those in the Sacramento River Basin. Also, the relationship between anadromous and nonanadromous *O. mykiss*, including possibly residualized fish upstream from dams, is unclear.

## ***Major Threats and Impacts to Pacific Salmonids***

Salmonid species on the west coast of the United States have experienced dramatic declines in abundance during the past several decades as a result of human-induced and natural factors. There is no single factor solely responsible for this decline. Given the complexity of the salmon species life history and the ecosystem in which they reside, it is difficult to precisely quantify the relative contribution of any one factor to the decline of a given species. Rather, given the available data, it is only possible to highlight factors which have significantly affected the status of a particular species.

Water storage, withdrawal, conveyance, and diversions for agriculture, flood control, domestic, and hydropower purposes have greatly reduced or eliminated historically accessible habitat and/or resulted in direct entrainment mortality of juvenile salmonids. Modification of natural flow regimes have resulted in increased water temperatures, changes in fish community structures, depleted flows necessary for migration, spawning, rearing, flushing of sediments from spawning gravels, gravel recruitment and transport of large woody debris. Physical features of dams, such as turbines and sluiceways, have resulted in increased mortality of both adults and juvenile salmonids. Attempts to mitigate adverse impacts of these structures have to date met with limited success.



Natural resource use and extraction leading to habitat modification can have significant direct and indirect impacts to salmon populations. Land use activities associated with logging, road construction, urban development,

mining, agriculture, and recreation have significantly altered fish habitat quantity and quality. Associated impacts of these activities include: alteration of streambanks and channel morphology; alteration of ambient stream water temperatures; degradation of water quality; reduction in available food supply; elimination of spawning and rearing habitat; fragmentation of available habitats; elimination of downstream recruitment of spawning gravels and large woody debris; removal of riparian vegetation resulting in increased stream bank erosion; and increased sedimentation input

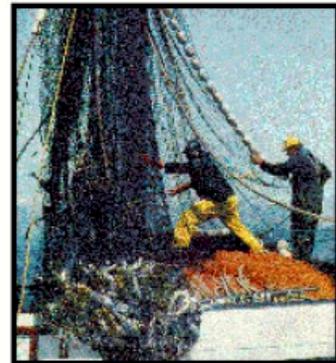


into spawning and rearing areas resulting in the loss of channel complexity, pool habitat, suitable gravel substrate, and large woody debris. Studies indicate that in most western states, about 80 to 90 percent of the historic riparian habitat has been eliminated. Further, it has been estimated that

during the last 200 years, the lower 48 United States have lost approximately 53 percent of all wetlands. Washington and Oregon's wetlands have been estimated to have been diminished by one third, while it is estimated that California has experienced a 91 percent loss of its wetland habitat.

The degree of spatial and temporal connectivity between and with watersheds is an important consideration for maintaining aquatic riparian ecosystem functions. Loss of this connectivity and complexity, such as the loss of deep pool habitats, has contributed to the decline of salmon. In Washington, the number of large, deep pools in National Forest streams has decreased by as much as 58 percent due to sedimentation and loss of pool-forming structures such as boulders and large wood. Similarly, in Oregon, the abundance of large, deep pools on private coastal lands has decreased by as much as 80 percent.

Salmon have been, and continue to be, an important target species for recreational fisheries throughout their range. During periods of decreased habitat availability, the impacts of recreational fishing on native anadromous stocks may be heightened. Commercial fishing on unlisted, healthier stocks has caused adverse impacts to weaker stocks of salmon, and illegal high seas driftnet fishing in past years may have also been partially responsible for declines in salmon abundance. However, such fisheries cannot account for the total declines in salmon abundance in North America.



Introduction of non-native species and modification of habitat have resulted in increased predator populations and salmonid predation in numerous river and estuarine systems. Piscivorous birds such as terns and cormorants, and pinnipeds such as sea lions and harbor seals are examples of potential salmon predators. Marine predation is also of concern in areas of dwindling salmon run-size. In general, predation rates on salmon are considered by most investigators to be an insignificant contribution to the large declines observed in west coast populations. However, predation may significantly influence salmonid abundance in some local populations when other prey are absent and physical conditions, such as narrow river mouths or human-made barriers such as fishing locks, lead to the concentration of adult and juvenile salmonids.

Natural environmental conditions have served to exacerbate the problems associated with degraded and altered riverine and estuarine habitats. Recent floods and persistent drought conditions have reduced already limited spawning, rearing, and migration habitat. Furthermore, climatic shifts over a decadal time scale appear to have resulted in decreased ocean productivity which may exacerbate degraded freshwater habitat conditions to some degree. Environmental conditions such as these have gone largely unnoticed until recently, when salmonid populations have reached critical low levels.

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In an attempt to mitigate for lost habitat and reduced fisheries, extensive hatchery programs have been implemented throughout the range of salmon on the west coast. While some of these programs have been successful in providing fishing opportunities, the impacts of these programs on wild stocks are not well understood. Competition, genetic introgression, and disease transmission resulting from hatchery introductions may significantly impact the production and survival of wild salmon. Commercial and recreational fisheries targeting stronger stocks supported by hatchery production may inadvertently result in adverse impacts to weaker, wild stocks. Furthermore, collection and utilization of wild fish for broodstock purposes may result in additional negative impacts to small or dwindling natural populations.

## *Listed Species Status*

### **Gulf Sturgeon: *Acipenser oxyrinchus***

Listing Date: 09/30/91

The National Marine Fisheries Service (NMFS) and US Fish and Wildlife Service (FWS) listed the Gulf sturgeon as a threatened species on September 30, 1991. NMFS and FWS share jurisdiction for this species under the Endangered Species Act.



#### **Species Biology**

The Gulf sturgeon, also known as the Gulf of Mexico sturgeon, is a subspecies of the Atlantic sturgeon. It is a large fish with an extended snout, vertical mouth, chin barbels, and with the upper lobe of the tail longer than the lower. Adults are 180 to 240 cm (71-95 inches) in length, with adult females larger than adult males. The skin is scaleless, brown dorsally and pale ventrally and imbedded with 5 rows of bony plates.

Adult fish are bottom feeders, eating primarily invertebrates, including brachiopods, insect larvae, mollusks, worms and crustaceans. Gulf sturgeon are anadromous, with reproduction occurring in fresh water. Most adult feeding takes place in the Gulf of Mexico and its estuaries. The fish return to breed in the river system in which they hatched. Spawning is believed to occur in areas of deep water with clean (rock and rubble) bottoms. The eggs are sticky and adhere in clumps to snags, outcroppings, or other clean surfaces. Sexual maturity is reached between the ages of 8 and 12 years for females and 7 and 10 years for males.

#### **Distribution and Abundance**

Historically, the Gulf sturgeon occurred from the Mississippi River to Charlotte Harbor, Florida. It still occurs, at least occasionally, throughout this range, but in greatly reduced numbers. The fish is essentially confined to the Gulf of Mexico. River systems where the Gulf sturgeon are known to be viable today include the Mississippi, Pearl, Escambia, Yellow, Choctawhatchee, Apalachicola and Suwannee rivers.

#### **Major Threats and Impacts**

As with sturgeon worldwide, dams have been a significant factor in the decline of the Gulf sturgeon. Three major rivers (the Pearl in Mississippi, the Alabama in Alabama, and the Apalachicola in Florida) within the range of the Gulf sturgeon have been dammed, preventing

use of upstream areas for spawning. The Gulf sturgeon are unable to pass through dam and lock systems.

In addition to the structures preventing Gulf sturgeon from reaching spawning areas, dredging, desnagging, and spoil deposition carried out in connection with channel improvement and maintenance represent a threat to the Gulf sturgeon. Although exact spawning areas are not known for all river systems the Gulf sturgeon inhabit, indications are that submerged rock ledges and clean rock surfaces are important for spawning. Modification of such features, especially in rivers in which upstream migration is limited by dams, could further jeopardize the reduced stocks of the Gulf sturgeon.

#### **Conservation and Recovery Efforts**

A Recovery and Management Plan for Gulf sturgeon was completed in September 1995. Genetic analyses of Gulf sturgeon indicate the population is divided into five genetically distinct stocks, each occupying a unique watershed or geographical unit. Also, Gulf sturgeon spawning and resting habitat have been documented and characterized in three river systems. Population surveys and freshwater and marine movement and migratory behavior have been studied in six watersheds. In addition, Gulf sturgeon outreach activities have contributed much toward public education.

### *Listed Species Status*

## **Shortnose Sturgeon: *Acipenser brevirostrum***

Listing Date: 03/11/67



The shortnose sturgeon was listed as endangered throughout its range on March 11, 1967. It is an anadromous fish that spawns in the coastal rivers along the east coast of North America from the St. John River in

Canada to the St. Johns River in Florida. It prefers the nearshore marine, estuarine and riverine habitat of large river systems. Shortnose sturgeon, unlike other anadromous species in the region such as shad or salmon, do not appear to make long distance offshore migrations.

No estimate of the historical population size of shortnose sturgeon is available. While the shortnose sturgeon was rarely the target of a commercial fishery, it often was taken incidentally in the commercial fishery for Atlantic sturgeon. In the 1950s, sturgeon fisheries declined on the east coast which resulted in a lack of records of shortnose sturgeon. This led the Fish and Wildlife Service (FWS) to conclude that the fish had been eliminated from the rivers in its historic range (except the Hudson River) and was in danger of extinction. FWS believed the population level of the shortnose sturgeon had declined because of pollution and overfishing, both directly and incidentally in shad gillnets.

### **Species Biology**

The sturgeon family is among the most primitive of the bony fishes. The shortnose sturgeon shares the same general external morphology of all sturgeon. Its elongated fusiform body is moderately depressed, and its protractable subterminal mouth with barbels is well suited for bottom feeding and a generally benthic existence. The body surface contains five rows of bony plates or scutes. Shortnose sturgeon are large, long-lived fish that inhabit a great diversity of riverine habitat. Shortnose sturgeon are found from the fast-moving freshwater riverine environment downstream and, into the offshore marine environment of the continental shelf.

The shortnose sturgeon is the smallest of the three sturgeon species that occur in eastern North America, having a maximum known total length of 143 cm and weight of 23 kg. Growth rate and maximum size vary with latitude, with the fastest growth occurring among southern populations. Maximum known age is 67 years for females, but males seldom exceed 30 years of age. Sex ratio among young adults is 1:1 but changes to a predominance of females (4:1) for fish larger than 90 cm fork length.

Males and females mature at the same length (45 to 55 cm fork length) throughout their range. However, age of maturation varies from north to south due to a slower growth rate in the north.

Males may mature at 2 to 3 years of age in Georgia, at age 3 to 5 from South Carolina to New York, and at age 10 to 11 in the St. John River, Canada. Females exhibit a similar trend and mature at age 6 or younger in Georgia, at age 6 to 7 from South Carolina to New York, and at age 13 in the St. John River. Age of first spawning in males occurs 1 to 2 years after maturity, but among females is delayed for up to 5 years. Approximate age of a female at first spawning is 15 years in the St. John River, 11 years in the Hudson and Delaware Rivers, 7 to 14 years in the South Carolina rivers, and 6 years or less in the Altamaha River, Georgia. Generally, females spawn every three years, although males may spawn every year.

Shortnose sturgeon are benthic feeders. Juveniles are believed to feed on benthic insects and crustaceans. Molluscs and large crustaceans are the primary food of adult shortnose sturgeon.

### **Distribution and Abundance**

The shortnose sturgeon is anadromous, living mainly in the slower moving riverine waters or nearshore marine waters, and migrating periodically into faster moving fresh water areas to spawn. One partially landlocked population is known in the Holyoke Pool, Connecticut River, and another landlocked group may exist in Lake Marion on the Santee River in South Carolina. Shortnose sturgeon occur in most major river systems along the eastern seaboard of the United States. In the southern portion of the range, they are found in the St. Johns River in Florida; the Altamaha, Ogeechee, and Savannah Rivers in Georgia; and, in South Carolina, the river systems that empty into Winyah Bay and the Santee/Cooper River complex that forms Lake Marion. Data are lacking for the rivers of North Carolina. In the northern portion of the range, shortnose sturgeon are found in the Chesapeake Bay system, Delaware River from Philadelphia, Pennsylvania to Trenton, New Jersey; the Hudson River in New York; the Connecticut River; the lower Merrimack River in Massachusetts and the Piscataqua River in New Hampshire; the Kennebec River in Maine; and the St. John River in New Brunswick, Canada.

### **Major Threats and Impacts**

Construction of dams and pollution of many large northeastern river systems during the period of industrial growth in the late 1800's and early 1900's may have resulted in substantial loss of suitable habitat. In addition, habitat alterations from discharges, dredging or disposal of material into rivers, or related development activities involving estuarine/riverine mudflats and marshes, remain constant threats.

Commercial exploitation of shortnose sturgeon occurred throughout its range starting in colonial times and continued periodically into the 1950's.

### **Conservation and Recovery Activities**

Placing the species on the endangered species list resulted in a great deal of research on the species in the northern river systems. NMFS will publish a recovery plan in December 1998 outlining actions that need to be taken in order to recover the species including: a rangewide genetic assessment; determination of endangered and threatened population size thresholds;

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status reviews for each of the individual rivers that shortnose sturgeon inhabit and ensuring that actions taken by Federal agency do not jeopardize the survival of shortnose sturgeon.

*Listed Species Status*

**Johnson's Sea Grass:  
*Halophila Johnsonii***

Listing Date: September 14, 1998

Johnson's seagrass has a very limited distribution and it is one of the least abundant seagrasses within its range. The species is only known to reproduce asexually and may be limited in distribution because of this characteristic. It plays a major role in the viability of benthic resources and has been documented as a food source for endangered West Indian manatees and threatened green turtles. NMFS is continuing to conduct ecological research on the species to better understand its life history and to use in conservation decisions affecting the seagrass ecosystems.



**Species Biology**

Identifying characteristics of Johnson's seagrass include smooth marginated, spatulate foliage leaves in pairs 0.5-2.5 cm long, a creeping rhizome with petioles, sessile (attached to their bases) female flowers, and longnecked fruits. The male flowers are unknown. Outstanding differences between Johnson's seagrass and other similar species are its distinct asexual reproductive characteristics and leaf morphology.

**Distribution and Abundance**

Johnson's seagrass is found in disjunct and patchy distribution along the east coast of Florida from central Biscayne Bay to Sebastian Inlet. The largest patches have been documented inside Lake Worth Inlet. The southernmost distribution is reported to be in the vicinity of Virginia Key in Biscayne Bay. The species has been found in coarse sand and muddy substrates and in areas of turbid waters and high tidal currents.

**Major Threats and Impacts**

Johnson's seagrass is the rarest species of its genus, has limited distributional characteristics, restricted reproductive capacity (being asexual), and is dependent on substrate stability. Potential for continued existence and recovery may be limited due to habitat alteration by a number of human and natural perturbations. Such perturbations include (1) prop scoring, (2) dredging, (3) storm action, (4) siltation and (5) altered water quality.

Alteration and subsequent destruction of the benthic community due to boating activities, propeller scoring and anchor mooring has been observed in Johnson's seagrass sites. Such activities result in breaking root systems, severing rhizomes and significantly reducing the physical stability of this ecosystem. Dredging redistributes sediments, buries plants and destroys bottom topography. Some abundant populations are located in close proximity to inlets, and are likely to experience erosional forces and siltation associated with severe storms. During hurricanes, storm surge may scour and redistribute sediments, thereby eroding or burying existing populations.

Siltation due to human disturbance and increased land-use can also threaten viability of the species. Degradation of water quality due to human impact is also a threat to the viability of ecologically important seagrass communities. Nutrient over enrichment, caused by inorganic and organic nitrogen and phosphorus loading via urban and agricultural land run-off, can stimulate increased algal growth that may smother Johnson's seagrass by shading rooted vegetation and diminishing the oxygen content of the water.

### **Conservation Efforts**

On September 15, 1993, NMFS published a proposed rule to list Johnson's seagrass as a threatened species (58 FR 48326). Designation of critical habitat was subsequently proposed on August 4, 1994 (59 FR 39716). A public hearing on both the proposed listing and critical habitat designation was held in Vero Beach, Florida on September 20, 1994. The public comment period was reopened until October 13, 1994, to include comments on both of the proposed actions.

Since publication of the proposed rule, additional information has been made available to NMFS that supplements available data on the status and distribution of Johnson's seagrass. This information was reviewed in a technical workshop held in St. Petersburg, Florida in November 1996, and was summarized in a workshop proceedings submitted to NMFS on October 15, 1997.

In addition, genetic studies confirming and supporting information presented in the proposed rule regarding the species separation of Johnson's seagrass have been published; peer review comments on the proposed rule have been received; and a report summarizing several years of surveys for Johnson's seagrass within the Indian River Lagoon has been completed .

On September 14, 1998 (63 FR 49035) NMFS published the final rule listing Johnson's seagrass as threatened under the Endangered Species Act of 1973. The proposed designation of critical habitat will be addressed in a separate Federal Register notice and additional comments will be solicited at that time.

NMFS has appointed a recovery team which expects to develop a draft recovery plan by September, 2000.

## Candidate Species Explanation and Species Status Discussions

A “candidate species” is, as its name implies, a candidate for listing under the Endangered Species Act (ESA). More specifically, it is a species or vertebrate population for which reliable information is available that a listing under the ESA may be warranted. There are no mandatory Federal protections required under the ESA for a candidate species. NMFS urges voluntary protection of candidate species.

The candidate species list is used to provide advance notification to the public that specific marine and anadromous species (and vertebrate populations) may warrant listing in the future. This can help the species and the public in two ways: Environmental planners and developers can locate and design long-term projects to minimize impacts to candidate species, reducing the likelihood that these projects will require modification later in the event of a species listing. The candidate species could be benefitted if voluntary conservation measures are undertaken to alleviate threats.

On July 14, 1997 (62 FR 134), NMFS revised its list of candidate species. Previous revisions of the list occurred in 1988 and June 11, 1991 (56 FR 26797). NMFS removed 37 species from the list. The status of four species had changed. While NMFS determined that the bottlenose dolphin is depleted under the Marine Mammal Protection Act on April 6, 1993, it also determined that it did not warrant listing under the ESA (58 FR 17789). The Saimaa seal was listed as endangered on July 28, 1993 (58 FR 40538). FWS listed the Delta smelt and the tidewater goby as threatened on March 5, 1993 (58 FR 12854) and February 4, 1994 (59 FR 5494), respectively. Six marine mammals, the flatback turtle, and the giant and southern giant clams were deleted from the list because they are foreign species for which significant proactive conservation efforts are unlikely to be stimulated due to inclusion in the candidate species list.

Additionally, there were insufficient data to determine population trends for the northern bottlenose whale and the starlet sea anemone, and they were removed from the list. Ten fish species were removed from the list because the information available to NMFS did not meet the more stringent standard of documentation now required for a candidate designation. Also, ten coral species were deleted because the information available indicates declines in certain populations, but not throughout the species’ ranges. Corals are invertebrates, and the ESA only allows invertebrates to be listed at the species level, and not at the population level.

As a result of the 1997 revision, 15 new species for which reliable information is available to NMFS were added to the list of candidate species.

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It is important to note that this list is limited by the information available. Therefore, it does not encompass all declining marine and anadromous species that may warrant listing in the future. Moreover, inclusion of a species on the candidate list does not create a higher listing priority for that species. As appropriate, NMFS will initiate a status review for any species or vertebrate population of concern, regardless of whether it is a candidate species, and the public may petition to list any species or vertebrate population. Inclusion in the candidate species list is intended to stimulate voluntary conservation efforts, which, if effective, can result in a lower likelihood of an ESA listing.

## **Nassau Grouper: *Epinephelus striatus***

The Nassau grouper was a new addition to the 1991 candidate species list. It is a tropical western Atlantic serranid that is an extremely popular food fish, resulting in its declining status.



### **Species Biology**

The Nassau grouper grows to about 100 cm (3 ft) and 25 kg (55 lbs). It is a top-level predator found from inshore to about 100 m. Adults are generally found near shallow high-relief coral reefs and rocky bottoms to a depth of at least 90 m.; juveniles (25-150 mm TL) have been found in and around coral clumps covered with macroalgae (*Laurencia spp.*) and over seagrass beds. Adults lead solitary lives outside of spawning aggregations.

Nassau grouper exhibit no sexual dimorphism in body shape or color. They are characterized by 4-5 irregular dark stripes on a pale tan or gray body, black dots around eye, a large black saddle on the caudal peduncle and a wide “tuning-fork” pattern on forehead. Nassau grouper, like most fish, can camouflage its body by changing color to match its surrounding environment. Although Nassau grouper were initially characterized as protogynous (changing sex from female to male) hermaphrodites, recent investigation indicates that Nassau grouper may not be strictly protogynous. Scientists have determined that Nassau grouper may display gonochorism (separate sexes), with potential for sex change, on the basis of histological and demographic data and the nature of the mating system.

Changes in the Nassau grouper diet by age/size have been reported. It has been determined that juveniles feed mostly on crustaceans, while adults (>30 cm) forage mainly on fish. Nassau grouper usually forages alone and is not a specialized forager.

### **Spawning Aggregations**

Nassau grouper reproduce in site-specific spawning aggregations. Spawning aggregations of a few dozen up to perhaps thousands of individuals have been reported from the Bahamas, Jamaica, Cayman Islands, Belize, and the Virgin Islands. These aggregations occur in depths of 20-40 m at specific locations of the outer reef shelf edge always in December and January around the time of the full moon in waters 25-26 °C. The synchrony of the spawning and the full moon is thought to help the fish use visual cues to migrate to common spawning areas.

### **Distribution & Abundance:**

The Nassau grouper is distributed throughout the islands of the western Atlantic including

Bermuda, the Bahamas, southern Florida and along the coasts of central and northern South America. It is not known from the Gulf of Mexico except at Campeche Bank off the coast of the Yucatan, at Tortugas, and off Key west.

**Major Threats and Impacts**

The Nassau grouper is an important finfish in the food fish industry of the West Indies and Caribbean - it is the most important finfish in the Bahamas, second only to lobster and conch. It is usually caught by hook and line, traps, or speargun. Because Nassau grouper spawn at historic areas, they are easily targeted during reproduction, which removes the reproductively active members of the group, possibly preventing successful spawning.

**Conservation Programs**

The NMFS, under the authority of the Magnuson-Stevens Fisheries Act, has classified the Nassau grouper as “overfished” in its October 1998, “Report to Congress on the status of Fisheries and Identification of overfished Stocks”.

Commercial or recreational retention of Nassau grouper is prohibited under the regulations promulgated to implement the Amendments to the South Atlantic Snapper-Grouper Fishery management plan as proposed by the South Atlantic Fisheries Management Council.

## **Warsaw Grouper:** *Epinephelus Nitrigus*

The Warsaw grouper was added to the candidate species list in 1997. Although there is very limited information available, it follows patterns similar to the other groupers on the candidate species list ( e.g. - Jewfish, Nassau Grouper).



### **Species Biology**

The color is grayish brown to dark red-brown background with numerous small, irregular white blotches on the sides. The fish can obtain weights of over 300 lbs. The color appears much lighter around the nape and along the posterior margin of the operculum. All of the fins are dark brown, except the white-splotchy spiny portion of the dorsal. Very little information is available about the reproduction of the Warsaw grouper, however, eggs and larvae are presumed to be pelagic. Like other *Epinephelus* groupers, the Warsaw is long-lived and has a slow growth rate. It is believed that these fish can attain ages exceeding 25 years. The grouper's large mouth enables it to engulf prey whole after capturing it in ambush or after a short chase. Crabs, shrimps and fishes are major foods.

### **Distribution and Abundance**

The Warsaw grouper is a very large fish found on the deepwater reefs of the southeastern United States. Warsaw grouper range from North Carolina to the Florida Keys and throughout much of the Caribbean and Gulf of Mexico to the northern coast of South America. The species inhabits deepwater reefs on the continental shelf break in waters 350 to 650 feet deep.

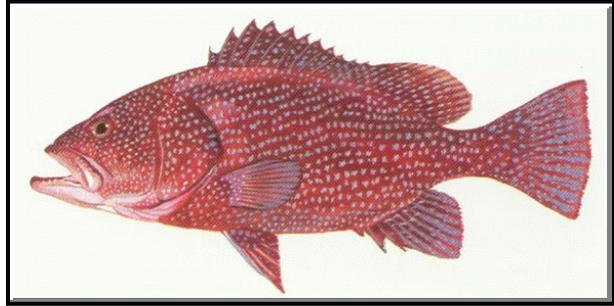
### **Major Threats and Impacts**

The major threat to the Warsaw grouper is mortality as a result of fishing.

### **Conservation Programs**

NMFS has designated this species as "overfished" as defined by the Magnuson-Stevens Fisheries Act. Quotas have been placed restricting the number of Warsaw groupers that may be landed to 1 fish/trip/vessel.

## **Speckled Hind: *Epinephelus drummondhayi***



The speckled hind was added to the candidate species list in 1997. It is considered one of the most beautifully colored groupers caught off the southeastern United States in the speckled hind. The hind gets its common name from the multitude of tiny white spots that cover the reddish-brown head, body and fins.

### **Species Biology**

Like other *epinepheline* groupers, speckled hind are protogynous hermaphrodites, which means they begin life as females and as they mature they become males. Most of the larger, older fish are males. Females reach sexual maturity at around four to five years of age. Spawning takes place offshore from July through September. The fertilized eggs are pelagic, and the newly hatched young are commonly found on the surface before migrating to the bottom.

Speckled hind generally engulf their prey whole. The fish opens its mouth and extends the gill covers rapidly to draw in a current of water, thus inhaling the food. Groupers are also known to pursue their prey and strike it. Prey items for the speckled hind include: fishes, crabs, shrimps and mollusks that inhabit the hard bottom.

### **Distribution and Abundance**

Speckled hind inhabit warm, moderately deep waters from North Carolina to Cuba, including Bermuda, the Bahamas and the Gulf of Mexico. The preferred habitat is hard bottom reefs in depths ranging from 150 to 300 feet, where temperatures are from 60 to 85 degrees F.

### **Major Threats and Impacts**

The major threat to the speckled hind is mortality as a result of fishing.

### **Conservation Programs**

NMFS has designated this species as "overfished" as defined by the Magnuson-Stevens Fisheries Act. Quotas have been placed restricting the number of speckled hind that may be landed to 1 fish/trip/vessel.

## **Jewfish: *Epinephelus Itajara***

The jewfish was added to the candidate species list in 1991 for the region of North Carolina southward to the Gulf of Mexico, which encompasses the entire range of this species in US waters. All harvesting of the jewfish in the Gulf of Mexico and Southern Atlantic Federal waters has been prohibited since 1990 and in the Caribbean since 1993. Stocks are not expected to recover quickly because of the late age of maturity for this species (4-7 years).



### **Species Biology**

The jewfish is the largest of the western north Atlantic groupers. It can reach about 455 kg (800 lbs.) Males range in size from 795-2057 mm TL and females from 338-2155 mm TL. Jewfish can be easily distinguished by the following features: terete shape, broad head, small eyes, and short dorsal spine. They tend to have brownish-yellow or greenish-gray bodies and small black spots on their fins. Although jewfish are very vulnerable to cold waters and red tide, they are one of the only groupers that can live in brackish waters. Fish taken from an exploited population were aged from 0-37 years, but it is likely that jewfish live much longer than 40 years if left unexploited.

### **Distribution and Abundance**

Historically, jewfish were found in tropical and subtropical waters of the Atlantic Ocean, both coasts of Florida, and from the Gulf of Mexico down to the coasts of Brazil and the Caribbean. Most adults are found in shallow waters, the deepest being about 150 feet. Spawning occurs at aggregation sites in July through September over full moon phases. Fish may move up to 100 km from inshore reefs to the offshore spawning aggregations in numbers of up to 100 or more on ship wrecks, rock ledges, and isolated patch reefs along the southwest coast of Florida. Aggregations declined in the 1980's from 50-100 fish to less than 10 per site. Since the harvest prohibitions imposed in 1990 and 1993, aggregations have rebounded somewhat to 20-40 fish per site. When jewfish are not on their spawning aggregations, they are dispersed along shallow reefs. Historically, they were abundant in very shallow water, often associated with piers and jetties along the Florida Keys and southwest coast of Florida. They are no longer abundant in these shallow areas.

Juvenile jewfish have been found along shallow mangrove shorelines, underneath mangrove prop roots. Their historical center of abundance is in the Ten Thousand Islands area of southwest Florida.

**Major Impacts and Threats**

The most likely cause of drastic declines was the heavy fishing pressure on aggregations. When large numbers of normally dispersed fish are concentrated at predictable areas and times, they are highly vulnerable to overexploitation. Fishing on spawning aggregations also removes many reproductive individuals before they have had the opportunity to spawn. Many jewfish were caught between the ages of 9-15 years, meaning that individuals only lived through only a few reproductive years before being captured. Their slow growth rate, long lives, and large size at sexual maturation has made them especially susceptible to overfishing. Finally, their genetic diversity could be impacted when the fishing mortality rate is greater than the natural mortality rate.

**Conservation Programs**

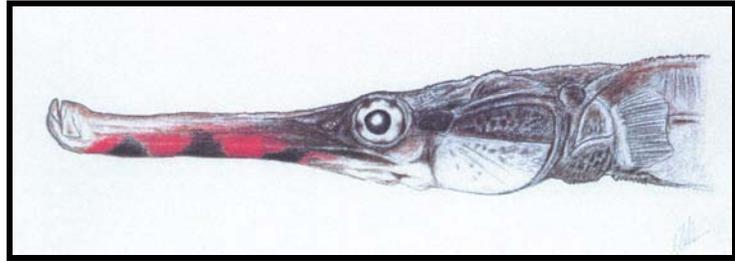
The NMFS, under the authority of the Magnuson-Stevens Fisheries Act has classified the jewfish as “overfished” in its October 1998, “Report to Congress on the Status of Fisheries and Identification of Overfished Stocks”.

Commercial or recreational retention of jewfish is prohibited under the regulations promulgated to implement the Amendments to the South Atlantic Snapper-Grouper Fishery management plan as proposed by the South Atlantic Fisheries Management Council.

The main group researching the jewfish for NMFS is the Southeast Fisheries Science Center (SEFSC). The SEFSC has three main goals regarding jewfish:

1. To quantify the presence of juveniles in their nursery habitat of mangrove shorelines and the level of abjection of those habitats.
2. To enforce all fishing prohibitions.
3. To build an outreach/educational program to teach the need to protect the species.

**Opossum Pipefish:**  
*Micropis brachyurus*  
*lineatus*



The opossum pipefish was added to the candidate species list in 1997.

The predominant areas in which there is concern for this pipefish is in the Indian River Lagoon of Florida. NMFS initiated a status review of this species in 1998 to determine if listing under the ESA is warranted.

**Species Biology**

The opossum pipefish has several very unique characteristics. It is the only tropical western Atlantic pipefish that broods eggs on its trunk rather than its tail. Brooding male opossum pipefish have been captured in tributaries to the Indian River Lagoon, Florida, during all months except January and February. The opossum pipefish is considered to be a large pipefish with a standard length (SL) of about 194 mm (7.64 in). It has a long snout— 1.5-2.0 in. head length— and about 40 rings on its trunk and tail. The opossum pipefish is also very colorful. The most conspicuous color is the brilliant red lower half of the snout overlaid with alternating jet black bands. Most of its head is sienna brown with dark red blotches on each lateral trunk ring, small silver stripes on its mid-side, and a red caudal fin with one central dark stripe.

**Distribution and Abundance**

The opossum pipefish is a circumtropical species whose breeding adults are only found in freshwater associated with certain vegetation (usually panic grass (*Panicum sp.*) and smart weed (*Polygonum spp.*)). Predictable breeding adult populations are limited to tributaries of the Indian River Lagoon, the Sebastian, St. Lucie and Loxahatchee rivers. This specifically limits the adult population to this coastal area of Florida adjacent to the warm Florida Current. All of these areas receive freshwater from inland and upland sources as part of an extensive coastal flood control system.

**Major Threats and Impacts**

The main reason that the opossum pipefish is becoming very rare is that its habitat is disappearing. This is a result of several factors. First, continuous human settlement limits the areas in which these pipefish live. The rapid and continual growth of the coastal human population displaces pipefish habitat. Because these pipefish need access to very specific vegetation types and to freshwater, they have few places they can migrate to. Furthermore, migration is limited because of flood structures which block rivers and canals that offer pipefish habitat. Lastly, herbicide treatment, which also destroys vegetated pipefish habitat, provides a potential threat for this limited Florida population.

**Conservation Programs**

Although the opossum pipefish is not a very well-known fish and the numerous threats to its extinction have not been highly publicized, there are groups who have extensively studied the opossum pipefish. They include the Harbor Branch Oceanographic Institution and the Florida Museum of Natural History.

## **Mangrove Rivulus: *Rivulus marmoratus***

One of the new additions to the 1997 candidate species list was the mangrove rivulus. This is the only native species of the genus *Rivulus* that can be found in North America. It is widely distributed but locally rare in Florida waters. In 1998, NMFS initiated a status review to determine if listing this species under the ESA is warranted.



### **Species Biology**

The mangrove rivulus has a long slender body with dark brown to maroon coloration. On the sides of the body there may be small black dots. The maximum length is 60 mm total length (TL), although the average is about half that at 24 mm TL. The mangrove rivulus is unique among vertebrates in its method of reproduction. It is the only known vertebrate self-fertilizing hermaphrodite. This means that both the eggs and the sperm are produced by one parent, and the young are genetically identical to the parent.

### **Distribution and Abundance**

The mangrove rivulus can be found from south-central Florida down south through the West Indies to coastal areas of South America. It can also be found throughout the waters of Cuba, the Bahamas, Jamaica, and Yucatan. On the east coast of Florida, the preferred micro-habitat is the land crab burrow. In south Florida and on the west coast the preference is for stagnant pools and old mosquito ditches in mangrove forests.

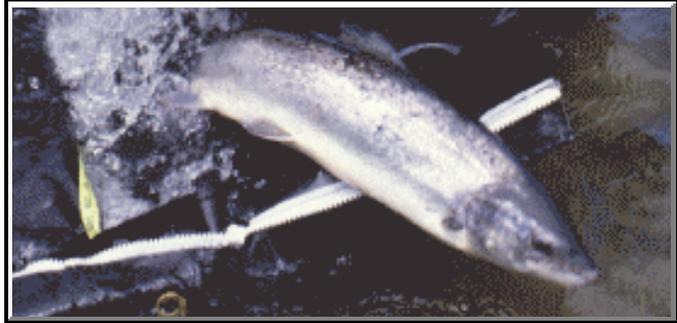
### **Major Threats and Impacts**

This species is extremely vulnerable to habitat modification, environmental alteration, and human development/encroachment. Much of the suitable habitat has been isolated and fragmented as a result of the destruction of mangroves and impounding of high marsh for mosquito control. Irregular population decreases have occurred because of unusually cold waters. The mangrove rivulus is limited at the northern end of its range because of cold waters. Although it is obvious that the population of this species has been dramatically reduced, it is difficult to evaluate the distribution and status because of natural rarity and its secretive tendencies.

### **Conservation Programs**

Currently, there is limited information available on the mangrove rivulus. NMFS has begun a status review and the state of Florida lists the mangrove rivulus as a species of special concern.

## Atlantic salmon: *Salmo salar*



One distinct population segment (DPS) composed of seven river populations of Atlantic salmon was proposed for listing as threatened on September 29, 1995.

The seven Maine rivers are the following:

Sheepscot, Ducktrap, Narraguagus, Pleasant, Machias, East Machias, and Dennys rivers. Because the possibility exists that additional populations could be added to the seven rivers DPS in the future, and for purposes of future conservation activities, the Services have renamed the seven rivers DPS the Gulf of Maine DPS. Other Atlantic salmon populations will be added to the Gulf of Maine DPS if they are found to be naturally reproducing and to have historical, rivers specific characteristics. The area within which populations meeting these criteria for addition to the DPS would most likely be found is from the Kennebec River north to, but not including, the St. Croix River.

NMFS and U.S. Fish and Wildlife Service (USFWS) determined that the Atlantic salmon populations in these seven rivers are, as a group, reproductively isolated and discrete. Naturally-reproducing Atlantic salmon in U.S. rivers are substantially reproductively isolated from those in Canada. A critical factor in determining the significance of the river populations of U.S. Atlantic salmon was the continuous persistence of a substantial component of native stock reproduction. The continuous presence of U.S. Atlantic salmon in indigenous habitat provides evidence that important local adaptations have persisted. At present, differences are subtle and difficult to assess because of low abundance. Within the U.S., Atlantic salmon populations exhibit strong fidelity to natal streams. An examination of U.S. populations of Atlantic salmon provides evidence of their distinctness from stocks in Canada and northern Europe.

The original range of Atlantic salmon in the United States was from the Housatonic River in Connecticut, north to U.S. tributaries of the St. John River in New Brunswick, Canada. The historic Atlantic salmon run in the United States has been estimated to have approached 500,000 fish. The species began to disappear from U.S. rivers 150 years ago and currently, only remnant populations occur in a limited number of rivers in Maine. Throughout the past 24 years, the Dennys and Narraguagus rivers have had returns that averaged 20 percent of the escapement goal, and the Pleasant, Sheepscot, and Machias rivers have had returns that averaged between 10 and 12 percent of their escapement goals. However, recent downward trends in abundance have put most of these seven rivers at less than 10 percent of their respective escapement goals.

### **Species Biology**

Anadromous Atlantic salmon have a relatively complex life history that extends from spawning

and juvenile rearing in freshwater rivers to extensive feeding migration in the high seas. Adult Atlantic salmon ascend the rivers of New England beginning in spring, a migration that peaks in June and continues into the fall. Juvenile salmon feed and grow in the rivers from one to three years before undergoing smoltification and migrating to the ocean. Atlantic salmon of U.S. origin are highly migratory, undertaking long marine migrations between the mouths of U.S. rivers and the northwest Atlantic Ocean where they are widely distributed seasonally over much of the region. Most Atlantic salmon of U.S. origin spend two winters in the ocean before returning to freshwater to spawn. Those that return after only one year are called grilse.

### **Distribution and Abundance**

The populations of anadromous Atlantic salmon present in the Gulf of Maine Distinct Population Segment represent the last wild remnant of U.S. Atlantic salmon. Restoration efforts for Atlantic salmon are ongoing in other watersheds where the locally-adapted stocks have been extirpated.

### **Major Threats and Impacts**

The construction of hydropower dams with either inefficient or non-existent fishways was a major cause for the decline of U.S. Atlantic salmon. Dams adversely impact Atlantic salmon by impeding both their upstream and downstream migration, increasing predation, altering the chemistry and flow pattern of rivers, increasing water temperature, and reducing available flow downstream. Currently there are no hydropower dams on the seven rivers that have the potential to adversely impact the species. Beaver and debris dams have been documented on these rivers and may partially obstruct passage.

One of the predominant land uses of the central and northern coastal Maine watersheds is the growth and harvest of forest products. Forest management practices can cause numerous short- and long-term negative impacts to Atlantic salmon, including siltation, shade reduction, and increased water temperature. Another significant land use in eastern Maine watersheds is lowbush blueberry agriculture. In addition, interest in cranberry cultivation is increasing. These agricultural activities can impact Atlantic salmon through water extractions and diversions and pesticide application. Currently regulatory mechanisms are in place such that forest practices and agricultural practices are not considered a major threat to Atlantic salmon.

Historically, the marine exploitation of U.S. origin Atlantic salmon occurred primarily in foreign fisheries. U.S. origin Atlantic salmon have been documented in the harvests of West Greenland, New Brunswick, Nova Scotia, Newfoundland, and Labrador. The U.S. is a party to the North Atlantic Salmon Conservation Organization (NASCO) which was formed for the purpose of managing salmon through a cooperative program of conservation, restoration and enhancement of North Atlantic stocks. Since 1987 there has been a Fishery Management Plan in place which prohibits the possession of Atlantic salmon in the Exclusive Economic Zone. There is currently a limited catch and release fishery for Atlantic salmon in these seven Maine rivers.

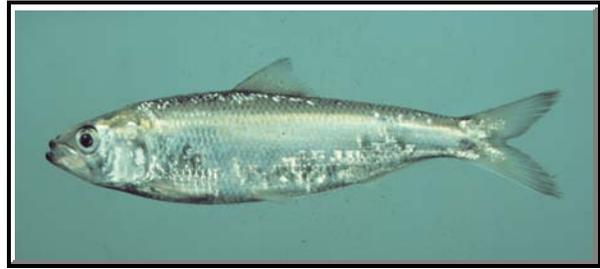
Aquaculture facilities raising Atlantic salmon in net pens are located within 20 km of the mouths

of five of the rivers within the DPS. Atlantic salmon that have escaped from aquaculture pens are known to have entered some of these rivers. The escape of fish from Atlantic salmon aquaculture operations could pose a threat to the genetic integrity of Atlantic salmon within the DPS. In addition, concentrations of aquaculture salmon could increase the vulnerability of wild stocks to disease. Scientific evidence suggests that low natural survival in the marine environment is a major factor contributing to the decline of Atlantic salmon throughout North America. It appears that survival of the North American stock complex of Atlantic salmon is at least partly explained by sea surface water temperature, during the period when Atlantic salmon are concentrated in winter months in habitat at the mouth of the Labrador Sea and east of Greenland.

NMFS and USFWS outlined the above factors for decline in a Status Review prepared to support the proposed rule. The proposed rule contained a special provision pursuant to section 4(d) of the ESA to invite the State of Maine to prepare a Conservation Plan for Atlantic salmon and therefore remain as the lead manager of the species. In order to draft that Conservation Plan, the Governor of Maine convened a Task Force composed of state agency representatives, private industry, conservation groups, and concerned stakeholders. The Conservation Plan contains a number of actions and measures to reduce potential impacts to Atlantic salmon from recreational fishing, agriculture, aquaculture, and forestry. NMFS and USFWS withdrew the proposed rule to list on December 18, 1997. In making this determination, the Services considered the status of the Gulf of Maine DPS and took into account the efforts being made to protect the species including the development of the State of Maine's Conservation Plan, the extent of implementation of the Plan, private and Federal efforts to restore the species, and international efforts to control ocean harvest through NASCO. The Services committed to making the annual report on Conservation Plan implementation available to the public for review and comment and identified actions or developments that would cause them to reinitiate the listing process. Atlantic salmon status will be reviewed annually and, if necessary, NMFS will reinitiate the listing process.

In a Notice also published in the Federal Register on December 18, 1997, NMFS stated that it had placed the Atlantic salmon on the candidate species list to aid in public awareness about the species.

## **Alabama Shad: *Alosa alabamae***



The Alabama shad was added to the candidate species list in 1997. This species has experienced significant population declines in the last forty years as an increased number of dams have been built for navigation,

hydroelectric generation and flood control. These dams block this shad's upstream migration to suitable spawning sites. Although these dams are not the only threat to the species, they are the most prevalent.

### **Species Biology**

The Alabama shad is often misidentified as the Skipjack herring. There are, however, numerous differences in features such as the Alabama shad's pointed snout, an included lower jaw (may be slightly projecting, the jaw on the skipjack protrudes in front of the upper jaw) and many more gill rakers on the lower arm of the first gill raker arch. The average age of spawning fish is two years. Young remain in fresh water for the first six to eight months of their lives. Thirty-eight percent are repeat spawners, as is apparent by spawning marks on the shad's sides. Adults leave the spawning area soon after spawning is complete. The Alabama shad lives to about six years. Females are larger than males; the male's total length range is 90 to 419 mm and the female's is 360 to 457 mm.

### **Distribution and Abundance:**

The Alabama shad is an anadromous species that spawns in large flowing rivers from the Mississippi River to the Suwannee River of Florida. The largest existing population occurs in the Apalachicola River. Populations also persist in the Pascagoula River drainage of Mississippi and the Mobile River drainage of Alabama. Fish enter freshwater during the spawning season (January to April) when water temperature reaches 19 to 22° C. Spawning is known to occur over sand, gravel, and rock substrates in a moderate current in the Apalachicola River below Jim Woodruff Lock and Dam and in the Choctawhatchee and Conecuh rivers in south central Alabama.

### **Major Threats and Impacts**

The great decline in the status of the Alabama shad in Alabama is mostly due to a series of high lift navigating dams in the Alabama and Tombigbee rivers which block spawning migration to the Mobile Basin.

Other threats to the shad include poor water quality and commercial and navigational dredging of sand bars used for spawning.

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In the past, commercial fishing was a threat to the shad. During the 1800's, this species supported a commercial fishery on the Ohio River. In 1899, approximately 6,950 pounds of Alabama shad were taken from the river, and in 1903 approximately 8,750 pounds.

## Dusky Shark: *Carcharhinus obscurus*



The dusky shark was added to the candidate species list in 1997. Although not stated in the Federal Register notice, only the population in the Northwest Atlantic Ocean are considered as candidate species.

### **Species Biology**<sup>21</sup>

The dusky is a large, fairly slender shark with a low interdorsal ridge. The rounded snout is shorter or equal to the width of the mouth. The first dorsal fin originates over or near the free rear tips of the pectoral fins. The color is bronzy gray to blue gray above with white ventrally.

*Carcharhinus obscurus* is a large shark that reaches 360 cm and 180 kg. In the northwestern Atlantic, males attain sexual maturity at 231 cm (fork length) and 19 years of age, while females mature at 235 cm (fork length) and 21 years. Similar sizes at maturity have been reported from South Africa and Australia. The oldest dusky shark reported from vertebral aging studies is 37 years, although they are believed to live to a maximum of 40 to 50 years.

Tagging studies in the southwestern Indian Ocean, the western North Atlantic Ocean and the Gulf of Mexico, and the southeastern Indian Ocean have all shown that *C. obscurus* is a highly migratory species. The longest distance between tagging and recapture is 2,052 nautical miles, and the longest period at liberty 15.8 years. Movements normally show seasonal patterns, with adults moving into more temperate areas as temperatures rise in summer. Movements of adults are larger than those of neonates and juveniles.

The dusky shark is viviparous, with litters normally ranging in size from 3 to 14. There is little information available to estimate accurately the gestation period, although recent work has suggested that it may be as long as 22 to 24 months. The lack of large yolky ova in the ovary of late-term pregnant *C. obscurus* indicates that there may be a one year resting period between birth and mating, making the reproductive cycle at least 3 years long.

Major nursery areas for *C. obscurus* have been identified off the Natal coast of South Africa, the New Jersey to South Carolina coast of the United States, and the southwest coast of Australia. The neonates occur in nearshore waters in all of these nursery areas, but do not enter lower salinity areas.

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<sup>21</sup> Adapted from a DRAFT species status report prepared by the IUCN Shark Specialist Group. Compiled by Merry Camhi, National Audubon Society; Jack Musick, Virginia Institute of Marine Sciences; and Colin Simpfendorfer, Western Australia Marine Research Laboratories - with additional input from NMFS-HMS.

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*C. obscurus* has a varied diet that includes bony fishes, cartilaginous fishes (sharks and rays) and squid. Young sharks mostly consume small pelagic bony fishes (e.g., sardines and anchovies) and squid. With increasing size larger fish (e.g., groupers, jacks) and elasmobranchs (e.g., dasyatids, *Raja* spp., *Rhinobatus* spp., squatinids, carcharhinids, mustelids and squalids) become more important in the diet. As a common apex predator *C. obscurus* plays an important (but poorly studied) role in the marine ecosystem. In the western Atlantic, the dusky has always been less abundant than some other species of carcharhinid sharks with which it is sympatric, such as the sandbar shark. This seems to be in keeping with its larger size and higher trophic position.

Recent demographic analyses of *C. obscurus* in the western Atlantic has generated estimates of the annual rate of population increase of 2.8% and 5.57%. Both of these estimates are for the population without fishing mortality and assume a two-year reproductive cycle. Given that it is now thought that the reproductive cycle lasts three years these population increase rates may be even lower. The low rates of population increase highlight the need for conservative management of fisheries that capture *C. obscurus*.

\**Carcharhinus obscurus* estimated life history parameters

Age and/or size at maturity	f: 21 yrs (235 cm); m: 19 yrs (231 cm)
Longevity/maximum size	40-50 yrs/360 cm (180 kg)
Gestation time	22-24 months
Reproductive periodicity	3 years
Average annual fecundity or litter size	3-14 pups
Annual rate of population increase	2.8% - 5.6%

### **Distribution and Abundance**

This species has a wide-ranging (but patchy) distribution in warm-temperate and tropical continental waters. It is coastal and pelagic in its distribution, where it occurs from the surf zone to well offshore, and from the surface to depths of 400 m. Because it apparently avoids areas of lower salinities, it is not commonly found in estuaries.

In the western Atlantic, it extends from southern New England to the Caribbean and Gulf of Mexico to southern Brazil. However, its distribution off Central America is poorly known. Its occurrence is uncertain in the eastern North Atlantic, but it has been recorded around oceanic islands off western Africa. These records and others from tropical insular areas may be misidentifications of a sibling species (*C. galapagensis*). In the western Indian Ocean, it occurs off South Africa, Mozambique, Madagascar, and possibly in the Red Sea. In the western Pacific

it is found in the waters of Japan, China, Vietnam, Australia, and New Caledonia. In the eastern Pacific, the dusky extends from southern California to Gulf of California, Revillagigedo Islands, and possibly Chile.

The dusky shark undertakes long temperature-related migrations. On both coasts of the U.S., dusky migrate northward in summer as the waters warm and retreat southward in fall as water temperatures drop. The dusky shark occurs throughout Australian waters. In western Australia, adolescents and adults move inshore during the summer and fall, with neonates occupying separate inshore areas. Seasonal migrations (north in winter and south in summer) also occurs off South Africa. In the Indian Ocean, the young are known to aggregate in dense assemblages when feeding.

### **Major Threats and Impacts**

Currently the principal threat to *C. obscurus* is from commercial and recreational shark fisheries off the east coast of North America, the southwest coast of Australia, and the eastern coast of South Africa. In each of these locations there are longline and/or gillnet fisheries that target sharks, including *C. obscurus*. In all cases these are multispecies fisheries making the management of a single species such as *C. obscurus* more difficult. Off North America the proportion of *C. obscurus* in the catch is decreasing, while fishing for more abundant species continues, which could drive this population toward extirpation.

The rapid expansion of the commercial shark fishery in the U.S. in the late 1980s was fueled in large part by the demand for shark fins in the markets of Asia. Dusky sharks have one of the highest rated fins for shark fin soup because of their large size and high fin needle content (ceratotrichia). Although dusky meat is used domestically in the U.S., the very high value of the fins suggests that the decline in this dusky shark population over the past decade has been, and continues to be, driven by international trade in shark fins. There is little reason to believe that the demand for dusky shark products will lessen, especially as other fishery resources become increasingly depleted.

The flesh of the young *C. obscurus* is highly regarded and fetches a good price on local markets. Fins are also sold. Assessment of the fishery using population models is difficult, and a tagging study has been undertaken to determine exploitation rates. Current estimates are that 18-28% of neonates are caught in the first year. Although this is high, assessments indicate that this level of exploitation may be sustainable since only a small number of year classes are targeted.

In addition, dusky sharks are taken as bycatch in directed tuna and swordfish longline fisheries (as well as being targeted catch by these vessels), in tuna and swordfish gill net fisheries. In the Gulf of Mexico during the late 1980s, the dusky shark was the fourth most abundant species in the tuna longline bycatch, where medium to large dusky sharks were often shot, finned, and discarded. Because of its high-value fin, dusky sharks caught incidentally on tuna and swordfish longlines are now regularly landed rather than released.

Additionally, Dusky sharks are one of the most important species in the trophy shark tournaments held in Florida, USA.

**Status and IUCN threatened species assessment**

The dusky shark was added to the NMFS candidate species list in 1997. Declining catch rates for dusky sharks in the western Atlantic are a cause for concern. Recent reviews of catch and landings data for the large coastal shark assemblage in the western Atlantic (including dusky and other requiem sharks), found that by 1986 the abundance of many of the large coastal species had probably declined by 50-75% from 1970s levels -- even prior to the expansion of the commercial shark fishery in 1986. Today the dusky shark population in the northwestern Atlantic and Gulf of Mexico is probably at 15-20% of its mid-1970s abundance.

The IUCN Shark Specialist Group recently evaluated the status of *C. obscurus* using the new listing criteria for the IUCN Red List of Threatened Species. On a global basis, the dusky shark was determined to be "Lower risk, near threatened." However, the U.S. population in the Northwestern Atlantic and Gulf of Mexico was evaluated to be "Vulnerable" based on the decline in abundance indices. The status in Australia at this point is "Lower risk, near threatened."

**Conservation Programs**

Dusky shark, as part of the large coastal shark (LCS) management unit was identified as overfished in 1993 when the FMP was implemented. This classification was reaffirmed in the 1997 Report to Congress.

## **Sand Tiger Shark: *Odontaspis taurus***



The sand tiger shark is one of three species of shark added to the candidate species list in 1997.

### **Species Biology**<sup>22</sup>

The sand tiger shark has a very stocky body and is light brown to greyish color above, merging to off-white on the belly. Dark blotches or spots may occur on the upper two thirds of the body, particularly in juveniles. It has a conical nose, a dorsally flattened head, and all five gill slits are located before the pectoral fin. A small pit is located on the upper side of the caudal peduncle. The teeth, which are similar in both jaws, are long and pointed, with a small spine-like cusp on either side. The first dorsal fin is situated immediately in advance of the ventral fins. The two dorsal fins and the anal fin are all approximately the same size, and the caudal fin has an elongated dorsal lobe.

The maximum size of the species has been given variously as ~3.2 m, ~2.75 m and ~142 kg, and ~3.2 m and ~300 kg. Catch records from beach netting in Australia suggest that sand tiger sharks may grow to 4.3 m. The oldest individuals recorded in aquaria were 13 years and 16 years.

Sand tiger sharks occur either alone or in small to medium sized schools. They have been observed hovering motionless just above the seabed in or near deep sandy -bottomed gutters or rocky caves, usually in the vicinity of inshore rocky reefs and islands, They are generally coastal, usually being found from the surf zone down to depths around 75 feet. However, they may also be found in shallow bays, around coral reefs and to depths of 600 feet on the continental shelf. They usually live near the bottom, but may also be found throughout the water column.

This shark is a slow but strong swimmer that is usually more active at night. Although its body is more dense than the water, it has been found to swallow air at the surface and hold it in its stomach to maintain neutral buoyancy.

Mating occurs between late October and the end of November. Courtship may be a lengthy process which involves the males inflicting nips on the female. If she is receptive, mating follows. If not, the male continues biting, inflicting wounds all over her body until she flees.

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<sup>22</sup>Adapted from a DRAFT species status report prepared by the IUCN Shark Specialist Group. Compiled by David Pollard and Adam Smith - with additional input from NMFS-HMS.

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Full term pregnant females move southward each year during July and August to give birth in early spring, and then return northward. Not all migrating females are sexually active and mature females generally reproduce only once every two years.

This species is ovoviviparous (meaning that they develop as unattached embryos within the uterus, with energy supplied by large egg yolks) as opposed to viviparous (live placental birth) or oviparous (laying egg cases - like skates), and usually only one or occasionally two pups are born per litter. This is because the remaining eggs and developing embryos are eaten by the largest and/or most advanced embryo in each horn of the uterus (uterine cannibalism). The gestation period may last from 9 to 12 months, and size at birth is relatively large, about 1 meter.

<i>*Odontaspis taurus</i> estimated life history parameters	
Size at maturity	2 meters
Maximum size	3.2-4.3 meters
Gestation time	9-12 months
Average annual fecundity or litter size	1-2 pups

**Distribution and Abundance**

Sand tiger (grey nurse) sharks have a broad inshore distribution. In the Western Atlantic, this shark occurs from the Gulf of Maine to Florida, in the northern Gulf of Mexico, in the Bahamas and in Bermuda.

**Major Impacts and Threats**

Sand tiger sharks have been fished throughout their range, but are of variable economic importance regionally. The species is highly regarded as a food fish in Japan, but not in the Western Atlantic. It is caught primarily with line fishing gear, but is also taken in bottom-set gillnets and on pelagic and bottom trawls. The meat is utilized fresh, frozen, smoked and dried and salted, for human consumption. It has also been used for fishmeal, oil (from its liver) and its fins are used for the Oriental sharkfin trade. Sand tigers are very susceptible to fisheries because they aggregate in large numbers at particular coastal spots at certain times of year. These aggregations have been targeted in the past by fisheries.

In addition, the juvenile sand tiger sharks are most common and dependent on some of the most polluted estuaries of the eastern US: the Chesapeake, Delaware, and Narragansett bays and the Pamlico and Long Island Sounds.

Interuterine cannibalism is another factor that makes this species vulnerable, since it limits the litter size to one or two pups.

**Conservation Programs**

The sand tiger shark is managed by the Highly Migratory Species Fishery Management Plan (FMP) under the Magnuson-Stevens Fisheries Act. Under this FMP, the shark receives full protection from harvest on the Atlantic coast of the US. It is illegal to commercially or recreationally land this species or any parts (fins, meat, jaws, etc).

## ***Night Shark: *Carcharhinus signatus****

NMFS designated the night shark as a candidate species in 1997. Data on this species are minimal because the shark is a deepwater shark. Most of the data available on this species is fishery related.



### **Species Biology**

This is a tropical shark that seldom strays into cooler water. The green eye indicates that it is a deep-water species, usually found at depths greater than 150-200 fathoms during the day and 100 fathoms at night. It feeds primarily on fishes and shrimp. The sharks' reproduction is viviparous, which means that they give live birth to their young. Litter size ranges from twelve to eighteen pups. Little else is known about the reproductive biology of the species.

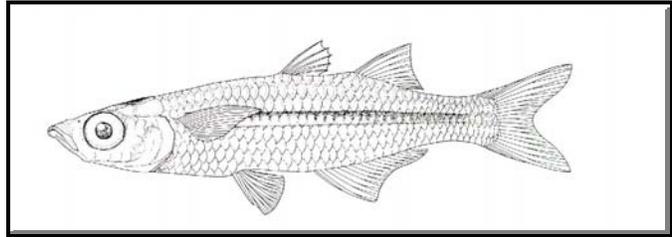
### **Distribution and Abundance**

The shark has been reported in waters from Delaware south to Brazil, including the Gulf of Mexico. It has also been reported from West Africa. It was formerly very abundant in deep waters off the northern coast of Cuba and the Straits of Florida.

### **Major Threats and Impacts**

The main threat to the night shark has been mortality associated with fishing. The shark is caught mainly on longlines in about 100 fathoms, usually at night.

## **Key Silverside: *Menidia conchorum***



The Key silverside was designated as a candidate species in 1991. There is currently discussion in the scientific community as to whether the Key silverside should be considered a distinct species. NMFS will monitor this discussion to determine whether it is a unique species or whether it is actually the tidewater silverside, *M. peninsulae*.

### **Species Biology**

This small fish lives in shallow, protected waters during the day, making it very difficult to observe. The key silverside is the smallest known species of *Menidia*. Its maximum size is 53 mm (about 2 inches). It is most easily distinguished from the other species in this genus by a lower anal ray count, fewer branchial lateral-line scales, and fewer total vertebrae. It is believed that the species spawns in the middle to late winter. The silverside is a diurnal species occurring in swift moving schools. The fish is commonly found in shallow water among black mangrove rhizomes, where it is less vulnerable to predation. It feeds on microscopic animals such as copepods, mysids, isopods, and most importantly, insects.

### **Distribution and Abundance**

This species is found in the Florida Keys, from Key West north to Long Key. Rarity within this area may be due to inaccessibility of the habitat to routine collecting. Because so little is known about the Key silverside and it appears to be rare, it has been kept on the candidate species list.

### **Major Threats and Impacts**

The main threat to the Key silverside is the loss of habitat due to the fish's association with black mangrove. Historically, the species was found in a few localities in the Keys: Key West; Big Pine, Cudjo, Rockland, Grassy and Long keys. Recent records have shown the fish's disappearance from Key West.

## **Atlantic Sturgeon: *Acipenser oxyrinchus oxyrinchus***



The Atlantic sturgeon is a significant species both biologically and commercially. Biologically, this species has intrigued scientists with its ancestry leading back to the dinosaurs. Commercially, this species has intrigued fishermen for its highly valued caviar. The Atlantic sturgeon was placed on the candidate species list in 1988. An exhaustive status review of the species was conducted in 1998, detailing the biology, analysis of threats, conservation efforts, and recommendations for further studies. Upon receipt of a petition to list this species, a status review was conducted. The status review described the information used to determine that listing the Atlantic sturgeon as an endangered or threatened species is not warranted at this time. The National Marine Fisheries Service has retained Atlantic sturgeon on its list of candidate species to monitor the sturgeon's status and the implementation and effectiveness of protective measures.

### **Species Biology**

Atlantic sturgeon is an anadromous species, meaning that it migrates from the ocean and returns to fresh water to spawn. It may live up to 60 years, reach lengths up to 14 feet (4.3 meters), and weigh over 800 pounds. There is no defined age at which this species reaches maturity because it appears to correspond with the temperature of the water in which it lives. In colder waters, males reach maturity at about 20 years old, and females at around 25 years old. In warmer waters, males reach maturity at about 9 years old, and females about 12 years old. Spawning occurs in large rivers where the salt and fresh waters meet and where the first natural falls (fall line) occur. Approximately 12-14 days after the eggs are deposited, larvae begin their bottom dwelling lives. Larvae then migrate downstream and will remain in estuarine waters for months or a few years. Then the juveniles as well as subadults may migrate long distances and enter other river systems to feed. Since Atlantic sturgeon is a species that matures late, there are more opportunities for individuals to die before reaching sexual maturity. However, Atlantic sturgeon has a long life span that will provide mature individuals many opportunities to breed.

### **Distribution and Abundance**

Atlantic sturgeon have been found along the entire Atlantic coast in North America from Hamilton Inlet in Labrador, Canada to the St. Johns River, Florida. In the United States alone, Atlantic sturgeon were present in 34 rivers from Maine to Florida. Currently, they can be found in 32 rivers from Maine to Georgia with spawning occurring in at least 14 of these rivers. During the 1800's, populations declined due to heavy fishing pressure, and presently all sturgeon fisheries are closed and will remain so for decades. During the early to mid 1900's, major industrialization caused degradation of sturgeon habitats, which have improved during the last

thirty years. Harvest in more recent years reduced abundance in most systems and caused a few known stocks to die off (Connecticut River, St. Marys River, GA/FL, and possibly the St. Johns River, FL). Atlantic sturgeon populations continued to survive despite these threats to the sturgeon and its habitat.

Information on current or even historic abundance of Atlantic sturgeon is lacking for most river systems. The most recent information is available for the Delaware and Hudson Rivers where sturgeon fisheries occurred until 1996. The data showed that high rates of commercial fishing resulted in decreased abundance. In some southern areas where the fishery had been closed for some time, data suggested that those stocks were rebuilding. With scientists collecting more data, organizations (federal, state, and private) improving sturgeon habitat, and the commercial fishery closed, Atlantic sturgeon populations should maintain or increase in abundance.

### **Major Threats and Impacts**

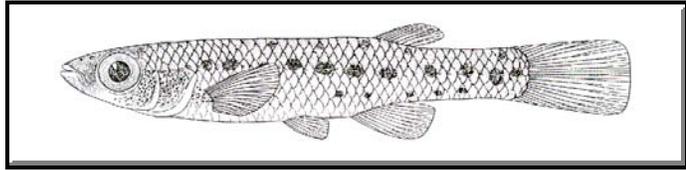
The original and most significant threat to Atlantic sturgeon was commercial fishing. Since the 1800's, sturgeon have been sought after for their eggs (caviar) and flesh (smoked). Records show that sturgeon were fished for in every major river along the Atlantic coast. Currently, there is no legal commercial fishery for Atlantic sturgeon, and retention of sturgeon caught as bycatch is prohibited.

Atlantic sturgeon stocks may have been further impacted through habitat degradation, especially in the early to mid 1900's. However, the species persisted in many rivers, and populations rebounded to the point where commercial fisheries occurred in many rivers until 1996. Habitat degradation includes dams, river dredging, and degraded water quality. Analysis shows that dams do not significantly limit access of spawning habitat since most dams are built on the fall line. The potential for dredging impact, (destruction of spawning or feeding habitats and disruption of spawning migrations) has been found to occur in only six rivers with spawning populations, with no dredging occurring during the past 20 to 25 years on 21 sturgeon rivers. While sturgeon are sensitive to a variety of water quality problems, including changes in temperature, decreases in dissolved oxygen, additions of nutrients, and the presence of contaminants, available evidence shows that overall water quality in Atlantic sturgeon habitats is substantially better than it was through the 1970's and is continuing to improve, especially in the Northeast and Mid-Atlantic states.

### **Conservation Programs**

Apart from the National Marine Fisheries Service and the U.S. Fish and Wildlife Service, many of the programs set up for conservation of the Atlantic sturgeon are created by the Atlantic States Marine Fisheries Commission's Amendment 1 to the Atlantic sturgeon Fishery Management Plan, including measures for preservation of existing habitat, habitat restoration and improvement, monitoring of bycatch and stock recovery, and breeding/stocking protocols. Other organizations involved with Atlantic sturgeon conservation include, but are not limited to, State and local governments, private and conservation organizations .

## **Saltmarsh Topminnow:** *Fundulus jenkinsi*



NMFS designated the saltmarsh topminnow as a candidate species in 1997. In 1998 NMFS initiated a status survey on this species to determine if listing under the ESA is warranted. Data on this species are minimal because large samples are hard to find. Most of the data available on this species is more than ten years old, so current status is very difficult to determine.

### **Species Biology**

The saltmarsh topminnow is one of the smallest members of the topminnow/killifish family Fundulidae, genus *Fundulus*, seldom exceeding 40-45 mm, with most individuals in scientific collections ranging from 25 to 35 mm. Although the life history of this species is poorly known, previous study suggests that this species may be close to an annual species, with few adults surviving past the breeding season in their second year of life. Research has shown the breeding season of this species to be from April through August. This short life span makes this species particularly vulnerable to drastic population level fluctuations from climate variability and environmental variations in available habitat. This species requires shallow flooded marsh surfaces for breeding and feeding, and coastal erosion and man-made conversions of marsh habitat to other uses is thought to be the greatest threat to the continued existence of this species.

Construction of new habitat for this species could be part of a management solution for enhancing this species' population stability. Coastal restoration construction projects are being implemented to reverse habitat alteration and destructive loss of marsh along the coast of the Gulf of Mexico, particularly in Louisiana.

### **Distribution and Abundance**

The species is endemic to the north-central coast of the Gulf of Mexico of southern United States, from Galveston Bay, Texas, eastward through Louisiana, Mississippi, Alabama and parts of western Florida. It is believed that specimens can be found in the Perdido, Escambia, and East Bays of Florida. They tend to live in salt marshes and brackish water, although it has been found that they can survive in freshwater. *F. jenkinsi* can also be found in shallow tidal meanders of *Spartina* marshes.

### **Major Threats and Impacts**

Habitat alteration is the most serious threat to the saltmarsh topminnow. In areas associated with the Lower Mississippi River delta system, land loss from coastal erosion is rapidly destroying the marsh surface that is part of the necessary habitat of this species. Conversion of marsh to deeper, open water eliminates the marsh surface that, when flooded, provides important feeding, shelter, and possible breeding areas for saltmarsh topminnow. Erosion of marsh areas on several of

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Louisiana's barrier islands has completely eliminated several locations where this species has been collected in the past. Conversion of marsh surface associated with estuarine streams and meanders to non-flooded "fast-lands" also threatens this species. Disposal of dredged materials also will interrupt or destroy habitat in that flooding is reduced or eliminated, thus restricting its use by this species.

Protection of marsh habitat is vital for the continued success of the saltmarsh topminnow along the Gulf Coast. Whether programs designed to restore coastal marsh will be successful in providing habitat for the saltmarsh topminnow has not been demonstrated yet.

## **White Abalone: *Haliotes sorenseni***

The white abalone is currently the only mollusk currently on the NMFS candidate species list. It was added in 1997 for the California region south to Baja California, Mexico. A short lived commercial fishery began in the early 1970s, peaked mid-decade and collapsed in the 1980's. Only occasional landings occurred after that time. It was also sought after by recreational divers, but actual landings are unknown. Recent studies

suggest that this species has likely suffered reproductive failure resulting from severe over-harvest. The fishery was closed in 1996. In 1998, NMFS initiated a status review on this species to determine if listing under the ESA is warranted.



### **Species Biology**

The white abalone is a herbivorous, marine, rocky benthic, broadcast spawning gastropod. The epipodium is tan and looks pebbly. The bottom of its foot is orange. The shell is oval-shaped, very thin and deep. They can be up to 10 inches, but are usually 5-8 inches. If fertilized, the eggs hatch after only one day, but high concentrations of sperm are required in order for an egg to be fertilized. Therefore, aggregations of adults are necessary for successful fertilization to occur.

### **Distribution & Abundance**

The white abalone dwells in deep waters - 80 to over 200 feet from Point Conception (southern California) southward to Baja California. Because of its depth range, this abalone was only described scientifically in 1940. It lives on rocky substratum such as pinnacles, rock piles, and deep reefs. Once occurring in numbers as high as 1 per square meter of suitable habitat, they now can be found only occasionally. Recent surveys found that densities average 1 per hectare in the Channel Islands of southern California.

### **Major Threats and Impacts**

Currently, the white abalone are frequently found alone, and have little chance for successful fertilization. Because populations are only small fractions of former numbers, recovery will be complicated by loss of genetic diversity from genetic bottlenecks, genetic drift and founder effects. Abalones are also vulnerable to various bacterial and parasitic infections. The fishery was historically managed using size limits and seasons, but such methods failed because they did not account for density dependent reproduction and assumed regular successful settlement of the larvae.

**Conservation Programs**

There are numerous groups, both in the United States and internationally, doing work to gather more information and build programs to help save the white abalone. Some of these active groups include the Channel Islands National Park Service and the California Department of Fish and Game. These groups assess abalone populations and conduct research into the basic biology, disease pathology and ecology of abalones.

